1. EASTERN PACIFIC OCEAN

This section updates the assessment of the status of the tuna stocks in the eastern Pacific Ocean (EPO) in the ISSF report on the status of the world's tuna stocks published in August 2009. The Scientific Assessment Review Meeting of the Inter-American Tropical Tuna Commission (IATTC, www.iattc.org), which is responsible for tuna in the EPO, took place in May 2009, and the Commission met in June. This report takes into account the information presented at those meetings, and the conclusions and decisions that were reached.

1.1. Catches

The preliminary estimate of the catches (including discards) of yellowfin, skipjack, and bigeye tunas from the eastern Pacific Ocean (EPO) during 2008 is about 590,000 tonnes, the second lowest annual catch recorded in the EPO since 1998 (Figure B-1). It represents approximately 20% of the Pacific catch, and about 13.5% of the global tuna catch. The 2008 skipjack catch from the region was about 296,000 tonnes, or 51% of the EPO total, yellowfin about 187,000 tonnes, or 32%, and bigeye about 95,000 tonnes, or 16%. Albacore catches in both the north and south Pacific declined during 2008. Purse-seine vessels accounted for about 96% of the total catch, longliners and pole-and-line vessels most of the remainder.

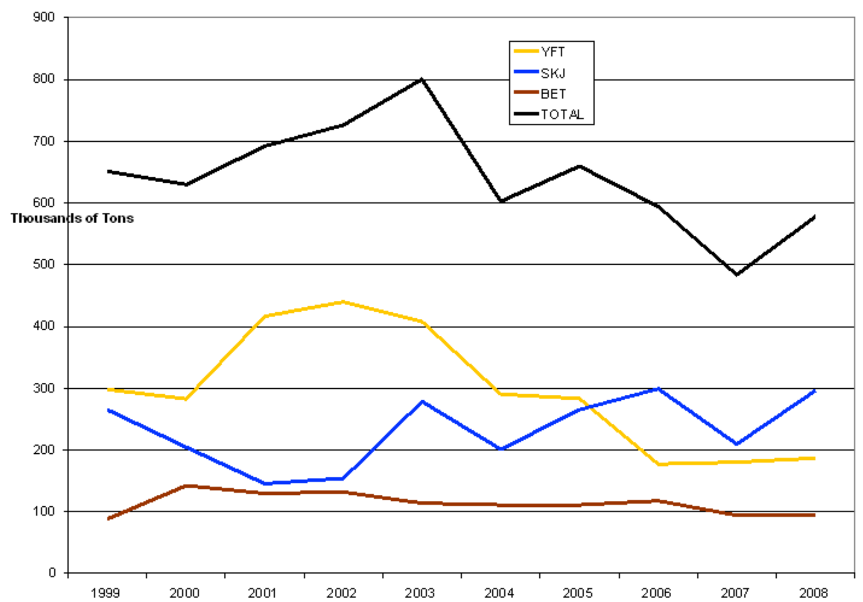

FIGURE B-1. Catches from the eastern Pacific Ocean, 1999-2008.

About 28,600 purse-seine sets were made during 2008 (Figure B-2). Of these, 32% were made on tunas associated with dolphins, which accounted for 22% of the tuna catch and 62% of the yellowfin catch; catches on dolphins peaked in 2002 at about 305,000 tonnes, but declined until 2006, after which they began to increase slightly. About 29% of all purse-seine sets were associated with floating objects (mostly fish-aggregating devices, or FADs), and these accounted for 48% of all tuna caught, 53% of the skipjack, and nearly all of the surface-caught bigeye; since 1999 there has been no trend in catches taken in floating-object sets.

Unassociated sets accounted for about 38% of the total sets made, but only 30% of the catch. Since about 1999, the catch taken in unassociated sets has varied between about 100,000 and 200,000 tonnes annually, but showed no trend.

1.2. 2009 assessments

Assessments and/or reviews of the status of the yellowfin, bigeye, and skipjack stocks were conducted by the scientific staff of the IATTC and presented at the Stock Assessment Review Meeting (SARM) in May 2009. The full reports of these assessments, which are reviewed below, are available on the IATTC website.

1.2.1. Yellowfin

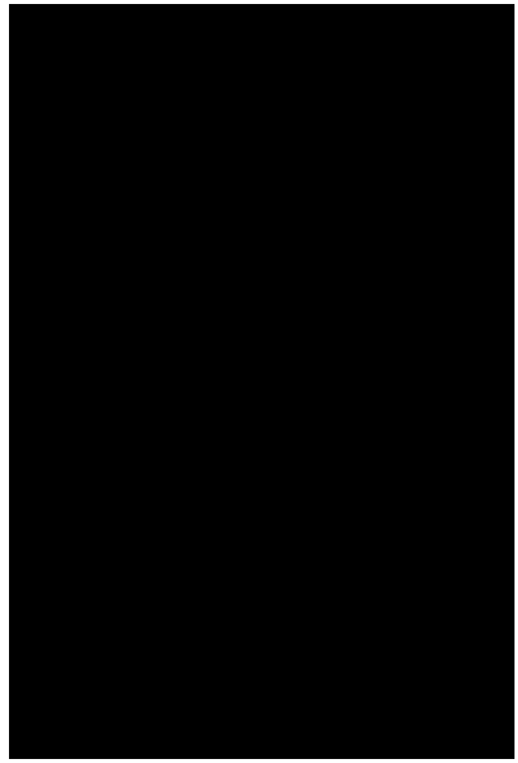

FIGURE B-2. Catches from the EPO, by set type: associated with dolphins (DEL), associated with floating object (OBJ), and unassociated (NOA). (IATTC-80-05)

The most current assessment for yellowfin tuna, presented at the IATTC SARM in May 2009, utilizes data through 2008. This assessment differed from the previous assessments in that a Stock Synthesis Version 3 (SS3) methodology was used rather than the A-SCALA methodology. There are several differences in the two approaches: the SS3 model, *inter alia*, uses a sex-specific approach, includes indices of abundance rather than fishing effort, and uses functional forms for selectivity.

The current analysis corroborates the earlier findings that the population experienced two or three periods of differing recruitment productivity, and that the higher periods of recruitment resulted in greater biomass. Biomass was at relatively low levels during the period of low recruitment in 1975-1982, increased substantially with the increase in recruitment during 1982-2002, and then declined during 2002-2006. Higher recruitments during 2007 and 2008 are resulting in current increases in biomass. As expected, trends in spawning biomass closely follow the trends in total biomass. For the base case analysis, in which steepness was set equal to 1.0 (meaning that there is no relationship between the size of the spawning stock and the subsequent recruitment), spawning biomass and total biomass during 2008 were greater than the corresponding maximum sustainable yield

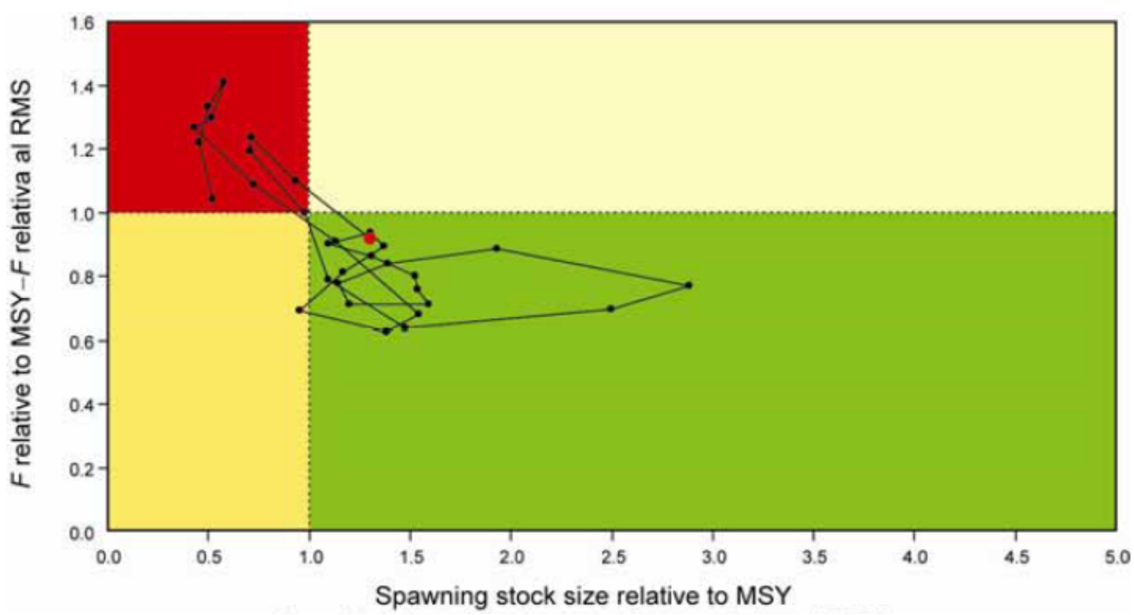

FIGURE B-3. Phase plot for stock size and fishing mortality for yellowfin tuna in the EPO relative to the reference levels (IATTC 2009).

(MSY) level. However, for a steepness of 0.75 the ratios of biomass and spawning biomass to the corresponding figures for MSY are less than 1.0.

The estimate of MSY for the base case analysis was 273,000 tonnes, and for the 0.75 analysis 310,000 tonnes. Recent catches have been lower than either of these estimates. Correspondingly, for the base case analysis, the ratio of current fishing mortality to fishing mortality at MSY is less than 1, as it has been for most of the period prior to 2008, but for the alternative 0.75 analysis the ratio was greater than 1 during 2008.

Figure B-3, which uses the base case analysis and a steepness value of 1.0 and shows trends in the estimates of biomass and fishing mortality relative to the corresponding MSY reference points, shows that the stock of yellowfin in the eastern Pacific Ocean is **not in an overfished state, or being overfished.**

If a steepness value of 0.75 for the relationship between spawning biomass and resulting recruitment is used in the analysis, the outcome is more pessimistic, and indicates that spawning biomass is below the MSY level.

The IATTC SARM report noted that “Under current levels of fishing mortality (2006-2008), the spawning biomass is predicted to slightly decrease, but remain above the level corresponding to MSY. Fishing at F_{MSY} is predicted to reduce the spawning biomass slightly from that under current effort and produces slightly higher catches.”

Eastern Pacific Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	2008		
Yellowfin	224,000	189,000	273 000	$B_c > B_{MSY}$, $F_c < F_{MSY}$

1.2.2. Bigeye

The 2009 assessment of bigeye tuna in the EPO employed the SS3 methodology. For the analysis it was assumed that bigeye in the EPO comprised a separate stock from western Pacific. There is uncertainty in the assessment resulting from the fact that the observed data may not perfectly represent the population of bigeye in the EPO, nor does the model perfectly represent the dynamics of the bigeye population or the fishery. As for yellowfin, it was assumed for the base case assessment that no relationship exists between spawning stock size and recruitment (steepness of 1). The sensitivity to this parameter was examined by using a stock-recruitment relationship with a steepness of 0.75. Analyses of the sensitivity of the model to assumed growth functions and to different western boundaries of the fishery was also conducted.

For the base case results the MSY was estimated to be about 84,000 tonnes. The catch (including discards) in most recent years has exceeded that amount, and in 2008 was about 16% higher, at 98,000 tonnes.

Fishing mortality of young fish increased substantially with the introduction of FAD fishing in the mid-1990s. Total fishing mortality has been nearly 20% greater than the corresponding MSY level.

The total biomass of bigeye has been declining in most years since early in the FAD fishery, and is currently very near to the corresponding MSY level. The estimates of spawning biomass have tracked very closely the trends in total biomass, but with a 1-2 year lag. The spawning biomass ratio (current biomass/biomass at MSY) fell below the MSY level in 2004, and has remained at less than 1 since; at the beginning of 2009 it was 0.89.

The sensitivity analysis using a steepness of 0.75 gives a more pessimistic view: the total biomass and spawning biomass ratios are 0.62 and 0.52, respectively. However, no relationship between spawning stock size and recruitment has been identified for bigeye in the EPO. In fact, the estimate of recruitment for 2008, emanating from a spawning biomass that was below the

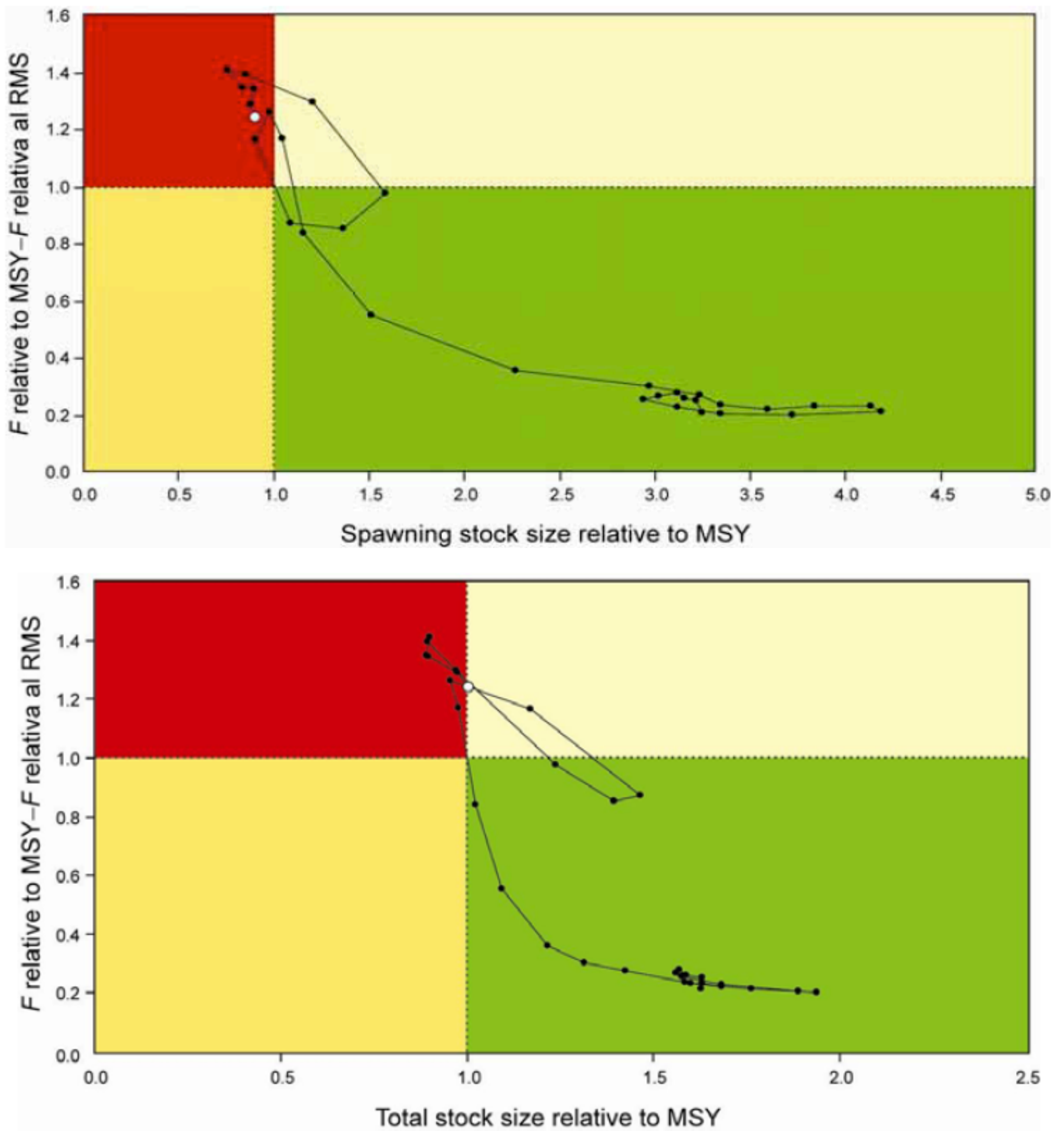

FIGURE B-4. Trends in ratios of estimates of biomass and fishing mortality to MSY levels for bigeye tuna in the EPO. The top panel represents spawning biomass, and lower panel total biomass (fish 3+ quarters of age). The black dots are three-year averages, and the white dot represents the estimate at the beginning of 2009. (IATTC 2009)

MSY level, was the third highest in the history of the fishery. Retrospective analysis reflects a low degree of confidence in the most recent estimates of recruitment.

From the base case analysis and the trends depicted in Figure B-4, it is clear that the stock of bigeye in the EPO is either **in a slightly overfished state or just entering an overfished state**, and **significant overfishing is occurring**.

For the base case analysis it has been estimated that, if fishing mortality is kept at the 2006-2008 level, the total biomass as well as spawning biomass will continue to decline, and reach historically low levels. However, if the fishing mortality is reduced to the MSY level, the spawning stock biomass will recover to near the MSY level by 2013.

Eastern Pacific Ocean	Landings (tonnes)	MSY (tonnes)	

	2004-2008	2008		Status
Bigeye	106,000	98,000	81,000	$B_c<B_{MSY}, F_c>F_{MSY}$

1.2.3. Skipjack

The last full assessment for skipjack tuna was in 2005, although an evaluation of a set of fishery indicators was given in 2008. The analysis demonstrated a high degree of uncertainty, particularly with respect to the determination of MSY reference points. To provide an alternative to using MSY-based reference points, in 2006 IATTC scientists developed a simple assessment model to generate indicators for biomass, recruitment, and exploitation rate, which would allow comparison of current indicator values with the distribution of indicators observed historically. To compare the current values with the historical values, the 5th and 95th percentiles of the distributions were used as reference levels. Eight indicators were evaluated with respect to 2008 data. Similar to previous findings, data- and model-based indicators have yet to detect any adverse consequence of increases in the effort and catch indicators.

Nothing in the 2009 analyses, indicators, or recent observations in the fishery alter the previous conclusions that the stock of **skipjack in the EPO is not in an overfished state or that overfishing of the stock is not occurring**.

Eastern Pacific Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	2008		
Skipjack	254,000	297,000	n/a	$B_c>B_{MSY}, F_c<F_{MSY}$

1.2.4. Albacore in the Pacific

An update of Pacific albacore is presented in the update on the status of the stocks in the western and central Pacific.

1.3. Management measures for the eastern Pacific Ocean

The member governments of the IATTC failed to implement a management program for tunas in the EPO for 2008, even though the Commission staff recommended such measures. However, in June 2009, the members approved a resolution establishing a management program for the remainder of for 2009, 2010, and 2011. The resolution requires:

All purse-seine vessels of more than 182 metric tonnes of carrying capacity that fish in the EPO for yellowfin, bigeye, and skipjack tunas to stop fishing in the EPO for a period of 59, 62, and 73 days during 2009, 2010, and 2011, respectively. The closures can be for either of two periods, August-September or November-January.

Purse-seine vessels of between 82 and 272 metric tonnes capacity may make one trip of no more than 30 days' duration during the specified closure periods, contingent upon carrying an IATTC observer during the voyage.

The fishery for yellowfin, bigeye, and skipjack tuna by purse-seine vessels within the area bounded by 96º and 110ºW between 4°N and 3°S shall be closed from 29 September through 29 October.

Total annual longline catches of bigeye tuna in the EPO during 2009-2010 are not to exceed about 2,500 tonnes for China, 32,500 tonnes for Japan, 12,000 tonnes for Korea, and 7,600 tonnes for Chinese Taipei, with the amounts for 2011 to be determined.

The Director of the IATTC is authorized to establish to a pilot program for research on FADs, to include, *inter alia*, provisions for the marking of FADs, maintaining a record of the numbers of FADs on board each vessel at the beginning and end of each fishing trip, and recording the date, time, and position of deployment of each FAD.

Subject to the availability of the necessary funding, the Director will continue the experiments with sorting grids for juvenile tunas and other species of non-target fish in the purse-seine nets of vessels that fish on FADs and on unassociated schools.

Renewal, for 2010, of the program to require all purse-seine vessels to first retain on board and then land all bigeye, skipjack, and yellowfin tuna caught, except fish considered unfit for human consumption for reasons other than size.

2. WESTERN AND CENTRAL PACIFIC OCEAN

This section updates the assessment of the status of the tuna stocks in the western and central Pacific Ocean in the ISSF report published in August 2009. The Scientific Committee of the Western and Central Pacific Fisheries Commission (WCPFC, www.wcpfc.int), which is responsible for tuna in the WCPO, met in August 2009, while the Annual Session of the Commission was held in December 2009. This report takes into account the relevant information presented at those meetings, and the conclusions and decisions that were reached. It is based on data available as of 31 December 2009.

2.1. Catches

Preliminary catch figures for the Western and Central Pacific Ocean (WCPO) show that about 2,426,000 tonnes of tuna were caught from the region during 2008. This represents the highest annual catch recorded, but by only about 26,000 tonnes (Figure B-5). The 2008 WCPO catch forms about 81% of the Pacific catch, and 56% of the global catch. The skipjack catch from the

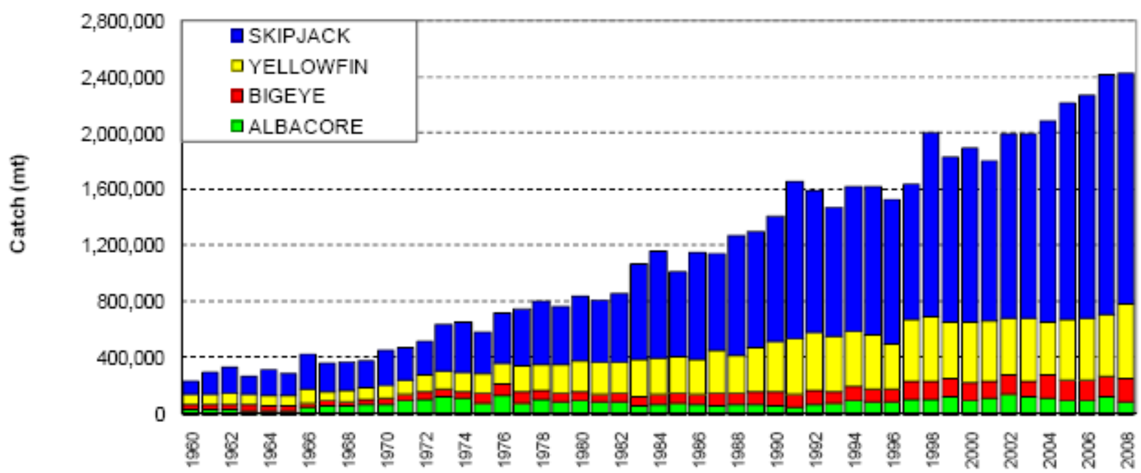

FIGURE B-5. Catches from the WCPO (from SC5).

region was about 1,635,000 tonnes, or 67% of the total, yellowfin about 539,000, or 22% (the highest on record), bigeye about 157,000 tonnes, or 6%. Albacore catches in both the north and south Pacific declined during 2008. Purse-seine vessels accounted for about 73% of the total catch, longliners about 10% percent, pole-and-line about 7%, and a variety of other gears the remainder.

Setting on unassociated schools is the predominant form of fishing by purse seiners. This type of fishing accounted for 63% of all sets, while sets on floating objects accounted for most of the remainder. All purse-seine fleets, with the exception of U.S. vessels, showed increases in sets on fish-aggregating devices (FADs) during 2008.

2.2. 2009 assessments

2.2.1. Yellowfin

The most recent yellowfin stock assessment, using the MULTIFAN-CL model, was in 2009. The assessment was reported on at the WCPFC's Science Committee 5 (SC5) meeting held in August in Vanuatu. The model analysis used a spatial and fishery structure equivalent to that used in the previous assessment, but a number of refinements concerning catch histories of the important fisheries were made for the 2009 analysis, particularly higher levels of catch from purse-seine sets on floating objects (including FADs) and levels of catch from the Philippine fishery. Also, consideration was given to a range of assumptions concerning weighting of longline catch-per-unit-of-effort (CPUE) indices, size frequency data, and changing catchability.

Estimates of yellowfin biomass derived from the model show relatively high levels in the early years of the fishery, and a declining trend as the fishery expanded. It was estimated that the unfished biomass of yellowfin was reduced by about 40% as a result of fishing; this is considered to be a modest level of depletion overall. In the equatorial region, where most of the yel-

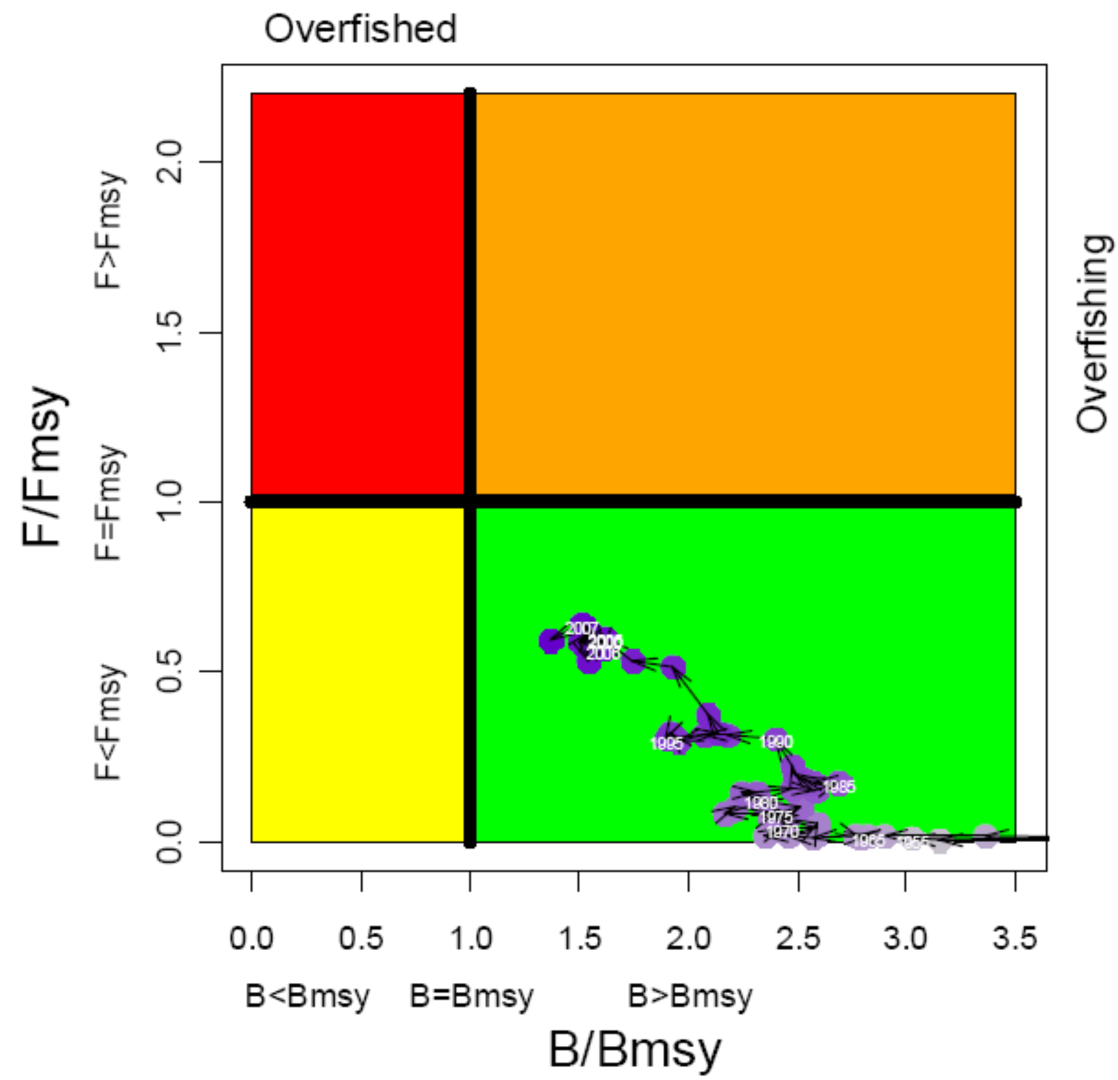

FIGURE B-6. Trends in stock status of yellowfin tuna relative to B_{MSY} and F_{MSY} reference points, 1952-2008. Darker purple points represent more recent years (from Langley *et al.*, SC5).

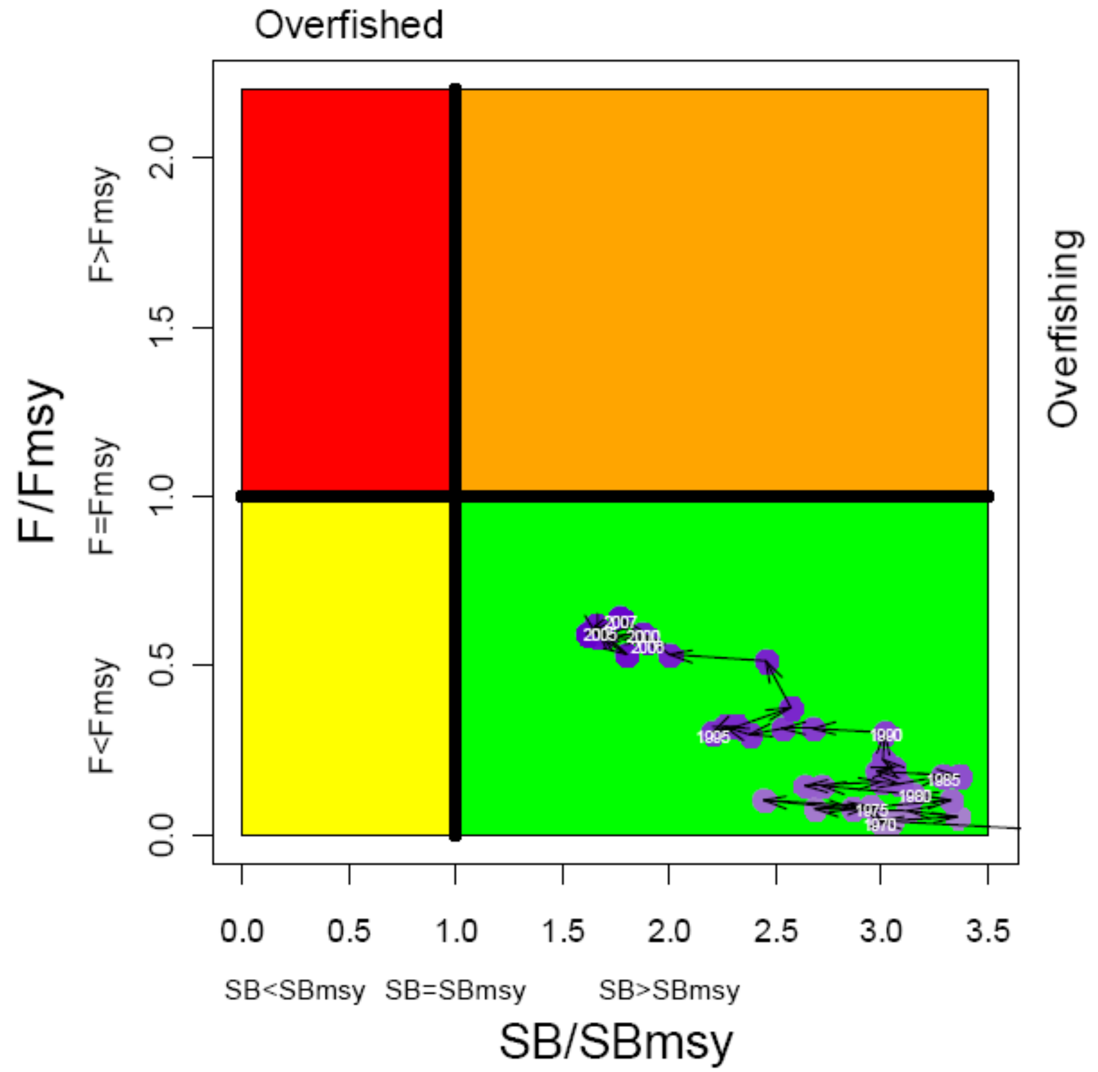

FIGURE B-7. Trends in spawning stock biomass of yellowfin tuna relative to SB_{MSY} and F_{MSY} reference points, 1952-2008. Darker purple points represent more recent years (from Langley *et al.*, SC5).

lowfin fishery occurs, reductions from the unexploited level were about twice as great, while in other areas they were minimal. The Philippines and Indonesian domestic fisheries are responsible for the highest impact on the yellowfin stock in the equatorial region, while the longline fishery has a small impact in all areas.

Although a number of changes in model assumptions were made in the 2009 analysis, assumptions about the steepness of the relationship between spawners and recruits had the greatest impact on the results. A series of model runs were made in which steepness was varied between 0.55 and 0.95. Assuming a moderate steepness value of 0.75 resulted in a stock status that was an improvement over the previous assessment, and for this 0.75 value, $F_{current}/F_{MSY}$ was estimated to be between 0.54 and 0.68, indicating that the fishing mortality (F) was much less than that required to take the maximum sustainable yield (MSY); $B_{current}/B_{MSY}$ was estimated to be 1.41-1.67 while $SB_{current}/SB_{MSY}$ was 1.50-1.79, both indicating biomass well above the MSY level. For steepness values between 0.55 and 0.95, biomass ratios were above 1.0 and fishing mortality ratios were below 1.0 in all cases.

The estimates of MSY varied between 552,000 and 637,000 tonnes, values significantly greater than current levels of catch.

Based on the 2009 assessment, the population of yellowfin in the WCPO is estimated **to not be in an overfished state,** and current fishing mortality is estimated to be less than that needed to harvest the MSY, indicating the **overfishing is not occurring**. However, in the equatorial region (Area 3), where about 90% of the yellowfin catch is taken, the stock may be fully exploited; this conclusion results from the fact that, when the data from all areas are combined, the three areas that provide the remaining 10% of the catch, and for which fishing mortality is low and biomass is high relative to MSY reference levels, tend to "buffer" the area-wide estimate of fishing mortality and biomass. Therefore, the interpretation that there is additional exploitation potential for yellowfin tuna from the tropical region should be avoided.

The probability distributions resulting from the analysis reveal that there is a very low probability that biomass is below the MSY level, or that fishing mortality is above the MSY level. Even though the key source of uncertainty in the analysis is attributable to assumptions regarding the steepness of the stock-recruitment relationship, sensitivity analyses indicated changes in the steepness did not significantly alter the conclusions.

The plots in Figures B-6 and B-7 provide a graphical representation of the status of the stock relative to certain MSY reference points.

Some caution was expressed regarding the results of the analysis, since the estimates of MSY are based on a long-term series of data, and recent levels of estimated recruitment are well below the long-term average used to calculate the MSY. If recruitment remains low, yield from the fishery would be lower than the MSY estimates.

Because fishing mortality in Area 3 is near the MSY level, and because it would be prudent to maintain biomass approximately 5% above the MSY level, it was recommended during the SC5 meeting that fishing mortality in Area 3 not be increased over current levels.

Western and Central Pacific Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	2008		
Yellowfin	448,000	543,000	552-637,000	$B_c > B_{MSY}$, $F_c < F_{MSY}$

2.2.2. Bigeye

Rather than a full assessment, which was conducted in 2008, a streamlined assessment was done for 2009 and presented during the SC5 meeting. The streamlined assessment reports on less of the background and supporting material, but the analysis is nonetheless comparable to the earlier analyses. The analysis for 2009, which focused on several changes in data and model structure to the previous analyses, was done primarily to facilitate an evaluation of the potential benefits of the 2008 conservation resolution for bigeye and yellowfin approved by the WCPFC.

An updated version of MULTIFAN-CL was used for the assessment. More than 130 runs of the model were made using a number of alternative assumptions. The assumptions regarding steepness of the spawner-recruit relationship, and the level of catches in the fishery for small fish in Indonesia and the Philippines, resulted in some of the most dramatic effects on the outcome of the various model runs. The model 10 run was considered to provide the most comparable results to the 2008 assessment.

Several important results of the analysis for the model 10 run were:

1. Recruitment estimates showed a decreasing trend until about 1970 and increasing thereafter, with highs during 1995-2005, after which estimates have declined to the long-term average.

2. By 1970, biomass had declined to about half of its initial (1952-1956) level, and remained relatively constant at that level until about 2007; however, spawning biomass, which declined precipitously from its initial level until about 1965, has continued to decline, and is now at about 30% of its initial level.

3. Using the long-term series of estimates of recruitment, MSY was calculated to be about 57,000 tonnes, and recent catches have been well above that level; MSY estimated for current high levels of recruitment was also shown to be significantly less than current catch levels. Based on these findings, and recognizing that these recent high catches are the result of recent high levels of recruitment, it was stated in the assessment that: "…**we conclude that current levels of catch are not sustainable…**" even if the high levels of recruitment continue.

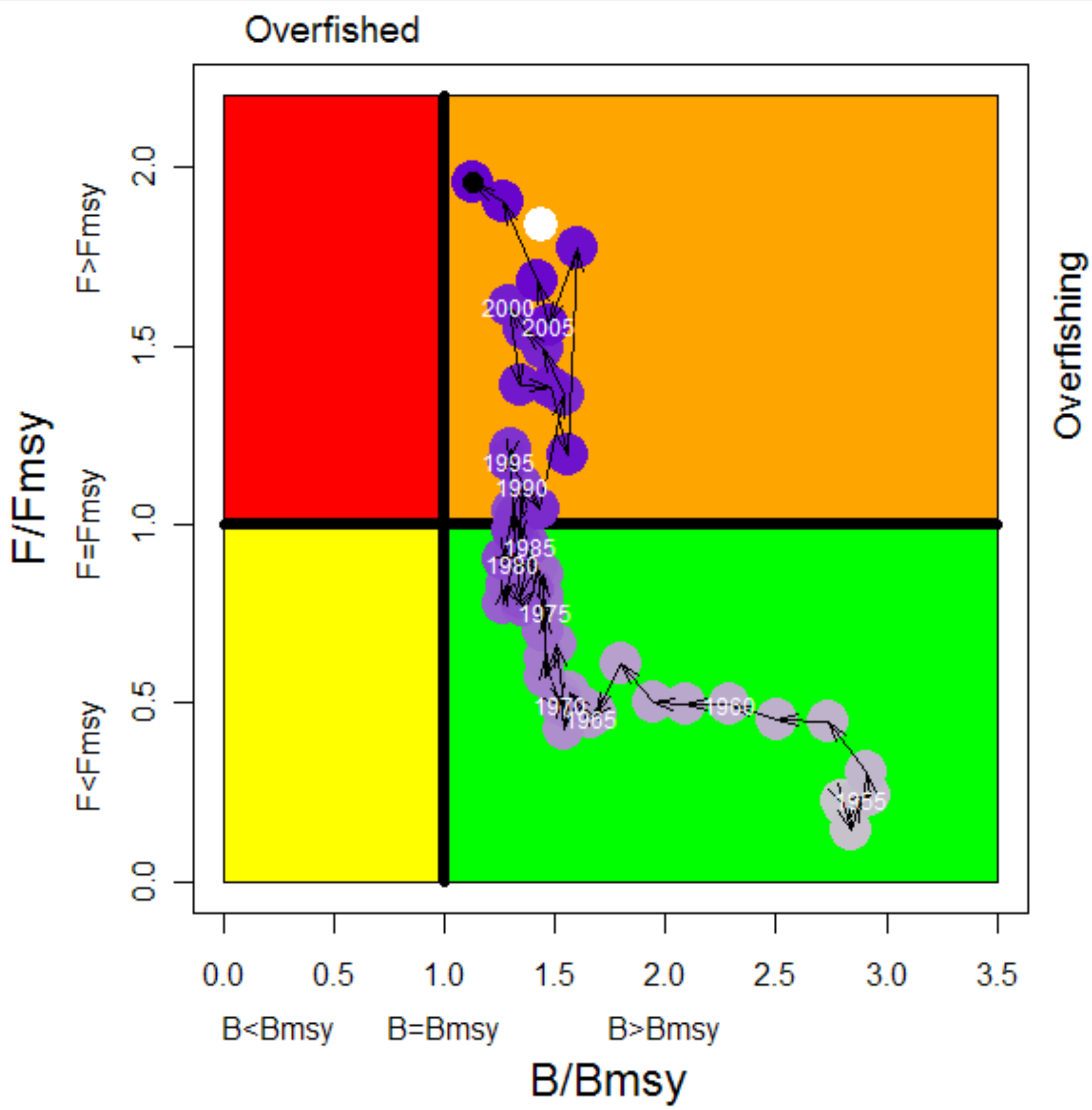

FIGURE B-8. Temporal trend in annual stock status of bigeye tuna relative to B_{MSY} and F_{MSY} reference points, 1952–2008, from run 10. The colour of the points is graduated from mauve (1952) to dark purple (2008), and the points are labelled at 5-year intervals. The white circle represents the average for 2004-2007, and the black dot represents the last year of the model (2008), for which total biomass is uncertain (from SC5, Harley *et al.*)

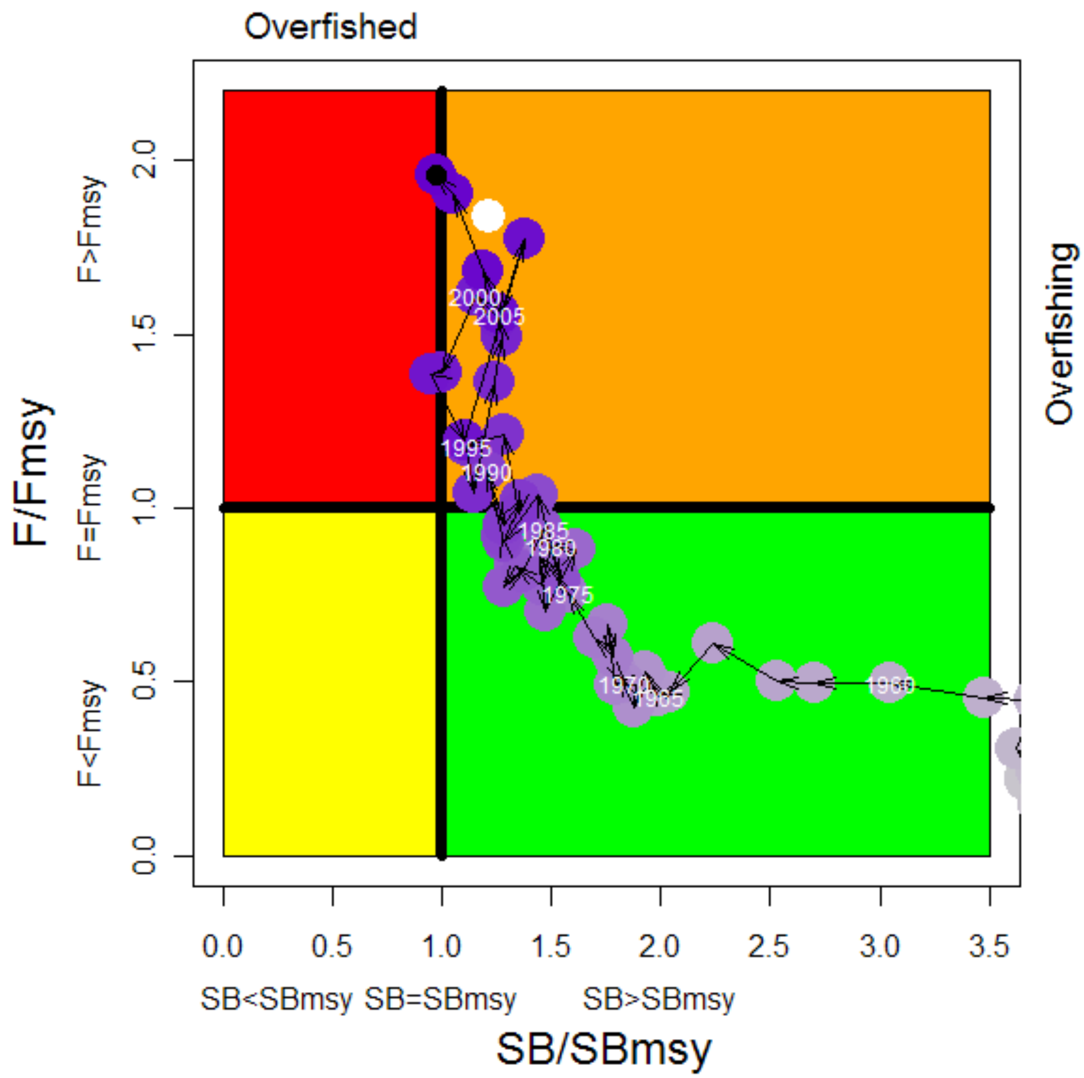

FIGURE B-9. Temporal trend in annual stock status of bigeye tuna relative to SB_{MSY} and F_{MSY} reference points, 1952–2008, from run 10. The colour of the points is graduated from mauve (1952) to dark purple (2008), and the points are labelled at 5-year intervals. The white circle represents the average for 2004-2007, and the black dot represents the last year of the model (2008), which is considered more reliable for spawning biomass than for total biomass (from SC5, Harley *et al.*)

4. Fishing mortality has increased steadily since the introduction of commercial fishing. In all cases examined, $F_{current}/F_{MSY}$ is considerably greater than 1.0, and it was estimated that a 34%-50% reduction from the level of fishing mortality in 2004-2007 would be needed to keep the biomass above the level corresponding to MSY. For comparative purposes, in 2006 a 25% reduction from 2001-2004 average levels was recommended, and in 2008 a 30% reduction from the 2003-2006 average level. **Based on the results of the analysis, overfishing is occurring in the bigeye tuna stock.**

5. The current situation in the fishery respecting biomass is that $B_{current}/B_{MSY}$, where $B_{current}$ is for the 2004-2007 period, is equal to 1.44; however, there is a 70% probability that the latest estimate of spawning biomass, which is for 2008, is less than the spawning biomass at MSY (0.89). It was predicted that, if fishing mortality continues at current levels, the biomass

would be reduced to about half the MSY level. Based on the analysis results, it was concluded that "**it is likely that bigeye tuna is in, at least, a slightly overfished state, or will be in the near future.**" It was also concluded that yields could be increased if fishing mortality of small fish was decreased.

These results are depicted graphically in Figures B-8 and B-9, which were taken from the report by Harley *et al.* presented at the SC5 meeting.

Because the stock of bigeye may just be entering an overfished state, and fishing mortality is well in excess of the MSY level, the Scientific Committee recommended that fishing mortality of bigeye in the WCPO be reduced by 43% from the 2007 level.

Western and Central Pacific Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	2008		
Bigeye	149,000	158,000	57,000	$B_c > B_{MSY}$, $F_c > F_{MSY}$

2.2.3. Skipjack

The last assessment for skipjack in the WCPO was in 2008 and it concluded that the stock **was not in an overfished state nor was overfishing occurring**. Nothing has been observed in the fishery that indicates that this conclusion should be changed, although some mild concern over possible shifts in distribution of skipjack in the northern regions of the WCPO has been expressed.

Western and Central Pacific Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	2008		
Skipjack	1,584,000	1,636,000	2,200,000	$B_c > B_{MSY}$, $F_c < F_{MSY}$

2.2.4. South Pacific albacore

A comparative stock assessment using MULTIFAN-CL was conducted for southern Pacific albacore using catch statistical data through mid-2008, and the results, presented at the SC5 meeting, were compared with the 2008 assessment results. A number of major changes with respect to input data for the model and model structure were made over the 2008 assessment. The changes, included, *inter alia*, revised CPUE data for DWFN longline fisheries and changes to growth modelling; as was the case in the previous assessment, the full range of steepness values was used to characterize stock status.

For all runs of the model, $F_{current}/F_{MSY}$ was less than 1.0, indicating that overfishing was not occurring. Similarly, $SB_{current}/SB_{MSY}$ was much greater than 1.0, varying between 1.7 and 4.9, indicating that the stock is not in an overfished state. Much of the variability in these ratios was attributable to the steepness of the spawner-recruit relationship.

Estimates of recruitment over the period of years examined showed no trends, and were not related to spawning biomass. The results of the assessment give no indication that current catch levels are not sustainable.

One of the factors contributing to the healthy outlook for the stock is the that the mean size of the fish in the longline catches is very near the optimum size in terms of maximizing the yield per recruit. Nevertheless, current levels of fishing pressure appear to be affecting are estimated to have reduced longline catch rates by 20-50% from initial levels

Similar to the previous assessments, **overfishing of southern albacore is not occurring, nor is the stock in an overfished state**

Figures B-10 and B-11, which show time trends relative to MSY reference points, reflect the healthy state of the stock.

Pacific Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	2008		

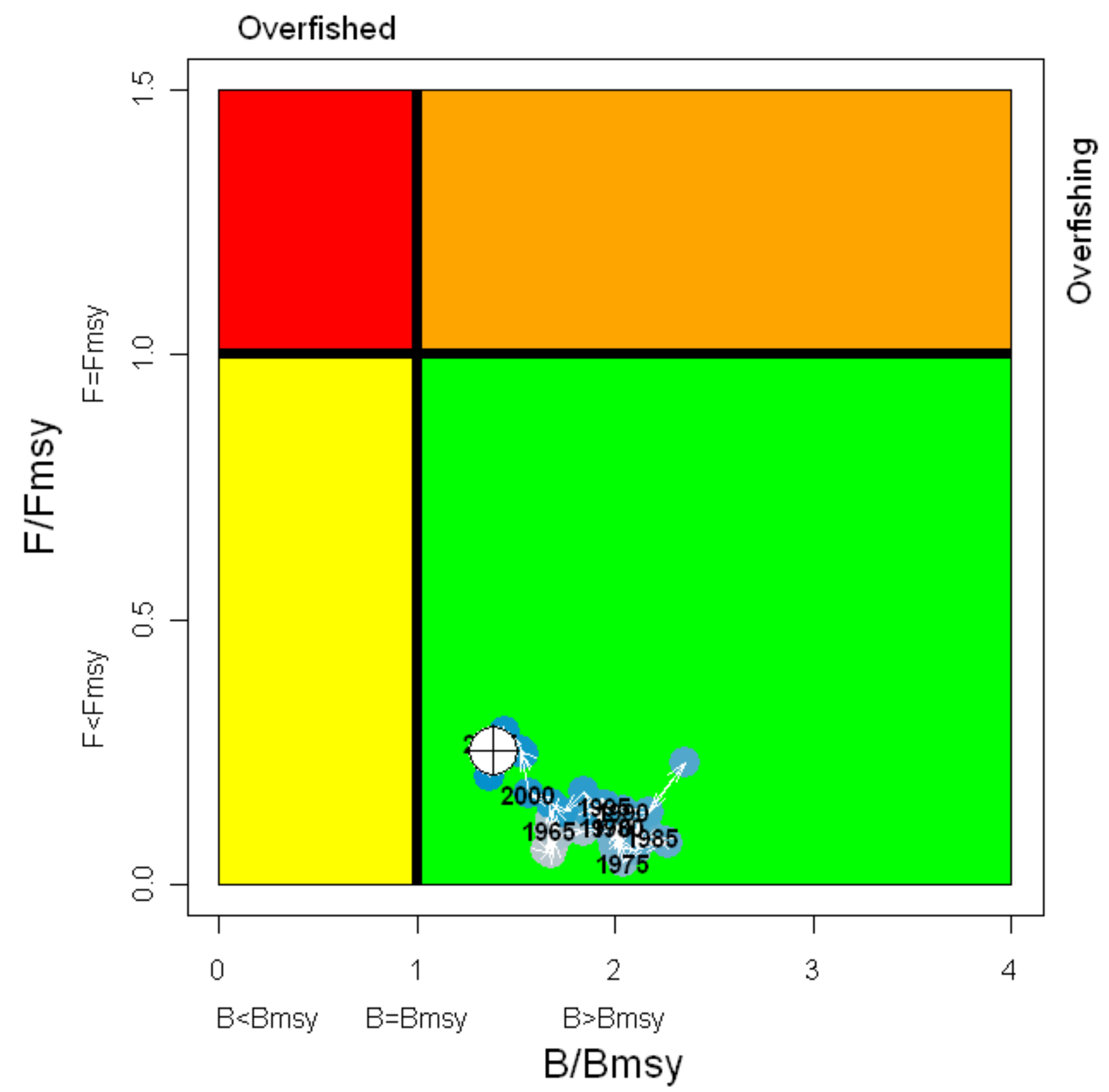

FIGURE B-10. Temporal trend in annual stock status of south Pacific albacore, relative to B_{MSY} and F_{MSY} reference points, 1960-2007. The colour of the points is graduated from pale blue (1960) to blue (2007), and points are labelled at five-year intervals. The last year of the model (2008) is excluded because it is highly uncertain (from Hoyle and Davies, SC5).

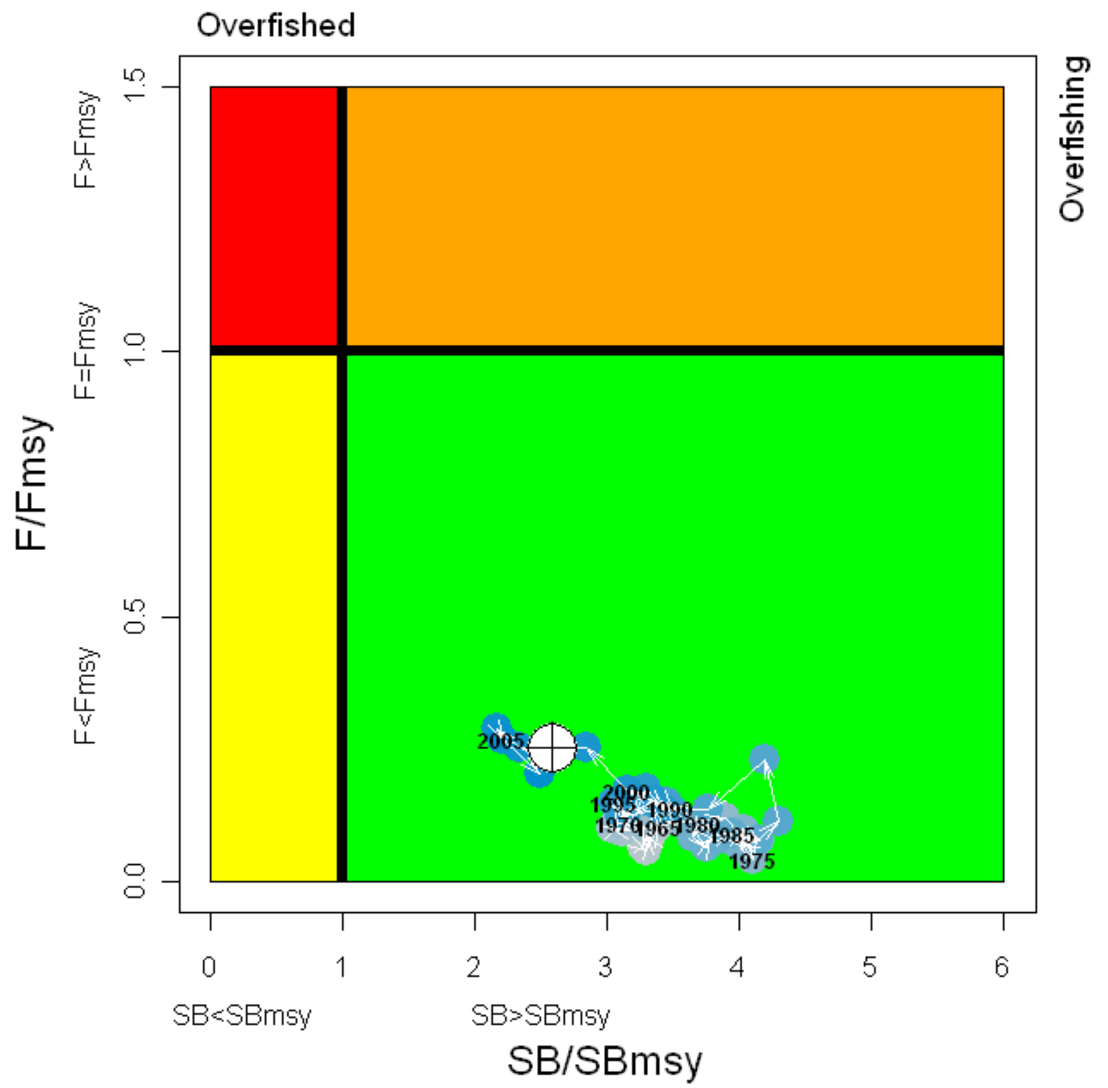

FIGURE B-11. Temporal trend in annual stock status of south Pacific albacore, relative to SB_{MSY} and F_{MSY} reference points, 1960-2007. The colour of the points is graduated from pale blue (1960) to blue (2007), and points are labelled at five-year intervals. The last year of the model (2008) is excluded because it is highly uncertain (from Hoyle and Davies, SC5).

South Pacific albacore	60,000	52,000	97,000	$B_c > B_{MSY}$, $F_c < F_{MSY}$

2.2.5. North Pacific albacore

The most recent assessment of north Pacific albacore was in 2006, using data through 2005; there has been no complete assessment since then, but one is planned for 2012. The 2006 assessment concluded that **the stock is not in an overfished state, but fishing mortality was high and consideration should be given to reducing it**. Lacking a complete assessment, there is no new information on the status of the stock, nor recommendations regarding conservation and management. It was reported during the SC5 meeting that the International Scientific Committee (ISC) continues to consider that the rate of fishing mortality, which during 2002-2004 was above most reference points used as proxies for $F_{MSY\ (except\ Fmax)}$. **Fishing mortality should not be increased**, even though the spawning biomass is at the second highest level in the history of the fishery. It was noted that, if fishing mortality stays at current rates, the spawning biomass will be reduced to the long-term average by the middle of 2010.

Pacific Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	2008		
North Pacific albacore	79,000	73,000	66-100,000	$B_c > B_{MSY}$, $F_c \leq F_{MSY}$

2.3. Management measures: yellowfin and bigeye

The WCPFC utilizes binding conservation and management measures (CMMs) for addressing the issue of conservation and management. The most recent CMM approved for conservation of yellowfin and bigeye was CMM 2008-01, whose objectives are to: 1) ensure that bigeye and yellowfin tuna stocks are maintained at levels capable of producing their maximum sustainable yield and to achieve, through the implementation of a package of measures, over a three-year period commencing in 2009, a minimum 30% reduction in bigeye tuna fishing mortality from the annual average during the 2001-2004 period or 2004, and, 2) ensure that there is no increase in fishing mortality for yellowfin tuna beyond the annual average during the 2001-2004 period or 2004. The details of this conservation program are available in an earlier ISSF report, available on the ISSF website (http://iss-foundation.org/).

In a study prepared for the SC5 meeting (WCPFC-SC5-2009/GN-WP-17), Hampton and Harley presented an evaluation of CMM 08-01 to determine whether the measures mandated therein are capable of meeting its objectives with respect to bigeye and yellowfin in the WCPO. Two different models were used to make projections over a 10-year period. The ratios of F/F_{MSY} and B/B_{MSY} projected to 2018 were used as indicators of performance in achieving the goals of CMM 08-01. For bigeye, these projections suggested that the spawning biomass would fall to about 0.4-0.6 of the level corresponding to MSY by 2018, and that that there would be little, if any, reduction in F over the high levels estimated for 2007-2008. The analysis showed that "the main reasons for the lack of effectiveness of the measure are (i) the reductions in longline catch do not result in the required reduction in fishing mortality on adult bigeye tuna; (ii) the increase in purse seine effort allowed under the measure, and the increase in purse seine catchability (fishing mortality per unit effort) that has occurred since 2001-2004, is not sufficiently offset by the FAD and HSP closures to reduce purse seine fishing mortality below 2001-2004 average levels; and (iii) the exclusion of archipelagic waters, which encompasses most of the fishing activity of the Indonesian and Philippines domestic fleets and significant amounts of purse seine effort in Papua New Guinea and Solomon Islands, from the measure effectively quarantines an important source of fishing mortality on juvenile bigeye tuna."

The projections for yellowfin tuna are much more optimistic than those for bigeye. As pointed out above, current fishing mortality for yellowfin is well below the MSY level, while the spawning biomass is well above the MSY level. Given the provisions of CMM 08-01, the evaluation projected that fishing mortality in 2018 will range from about 8% below to 15% above the 2001-2004 average. The spawning biomass of yellowfin in 2018 is predicted to be close to what is was during 2001-2004, remaining at or above the corresponding level at MSY.

This study, as well as some additional information (WCPFC6-2009/IP18), was also reported to the WCPFC sixth annual session in December 2009. The latter paper re-emphasized that substantial cuts in bigeye catch and/or fishing effort directed at bigeye tuna in all components of the fishery will be required to reduce fishing mortality to levels consistent with MSY. The WCPFC accepted these conclusions , and agreed to consider the issues raised during the meetings of the Scientific Committee and the Technical and Compliance Committee in 2010, with a view to bringing forward a new package of measures for consideration at the next session of the WCPFC in December 2010.

2.4. Management measures: albacore

In 2005, the IATTC and WCPFC approved resolutions calling on States to not allow their vessels fishing for northern albacore to increase fishing effort beyond the then current levels. For southern albacore, WCPFC approved a resolution that calls for no increases in the number of vessels fishing in the Convention Area below 20ºS over the 2005 or 2000-2004 levels.

No new management recommendations have been made by either the Inter-American Tropical Tuna Commission (IATTC) or the WCPFC during 2009.

3. ATLANTIC OCEAN

This section updates the assessment of the status of the tuna stocks in the Atlantic Ocean in the ISSF report on the status of the world's tuna stocks published in August 2009. The International Commission for the Conservation of Atlantic Tunas (ICCAT, www.iccat.int) is responsible for assessing and managing Atlantic tuna stocks. ICCAT's Standing Committee on Research and Statistics (SCRS) last met in October 2009, and the Commission met in November. This report takes into account the information presented at those meetings, and the conclusions and decisions that were reached. It is based on data available as of 31 December 2009.

3.1. Summary

The preliminary estimate of the landings (which do not include fish caught but discarded at sea) of yellowfin, skipjack, and bigeye tunas from the Atlantic Ocean during 2008 is about 326,000 tonnes, which remains low relative to the level of landings in the early 1990s (Figure B-12). Of these landings in 2008, 46% corresponded to skipjack, 33% to yellowfin and 21% to bigeye.

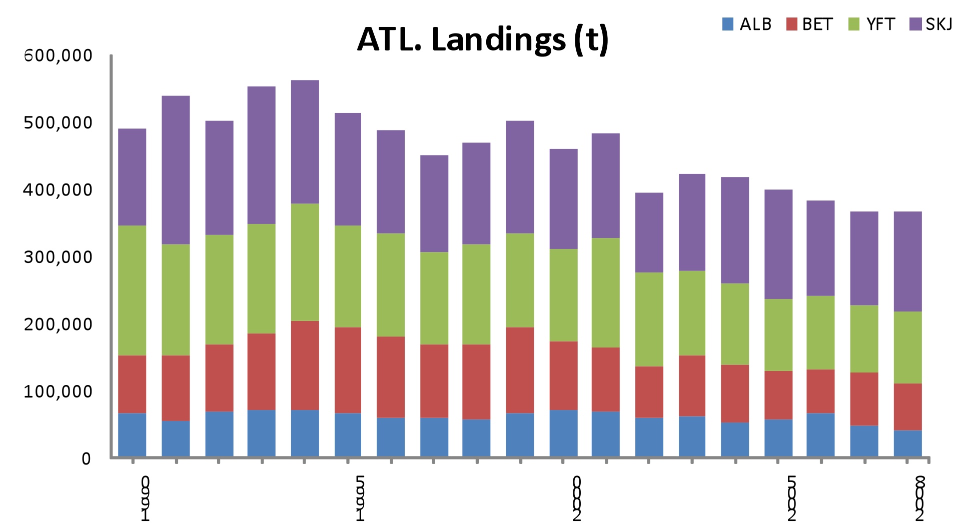

FIGURE B-12. Landings of skipjack, bigeye, yellowfin and albacore in the Atlantic Ocean, 1990-2008.

Albacore landings in the Atlantic (North and South combined) declined by 7% in 2008, to a level of 39,000 tonnes (Figure B-12). Mediterranean landings also decreased, to a reported figure of 2,600 tonnes, but this is probably incomplete.

3.2. Yellowfin

Atlantic yellowfin are distributed widely throughout tropical and subtropical waters. Surface fisheries for them occur in the eastern Atlantic between Portugal and South Africa, and in the western Atlantic between the Gulf of Mexico and southern Brazil; longline fisheries occur throughout the entire tropical and temperate Atlantic. The primary spawning ground for yellowfin is in the Gulf of Guinea, with lesser spawning activity in the Gulf of Mexico. Because tagging data show a number of trans-Atlantic migrations and longline data show a continuous distribution across the Atlantic, yellowfin throughout the Atlantic are considered to belong to a single stock for management purposes. As in other oceans, surface-caught yellowfin are generally small and are found in mixed schools with skipjack and small bigeye; the larger yellowfin are taken mostly by longline fishing.

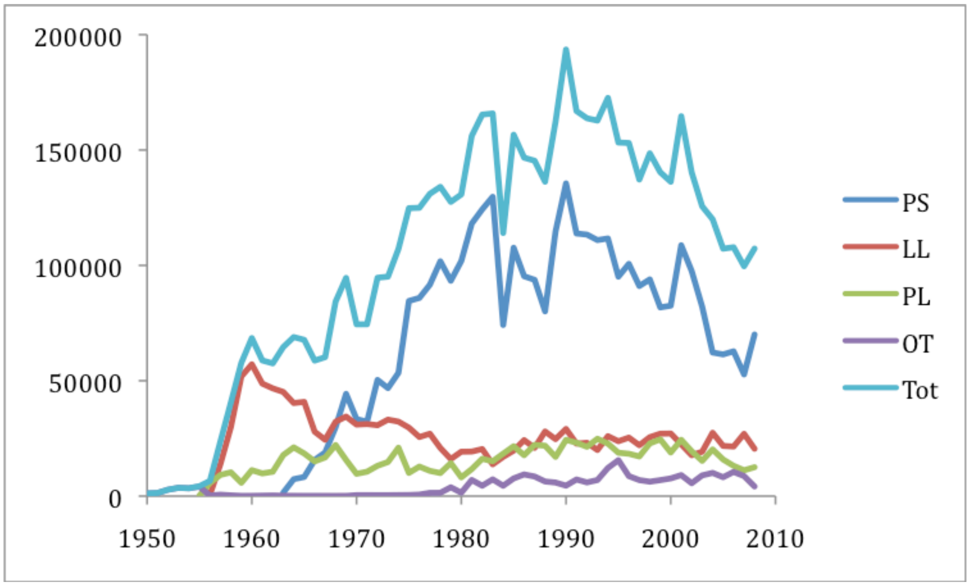

FIGURE B-13. Landings of yellowfin in the Atlantic Ocean by gear type, 1950-2008.

A variety of fishing gear is used to harvest yellowfin in the Atlantic, but purse-seine accounts for nearly 58 percent of the harvest, longline 22 percent, pole-and-line for 13 percent, and a variety of other gears for the remaining. The top five producers of yellowfin from the Atlantic are in descending order: France, Spain, Ghana, Panama, and Japan.

Yellowfin landings in the Atlantic have declined by about 45 percent since the peak catch of 194,000 tonnes in 1990, and from 2001 to 2007 declined steadily to less than 100,000 tonnes (Figure B-13). During 2007-2008, catches increased by nearly 8,000 tonnes. These trends in catches largely reflect the trend in the number of purse seiners operating in the Atlantic Ocean, which declined from 71 in 1991 to 22 in 2006, and then increased (Figure B-14). The recent increase in purse-seine effort and catches has been due to vessels moving from the Indian Ocean to the eastern Atlantic.

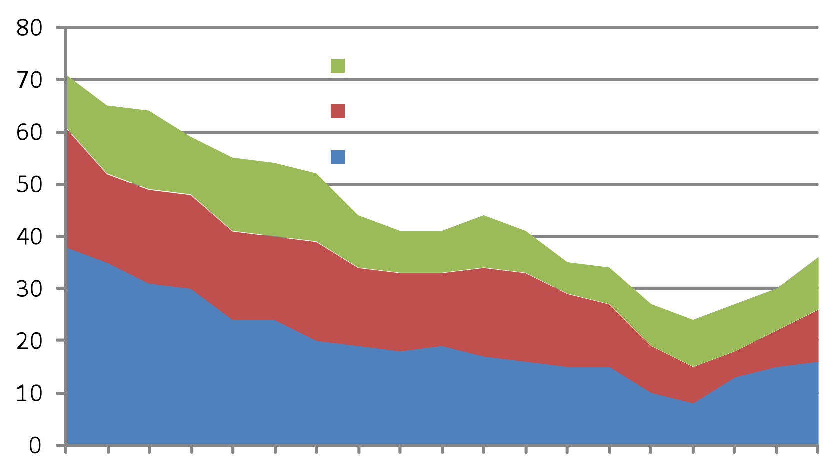

FIGURE B-14. Number of purse seiners of European Union and associated flags operating in the Atlantic Ocean, 1991-2009.

3.2.1. Most recent stock assessment

The most recent full assessment of yellowfin tuna, which used data through 2006, was carried out in 2008. In that analysis, the ASPIC version of a production model, and VPA and Yield/Recruit forms of age-structured models, were used. In the production model mostly catch and effort data are used, while age-structured models use information on the numbers and weights of fish caught, by age groups, natural mortality rates, starting or ending fishing mortality rates, and other biological parameters.

The production model analysis estimates the MSY to be about 147,000 tonnes, and shows the 2006 fishing mortality to be 89 percent of what the equilibrium fishing mortality would be at MSY, and the relative biomass to be 0.83, or the current biomass to be slightly less than that corresponding to MSY.

The estimate of MSY for the age-structured or VPA model was about 131,000 tonnes; the same analysis estimated that fishing mortality during 2006 was about 84 percent of the level corresponding to MSY, and the ratio of the biomass during 2006 to the biomass at MSY was estimated to be 1.09, or that the biomass was about 10 percent greater than that corresponding to MSY.

Trend estimates from the VPA show that overfishing had occurred in the past, but is not occurring currently. The ASPIC modelling indicates that there has been both overfishing and an overfished state in recent years, but that overfishing was not occurring in 2006, the last year of the assessment. Combining the results of the two models produces an estimate that there is a 60% chance that the stock biomass is below the MSY level (Figure B-15).

Using the VPA model results projections were made considering a number of constant catch possibilities. These projections suggested that catches of 130,000 tonnes or less are sustainable; catches in excess of that amount would result in overfishing. Therefore, the recent level of catches (under 110,000 tonnes) is expected to allow the stock to continue rebuilding to a biomass above the MSY level.

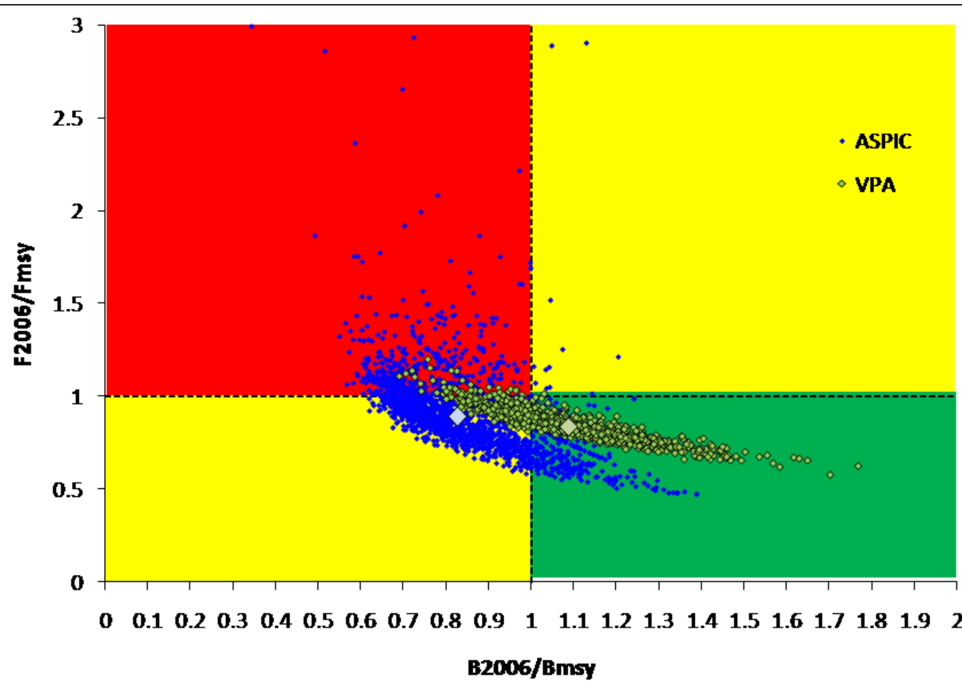

FIGURE B-15. Current status of Atlantic yellowfin, showing uncertainty, based on VPA and production models. The point estimates are shown as the large diamonds and the array of points reflect bootstrap estimates of uncertainty (SCRS-ICCAT).

Additional analyses also corroborate earlier findings that if the catch of small yellowfin could be reduced, gains in potential yield and spawning biomass would be realized.

Based on the 2008 assessment it appears the stock is **not currently being overfished** and, though it may be in **a slightly overfished state** (catches for the past five years have been less than the MSY), it is rebuilding.

3.2.2. Next scheduled stock assessment

The date for the next stock assessment of Atlantic yellowfin has not been set.

3.2.3. Conservation and management of yellowfin

One of the earliest management measures implemented by ICCAT was the establishment of a minimum size limit of 3.2 kg for yellowfin in 1973. The rationale behind this measure was that by protecting small yellowfin the yield per recruit and the total yield could be increased. However, after many years of observing that a large share of the catch of purse-seine and pole-and-line vessels was comprised of fish under the 3.2 kg limit, the measure was repealed in 2005.

In 1993 the Commission implemented an additional management measure stipulating that there be no increase in the level of effective fishing effort exerted on Atlantic yellowfin tuna over the level observed in 1992. Effective fishing effort is effort that is proportional to fishing mortality as compared to nominal fishing effort which does not take into account changes in efficiency. For example if a fleet spent 100 days at sea fishing in 1993 the nominal fishing effort would be 100 days. If that same fleet did not change its efficiency and in 2003 spent 100 days at sea fishing the effective fishing effort would not have changed, it would still be 100 days, the same as the nominal effort. If however, the same fleet improved its efficiency 3 percent per year, and then spent 100 days fishing in 2003, its nominal effort would still be 100 days, but its effective effort would more than 130 days. This measure has been implemented each year since 1993.

In order to protect small bigeye, in 2004 ICCAT implemented a measure to close the area in the Gulf of Guinea between the equator and 5°N from 10ºE to 20°E to fishing by purse-seine and pole-and-line vessels during November. Although the intent was to protect small bigeye, the measure offers protection to small yellowfin as well, since they occur in that area during November. In November 2010, ICCAT will consider possible changes to this time-area closure.

Atlantic Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	2008		
Yellowfin	108,000	107,000	124-150,000	$B_c<B_{MSY}, F_c<F_{MSY}$

3.3. Bigeye

Bigeye are distributed throughout the Atlantic Ocean between about 50ºN and 45ºS; they are not found in the Mediterranean. Large bigeye in the Atlantic, like bigeye in other oceans, spend much of there time during daylight hours at depth, coming to the surface more frequently at night. Small bigeye tend to spend more time near the surface, particularly when they associate with floating objects, whale sharks and seamounts. It is this behaviour that makes them vulnerable to purse-seine nets. They spawn widely throughout tropical waters and as they grow larger tend to move to more temperate areas in the Atlantic. One of the major nursery grounds for juvenile bigeye is the Gulf of Guinea. Genetic information, tagging data, and the spatio-temporal distribution of catches suggest a single interbreeding population Atlantic wide.

Portuguese pole-and-line fishermen were the first to harvest bigeye on a large commercial scale; this gear continues to account for about 15 percent of the bigeye catch from the Atlantic. Japanese longline vessels began fishing bigeye in the Atlantic during the mid-1950s; longline fleets from Japan, Chinese Taipei, China and a number of other nations continue to take about 50-60 percent of the bigeye catch from the Atlantic. Purse-seine vessels have always taken some bigeye since they first began fishing in the Atlantic in the late 1960s, but the amount was small until the development of the fishery on fish-aggregating devices (FADs); they now account for about 25 percent of the catch. Longline takes bigeye averaging 40-50 kg, pole-and-line take bigeye average about 20-30 kg, and purse-seine caught fish average 3-4 kg.

Catches of bigeye have increased steadily since the 1950s and peaked in 1994 at about 132,000 tonnes; they have declined steadily since then, and since 2005 have oscillated between 65 and 75,000 tonnes, about half those of the peak year (Figure B-16). All of the major fisheries for bigeye in the Atlantic suffered declines in catch. The declines were concurrent with reductions in the number of purse-seine vessels and with declines in the catch rate for longline and pole-and-line vessels.

3.3.1. Most recent stock assessment

The most recent stock assessment for Atlantic bigeye was conducted in 2007. Several different models, including VPA, MULTIFAN-CL, and general production models were used in the assessments. There was a range of evaluations of the stock of bigeye that resulted from the various model applications and not all of them were considered to be equally likely. Most of the conclusions regarding the status of the stock were based on general production models. The analysts noted that there were shortcomings in data for some fisheries as well as a lack of data from IUU fishing (estimated to be as high as 25,000 tonnes during the 1990s), and these were considered to be cause for concern.

The MSY was estimated to be 90-93,000 tonnes. Bigeye biomass showed a sharp declining trend beginning in the late 1980s, falling below the MSY level in 1997, and has remained slightly below MSY since. The trend in fishing mortality shows a similar, but inverse pattern, increasing rapidly during the mid-1980s and exceeding the MSY level in 1993; it has remained above that level since, with the exception of 2006; F_{2006}/F_{MSY} is 0.87, or less than needed to take the MSY.

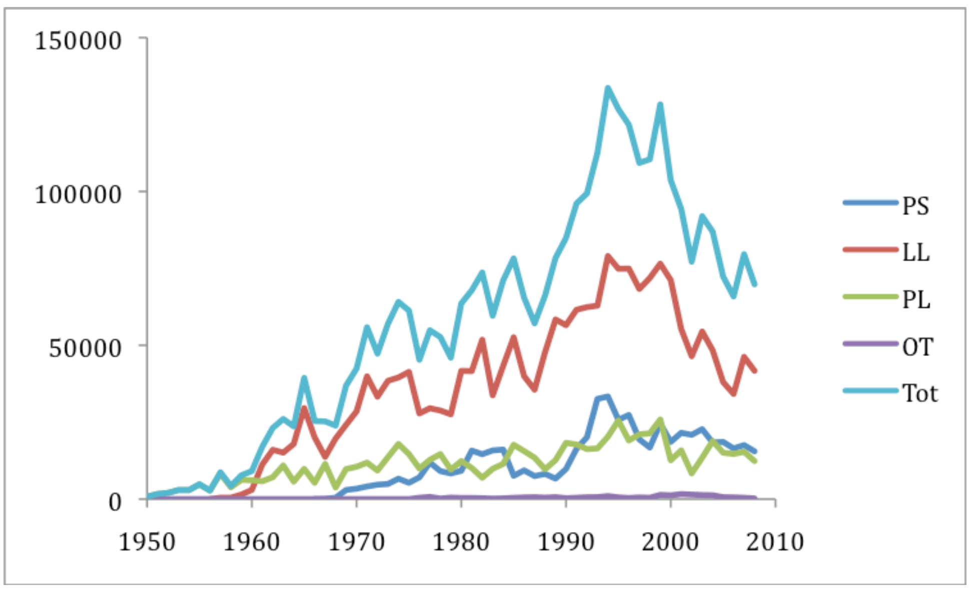

FIGURE B-16. Trend in catches of bigeye tuna in the Atlantic Ocean, 1950-2008.

Using the models to make projections of the stock under varying levels of catch it was estimated that if catches were maintained at or below 85,000 tonnes, the biomass would rebuild to the MSY level within a few years, however if catches were kept constant at 90,000 tonnes or more the biomass would decline further.

Based on the most recent assessments, the biomass of bigeye in the Atlantic Ocean is about 92

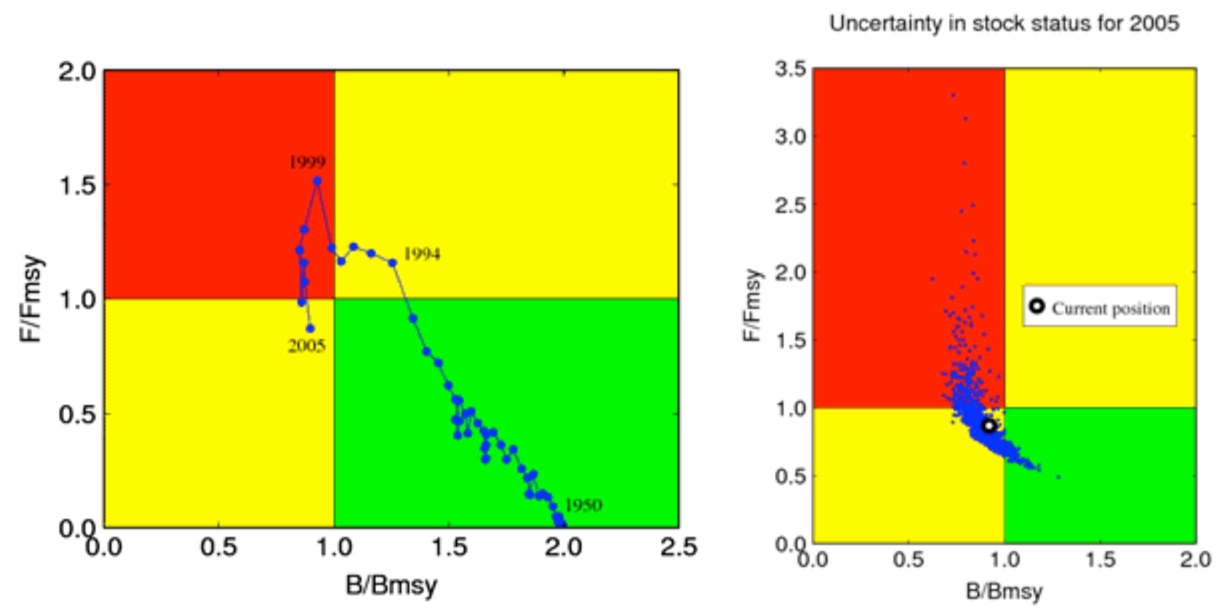

FIGURE B-17. Current status of Atlantic bigeye. Left: trend in biomass and fishing mortality ratios over time. Right: status in 2005 and spread of uncertainty.

percent of the size it should be at MSY, in other words **the stock is currently in a slightly overfished state** (Figure B-17), however, if catches remain at the 2006-2007 level the stock will increase to above the level corresponding to MSY. Because fishing mortality during 2006-2008 was below the MSY level, **the stock is not being overfished,** and should be increasing slightly as long as catches do not exceed 85,000 tonnes.

3.3.2. Next scheduled stock assessment

The next assessment of Atlantic bigeye is scheduled for July 2010.

3.3.3. Conservation and management of bigeye

Over the years ICCAT has established a number of conservation and management measures for bigeye tuna in the Atlantic. One of the first was a minimum size limit of 3.2 kg; this limit was set in 1979 in order to enhance the enforcement of the yellowfin minimum size limit, because small yellowfin and bigeye are difficult to distinguish. A large portion of purse-seine caught bigeye is below this minimum size limit, and as for yellowfin, the size limit was repealed because it could not be enforced.

A number of bigeye measures were introduced between 1997 and 2003 to require CPCs to keep the number of vessels, the levels of effort, and the levels of catch to no more than 1992-1993 averages.

In 2004 a series of controls on bigeye fishing were approved and implemented for 2005-2008: 1) Limit the numbers of fishing vessels to less than the average number that fished during 1991 and 1992; 2) limit China to 45 longline vessels, Chinese Taipei to 98 longline vessels, Philippines to 8 longline vessels and Panama to 3 purse-seine vessels; 3) bigeye catch limits were assigned for 2005-2008 with the current limits being 5,900 tonnes for China, 24,000 tonnes for European Union vessels, 5,000 tonnes for Ghana, 25,000 tonnes for Japan, 3,500 tonnes for Panama, and 16,500 tonnes for Chinese Taipei; 4) a total allowable annual catch (TAC) of 90,000 tonnes; and 5) a prohibition against fishing by purse-seine and pole-and-line vessels, as described in Section 2 above.

In 2009, the controls adopted in 2004 were amended to lower the TAC to 85,000 tonnes, and to allow additional longline vessels for Chinese Taipei (7) and the Philippines (2). In addition, a number of quota transfers were permitted.

During 2005-2007, ICCAT took several measures against Chinese Taipei because of IUU fishing activities by its vessels. These measures included quota reductions, mandatory scrapping of vessels, limits on the amount of bigeye taken as bycatch, and 100% observer coverage.

There are substantial uncertainties regarding the bigeye catches taken historically by the Ghanaian fleet, due to insufficient or incomplete sampling for species composition and total catches. ICCAT has mandated Ghana to submit in 2010 an action plan to strengthen the collection of fishery statistics and to develop control measures to ensure the full implementation of ICCAT management measures.

Atlantic Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	2008		
Bigeye	75,000	70,000	90-93,000	$B_c<B_{MSY}$, $F_c<F_{MSY}$

3.4. Skipjack

Skipjack tuna are found throughout the tropical and subtropical waters of the Atlantic Ocean between roughly 45°N and 35°S; they grow rapidly, do not live as long as other species of tunas, and have a high population turnover rate making them more difficult to overfish than other tuna species. The population of skipjack in the Atlantic is divided into an eastern and western stock. The fishery on the eastern stock takes about 80 percent of the total catch and the western stock 20 percent. Total catches increased steadily from the 1950s to a peak of 208,000 tonnes in 1991, with a rapid increase in the 1980s due to the introduction of FAD fishing. After 1991 catches declined, and in recent years have averaged 150,000 tonnes. The 2008 catches were 127,000 tonnes and 22,000 tonnes in the western and eastern Atlantic, respectively (Figure B-18).

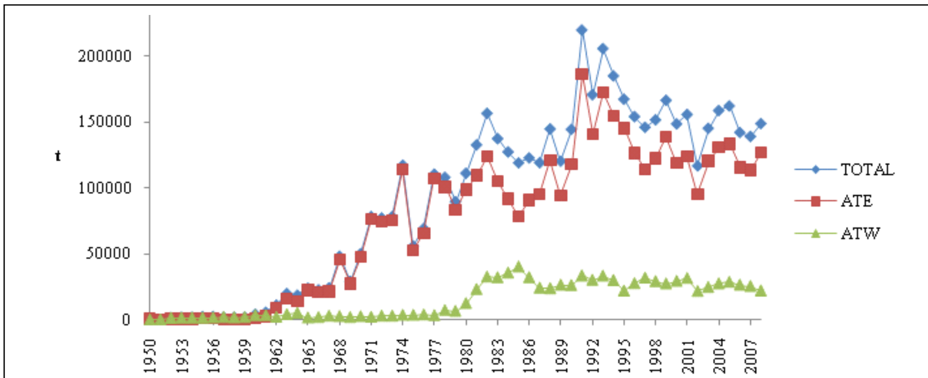

FIGURE B-18. Skipjack landings in the Atlantic Ocean, 1950-2008.

In the eastern Atlantic about 64 percent of the catch is taken by purse-seine vessels, 32 percent by pole-and-line vessels, and the remainder by a wide variety of gear; for the western Atlantic the corresponding figures are 7 percent and 90 percent, respectively. The major purse-seine fisheries in the eastern Atlantic are carried out by Spain, Ghana, Panama and France. For pole-and-line, the major fishing countries are Ghana, Spain and Portugal.

Nominal fishing effort on skipjack tuna, although not measured, is assumed to have decreased substantially in the purse-seine fishery; carrying capacity of purse-seine vessels declining from about 70,000 tonnes in 1982 to less than 35,000 tonnes in 2006. However during this same period, vessel efficiency was estimated to have increased on the average 3 percent per year, also total mortality in the fishery due to fishing increased somewhat.

3.4.1. Most recent stock assessment

The last stock assessment of Atlantic skipjack tuna was carried out in 2008. Based on tagging data, catch distributions, and other biological parameters, the Atlantic skipjack population is considered to be comprised of two independent, non-mixing stocks, one in the east and the other in the west, and as such, each is treated separately for management purposes.

For the eastern stock, assessments were conducted using several models and eight available series of catch-per-unit-of-effort (CPUE) data. The CPUE series were adjusted to reflect an assumed increase in effective fishing effort of 3% per year. The estimates of MSY from these models ranged from 143 to 170,000 tonnes. The models run were not very informative, because there is little contrast in the fishery data, which leads to large uncertainties. However, most

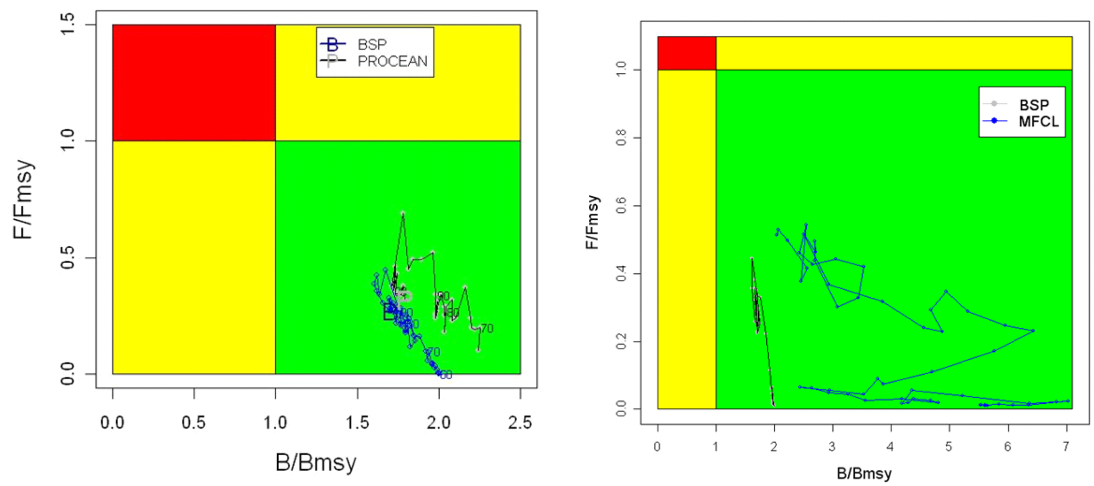

FIGURE B-19. Status of skipjack in the eastern Atlantic (left) and western Atlantic (right). The lines show the trends in the estimated biomass and fishing mortality ratios over time, using different assessment models (SCRS-ICCAT).

models led to the conclusion that the stock has not experienced overfishing to date.

The assessment for the western stock also used data that were not very informative in terms of contrast, and the results also suggest that the stock has not yet experienced overfishing. The estimates of MSY for the western stock range from 30 to 36,000 tonnes.

In summary, there is no evidence that either stock of skipjack is in an overfished state or that overfishing is occurring (Figure B-19).

3.4.2. Next scheduled stock assessment

There is no schedule for the next full assessment of skipjack tuna in the Atlantic.

3.4.3. Conservation and management of skipjack

There currently is no specific regulation in effect for the management of skipjack, nor has the SCRS recommended any management measures for this species. However, the moratoria applied voluntarily by the Spanish and French industry, which closed a certain section of the fishery with floating objects during November-January from 1997 through 1999, and the ICCAT recommendation to close a similar area during subsequent years, has had an effect on skipjack catches made on FADs. The average annual catch of skipjack per vessel decreased by about 18 percent as a result of the moratoria; the average annual catches by purse-seine fleets that implemented the moratoria decreased by 42,000 tonnes (41 percent), but the overall decrease in effort as a result of less purse-seine vessels operating in the Atlantic probably contributed to this decline as well.

Atlantic Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	2008		
Skipjack - East	124,000	127,000	143-170,000	$B_c>B_{MSY}, F_c<F_{MSY}$
Skipjack - West	26,000	22,000	30-36,000	$B_c>B_{MSY}, F_c<F_{MSY}$

3.5. Albacore

Albacore are distributed widely throughout the Atlantic Ocean between about 60°N and 50ºS. The stocks support large surface fisheries in the Bay of Biscay, near the Canary Islands, around the Azores, and off southern Africa. Atlantic-wide catches (not including the Mediterranean)

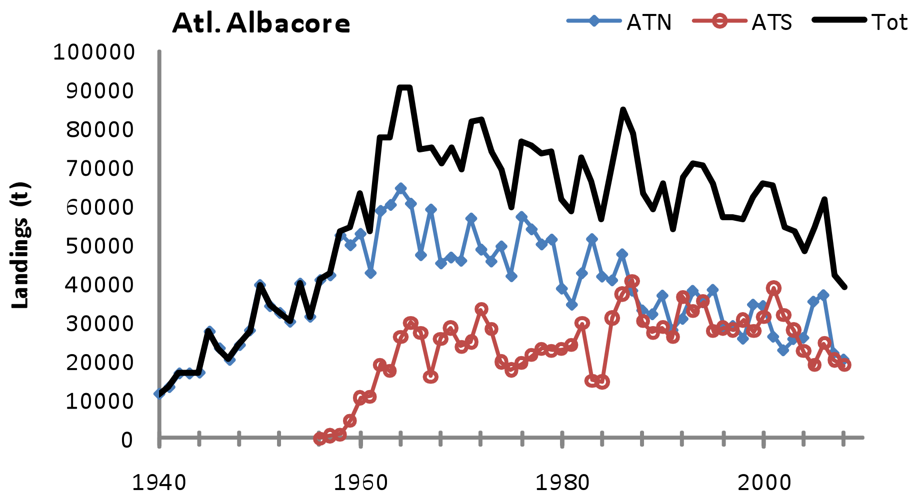

FIGURE B-20. Trend in landings of Atlantic albacore (north and south), 1940-2008.

have shown a great deal of variability between 1982 and 2008, but with a slight decreasing trend. The all-time high of about 91,000 tonnes was taken in 1964-1965, after which catches declined to a low of about 40,000 tonnes in 2008, due primarily to decreasing catches in the northern Atlantic (Figure B-20).

Although the distribution of albacore is continuous throughout the Atlantic, scientists consider that there is a northern and southern stock, separated at 5°N, and a separate stock in the Mediterranean Sea. It is likely that there is some mixing of young albacore from the southern stock with albacore from the Indian Ocean, although to what extent is not known. Catches from the northern and southern stock are similar, averaging 28 and 21,000 tonnes, respectively, since 2003.

Catches in the Mediterranean have averaged about 5,000 tonnes per year, about half taken by longline and the other half by purse-seine vessels; Italian fleets harvest about 70 percent of the Mediterranean catch. The Mediterranean stock has never been assessed. However, ICCAT has scheduled a data-preparatory meeting in June 2010 to compile more complete fishery statistics, with the objective of assessing the stock in 2011.

3.5.1. North Atlantic albacore

Most of the catch of northern albacore is made by surface fishing gear; over the last five years pole-and-line vessels accounted for 35 percent of the catch, trolling vessels for 28 percent, trawlers for 17 percent, and longline about 17 percent. The Spanish fishery accounts for about 62 percent of the north Atlantic catch, followed by France with 16 percent, and Chinese Taipei with 8 percent. The surface fisheries of Spain, France, and Portugal operate mainly in the Bay of Biscay and around the Azores and Canary Islands during the summer and fall, and they generally take young fish between 3 and 15 kg. Longline vessels operate throughout the year in the north Atlantic and target fish between 5 and 45 kg.

Catches of northern albacore reached about 65,000 tonnes in the mid-1960s, the highest in the history of the fishery, but have declined since to a low of about 20,000 tonnes in 2008 (Figure B-20). Some of this decline in catch is attributed to a reduction of fishing effort by several of the traditional surface and longline fisheries. The Spanish troll and pole-and-line fleets, particularly the latter, have been increasing their catches, while catches of other fleets associated with the European Union have decreased. Catches by surface fisheries are very variable from year to year, as environmental effects influence the availability of albacore to these fisheries.

3.5.1.a Most recent stock assessment

The most recent assessment for the northern stock of albacore was conducted in 2009. The MULTIFAN-CL model that was used in the 2007 assessment was updated, using data from 1930 to 2007.

Recruitment showed a great deal of variability among the years examined, the highest being about 30 million 1-year old recruits and the lowest about 5 million. During recent years recruitment has averaged about 8 million fish. The abundance of the population in the coming years is highly dependent on the level of recruitment.

Trends in the ratio of the fishing mortality exerted by the fishery in each year to the fishing mortality when the population is at a level capable of supporting the MSY were examined to determine if overfishing had been occurring. The results showed that, with few exceptions, since 1955 the ratio was greater than one, indicating that overfishing had been occurring. In 2007, the ratio was slightly above one (F_{2007}/F_{MSY}=1.04).

Trends in the biomass in each year to the biomass at MSY were also examined, and they showed that since 1993 the biomass had been less than biomass at MSY. The stock is currently about 40 percent below the MSY level (B_{2007}/B_{MSY}=0.6). Also, in the spawning biomass showed decreasing trend since the inception of the fishery, and is currently about one quarter of the level it was when the fishery began.

The estimates of MSY for the northern stock have varied between about 26 and 34,000 tonnes, dependent upon the age-specific fishing mortality being exerted. When larger fish are taken, on average MSY tends to increase, but decreases when more small fish are harvested. The current estimate of MSY is 29,000 tonnes. Four out of ten of the most recent annual catches have exceeded the MSY. The catch in 2008 was 30% below the MSY.

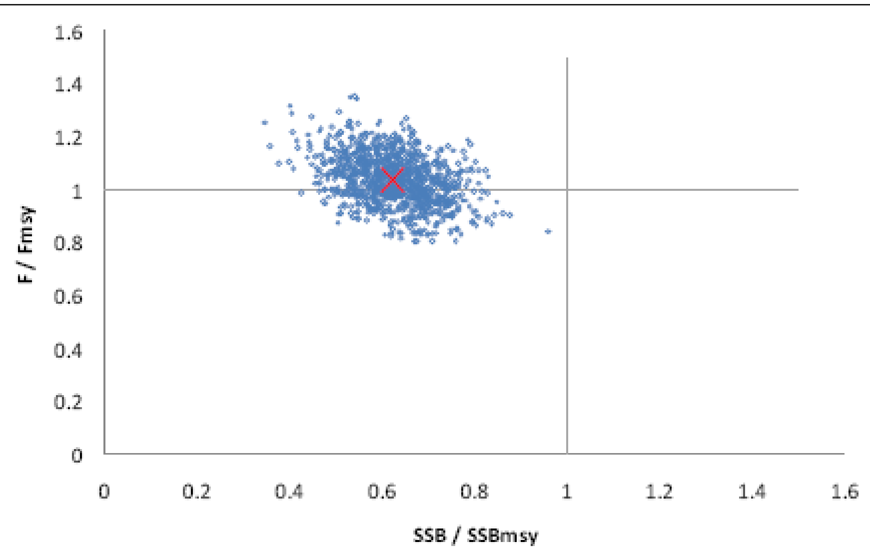

FIGURE B-21. Current status of north Atlantic albacore, showing uncertainty. The point estimate is shown as an X and the array of points reflects bootstrap estimates of uncertainty (SCRS-ICCAT).

Based on the current assessment **the stock**

of northern albacore is in an overfished state, and **slight overfishing is taking place**, which is reflected in the phase plot shown in Figure B-21.

If fishing mortality continues high and recruitment remains average or less, biomass will continue to decrease, however, these decreases could be offset if catches remain low.

3.5.1.b Next scheduled stock assessment

No date has been set for the next stock assessment of northern albacore, although it may be conducted jointly with the next assessment of southern albacore in 2011. SCRS has been mandated to monitor the stock and advise the Commission on management measures needed to achieve rebuilding.

3.5.1.c Conservation and management of north Atlantic albacore

In 1998 ICCAT approved a recommendation calling on all CPCs with fleets fishing for northern albacore to limit, beginning in 1999, the numbers of vessels in their fleets to no more than the average number of their vessels fishing for albacore during 1993-1995. Each CPC was required to submit a list of the vessels it authorized to fish for albacore during 1999, and to resubmit a list of such vessels for each year thereafter. Japan was specifically requested to limit its catch of albacore to no more than 4 percent of its total longline catch of bigeye tuna. The provisions to limit fleets would not apply to nations whose fleets harvested less than 200 tonnes of northern albacore per year

An additional resolution applying to northern albacore was approved by ICCAT in 2003 for application during 2004 to 2006; it restricted catches to the then current levels of catch, or a TAC of 34,500 tonnes, with specific allocations for different members. The resolution allowed for adjustments to be made for over-catches, under-catches, and transfers of under-catches to other parties, and also sustained the measures for limiting the number of vessels authorized to fish for northern albacore. A resolution was approved in 2006 extending all of these measures through 2007.

In 2007 the Commission, following the scientific advice of the SCRS, established a TAC of 30,200 tonnes for 2008 and 2009. In 2009, again following SCRS advice, the TAC was reduced to 28,000 tonnes for 2010 and 2011.

Atlantic Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	**2008**		
North Atlantic albacore	28,000	20,000	29,000	B_c<$B_{MSY,}$ F_c>F_{MSY}

3.5.2. South Atlantic albacore

Catches of albacore in the south Atlantic have varied between a high of 41,000 tonnes in 1987 and a low of 15,000 tonnes in 1984. From 1988 to 2001 catches were relatively stable, averaging 30,000 tonnes per year; they peaked in 2001 at 39,000 tonnes, and then declined. The most recent 5-year average is 21,000 tonnes (Figure B-20).

During recent years, south Atlantic albacore landings have been primarily attributable to three fisheries: longline vessels from Chinese Taipei (56%), and pole-and-line fleets from South Africa (18%) and Namibia (13%). Over the last few years, longline fleets have taken nearly 70 percent of the catch from the south Atlantic, and pole-and-line fleets 25 percent. Catches by the Brazilian longline fleet, which fished mostly off the east coast of South America and caught more than 4,000 tonnes per year, have recently declined by nearly 90 percent. This was likely attributable to the exodus of Chinese Taipei longline vessels that previously fished under special arrangements with Brazil. The Chinese Taipei fleet operates throughout the south Atlantic, and targets fish between 5 and 35 kg; some of the Chinese Taipei catch is from a directed albacore fishery, and some is taken as bycatch in the bigeye and swordfish fishery.

Surface fisheries in the south Atlantic operate mainly during October to May and capture juvenile and sub-adult fish between 7 and 16 kg.

3.5.2.a Most recent stock assessment

The most recent stock assessment of southern albacore was conducted during 2007. The analysis carried out was similar to that completed for the northern stock; MULTIFAN-CL was used in the assessment, using data up to 2005. The catch rates used to tune the model showed a decreasing trend for the longline indices, but stability in the case of the surface fisheries.

As was the case for northern albacore, the estimate of recruitment for the most recent year class of the southern stock entering the fishery was above average, although confidence in the estimate will remain low until the year class is subjected to fishing for another year or two.

The biomass has shown a general decreasing trend as would be expected as exploitation increases, but at the end of 2005 was very near the MSY level, the point estimate being more than 90 percent of that level, with a range of 0.71-1.16.

The ratio of current fishing mortality to fishing mortality at MSY shows that in recent years it has been less than 1, and in 2005 was 0.6, or only 60 percent of the MSY level.

The current estimate of MSY is 33,300 tonnes, ranging between 29,900 and 36,700 tonnes. Only one out of the last ten years has exceeded the AMSY estimate, and since 2004 none of the catches have exceeded the replacement yield of 28,800 tonnes. This implies that biomass should be increasing and, if current levels of catch are maintained, will soon exceed, or may have already exceeded, what it should be at MSY.

Based on these analyses, **the southern stock of albacore is not being overfished, but conservatively speaking, it may be in a slightly overfished state** (Figure B-22). It should be noted however, that since catches have been substantially below the replacement yield and fishing mortality below the MSY level for an extended period, it is likely that the stock is not in an overfished state.

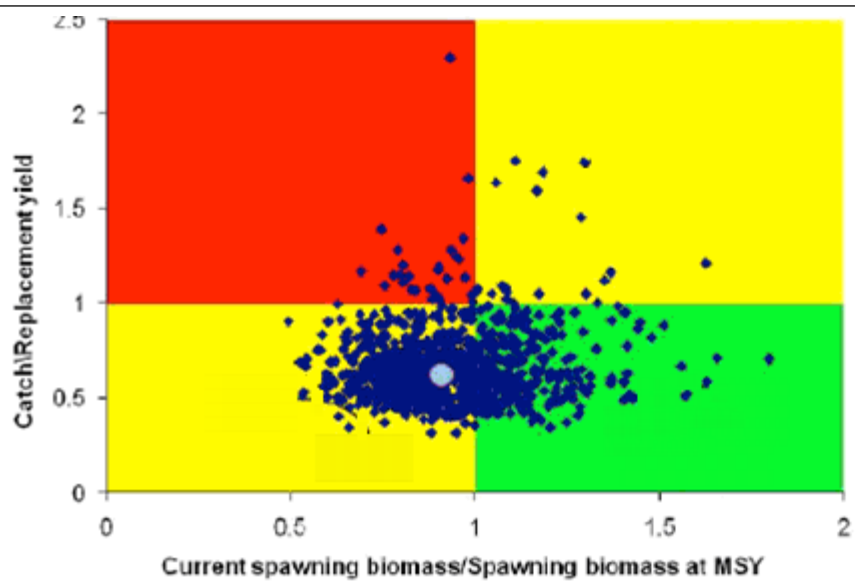

FIGURE B-22. Phase plot for south Atlantic albacore, showing uncertainty in 2005 point (ICCAT).

3.5.2.b Next scheduled stock assessment

The next stock assessment of south Atlantic albacore will take place in 2011.

3.5.2.c Conservation and management of south Atlantic albacore

In 2004 ICCAT approved a resolution designed to limit the catch of albacore south of 5ºN to no more than 30,915 tonnes, which was based on the then best estimate of MSY. The resolution stipulated that if the catch in 2004 exceeded 29,200 tonnes, the TAC of 30,915 for 2006 would be reduced by the excess of the overage. Likewise if the 2005 catch exceeded the 2006 TAC, the 2007 TAC would be reduced by the overage. Also, CPCs that caught no more than 100 tonnes during 1992-1996 would be allowed to increase their catch by 10 percent. The current TAC for south Atlantic albacore is 29,200 tonnes. For 2009-2011 the TAC was set for 29,200 tonnes; and again, if the catch in 2008 exceeds the 29,900 tonnes the catch in 2009 shall be reduced through the full amount of the excess. If the catch in any year until 2011 should exceed the replacement yield of 28,800 the conservation measures for southern albacore will be reviewed. Those CPCs that caught less than 100 tonnes during 1992-1996 are subjected to an annual catch limit of 100 tonnes, and those catching more than 100 tonnes to a catch limit of 110 percent of their average catch during 1992-1996. In the case of Japan, it shall endeavour to limit its catch of southern albacore to 4 percent by weight of its total longline bigeye catch in the Atlantic south of 5°N.

Atlantic Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	**2008**		
South Atlantic albacore	21,000	19,000	30-37,000	B_c<B_{MSY}, F_c<F_{MSY}

4. INDIAN OCEAN

This section updates the assessment of the status of the tuna stocks in the Indian Ocean in the ISSF report on the status of the world's tuna stocks published in August 2009. It is based on the report of the Scientific Committee of the Indian Ocean Tuna Commission (IOTC, www.iotc.org), which met in December 2009, and the management decisions adopted subsequently by IOTC in March 2010.

4.1. Catches

Total catches of yellowfin, bigeye, skipjack, and albacore in the Indian Ocean have declined slightly in recent years, with a total of 870,000 tonnes in 2008 (Figure B-23). The catch of yellowfin in 2008, 322,272 tonnes, was about the same as in 2007, but below the record value of 509,300 tonnes obtained in 2004. The catch of skipjack, 405,198 tonnes, was also lower than in previous years. The bigeye catch in the region was 110,288 tonnes. Catches of albacore have increased recently, and in 2008 reached 33,056 tonnes.

Just over half of the catches of these species are taken by purse seiners (34% of total catch) and longliners (20%), while pole-and-line vessels (14%) and gillnetters (23%), together with other artisanal gears, take the remainder. Catches by artisanal and semi-industrial fleets are substantial in this ocean, and important issues remain regarding the quality and accuracy of the data obtained from many of these fleets.

Sets on fish-aggregating devices (FADs) account for the majority (65%) of purse-seine catches.

4.2. Assessments

4.2.1. Yellowfin

An assessment of yellowfin tuna was conducted during the 2009 meeting of the IOTC Working Party on Tropical Tuna (WPTT) using MULTIFAN-CL, and was later presented to the Scientific Committee (SC) meeting in December. This is the second year that this model, which incorporates spatial structure and data obtained through the Regional Tuna Tagging Project - Indian Ocean (RTTP-IO), has been used for the assessment. Further refinements are still required, especially to clarify uncertainties in growth patterns and the spatial dynamics of the stock. The

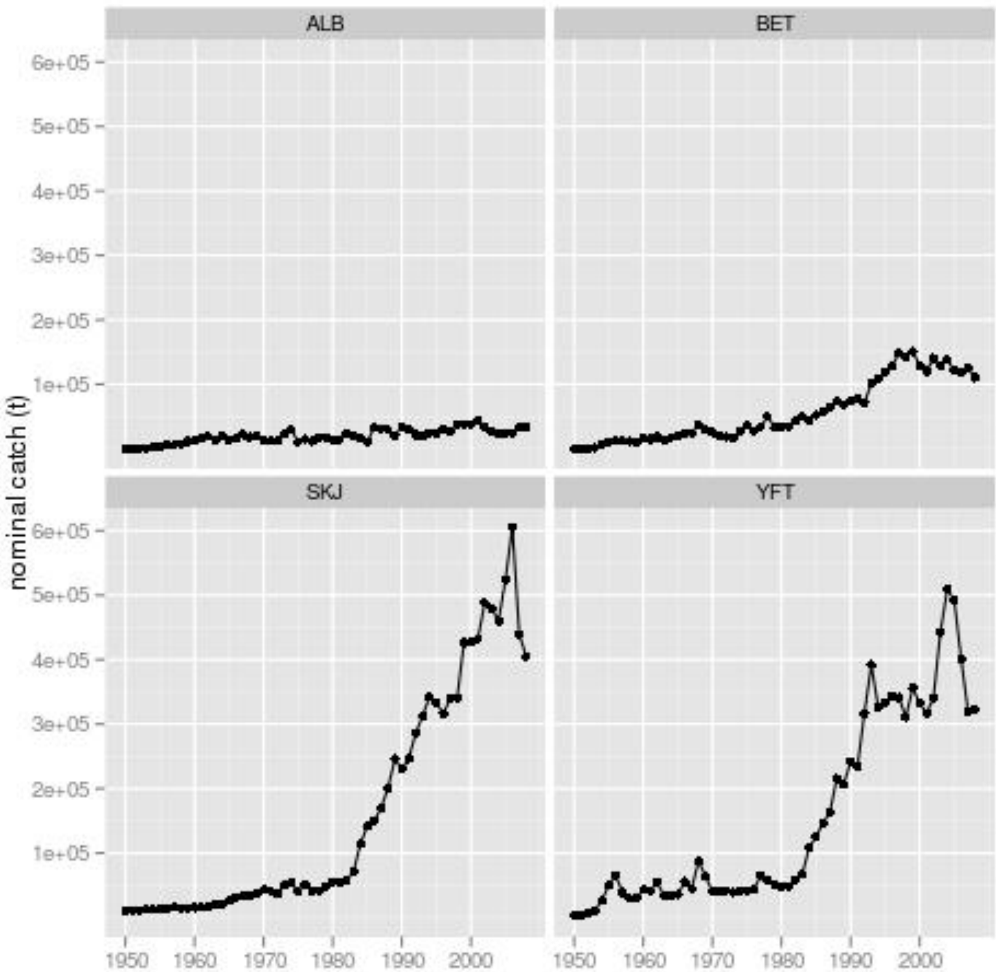

FIGURE B-23. Nominal catches of the four main tuna species in the Indian Ocean (IOTC, October 2009).

conflicting trends between the catch series and the main index of abundance, the standardized catch per unit of effort (CPUE) series from the Japanese longline fleet, are a limiting factor for this assessment.

In common with other assessments, assumptions made about the steepness of the stock-recruitment relationship have a major influence on the final results. The SC's advice to the Commission is based on reference points obtained using a value of 0.8 for this parameter. The estimates of maximum sustainable yield (MSY) obtained were about 300,000 tonnes, slightly below the average catches obtained in the 1992-2002 period (337,000 tonnes).

The high catches observed in 2004-2006, peaking at 509,000 tonnes in 2004, were most likely caused by increased catchability due to large concentrations of yellowfin in a small area of the eastern Indian Ocean. Oceanographic factors and the availability of food resources appear to explain the observed behaviour well. These high catches are likely to have impacted the stock, and have probably subjected it to a period of overfishing (Figure B-24).

Biomass estimates for 2007, used by the SC to provide advice, indicate a stock close to becoming overfished. Catch trends in some areas, like the Arabian Sea, are at historically low levels.

Based on the latest assessment, current catches are still above MSY, and the stock might be

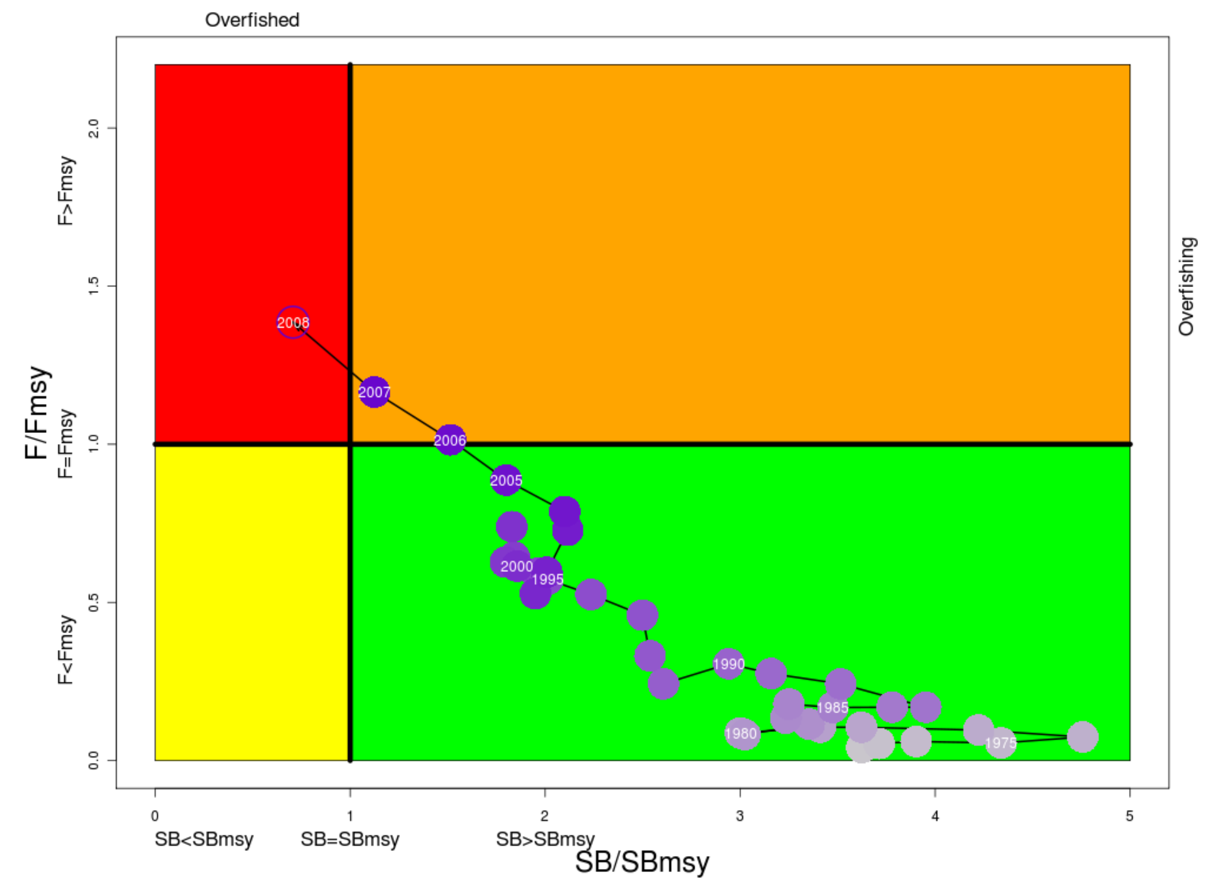

FIGURE B-24. Temporal trend in annual stock status of yellowfin tuna in the Indian Ocean relative to SB_{MSY} and F_{MSY} reference points, 1975–2008. The colour of the points is graduated from mauve (1975) to dark purple (2007), and the hollow circle represents the last year of the model (2008). (IOTC Scientific Committee report, December 2009)

already below or very close to the spawning stock biomass (SSB) at MSY level. This stock, which was clearly overfished during 2003-2006, is considered to be **fully fished or slightly overfished and overfishing is occurring.**

Indian Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	**2008**		
Yellowfin	411,000	318,000	300,000	$B_c<B_{MSY}$, $F_c>F_{MSY}$

4.2.2. Bigeye

Various stock assessments of bigeye were presented in 2009. The models applied ranged from different biomass dynamics models to an age-structured statistical catch-at-age assessment using Stock Synthesis 3. The main source of information on the dynamics of the stock is also the index of abundance generated from the standardized CPUE series of the Japanese longline fleet. Some of the dynamics in this index are in clear contradiction with the trends in total catch, and their interpretation is still difficult.

The range of MSY estimates obtained did not differ markedly in most runs, and was in agreement with previous estimates. The SC adopted a value of 110,000 tonnes as the best available estimate. Catches in 2008 were around the MSY level (110,300 tonnes), but have been higher than that for some of the last few years. The stock biomass is estimated to be above MSY levels, but has been declining since the 1970s. Fishing mortality has generally been on the increase for the last two decades, and the most recent value is slightly below the MSY level. The SC considers the bigeye stock to be fully exploited.

The main concerns about the bigeye assessments relate to the availability of size data in most of the industrial longline fisheries, the form and values of the assumed natural mortality at age function, and the unexplained dynamics in the CPUE-based index of abundance, including the effects of the standardization procedure on some of the observed trends.

Recent changes in the fishery due to piracy activities close to the Somali coast and in other areas will probably reduce the catches of juvenile bigeye associated with FADs, since the abundance of juvenile bigeye in the alternative areas used by the European purse-seine fleet is much lower. This trend could obviously be reversed if the security situation in those waters improves. **The Indian Ocean bigeye stock is fully exploited; overfishing is not occurring and it is not overfished.**

Indian Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	**2008**		
Bigeye	122,000	107,000	100-115,000	$B_c>B_{MSY}, F_c<F_{MSY}$

4.2.3. Skipjack

No formal stock assessment of skipjack has ever been conducted in the Indian Ocean. Updates to catch indicators (total catches and nominal effort, mean size in catch) were presented for the main fisheries (European purse seiners and Maldivian pole-and-line vessels). Data from the Maldives appear to indicate that signs of an effect of the long history of fishing and the recent increase in fishing pressure on catch rates and size of fish caught could be detected, but given the quality of the data currently available, no definite conclusions could be drawn.

The observed drop in total catches in recent years has been partly attributed to changes in the purse-seine fishery due to piracy and fuel prices; for example, a number of purse-seine vessels have left the Indian Ocean and are now operating in the Atlantic. The decrease is almost exclusively found in the FAD fishery, although lower catch rates have also been reported from the Maldives. **The stock is not overfished and overfishing is not occurring.**

Indian Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	**2008**		
Skipjack	500,000	447,000	n/a	$B_c>B_{MSY}, F_c<F_{MSY}$

4.2.4. Albacore

No further analyses of the status of albacore were conducted in 2009. Catches in 2008 have remained close to those in 2007 at 33,000 tonnes, an increase over those of the 2003-2006 period, but still within the range of values of the estimated MSY.

The SC considered that **albacore is not overfished**, and that **overfishing is not occurring**.

Indian Ocean	Landings (tonnes)		MSY (tonnes)	Status
	2004-2008	**2008**		
Albacore	28,000	33,000	28-34,000	$B_c>B_{MSY}, F_c<F_{MSY}$

4.3. Management measures

4.3.1. Yellowfin

In 2009, the SC recommended that catches of yellowfin tuna should not exceed the estimated MSY of 300,000 tonnes. Monitoring and data collection in certain fisheries should be improved to be able to monitor the status of the stock more closely. Current delays between fishing, data collection, reporting to IOTC, assessment, management advice and decision making (up to 4 or 5 years) might make the reversal of overfishing a very slow process, with negative effects on the sustainability of this stock. The SC also noted that currently no management measures are in place for this stock that would ensure that catches and/or effort are maintained below desirable levels, but no specific recommendation was made regarding what those might be. At its meeting in March, 2010, IOTC adopted a Resolution that establishes a time-area closure during 2011 and 2012. The closure, which applies to an area outside the Somalian EEZ, is intended to reduce fishing pressure on yellowfin and bigeye stocks, and applies to longline vessels during February and to purse seiners during November. In the same Resolution, IOTC members committed to agree on an allocation quota system at the Commission's 2012 annual meeting. The SC was given a mandate to evaluate the time-area closure and to develop management options for the Commission to consider in 2012.

4.3.2. Bigeye

The SC recommended that catches of bigeye tuna should not exceed 110,000 tonnes. The Resolution adopted in 2010, described in the preceding paragraph, also applies to bigeye.

4.3.3. Skipjack

No management measure was recommended for skipjack, although the SC supported the WPTT recommendation that possible analyses of the stock, including a full stock assessment, be considered in 2010, given certain recent apparent trends in catch rates and mean sizes for various fisheries.

4.3.4. Albacore

No management measures have been recommended for albacore, in view of the preliminary estimate of stock status and the recent trends in the fishery. The low price of albacore, compared to other tuna species, make an increase in effort very unlikely in the near future.