An overview of Indian Ocean albacore: fisheries, stocks and research

By Alain Fonteneau[1]

The French albacore tuna fleet in Groix Island (France) at the beginning of the century, 1910

Summary

This paper develops an overview of the Indian Ocean albacore stock. It reviews the changes in the various fisheries and the main characteristics of the albacore biology. The stock structure of this stock is discussed as a function of the oceanic environment, giving weight to the hypothesis that the South African fishery active in the Atlantic on small albacore could exploit albacore from the Indian Ocean stock. The paper discuss the major present difficulties in doing a realistic stock assessment of albacore tuna in the Indian Ocean. Nevertheless and without such assessment, it can probably be concluded that this stock has not yet been intensively exploited by the Indian Ocean fisheries.

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1-Introduction

The stock of albacore tuna, *Thunnus alalunga*, has never been thoroughly studied by the IPTP or IOTC scientists, and the Shimizu WG will be one of the first opportunities to review the present status of this stock. This tuna is typically a temperate tuna species that is fished world wide by a combination of surface gears (trolling, bait boat, mid-water trawl) catching primarily the young individuals (but also the adults), and by longliners catching only the adults. This species is the only tuna that has been showing world wide flat trends in the levels of its yearly catches (figure 1), but also apparent long term fluctuations in its yearly catches. In the Indian Ocean, recent albacore catches are showing an increasing trend, and there is no doubt that at least this fishery should be closely monitored as it is not known if these increased catches will be sustainable or not in the long run. The first meeting of the temperate tuna WG is a good opportunity to examine the changes in this Indian Ocean fishery, to compare these trends to the ones observed in other oceans, and to make recommendations upon scientific research that are needed to better understand and better modelize the dynamics and the exploitation of the stock as well as to try to evaluate its potential MSY. This paper will try to do a step targeting these goals, trying to incorporate in its discussion various points and data taken from albacore stocks fished in other oceans, and discussing the albacore stock from an unconventional point of view (e.g. different from the traditional assessment routine work).

2- Albacore fisheries

The detailed review of the Indian Ocean albacore fisheries will be done by the IOTC secretariat, but in such an overview paper it is important to keep in mind and to analyze the major characteristics and trends in the albacore fisheries. This overlook panorama will be done thereafter.

2-1-Catch trends

Yearly trend of total albacore catches (figure 1) do show in the Indian Ocean a quite flat profile, with only minor oscillations and an increase during recent years. Similar flat trends have also been observed in other oceans and stock, but it can be noted that albacore catches in the Indian Ocean have been showing during recent years a higher rate of increase that in any other oceans. Such flat catch trends have been seldom observed for the other tuna species, as most or all other tuna species and stocks have been showing world wide steadily increasing catches (at least until recently).

Most albacore catches are taken by fisheries in temperate waters with the exception of purse seine catches taken at the northern limit of the stock in warm waters2 .

2-2-Fishing gears

Only three typical albacore fisheries have been active in the Indian Ocean (fishing map figure 28):

(1) the **longline**, by far and always the dominant one targeting large albacore in all temperate waters; its average yearly fishing zones are shown figure 2 and 3, when its quarterly fishing zones are given figure 5.

(2) the Taiwanese large **drift net** fishery banned since 1992, after a 6 years period of activity, that was targeting small albacore north of the subtropical convergency (Figure 4).

(3) minor by-catches of adult albacore taken in free schools by the equatorial **purse seine** fishery targeting YFT and SKJ. This species is of course a by-catch species for purse

seiners, but because of its high landing value (albacore being sold at the highest price in the purse seine fishery, much more than yellowfin). The fishing zones of this fishery are shown figure 16 as well as its seasonal patterns of activity.

The overall changes of the yearly catch as a function of fishing zones (Longhurst areas) is shown figure 23)

The Indian Ocean is the only ocean without a surface fishery: pole and line or trolling vessels, surface gears have been always observed (at a variable degree) in all the other oceans, but not in the Indian Ocean, and it appears that albacore tuna fished in the Indian Ocean has been never caught significantly by any artisanal coastal fishery.

However, the potential problem that the South African and Namibian surface fisheries catching small fishes (average 80cm) in the Atlantic are possibly exploiting fishes from the Indian Ocean stock should be kept in mind in the analysis of the Indian Ocean tuna fisheries and further studied. This hypothesis that the P&L SAF fishery is exploiting albacore from Indian Ocean and Atlantic stocks has been widely accepted at least as a working hypothesis by various experts working in the Atlantic and in the Indian Ocean (Lebeau 1971). It is clear that there is no environmental frontier for albacore between the Indian Ocean and Atlantic oceans and that there is some potential rate of mixing between the Indian Ocean and Atlantic albacore population, especially for young individuals. The potential stock structure of Indian Ocean and South Atlantic albacore is shown figure 18 and it will be discussed in the stock structure paragraph.

2-3- Countries

Few countries have been or are active significantly catching this species; albacore fisheries have been dominated by Japan until the late sixties; they are since 1970 widely dominated by Taiwan and its associated flag of conveniency (belonging to Taiwanese owners) (figure 24).

2-4- Fishing zones and seasons

It can be noted that the major albacore fishing zones have been quite stable over time during the last 50 years, namely the south Indian Ocean gyres, the south east African coast and the subtropical convergency, with minor catches taken outside these 3 zones. The average fishing zones of longliners are shown figure 15 giving the average total catches by 5° squares of all longline catches. The albacore fishing zones by longliners are shown figure 2 and 3. The richest albacore areas, the ***albacore "hot spots"*** were large quantities of albacore have been commonly taken by longliners during the history of the fishery (>than 200t /month & 5° square) are shown by figure 25. Most of these major fishing zones belong to quite temperate ecosystems. It should also be noticed that the longline albacore fisheries are showing (like in other oceans world wide) a marked seasonality, with their maximal activities at the southern latitudes during the 2nd and 3rd quarters (winter time) The historical drift net fishery was fishing in the cold waters (13 to 18°C) of the subtropical convergency, when the longline fisheries are fishing in a wide range of areas and SST: 14°C et 28°C. It should also be noted that this surface fishery was active seasonally only during the summer time from November to March, e.g. during a fishing season opposite to longliners in the same fishing zone. Despite of the lack of size data, it can reasonably be assumed that this drifnet fishery was probably targeting juvenile albacore during their summer migration (as such summer time fishery of juvenile albacore fished in shallow waters is a fishing pattern that is typical of albacore fisheries world wide).

- The albacore catches taken by purse seiners are always caught in warm waters close to the equatorial areas and at the northern limit of the subtropical gyre. The mean fishing seasons of these by-catches are in June west of Seychelles and 2nd quarter in the Mozambic channel (figure 16).

2-5-Sizes taken

fisheries are taken in the same range of sizes (adults) (figure 27). The only fishery catching small albacore is the coastal SAF fishery active in the South East Atlantic, but the origin of these fishes (are they born in the Atlantic or in the Indian oceans?) is still questionable.

2-6- albacore value

3- Biology and stock structure

Albacore is typically a temperate tuna living primarily in the mid oceanic gyres of the Pacific, Indian and Atlantic oceans.

The biology of albacore stock in the Indian Ocean has been very little studied by scientists and the more interesting references are often quite old (such as Lebeau 1971 or Morita 1978)

This species tend to show in the Pacific and Atlantic oceans a clear segregation between two southern and northern stocks, that tend to be well identified in associated with the oceanic gyres that are typical of these areas. In the Indian Ocean, there is only one southern stock, simply because there is no northern gyre in this ocean. In the Indian Ocean, albacore is inhabiting the 3 following Longhurst ecosystems:

- ISSG: ***Indian Ocean South Subtropical Gyre***
- SSTC: ***South Subtropical Convergence***
- EAFR: ***East Africa coastal***

The albacore catches, its CPUE and the total nominal fishing effort exerted by longliners in these Longhurst areas are given figures 6 to 9.

Albacore can be classified as being a **typical temperate tuna**, and a typical case of highly migratory species (as bluefin and southern bluefin), doing “real” yearly extensive seasonal migrations at all ages of its life: feeding as well as spawning migrations. This species is probably also showing a homing behavior (when the adult come back in due time to the area where they were born) taking into account the apparent quite small sizes of its spawning strata. . Such migratory behavior is quite different from the limited movement patterns and high “viscosity” that is often observed for most tropical tunas (such as yellowfin, skipjack and bigeye).

As most albacore fisheries world wide are showing clear seasonal patterns at all ages of their life, their seasonal **movement patterns can be quite easily hypothesized,** based on a careful analysis of time and area catch and cpue data by sizes (when these data are available), especially when taking into account the environmental parameters such as sea surface conditions (allowing to well identify spawning and feeding zones) and the availability of feeding zones suitable for albacore tuna. The comparison between movement patterns observed in the various oceans as a function of age and environmental condition is also useful to rebuilt these hypothetical migration patterns. It appears that –in most (or all?) oceans albacore primary movements tend to follow the surface currents around gyres. It appears for instance that the systematic large scale movements observed world wide for juvenile albacore are typical of this species. It is also quite clear based on the scientific literature that the adult albacore do spawn in warm waters (SST>25°C) like all other tuna species. These spawning and feeding migrations are quite easy to rebuild for albacore as a function of time and space distribution of fisheries, although in the Indian Ocean the absence of surface fisheries catching small albacore is a limiting factor to develop this type of tuna movements analysis

Hypothetical stock albacore structure in the Indian Ocean and South Atlantic: when significant tuna catches of adult tunas are taken in warm waters (for instance >25°C) each year in a given season and in a given area, these catches often correspond to a spawning strata. This simple rule is well confirmed for the two albacore stocks in the Atlantic, that are both showing in the western Atlantic a seasonal spawning in warm waters, north of 15°N and south of 5°S. This spawning shown by fishery data in relation with environmental data (Fonteneau 1998) is well confirmed by the analysis of local spawning condition done by biologists. A similar potential spawning is apparent in the same fishery data east of Madagascar (5 to 15°South), mainly during the 4th quarter. If this area is really a spawning zone, it could well be assumed that larvae and juvenile from this spawning strata could follow a trajectory similar to the one observed in the South Atlantic, e. g. a drift in the surface counter currents around the sub-tropical gyre (see figure 18) towards the northern limit of the subtropical convergency and the South African waters, possibly reaching Namibia?.

It should also be noted that albacore is the only and typical tuna species targeted in the deep waters of sub tropical gyres (swordfish being recently targeted during the night in the shallow waters of the same gyres). This low biodiversity of the longline catches in the main albacore fisheries is easily shown by the analysis of the longline fishery data: albacore is by far the most abundant tuna species caught in the subtropical gyre, 44% of total catches in the area on the 1960-2002 average catches. It appears that the typical albacore fishing zones where albacore is the most abundant do produce a wide majority of catches taken on this species, at least for the Taiwanese fishery targeting albacore (figure 10). However, it is also striking to note that even in the “best” albacore fishing zones where this species corresponds to nearly 100% of the Taiwanese catches, there has been a much greater specific diversity in the catches by Japanese longliners active in the same “albacore areas” (figure 10). This much larger and increasing bio-diversity of the Japanese catches even in the albacore areas is for instance apparent in the Indian Ocean as well as in the Atlantic ocean (figure 13). Such variable and heterogeneous targeting of the Japanese fleet will probably be very difficult to analyse and to correct in order to estimate a reliable albacore GLM CPUE indice.

It should also be noted that the tropical gyre, the main fishing zone of albacore, is by far the less productive area in the Indian Ocean tuna fisheries in term of its total catches per unit area (the same observation is done worldwide for all these tropical gyres). This is well shown by the following table comparing the average tuna production by million sq. naut. miles during the period 1960-2002. This conclusion on the low local productivity is also observed to less degree for the low CPUE also observed in the gyre area where the albacore is by far the dominant species in most catches by longliners.

Area	Yield 1960-2002	Size area	Prod/area	% albacore	Av. CPUE Total	Av. CPUE albacore
North	27858	4.7	5927	1.0	758	17
MONS	58851	14.0	4204	1.7	919	29
ISSG	32460	19.4	1673	43.8	510	257
EAFR	14606	3.7	3947	17.6	990	318

It should also be noted that based on the environmental data, for instant from the recent satellite imagery analysis done by Mélin and Hoepfner 2004, the ISSG area is by far the area showing the lowest primary productivity in the Indian Ocean.

What variable productivity of the albacore stocks?: albacore stocks are often considered by scientists as being highly variable, their biomass being widely driven in the Atlantic, Pacific and Indian oceans by natural cycles, more than by changes in the fishing pressure (Santiago 1998, Lasker 1985). This conclusion is far to be fully statistically demonstrated, due to the scarcity of long term analysis and to the lack of contrast in most fishery data, but it appears to be at least a strong working hypothesis. In this context, the MSY of albacore stocks (as well as the optimal effort producing the MSY) would be widely variable as a function of environmental cycles, as shown by figure 20. The best example of such “natural” variability being given by another temperate tuna, the Mediterranean bluefin tuna stocks (see Ravier and Fromentin 2004). If this conclusion is a valid one for the Indian Ocean albacore, it would unfortunately add a great complexity to the assessment and management of the albacore stock, as the two traditional targets of scientists and managers, MSY and its corresponding effort, would be widely fluctuating. However, it should also be recognized that the flat trends and low year to year variability of albacore catches on all stocks may rise some doubts upon the importance of these natural productivity cycles (on the opposite the bluefin Mediterranean cycles are well demonstrated by wide fluctuations of total catches). One possibility remains that the environmental variability could be a real one, but being primarily a geographical local variability and not necessarily a fluctuation of global productivity and of MSY (White and al. 2004). It is also possible that the frequent decline of various albacore fisheries could well be due to the low CPUE that can be obtained on this species and to the quite low value of this species in the sashimi market.

4- Some considerations on stock status?

The stock status of every albacore stocks fished world wide are always difficult to evaluate, because the contrast in the catch series are most often very low (figure 1): no increasing trend of effort and catches and subsequent overfishing that are often difficult to demonstrate. This is also the case in the Indian Ocean.

A spectacular decline of the early CPUE has been often observed for albacore stocks (see figure 7 and 12), including in the Indian Ocean, but this decline should probably be interpreted to the early decline observed for other tuna species (YFT). Such sharp early decline of CPUE is probably due, not to a real decline in stock biomass, but more probably to a combination of other factors (Maunder et al. 2004, ;;;;;). It should also be noted that such large early decline of longline CPUE has also been observed in the North Atlantic, an area where the albacore stock was already fully exploited by surface fisheries (and not a virgin stock!). The present conclusion is probably that the trend of albacore longline CPUE should not be used as an index tuning the adult stock biomass. Furthermore, the absence of any significant Japanese fishery targeting albacore since the late sixties or early seventies is such that all stock assessment on albacore cannot use the Japanese data and must rely entirely on the Taiwanese data, a data set heterogeneous in time, often of doubtful quality and lacking size data. This statistical problem adds to the traditional stock assessment difficulty faced for every tuna stocks. Nevertheless, various stock assessment done by the ICCAT in the North and South Atlantic albacore stocks have concluded that these stocks were either overfished or at full exploitation. This is especially the case in the South Atlantic (recent SCRS reports, Punt et al 1997, Sun et al 2002).

One final comment could still be that, at least, the Indian Ocean albacore stock appears to be exploited by longline and purse seine fisheries at its optimal sizes, in the absence of surface fisheries targeting its juvenile (a positive conclusion that could be modified if juvenile albacore exploited at small sizes by South African/Namibian surface fishery belongs -at least partly- to the Indian Ocean stock). This hypothesis can be considered as being a reasonable one (Penney et al 1992), as there is no environmental frontier for a juvenile albacore between the Atlantic and Indian oceans, and as the “logical” migration patterns of juvenile albacore born in the two oceans may well tend to converge in the highly productive SAF waters west of 20°E. As this SAF/Namibian fishery has been catching yearly about 10.000 t. of this juvenile albacore, this fishery could play a significant role on the exploitation of the Indian Ocean stock if these fishes are coming in significant quantities from the Indian Ocean spawner stock. It could also be noted that the apparent spawning zones of albacore in the Indian and Atlantic oceans are located at the same distance form the South African fisheries, with similar geostrophic surface currents leading from these two spawning zone to the SAF fishery) (Figure 19). On the other side the presently available genetic studies tend to conclude to a genetic heterogeneity between the adult albacore fished in the Eastern Indian Ocean and the fished caught in the South African Fishery (Yeh and al 1997), but this preliminary analysis would need to be validated.

As the effective fishing effort exerted targeting albacore remains very difficult to estimate, the analysis of catch trends through the rates of catch increase (Grainger & Garcia index) remains interesting to analyse (taking into consideration the average of the last 6 years, because albacore is a long living species exploited during many years). This index is given figure 29: it appears that this rate of catch increase has been showing during the last half century various apparent cycles of increasing catches followed by a decline of this rate; recent years are showing a major rate of catch increases, at the highest level observed in the history of the Indian Ocean albacore fisheries.

There is very little hope that any stock assessment model could provide a realistic stock assessment of the Indian Ocean albacore stock, due to the poor biological and statistical data base available on this species as well as to the lack of contrast in the half century of fishery data available.

Despite of this structural difficulties it can probably be concluded that the Indian Ocean albacore stock do no show yet any overfishing symptom, due to its quite low CPUE in value (as the longline effort are hardly profitable in the targeting of such species), and to the absence of surface fisheries catching small size albacore.

5- Conclusion

The present conclusion at the end of this study is that a realistic stock assessment albacore stock appears to be very difficult or impossible in the present context. However there is a clear and urgent need to improve statistics and research on this species that has been *de facto* “abandoned” by the IPTP and by the IOTC[2]. It is now time to compensate this long period of scientific lack of concern towards this very interesting species that has been fished during 50 years by the Indian Ocean fisheries.

There is first a deep need to improve the albacore statistics in a fishery dominated by Taiwan. There is also an urgent need to develop a comprehensive analysis of all the existing catch/cpue at size by time and area in order to estimate possible movement patterns, within the Indian Ocean and between the Indian and Atlantic oceans. This analysis would need to be conducted in close cooperation with the ICCAT scientists and data bases. Genetic/biochemistry studies would also be very useful to solve the heterogeneity between Atlantic and Indian Ocean fishes as well a tagging of these small albacore in the South African/Namibian fishery. This tagging would be easy to do and it would allow to see in which ocean the tagged albacore will be recovered by longliners.

In general, there is a strong need to coordinate better the Atlantic and Indian Ocean statistics and researches on albacore as there is a good probability of significant mixing rates between the albacore fished in the Southern Atlantic and in the Indian Ocean, and as the research upon
albacore have been very active in the ICCAT during the last 30 years..

[2] if albacore has been « abandonned » by the IOTC for administrative reasons, lack of an operational temperate tuna working group, there is no doubt that this stock is under the full responsibility of the IOTC for its statistics, research and management.

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Annex 1: summary of paper by Lebeau 1971

The results of observations made during the first expeditions of the 'CIAP' showed a marked decline in the **albacore** fishery at the end of the southern winter in the southwest Indian Ocean. However, catches on the west coast of **South** Africa improved at the end of summer and in the autumn. A study was undertaken to establish a link between the 2 fisheries. A scheme of migration was proposed, based on the existence of 3 zones of concetration: (1) a spawning area east of Madagascar, (2) a winter growth area in the southwest Indian Ocean, and (3) a growth area off the west coast of **South** Africa in summer and autumn. The winter fishery in the **South Atlantic**, homologous to that found in the southwest Indian Ocean, seems to be an extension of (3). It seems that westward movements occur simultaneously in the southeast **Atlantic** and southwest Indian oceans, It is feasible to suppose a common history for the fish in the early stages of the life cycle and eventual changes being produced in the stocks. Confirmation of this could be achieved with the aid of tagging. A further line of research is the location of winter and summer concentrations of young fish. Improved equipment on the 'CIAP' will greatly assist research. Daily monitoring of surface temp in the southwest Indian Ocean by meteorological services, would be of great value.

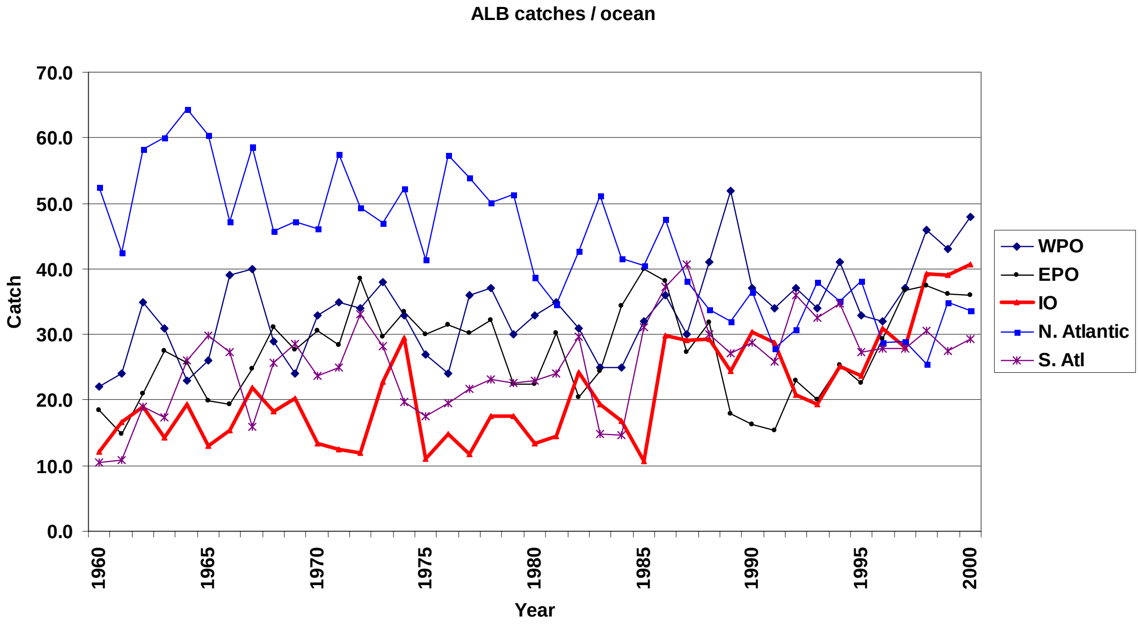
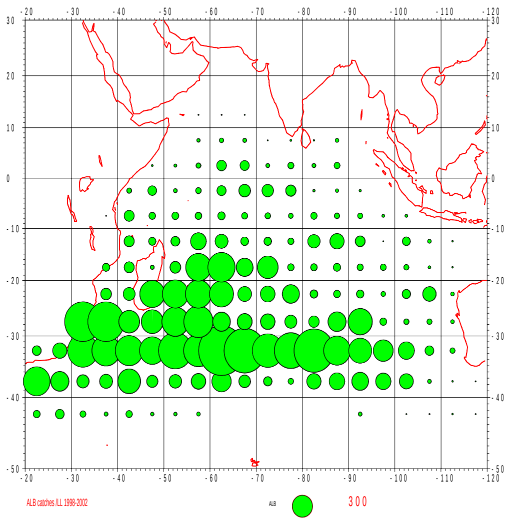


Figure 1: yearly catches of albacore estimated in the various oceans (WPO= Western Pacific, EPO=Eastern Pacific, IO=Indian Ocean)



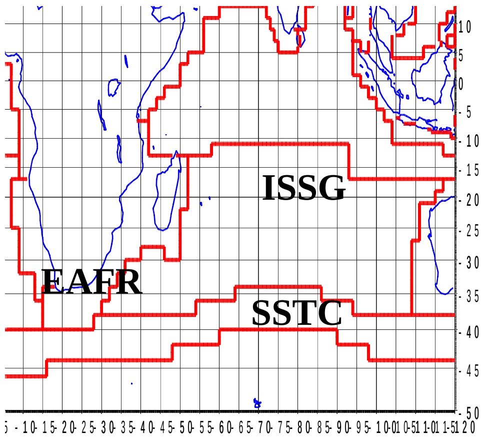


Figure 2: Average albacore catches by longlineres du … s that albacore is a temperate tuna, inhabiting the three … SG: ***Indian Ocean South Subtropical Gyre,*** SSTC: ***South Subtropical Convergence and*** EAFR: ***East Africa coastal)***

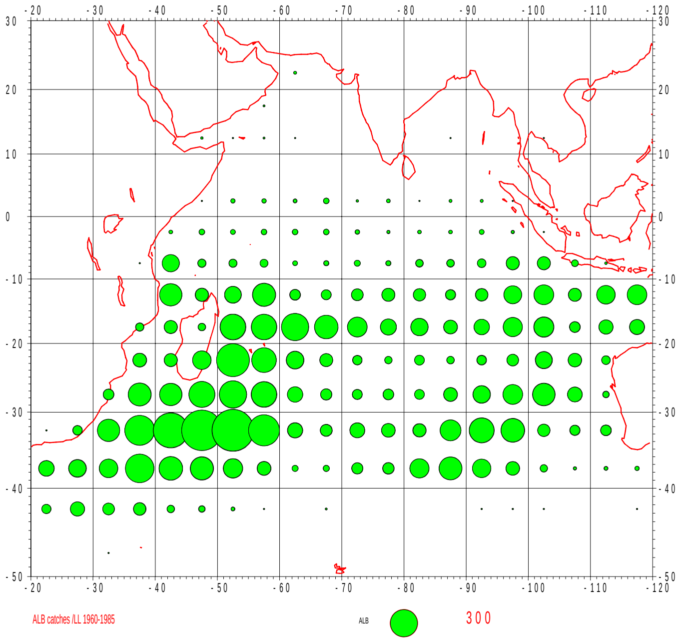


Figure 3 : Albacore historical catches taken by the longline fisheries, period 1960-1985

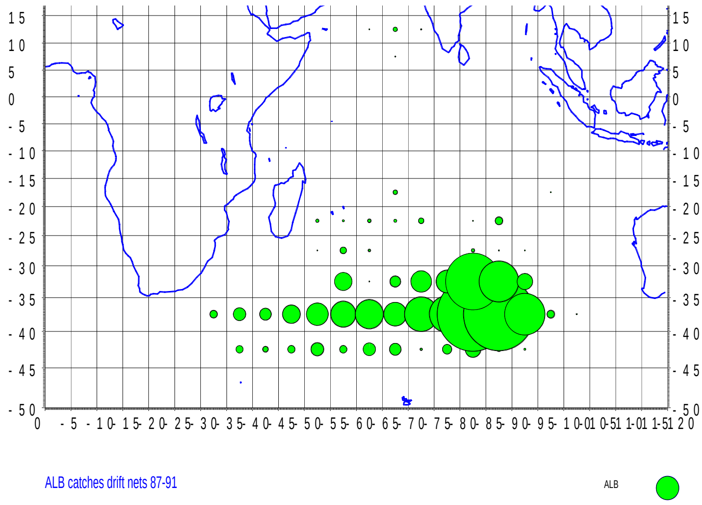


Figure 4 : Albacore historical catches taken by the driftnet fisheries, period 1986-1991

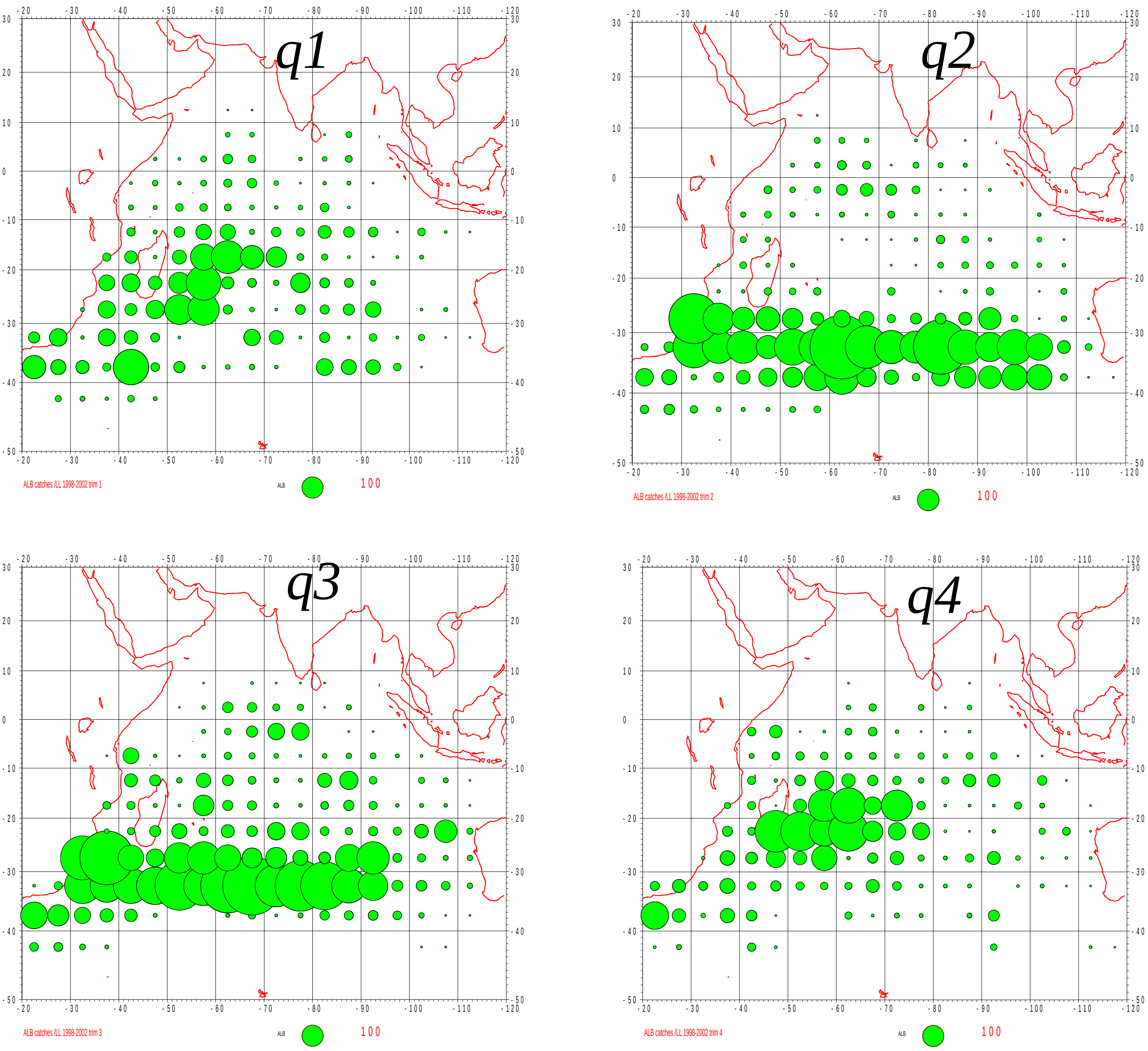


Figure 5: Average quarterly albacore catches by the longline fleet during the recent period 1998-2002

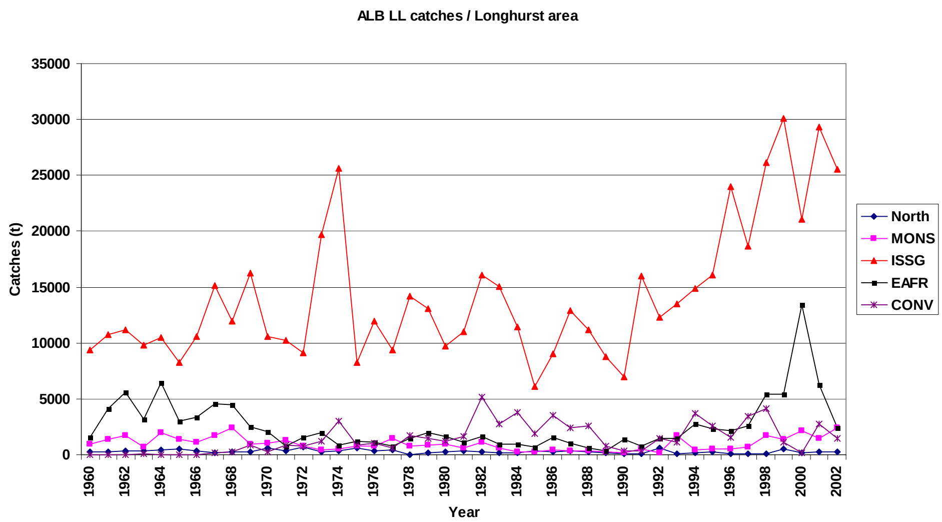


Figure 6: Total albacore catches estimated in each of the main Longhurst areas

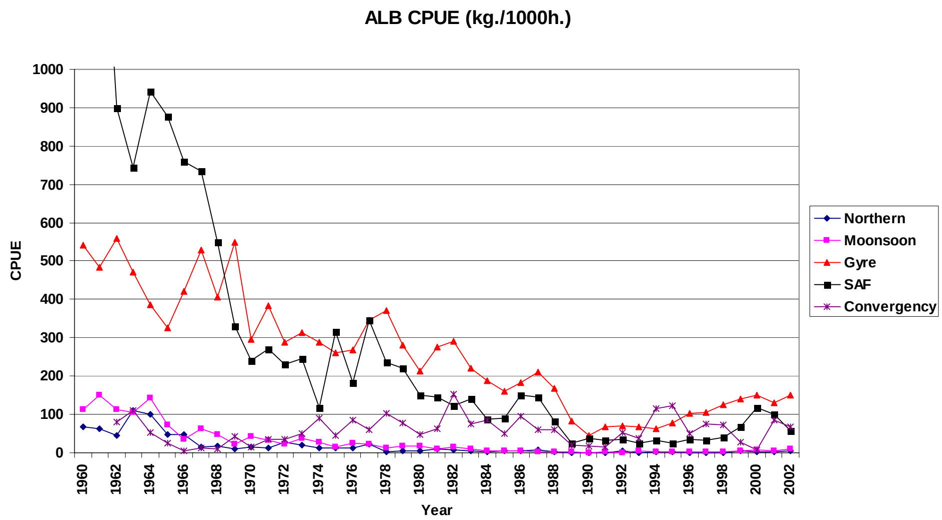


Figure 7: Total albacore CPUE in weight estimated in each of the main Longhurst areas for the combined fleets of longliners

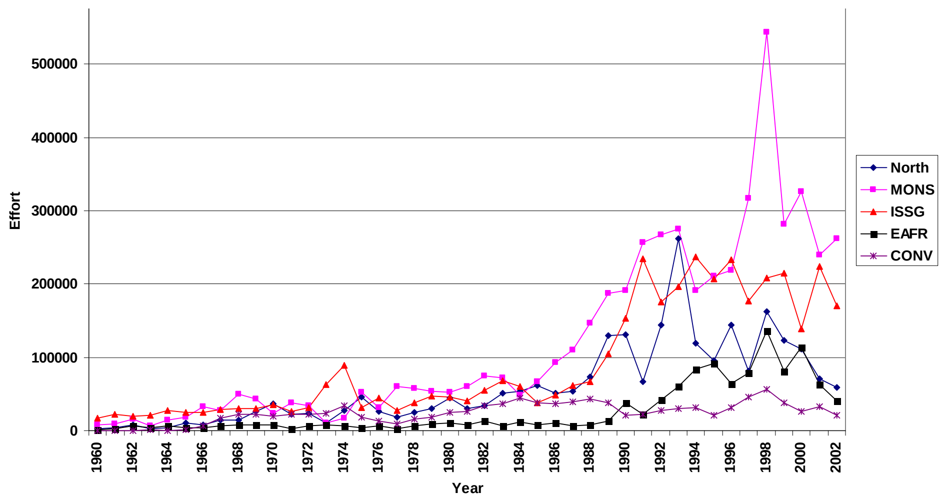


Figure 8: Total nominal effort by longliners estimated in each of the main Longhurst areas for the combined fleets of longliners.

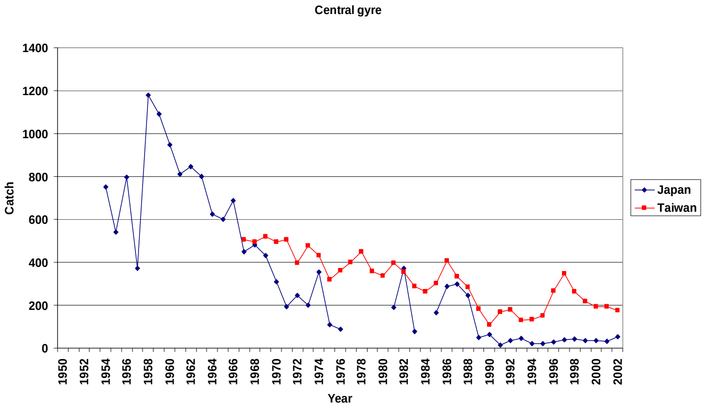


Figure 9: Yearly albacore CPUE in the central gyre area (15-35°S, 35-80°E) for the Japanese and Taiwanese longline fleets.

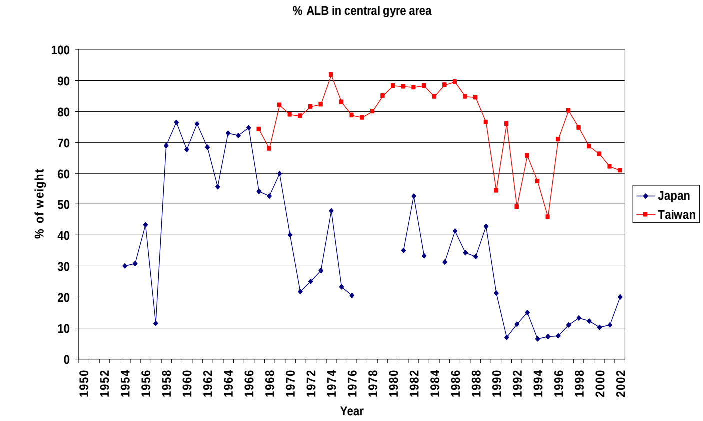


Figure 10: Yearly percentage of albacore in the total tuna catches by the Japanese and Taiwanese longline fleets in the central gyre area (15-35°S, 35-80°E)

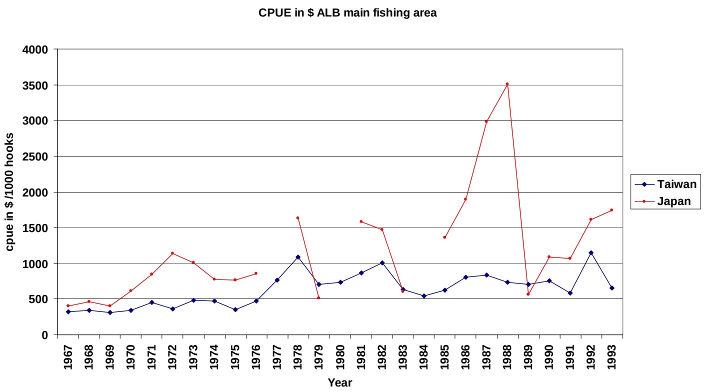


Figure 11: Yearly total CPUE in $US in the central gyre area (15-35°S, 35-80°E) for the Japanese and Taiwanese longline fleets.

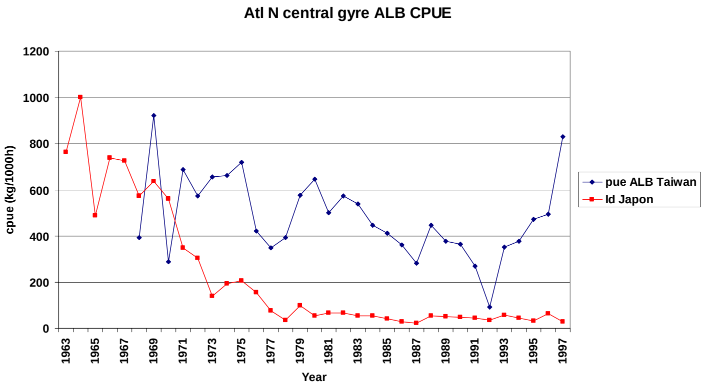


Figure 12: Yearly albacore CPUE in the North Atlantic central gyre area for the Japanese and Taiwanese longline fleets.

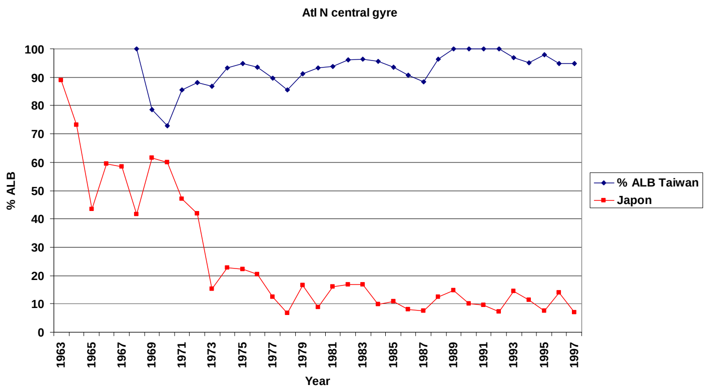


Figure 13: Yearly percentage of albacore in the total tuna catches by the Japanese and Taiwanese longline fleets in the North Atlantic gyre area

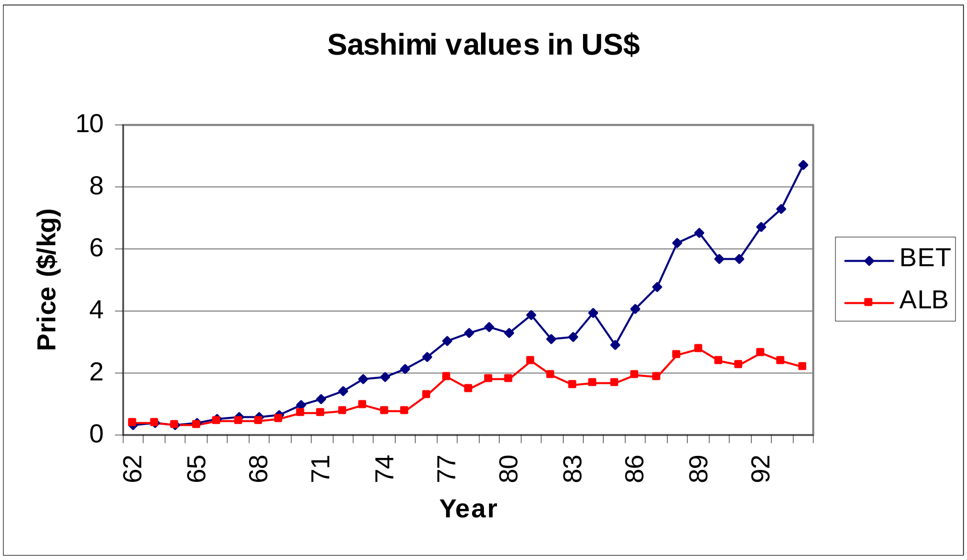


Figure 14: Estimated average landing prices in the Tokyo market of albacore and bigeye tunas taken by longliners during the period 1962-1995.

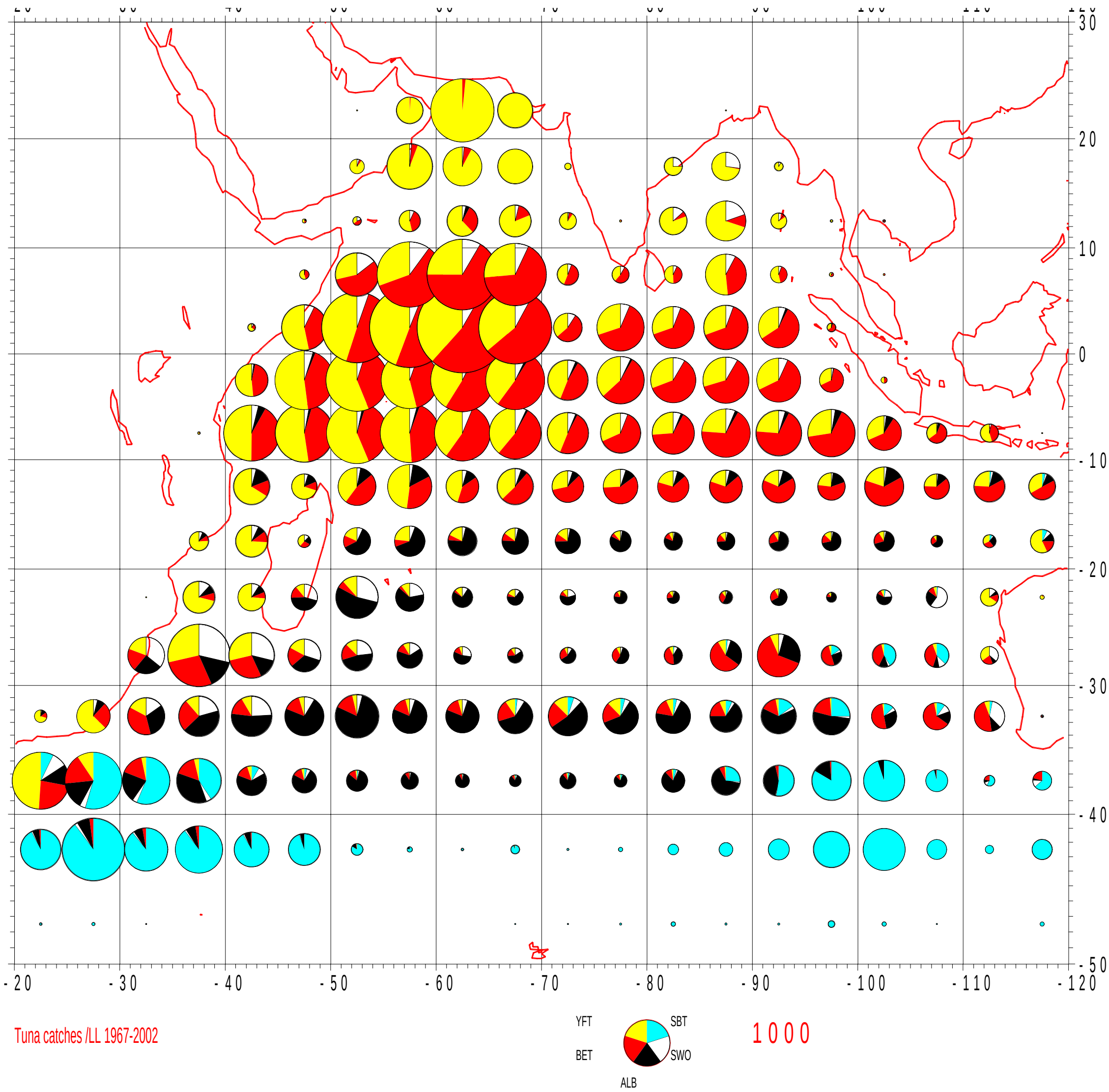


Figure 15: Average tuna and swordfish catches by species by longline fleets during the average period 1967-2002.

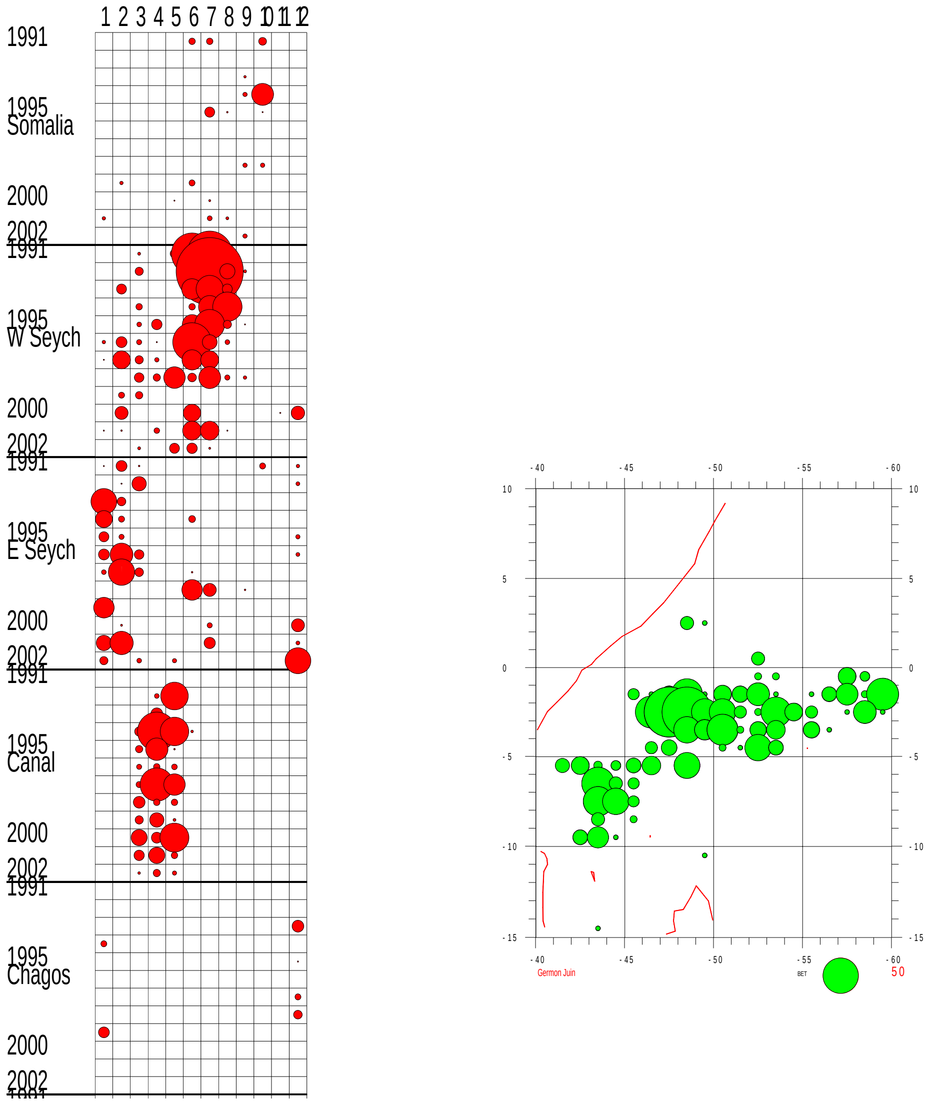


Figure 16: Average fishing map of albacore taken during recent years (1991-2002) by purse seiners and time and space diagramme of albacore catches by the same PS fishery (in the traditional ET areas)

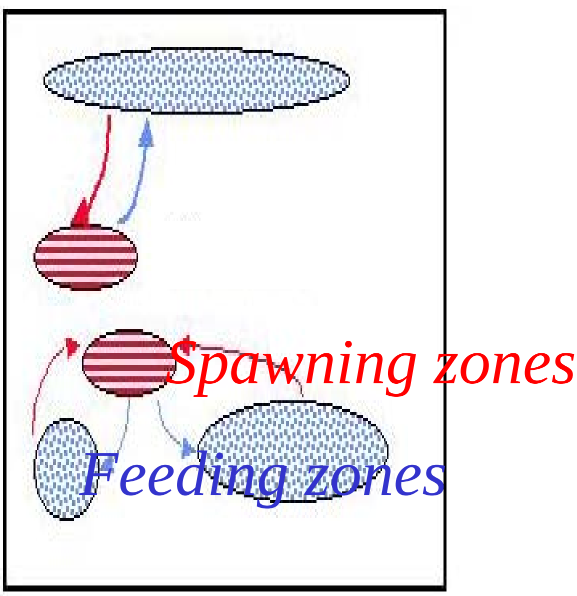


Figure 17: Typical migration schemes observed for the albacore stocks world wide between their spawning and feeding zones

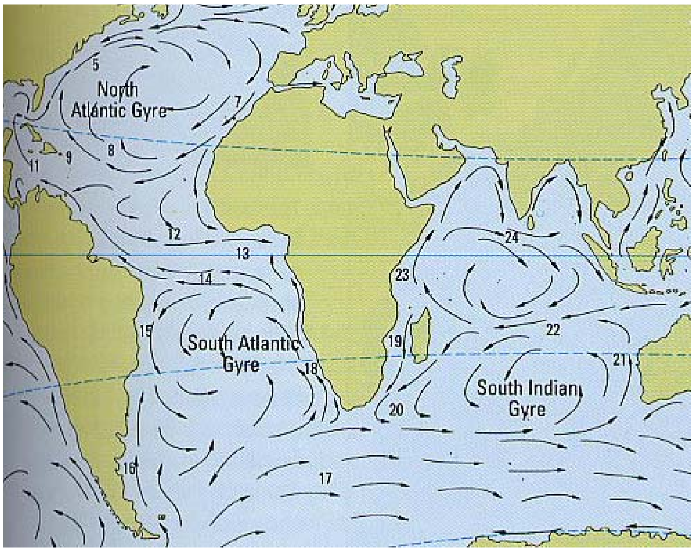


Figure 18 : Surface curents in the Atlantic and Indiian Oceans that are widely used by albacore in their seasonal migrations

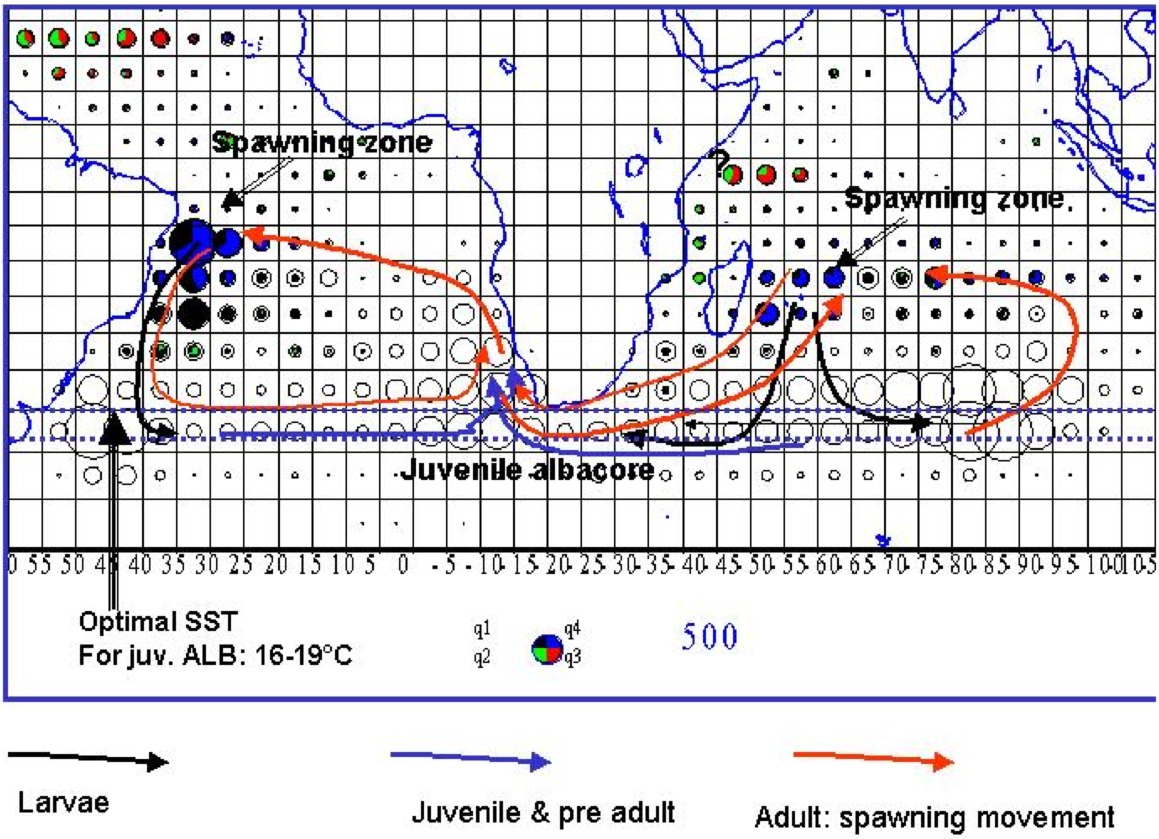


Figure 19: Average catches of albacore during recent years by the longline fisheries in the Atlantic and Indian ocean; all catches taken in warm waters (>25°C, e.g. potential spawning grounds) are shown in colours, as a function of the quarter during which the catch has been taken). The potential hypothetical movement pattern between potential spawning and feeding zones are also shown indicatively on this map.

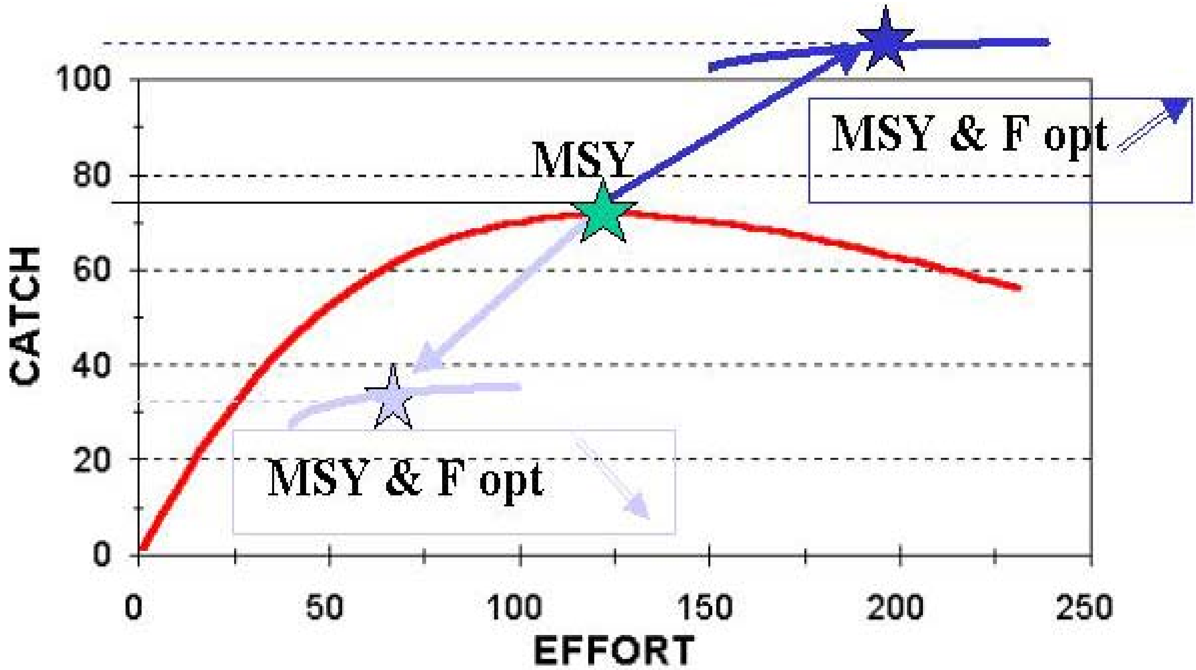


Figure 20 : Conceptual figure showing how the biological productivity of albacore stocks, then their potential MSY and otimal eforts, could be driven by environmental variabilty and cycles.

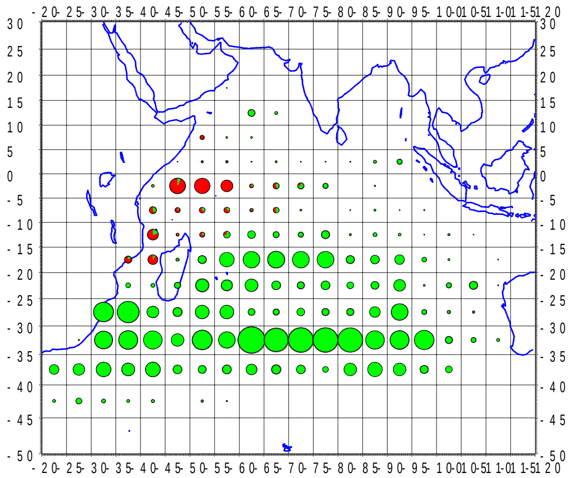


Figure 21: Average albacore catches by gear during the period 1990-2000

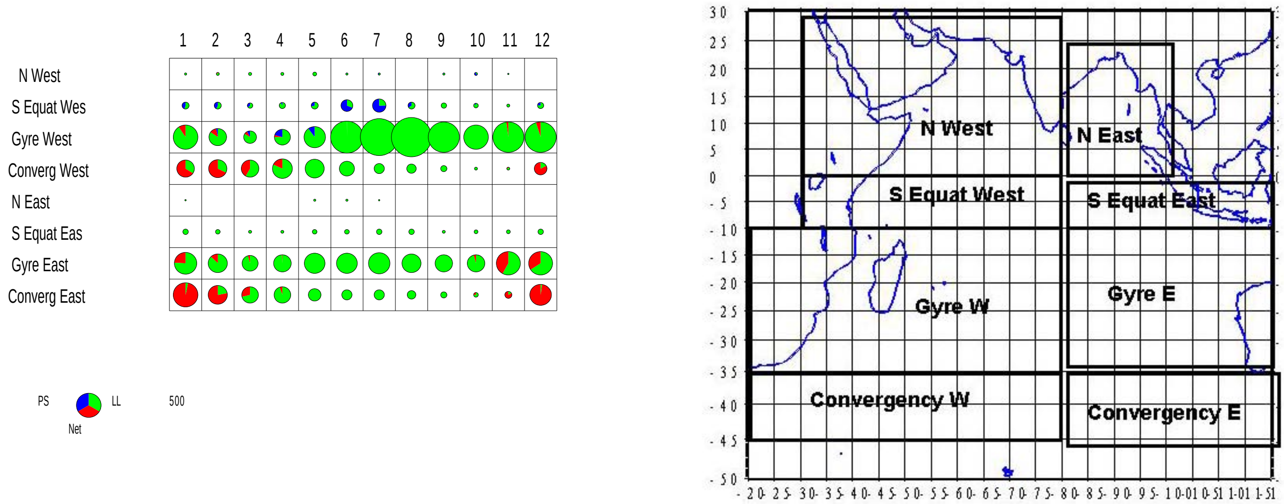


Figure 22 : Average monthly catches taken by gear and by area during the period 1990-2000; the area selected are shown on ther map, same figure)

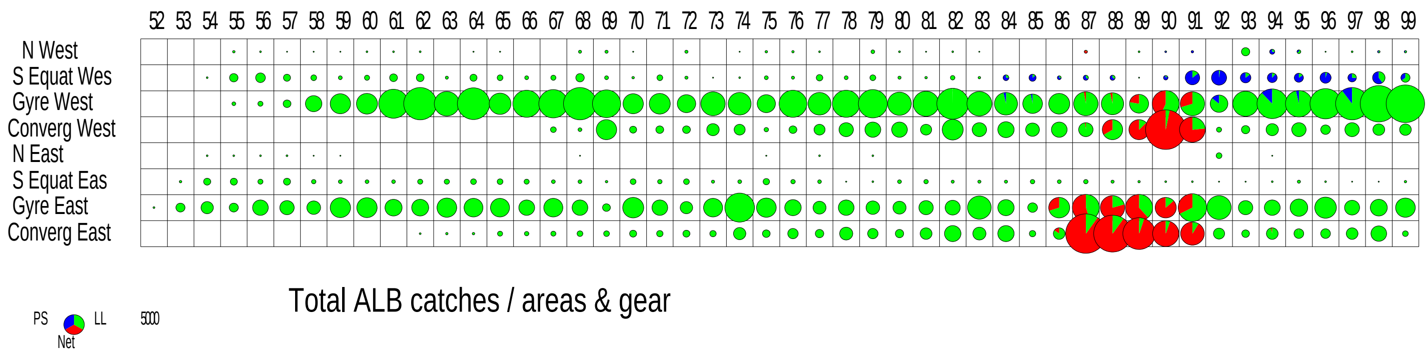


Figure 23: Yearly catches taken by gear and by area during the period 1952-2002 (the area selected are shown on the map, same figure)

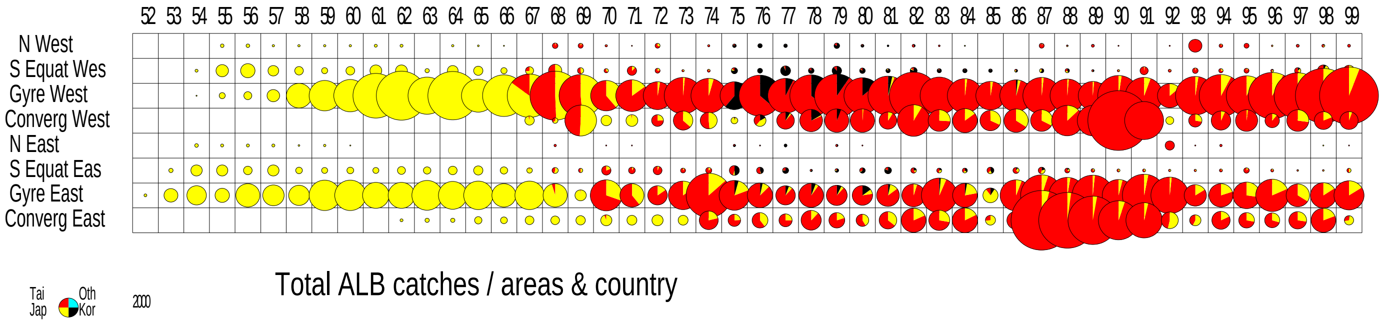


Figure 24 : Total catches of albacore taken by area by countries, for Japan, Korea, Taiwan and other countries (the areas are shown on the previous figure)

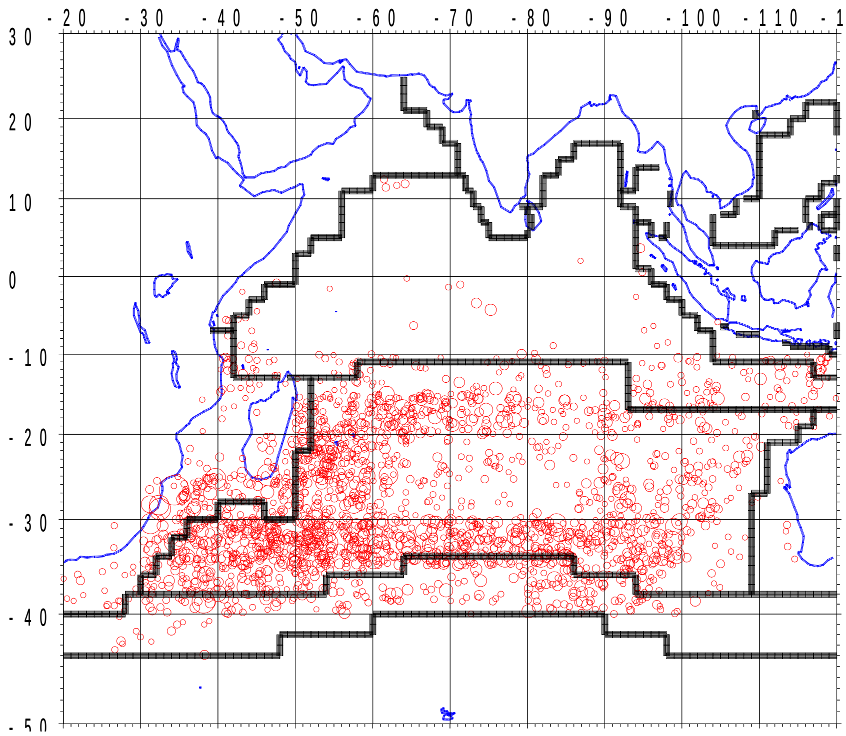


Figure 25 : Map showing each of the monthly albacore catches greater than 100 t in any given month and 5° square taken by all the longline fleets (each circle is proportionnal to the catch and has been positionned randomly in each 5° square)

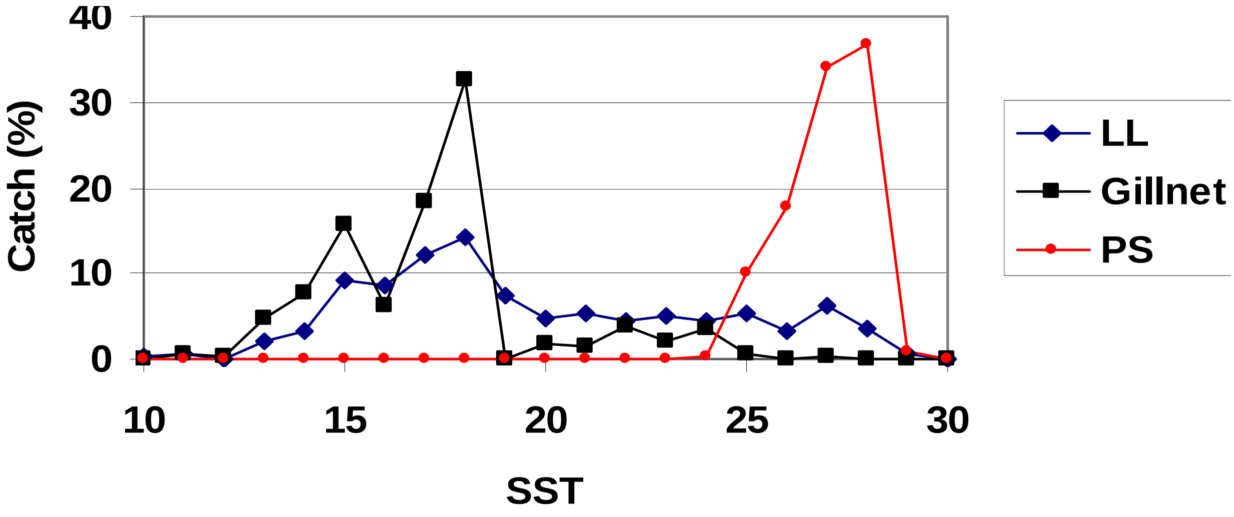


Figure 26: Average relationship between sea surface temperature and albacore catches by longliners, driftnets and purse seiners (SSR were calculated on the average SST by quarter and 5° squares taken from Levitu atlas)

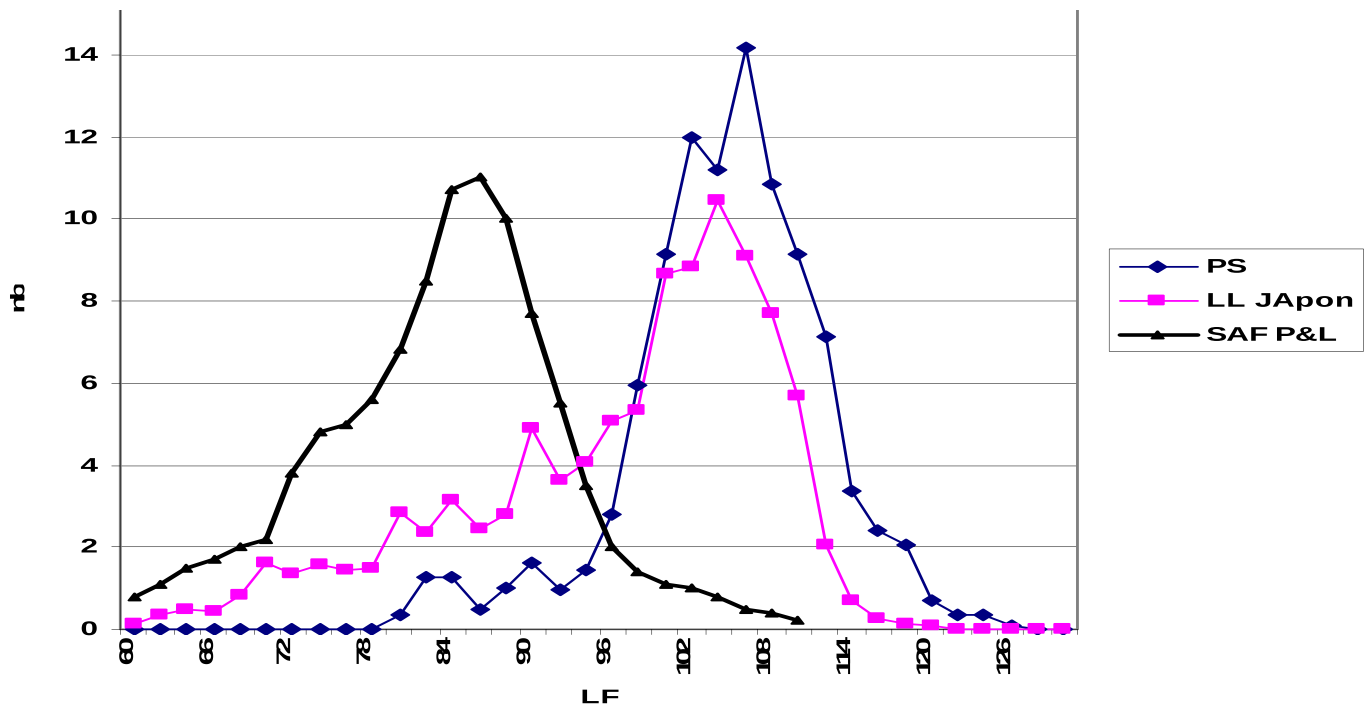


Figure 27: Average sizes of albacore taken by the various fisheries: longliners; purse seiners and South African pole and line fishery (probably from the South Atlantic stock).

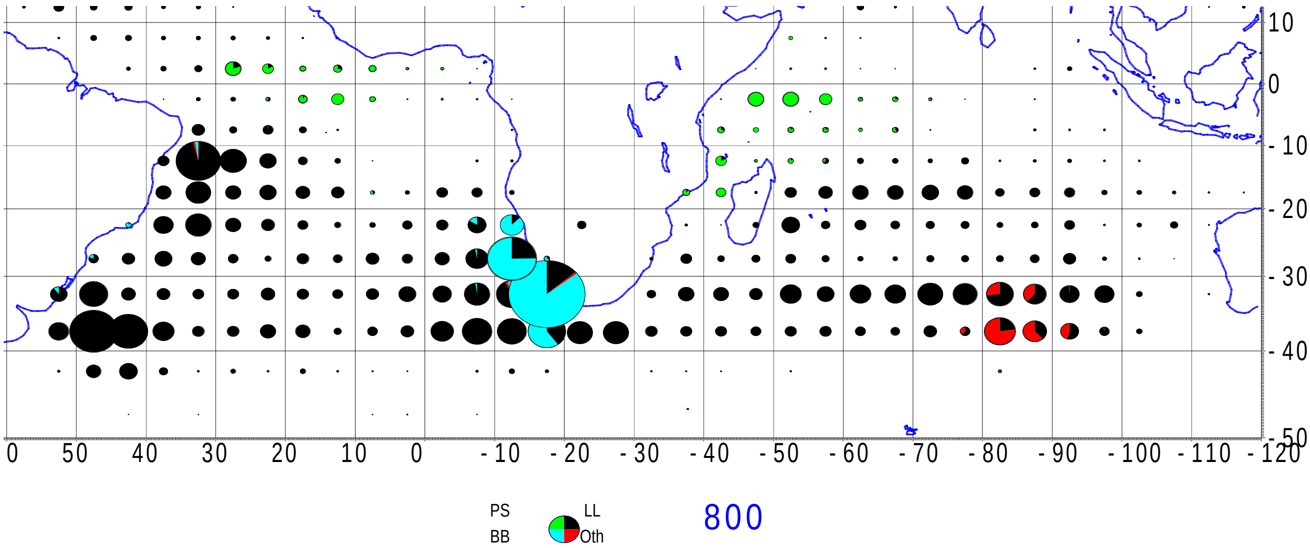


Figure 28: Albacore catches by gear registered during the period 1985-2000 (blue: P&L, black: LL, green PS)

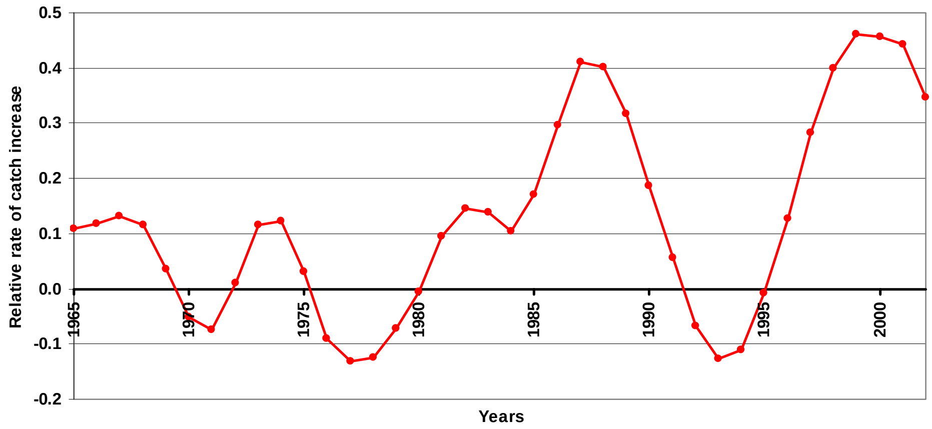


Figure 29: Rates of catches increase calculated for the Indian Ocean albacore fisheries (calculated over the 6 previous years) (Grainger and Garcia indices)