International Seafood Sustainability Foundation

STATUS OF THE WORLD FISHERIES FOR TUNA

SECTION A-2 – SUMMARY

This section summarizes the status of the four main species of tunas – yellowfin, bigeye, skipjack, and albacore – in each of the ocean areas covered by the four regional fisheries management organizations (RFMOs) responsible for tuna fisheries, the conservation and management measures taken for each of these species, and the situation regarding bycatches and discards in the fisheries. This information is available in greater detail in Sections B, C, and D of this report[1].

BACKGROUND

The purpose of this series of documents is to provide information on the status of the stocks of tuna from the world's oceans, to examine bycatch and mitigation issues, to review programs that regional fisheries management organizations (RFMOs) have undertaken to manage tunas and related species, and to examine how effective these programs are in conserving the stocks of tar-

[1] This report is based on data available on 15 April 2009

get and non-target species.

Excluding bluefin tuna, which is not discussed in this report, there are 19 stocks of four of the five principal species of tuna that support commercial fisheries – yellowfin, bigeye, skipjack, and albacore. Five RFMOs are responsible for tuna conservation and management; their objective is to maintain the populations at levels of abundance that can support the maximum sustainable yield (MSY), as qualified by relevant environmental and economic factors.

Catches of these four principal species have been hovering between 4 and 4.5 million tons annually during the last several years. Of this, about 65 percent comes from the Pacific Ocean, 26 percent from the Indian Ocean, and the remaining 9 percent from the Atlantic Ocean and the Mediterranean Sea. Skipjack makes up 60 percent of this catch, followed by yellowfin (24 percent), bigeye (10 percent), and albacore (5 percent). Since 2000, world catches of skipjack have increased by about 26 percent, while yellowfin decreased by 22 percent, albacore by 12 percent, and bigeye by 6 percent. Purse seine nets take about 60 percent of the world production, longlines about 15 percent, pole-and-line about 12 percent, and a variety of other gears the remainder.

1. THE EASTERN PACIFIC OCEAN

About 16 percent of the world production of tuna is from the eastern Pacific Ocean (EPO). The Inter-American Tropical Tuna Commission (IATTC) has responsibility for tunas in the EPO.

1.1. Species

1.1.1. Yellowfin

Catches of yellowfin tuna during the last several years have averaged about 330 thousand tons, varying between about 440 thousand tons in 2002 and 182 thousand tons in 2007. On average, purse-seine vessels take about 92 percent of the catch, longliners about 8 percent, and a variety of other gears the rest.

The most recent assessment of yellowfin tuna was in 2008. The current catch is less than that corresponding to the MSY, current total biomass is greater than biomass at MSY, the spawning biomass ratio (SBR, the ratio of the spawning biomass to that for the unfished stock) at the beginning of 2008 was 0.36, which is greater than the SBR at MSY of 0.34, and current fishing mortality is less than fishing mortality at MSY. These values suggest that **the stock is not in an overfished state, nor is overfishing occurring**; however, if a stock-recruitment relationship is assumed, the outlook becomes a little more pessimistic, suggesting that current biomass may be slightly below the level corresponding to MSY.

As a precautionary measure, the stock is classified as yellow, even though the IATTC analyses show fishing mortality to be less than that required to take the MSY, and the SBR to be greater than that at MSY; also, analyses assuming a stock-recruitment relationship give a more pessimistic view, and most likely increases in effort would not result in sustained increases in catch, but would cause the biomass to decline over current levels.

The next yellowfin assessment will be in May 2009.

There are currently no management measures in effect for yellowfin in the EPO.

1.1.2. Bigeye

In the EPO, annual catches of bigeye have fluctuated between 60 and 147 thousand tons over the last 30 years. Overall, the catch of bigeye from the EPO has declined from a high of 143 thou-

sand tons in 2000 to 94 thousand tons in 2007.

The most current stock assessment for bigeye was in May 2008. The analysis shows greatly increased rates of mortality on small fish since the advent of fishing on fish-aggregating devices (FADs) in 1993, but only slight increases for older fish. The discarding of small bigeye has a small, but detectable, impact on the depletion of the stock. Overall the spawning biomass is estimated to be about 17 percent of that expected had no fishing occurred.

At the beginning of 2008, the spawning biomass of bigeye in the EPO was about 9 percent below the MSY level, near the historical low.

The MSY estimate of 81,350 tons was derived from an assessment that included all gear types and the average fishing mortality during 2005-2007. Recent catches have been about 8 percent greater than the MSY. Also, under current conditions, the MSY could be taken with about 82 percent of the average annual fishing effort exerted during 2005-2007. This means that the fishing mortality is greater than that corresponding to the MSY, so **overfishing of the bigeye stock in the EPO is currently taking place**. Similarly, catches in recent years have been about 8 percent greater than the MSY, and the spawning biomass is currently about 10 percent less than the spawning biomass at MSY, which means that **the stock is in an overfished state.**

The next bigeye assessment will be in May 2009.

There are currently no management measures in effect for bigeye in the EPO.

1.1.3. Skipjack

Over the last two decades, skipjack catches in the EPO have varied between 72 and 318 thousand tons per year, and in 2007 were 221 thousand tons. Purse-seine vessels account for about 99 percent of the total catch. Since the advent of FAD fishing, the catch of skipjack in the EPO has doubled.

The most recent full assessment of skipjack in the EPO was conducted in 2002. The results of the modeling indicate that skipjack in the EPO is not fully exploited and can sustain current levels of exploitation, and catches can probably be increased on a sustainable basis. Because of its high and variable productivity, annual recruitment being a large portion of total biomass, skipjack is a difficult species to assess. Since the stock assessments and reference points for skipjack in the EPO are so uncertain, instead of using reference points based on MSY, the current values of indicators to the distribution of indicators observed historically were compared. A simple stock assessment model was used to generate indicators for biomass, recruitment, and exploitation rate. Eight indicators were evaluated; they do not show any negative impacts on the stock, and indicate that skipjack in the EPO is not fully exploited and can sustain current levels of exploitation, and probably catches can be increased on a sustainable basis. These current results support the conclusions from the A-SCALA analysis, and suggest that there was no reason for management concern for skipjack tuna in the EPO in 2003; **overfishing of the skipjack stock was not occurring nor was the stock in an overfished state.**

There is no schedule for the next skipjack stock assessment.

There are no management measures implemented for skipjack in the EPO.

1.2. Compliance and enforcement

An IATTC Compliance Working Group reviews and monitors compliance with conservation and management measures, recommends means of promoting compliance, including infractions and

sanctions, and informs the Commission of its work. The Commission maintains an IUU vessel list, which is posted on the IATTC website. IATTC Parties and cooperating non-Parties, known as CPCs, are requested to take a series of actions against IUU vessels and their flag states, which are designed to deter IUU fishing, including, *inter alia*, denial of port privileges and prohibition of commercial transactions, imports, landings and/or transshipments of species covered by the IATTC Convention from vessels on the IUU list. The Commission has also taken action to provide for the adoption of trade measures to promote compliance. These measures lay out a series of steps to be taken, through the Compliance Working Group and the joint IATTC/AIDCP Working Group on fishing by non-Parties, to identify CPCs and non-parties that fail to comply with the conservation and management measures.

1.3. Bycatch and discards

The IATTC maintains a comprehensive data base on bycatches in the purse-seine fishery, based mainly on reports by observers, who accompany every trip of large purse-seine vessels fishing in the EPO. The basic data show a wide array of species taken as bycatch, including billfishes, mahi-mahi, wahoo, rainbow runners, triggerfish, yellowtail, sharks and rays, dolphins, sea turtles, and a variety of small fishes. Regardless of the status of the various species, the problems of developing means to reduce or eliminate bycatch are similar.

Discards in the purse-seine fishery occur for various reasons, but mostly because the animals discarded are of little or no commercial value to the tuna-fishing vessels. In recent years, annual discards of tunas and tuna-like species by purse-seine vessels averaged about 25 thousand tons; most of these are skipjack tuna, but discards of various finfish species amounted to about 1.5 million animals, sharks to about 30 thousand individuals, and billfishes to about 5 thousand individuals, and about 22 sea turtles.

The impact of these bycatches on the respective populations from which they are removed is unknown, particularly in terms of their effect on the interactions among the species.

Longline vessels targeting tunas and billfishes make incidental catches of a wide variety of other species, including not only many species of bony fishes, but also sharks, rays, turtles, a few marine mammals, and seabirds. Unfortunately there are very few data available on the catches of these non-target species. In 2003 the IATTC began a program, supported by World Wildlife Fund, to reduce the incidental mortality of sea turtles captured by small coastal longline vessels. As a result of this program, a database of bycatch species in the coastal longline fishery is being assembled. In general, there is an urgent need to collect data from all classes of longline vessels fishing in the EPO, particularly the larger ones.

1.3.1. Measures taken to reduce bycatch and discards

Because of concern over the possible impact that bycatches may be having on the populations of these species and the ecosystem to which they belong, the Commission has initiated a number of programs in an attempt to reduce these impacts. One involves the use of specific types of fishing gear and practices proven effective in reducing dolphin mortality and the establishment of mortality limits on dolphins that could be taken in the purse-seine fishery. Another is the requirement for all purse-seine vessels to retain on board and then land all bigeye, skipjack, and yellowfin tuna caught, with a few exceptions. Data from the program show that discards have been reduced, although it is difficult to establish clearly whether these reductions were because of the program or some other factors.

The Commission has also established measures to reduce the bycatch of sea turtles, seabirds, and

sharks, and has undertaken research on gear, fish behavior around FADs, and fishing techniques that might lead to reducing or eliminating bycatch and discards.

2. THE WESTERN AND CENTRAL PACIFIC OCEAN

The western and central Pacific Ocean (WCPO) supports the largest tuna fishery of the world. In 2007, approximately 2,358 thousand tons of tuna were caught from the WCPO, of which skipjack accounted for 1,727 thousand tons (73 percent), yellowfin 432 thousand tons (18 percent), bigeye 140 thousand tons (6 percent), and albacore 59 thousand tons (3 percent). Purse-seine vessels account for about 72 percent of the total catch, longliners about 11 percent, pole-and-line 10 percent, and a variety of other gears the remainder.

The Western and Central Pacific Fisheries Commission (WCPFC) is responsible for the management of tunas in the area, and its objective is to ensure that the stocks are maintained at levels capable of producing the maximum sustainable yield.

2.1. Species

2.1.1. Yellowfin

The catch of yellowfin peaked in 1998 at 468 thousand tons, and has remained relatively stable since then; in 2007 the catch was about 432 thousand tons.

The most recent stock assessment was in 2007. Estimates of yellowfin biomass derived from the model show relatively high levels in the early fishery, a decline in the early 1970s, a slight increase in the mid-1970s, stability through the 1980s, and a steady decline until about 2005 when it began to increase. It is estimated that fishing mortality has caused the biomass to decline by about one-half from what it was before a fishery was initiated.

To evaluate the status of the stock, a number of reference points related to levels of biomass and fishing mortality relative to certain reference levels are examined. For the 2007 analysis: 1) current biomass/biomass at MSY=1.17 (*i.e.* the current biomass is 17% greater than the biomass needed to support the MSY) and current spawning biomass/spawning biomass at MSY=1.12, indicating that the population of **yellowfin is not in an overfished state**, and 2) current fishing mortality/fishing mortality at MSY=0.95 (*i.e.* current fishing mortality is 5% below the level needed to take the MSY), indicating the **overfishing is not occurring**.

It was concluded that the current catch from the fishery is approximately equal to the most recent estimate of MSY, 400 thousand tons, and that any increase in fishing effort would not result in a sustained increase in catch, Because there is a 47 percent probability that overfishing is occurring, and because the current biomass is so close to the MSY level, the WCPFC Scientific Committee recommended that fishing mortality for yellowfin tuna be reduced by about 10 percent from its 2001-2004 levels.

The next scheduled yellowfin assessment will be in August 2009.

The WCPFC utilizes two mechanisms for addressing the issue of conservation and management measures: 1) Resolutions containing non-binding statements and recommendations addressed to members and cooperating non-members; and 2) Conservation and management measures containing binding decisions relating to conservation and management measures.

The Commission maintains a record of vessels authorized by their flag states to fish in the Convention waters.

Provision has been made to establish a regional observer program, which will include national and sub-regional programs, coordinated by the Secretariat. The Secretariat is to achieve 20 percent coverage of purse-seine fishing in 2009, and 100 percent in 2010. Lower levels of coverage are targeted for longline and pole-and-line fisheries.

A package of measures, to be implemented in 2009 and to apply over a three -year period, aims to attain, at a minimum, a 30-percent reduction in fishing mortality of bigeye tuna from the annual average during either 2001-2004 or 2004, and to ensure that there is no increase in fishing mortality of yellowfin tuna beyond the annual average during either 2001-2004 or 2004.

Additionally, the purse-seine fishery within Exclusive Economic Zones (EEZs) in the area bounded by 20ºN and 20ºS will be closed to fishing on FADs between 1 August and 30 September, during which time all purse-seine vessels without an observer from the WCPFC Regional Observer Program on board are required to cease fishing and return to port. Similar measures are called for on the high seas.

The area bounded by 10°N and 10°S, 135°E and 179°E (termed the 'doughnut hole'), will be closed effective 1 January 2010, and the Commission will also consider the closure of all high seas pockets in the Convention Area between 20ºN and 20ºS.

The Commission also calls on Commission members and cooperating non-members (CCMs) fishing on the high seas to submit, by 1 July 2009, management plans for the use of FADs by their vessels on the high seas. These plans are to include strategies to limit the capture of small bigeye and yellowfin tuna associated with fishing on FADs.

The WCPFC has adopted full retention measures similar to those implemented by the IATTC.

Purse-seine vessels fishing within the area bounded by 20°N and 20°S on the high seas and the EEZs of one or more coastal States are required, effective 1 January 2010, to carry an observer from the WCPFC Regional Observer Program, and during 2009 observer coverage for such vessels should be 20 percent.

The total catch of bigeye tuna by longline fishing gear is subject to a phased reduction, such that, by 1 January 2012, the longline catch of bigeye tuna is 70 percent of the average annual catch during either 2001-2004 or 2004, and the catch of yellowfin tuna is not to be increased from the 2001-2004 levels.

The WCPFC will require, from 1 April 2009, all vessels greater than 24 meters in length overall, fishing on the high seas in the Convention area south of 20°N, and east of 175°E in the Convention area north of 20°N, to have an activated automatic location communicator (ALC) and participate in a WCPFC vessel monitoring system (VMS). Any coastal state may elect to nominate its EEZ for inclusion in this program.

2.1.2. Bigeye

During the last decade, annual catches of bigeye in the WCPO have averaged about 120 thousand tons, varying between about 100 and 160 thousand tons.

The most recent assessment of the bigeye stock was in August 2008. The current estimate of MSY for the bigeye fishery is about 65 thousand tons, with a fishing effort that is about 70 percent of the current average.

The ratio of current total biomass to total biomass at MSY has been increasing; in 2006 it was 1.27 and in 2007 was 1.37, and is currently 37 percent greater than the total biomass at MSY.

These high estimates of total biomass are sustained by high levels of recruitment.

The ratio of current fishing mortality to fishing mortality at MSY is estimated to be 1.32 for 2006 and 1.44 for 2007, indicating that fishing mortality is continuing to show an increasing trend.

Because the current level of biomass is greater than the equilibrium biomass at MSY (there is a 100 percent probability for the base case that the ratio is greater than 1.00) **the bigeye stock in the WCPO is not in an overfished state**.

Because there is a near 100 percent probability that the ratio of current fishing mortality over fishing mortality at MSY is greater than 1.0, **overfishing of bigeye is occurring in the WCPO.** While the biomass of bigeye is currently greater than the biomass at MSY, if recruitment returns to average levels and fishing mortality is at 2003-2006 levels, there is a high probability that the biomass will decline below the MSY level.

The next scheduled stock assessment of bigeye in the WCPO will be in 2009.

The discussions of conservation and management presented in the section on yellowfin apply to bigeye. Scientists estimate that a reduction of 31 percent in fishing mortality would be needed to maintain the biomass at the MSY level, and that, if fishing mortality stays at current levels, the biomass will decline to below the MSY level by 2013.

2.1.3. Skipjack

Of the total catch of 1,727 thousand tons of skipjack taken during 2007 by all fleets and all gears, purse-seine vessels accounted for about 1,500 thousand tons (87 percent).

For management purposes, the skipjack that support the WCPO fishery are considered to be independent of those to the east of 150°W.

The most recent stock assessment of skipjack was in 2008. The assessment was carried out for two areas: 1) the WCPO, stratified into six regions and 2) two regions encompassing the equatorial WCPO. The equatorial model provides a more robust assessment of the stock, and is considered the principal assessment. The biomass of skipjack is recruitment-driven, the impact of the fishery being estimated to be equivalent to a 15 percent reduction in total biomass from unexploited levels. The equilibrium biomass at the current level of fishing mortality is 5.8 million tons for the base case and 2.9 million for the equatorial region. The MSY that could be taken under average conditions was estimated to be 2.3 million tons for the base case and 1.3 million tons for the equatorial region. However, the latter (which is less than the current catch) is based on an equilibrium level of recruitment that is considerably less than recent levels. In fact, skipjack recruitment has been trending upwards since the early 1980s, perhaps due to a high frequency of El Niño conditions, which are thought to have a positive effect on skipjack recruitment. If a dynamic MSY is computed, *i.e.* the catch taken at F_{MSY}, then the resulting MSY estimate would currently be around 2 million tons for the equatorial region, which is a better comparison to the current catch of around 1.7 million tons.

With respect to reference points, the ratio of the equilibrium biomass at the current levels of fishing to the equilibrium biomass at MSY was estimated to be about 3.3 for the base case and 3.0 for the equatorial region, which indicates that the stock of **skipjack in the WCPO is not in an overfished state;** in fact, there is a zero probability that $B_{current}/B_{MSY}$ is anywhere near 1.0; the ratio of current fishing mortality to fishing mortality at MSY is less than 0.12 for the base case and 0.26 for the equatorial region, indicating that **overfishing of the stock of skipjack in the WCPO is not occurring**.

The next stock assessment is scheduled to be completed in 2009.

Because of growing concern over the rapidly-expanding number of purse-seine vessels operating in the region of the Pacific islands, in 1992 the Palau Arrangement, which set a limit of 205 vessels, was implemented. About 80 percent of the purse-seine catch from the WCPO is taken within the waters of the PNA. The number of vessels fishing in the area between 20ºN and 20ºS has exceeded this limit of 205, and is currently about 225.

Over its short history, the WCPFC has implemented a number of measures which are directed at controlling fishing capacity, most calling on CCMs to limit the numbers of their vessels to certain earlier levels.

The PNA developed the framework for a scheme to enhance the management of purse-seine fishing effort in their waters. The scheme establishes a vessel day scheme (VDS), which places limits on the total numbers of fishing days or total allowable effort (TAE) that is permitted in the waters under the jurisdiction of the PNA. The VDS does not directly limit fishing capacity or the number of vessels authorized to fish but, because the number of allowable fishing days is limited, could affect how many vessels might fish. The VDS, which was implemented on 1 December 2007, replaces the 205-vessel limit established by the Palau Agreement.

The most recent action taken by the Commission regarding capacity requires all CCMs to take the necessary measures to ensure that the total capacity of their respective other commercial tuna fisheries for bigeye and yellowfin do not exceed the average level for either 2001-2004 or 2004.

2.2. Compliance and enforcement

A Technical and Compliance Committee (TCC) has responsibility for monitoring and reviewing compliance with the conservation and management measures adopted by the Commission, and for making recommendations relating to the implementation of, and compliance with, conservation and management measures.

CCMs have a duty to report any infractions to the flag state of the vessel committing the infraction. The flag state has a responsibility to undertake an investigation of the allegations and to take appropriate legal action, and if the allegations are sustained, to impose sanctions adequate in severity to be effective in deterring future violations.

The Commission maintains a register of vessels authorized to fish in the area, and any vessel not on this list is considered to be fishing illegally. The Commission approved two conservation and management measures to improve surveillance, enforcement, and compliance: high seas boarding of IUU vessels, and a Commission IUU list.

Several of the Resolutions and conservation and management measures authorize the CCMs to under take joint non-discriminatory action, including trade sanctions, against states whose fisheries act to diminish the effectiveness of the Commission's conservation and management measures.

2.3. Bycatch and discards

Since the mid-1980s the Secretariat for the Pacific Community's Oceanic Fisheries Programme, the Forum Fisheries Agency, and several nations with vessels fishing in the WCPO initiated programs to place observers aboard purse-seine and longline vessels, for the purposes of collecting a variety of information, including estimates of discard and bycatch. Coverage was very low, 0.8 percent of all longline sets and about 3.5 percent of purse-seine vessels. These low levels of ob-

server coverage cannot produce very reliable estimates of discards and bycatch.

Purse-seine vessels in the WCPO also take large bycatches of a variety of non-target species, and sets on floating objects usually take significantly more bycatch than sets on unassociated schools; however, the overall levels seem to be less than those recorded in the EPO. Longliners catch more sharks than do purse seiners.

Both longliners and purse seiners capture sea turtles, but quantitative data on the amount captured are limited. Because all of the turtles taken in the longline and purse-seine fisheries are either threatened or endangered, any mortality of these species would be considered undesirable.

The incidence of interactions of seabirds with fishing gear has been reported to be low for the tropical western Pacific; almost no interactions were identified in the observer data base for purse-seine vessels and longliners fishing in the tropical regions. The problem seems to be much more severe in temperate waters, where longline vessels fishing for albacore were shown to have taken birds, which usually die as a result.

Observers have recorded very few mammals being taken by fishing gear in the WCPO.

The most commonly taken sharks are blue sharks and silky sharks.

There are several working groups that deal directly with the bycatch issue. They have concentrated on studying means of improving the data base and of mitigating bycatch.

Recent action within the Commission has led to the passage of several resolutions directed towards mitigating bycatch in the fisheries: longline vessels are required to use bird-scaring devices and deep setting line launchers or underwater chutes, as well as manage offal discharge; there are requirements for disentangling, resuscitating and releasing alive sea turtles; longline vessels are required to carry line-cutters and de-hookers for releasing turtles; beginning in 2010, longline vessels fishing for swordfish in shallow sets must use large circle hooks and only finfish for bait; all sharks captured and not released are to be fully utilized.

3. ALBACORE IN THE PACIFIC

Unlike the other species of tunas in the Pacific Ocean, albacore are divided into a northern and a southern stock; therefore, the IATTC and the WCPFC are jointly responsible for managing the Pacific albacore stocks, and the Pacific population of the species is treated separately in this report.

The total Pacific catch of albacore has varied between 70 thousand tons in 1965 and 170 thousand tons in 2002, and was about 145 thousand tons in 2007.

3.1. North Pacific albacore

Between 1977 and 1996 catches of north Pacific albacore averaged about 75 thousand tons, and in 2007 were about 86 thousand tons. About 38 percent of the catch is taken by pole and line, 22 percent by trolling; about 36 percent by longline, and the remainder by a variety of other gear types.

The most recent stock assessment was completed in December of 2006. The current biomass is estimated to be about 7 percent higher than the 1966-2005 average.

Projections to 2020 indicated that, if the current level of fishing mortality and average recruitment are maintained for each year from 2007 until 2020, the biomass would decline by about 30 percent to 126 thousand tons, and the spawning biomass would decline by about 40 percent to

about 92 thousand tons, which is about 20 percent greater than the lowest level seen in the fishery. It was concluded that the stock was rapidly approaching full exploitation, and that either fishing mortality or fishing effort on the stock should be reduced to some threshold precautionary level. Currently the biomass and the spawning biomass are well above average levels, but the fishing mortality, if maintained at the current level, will cause the stock to decline significantly. In other words the stock is **not in an overfished state**, but **fishing mortality is high,** and consideration should be given to reducing it.

The next scheduled full assessment for north Pacific albacore will be conducted in 2010

The IATTC and WCPFC approved resolutions calling on states to not allow their vessels fishing for north Pacific albacore to increase fishing effort beyond current levels.

3.2. South Pacific albacore

Catches of south Pacific albacore were 70 thousand tons in 2006, and 59 thousand tons in 2007.

In recent years the longline fishery has accounted for about 92 percent of the total catch, with the troll fishery taking most of the rest.

The most recent stock assessment was completed in 2008. Biomass was estimated to be low during the 1950s, increasing during the 1960s because of increased recruitment, moderate from 1970-2000, and then declining.

Overall, the rate of fishing mortality was relatively low throughout the history of the fishery.

The current analysis estimates a much lower MSY than the previous analyses, about 65 thousand tons compared to 180 thousand tons. The ratio of current fishing mortality to the level of fishing mortality at MSY was 0.44 for the base case, and the ratio of current spawning biomass to the estimate of biomass at MSY was 2.21 for the base case. Because fishing mortality is so much lower than the level that would be required to take the MSY, **the stock is not being overfished**, and because both the spawning biomass and total biomass are so much greater than the MSY level, the **stock is not in an overfished state**.

In 2005, the WCPFC CCMs agreed to not increase the number of their vessels that are fishing for albacore in the Convention Area south of 20°S above 2005 or 2000-2004 levels.

3.3. Limiting fishing capacity

There are no measures taken by either the IATTC or WCPFC specifically addressing the issue of capacity in the North Pacific albacore fishery. Nearly all of the catch of albacore in the North Pacific is made by longline, pole-and-line, and troll vessels. There have been no studies to determine whether there is excess fishing capacity in the pole-and-line and troll fleets. Studies of longline fleets in the EPO and WCPO have shown there is substantial excess capacity in these fleets.

The WCPFC resolution for management of the southern albacore fishery calls for no increases above 2005 or 2000-2004 levels in the number of vessels fishing in the Convention Area below 20ºS.

There are not enough data to determine with any degree of certainty whether fishing mortality has declined as a result of management efforts to curtail fishing effort.

3.4. Compliance and enforcement

The WCPFC and IATTC resolutions on north Pacific albacore share the same shortcomings and ambiguities. To monitor compliance with the measures to freeze fishing effort on northern albacore, the Commissions are supposed to receive information on catch regularly from the participating fishing fleets, but not all flag states have complied. Because the resolutions call for limiting fishing effort, and require timely reporting of catch, but not of effort, the Commissions are not able to evaluate compliance with the resolution on a short-term basis. Additionally, the resolutions mention that effort should not exceed current levels, but do not define "current levels." Because of these shortcomings and ambiguities in the details of the resolutions, compliance is difficult to monitor.

It is believed that IUU fishing for North Pacific albacore is occurring, but there is no concrete information regarding the characteristics and magnitude of this IUU fishing.

3.5. Bycatch and discards

Of the total catch of albacore from the Pacific, about 68 percent is taken by longline, 18 percent by pole and line, and 14 percent by trolling. Of these three gear types, longline vessels take by far the greatest amount of bycatch. Troll and pole-and-line vessels are very selective and have hardly any bycatch, but may have small amounts of discards.

The temperate longline fishery for albacore has captured significant numbers of seabirds, but with the use of bird-scaring gear the numbers have dropped. Most of the seabirds captured in this fishery die. The fishery captures about 17 percent as many turtles as the tropical shallow longline fishery and 12 percent as many as the tropical deep longline fishery. Of the turtles captured, about 33 percent die.

The troll and pole-and-line fisheries have very little bycatch, and what they do take is often landed and sold or kept for consumption on board. In some instances there are discards of albacore as a result of high-grading, but this is not too common.

3.5.1. Measures taken to reduce bycatch and discards

The work discussed above involving the use of mitigation measures such as bird-scaring lines (*tori* lines), colored bait, and circle hooks, is being undertaken for some of the albacore longline fleets, and the implementation of the WCPFC's CMMs (conservation and management measures) 07-04 on seabirds, 08-03 on turtles, and 08-06 on sharks, applies to many of the vessels fishing for albacore.

4. ATLANTIC OCEAN

Currently about 10 percent of the global catches of tuna are taken in the Atlantic Ocean. During 2007, the catches from the Atlantic consisted of about 150 thousand tons of skipjack (38 percent), 97 thousand tons of yellowfin (25 percent), 67 thousand tons of bigeye (17 percent), 49 thousand tons of albacore (12 percent), and 34 thousand tons of bluefin (8 percent). Purse-seine vessels take about 40 percent of the catch, followed by pole-and-line with 27 percent, longline with 19 percent, trolling with 4 percent, trawl with 3 percent, and other gear types the remaining 7 percent.

The International Commission for the Conservation of Atlantic Tuna (ICCAT) has responsibility for management of tunas in the Atlantic Ocean and adjacent seas.

4.1. Species

4.1.1. Yellowfin

Yellowfin catches in the Atlantic have declined by about 49 percent since the peak of 192 thousand tons in 1990, and since 2001 have declined by about 36 percent to about 97 thousand tons. Declines have been evident for pole-and-line, purse-seine, and longline vessels in both the eastern and western Atlantic. Concurrent with these declines in catch has been a decline in the number of purse-seine vessels, from 44 in 2001 to 24 in 2006, and the imposition of restrictions on the fishing effort by the Ghanaian pole-and-line fleet.

The most recent full assessment of yellowfin was in 2008.

Two models are used to assess the yellowfin stock in the Atlantic Ocean. The production model analysis estimates MSY to be about 147 thousand tons, 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 current biomass slightly less than the MSY level.

The estimate of MSY for the virtual population analysis (VPA) model was about 131 thousand tons; the estimated fishing mortality during 2006 was about 84 percent of the level corresponding to MSY, and the biomass was 10 percent greater than that corresponding to MSY.

The distribution of the estimates from both models shows that about 40% indicate a sustainable situation, in which the stock is not overfished and overfishing is not occurring. Catches in 2006 and 2007 are estimated to be well below the MSY levels, stock biomass is estimated to be near the MSY level, and recent fishing mortality rates are less than the MSY level.

Using the VPA model, projections suggested that catches of 130 thousand tons are sustainable; catches in excess of that amount would result in overfishing. If catches are maintained at current levels of 110 thousand tons, biomass would be expected to increase to above the MSY level.

Based on the 2008 assessment, it appears that the stock is **not currently being overfished** and although **it is possibly in a slightly overfished state it may have rebuilt to above the MSY level because** catches for the past five years have been less than the MSY

The ICCAT Standing Committee on Research and Statistics (SCRS) has set no schedule for the next full stock assessment of Atlantic yellowfin.

One of the earliest management measures implemented by ICCAT was the establishment in 1973 of a minimum size limit of 3.2 kg for yellowfin. 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. This measure has been implemented each year since 1993.

In order to protect small bigeye, the Commission implemented a measure in 2004 to close a 5- by 10-degree area to surface fishing in the Gulf of Guinea 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. The measure has been extended through 2010.

4.1.2. Bigeye

Catches of bigeye increased steadily since the 1950s, and peaked in 1994 at about 132 thousand

tons; they have declined steadily since then, and in 2006 and 2007 were about 67 thousand tons in each year. Since the early 1990s, purse-seine vessels have taken a significant portion of the total bigeye catch.

The most recent stock assessment for Atlantic bigeye was conducted in 2007. Most of the conclusions regarding the status of the stock were based on general production models.

Using two different formulations of the production model, MSY was estimated to be 90 or 93 thousand tons. 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 then. 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 currently at 0.87, or less than needed to take the MSY.

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

On the one hand, based on the most recent assessments, the biomass of bigeye in the Atlantic Ocean is about 92 percent of the size it should be at MSY, in other words **the stock may be currently in a slightly overfished state**; however, if catches remain at the 2006-2007 level, the stock will increase to above the level corresponding to MSY. On the other hand, since fishing mortality during 2006 was only 87 percent of what it should be at MSY and is expected to be about the same for 2007, **the stock is not being overfished,** and should be increasing slightly.

The next assessment of Atlantic bigeye is currently not scheduled.

Over the years, ICCAT has implemented 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; as with yellowfin it was rescinded 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 controls were implemented for 2005-2008, which set a total allowable catch (TAC) of 90 thousand tons, partitioned part of it among countries, set limits on the numbers of fishing vessels for various fleets, and prohibited purse-seine and pole-and-line vessels fishing during November in a 5- by 10-degree area in the Gulf of Guinea.

The Commission also reduced Chinese Taipei's 2006 bigeye quota because of IUU fishing in 2005.

4.1.3. Skipjack

The population of skipjack in the Atlantic is divided into eastern and western stocks. The fishery on the eastern stock takes about 80 percent of the total catch, and the western 20 percent. Total catches increased steadily from the 1950s to a peak of 208 thousand tons in 1991, latterly as a result of the introduction of FAD fishing. Since 1982 catches have varied between about 114 thousand and 200 thousand tons, and in 2007 were about 150 thousand tons. The catches in the western fishery have varied between 22 and 40 thousand tons since 1980, but have shown no increasing or decreasing trend.

The last stock assessment of Atlantic skipjack tuna was in 1999. Like skipjack in other oceans, because of difficulties in estimating directed fishing effort, continual spawning activity, difficulty in separating natural mortality from out-migration, and highly variable and dynamic growth, it has been difficult to apply classic population dynamics models to assess stock status. Consequently, no standardized assessment of the skipjack stocks was carried out; several fisheries indicators were used to examine changes in the stocks over time.

Estimates of the total mortality rate for the eastern stock have been decreasing as a result of the moratoria placed on fishing with surface gear in the Gulf of Guinea. The indices of abundance show a great deal of variability, but for the FAD fishery and the Senegalese "baitboat associated school" fishery, efficiency and catch rates increased.

For the western stock, catch rates in the Brazilian pole-and-line fishery have been fairly stable over the last decade, while they have declined for the Venezuelan purse-seine fleet. However, it is considered that these decreases may be due to specific environmental conditions that have affected the vulnerability of skipjack to the purse-seine fleet.

Standard indicators of stock condition, such as MSY, fishing mortality ratios, and biomass ratios have not been estimated for either stock; nevertheless there is **no evidence that either stock of skipjack is in an overfished state or that overfishing is occurring.**

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

There is currently no specific regulation in effect for the management of skipjack, nor has the SCRS recommended any management measures for skipjack. However, the moratoria applied by the industry during November-January of 1997-1999 on fishing in the Gulf of Guinea, and the ICCAT recommendation to close a similar area during subsequent years, has had an effect on skipjack catches 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 applied the moratoria decreased by 42 thousand tons (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.

4.1.4. Albacore

Atlantic-wide catches of albacore have shown a great deal of variability between 1982 and 2006, but with a decreasing trend. The all-time high of about 85 thousand tons was taken in 1986, after which catches declined to a low of about 50 thousand tons in 2004, and then varied between 48 thousand and 71 thousand until 2007, when the catch was 42 thousand tons. Catches in the Mediterranean Sea have averaged about 5 thousand tons per year.

Although distribution is continuous throughout the Atlantic, scientists consider that there is a northern and a 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 its extent is not known.

4.1.4.a North Atlantic albacore

Catches of north Atlantic albacore reached a peak of about 65 thousand tons in the mid-1960s, but declined through 2004. Annual catches during 2005-2006 were about 36 thousand tons, and 22 thousand tons in 2007. Some of the decline in catch is attributed to a reduction of fishing, while the recent increase is attributed to increased effort and catch by driftnets and trawls.

The most recent assessment for the northern stock of albacore was conducted in 2007.

Trends in the ratio of fishing mortality in each year to the fishing mortality when the population is at a level capable of supporting the MSY were, with few exceptions, greater than one, indicating that overfishing had been occurring. In 2004, the ratio was less than one, but increased to more than one in 2005, ranging between 1.3 and 1.7.

Trends in the biomass in each year to the biomass at MSY showed that, since 1993, the biomass has been less than biomass at MSY. However, the stock has been rebuilding, and is currently about 20 percent below the MSY level, whereas in 2000 it had been about 50 percent below the MSY level. Also the trend in spawning biomass has been increasing slightly.

The current estimate of MSY is 30.2 thousand tons. Four out of ten of the most recent annual catches have exceeded the MSY. The catch in 2007 was less than the replacement yield, which means the stock should be increasing in abundance.

Based on the current assessment, **the stock of northern albacore is in an overfished state**, and **overfishing is currently taking place.**

If fishing mortality continues high and recruitment stays average or less, biomass will continue to decrease; however, these decreases could be offset by the apparent strong recruitment and the lower TAC set for 2008 and beyond.

The next stock assessment of North Atlantic albacore is scheduled for July 2009.

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.

In 2007, ICCAT reduced the TAC to 30.2 thousand tons for 2008 and 2009; if this is respected, biomass should increase to the MSY level.

4.1.4.b South Atlantic albacore

Catches of albacore in the south Atlantic have varied between a high of 41 thousand tons in1987 and a low of 15 thousand tons in 1984. From 1988 to 2003 catches were relatively stable, averaging 30 thousand tons per year, but in 2007 they decreased to 20 thousand tons

Over the last few years longline fleets have taken nearly 68 percent of the catch from the south Atlantic, with Namibian and South African pole-and-line fleets taking most of the remainder.

The most recent stock assessment for southern albacore was conducted in 2007.

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 .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 a level corresponding to the MSY.

The current estimate of MSY is 33.3 thousand tons, ranging between 29.9 and 36.7 thousand tons. Only one out of the last ten years has exceeded the MSY estimate, and over the last four years none of the catches have exceeded the replacement yield of 28.8 thousand tons. This implies that biomass should be increasing and, if current levels of catch are maintained, will soon exceed what it should be at MSY, if it has not already done so.

Based on these analyses, **the southern stock of albacore is not being overfished, but conservatively speaking, it may be in a slightly overfished state.** 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.

The next stock assessment of south Atlantic albacore is scheduled for July 2009.

ICCAT has set a TAC of 29,200 tons for 2009-2011, with provisions to lower it if catches are in excess of the limit.

4.1.4.c Mediterranean albacore

Catches of albacore in the Mediterranean have average about 5 thousand tons in recent years. There have been no assessments of this stock.

4.2. Limiting fishing capacity

An ICCAT working group expressed concern that there is overcapacity in some of the tuna fisheries, particularly those for northern albacore and, possibly, yellowfin. An FAO technical working group estimated that there was excess capacity in both the longline and purse-seine fleets operating in the Atlantic Ocean. However, over the last few years purse-seine capacity in the Atlantic has declined from about 70 thousand tons to less than 35 thousand tons, as has nominal fishing effort. It is probable that the efficiency of the purse-seine fleet has increased progressively over the years, so that fishing capacity is not proportional to the decline in carrying capacity.

ICCAT has taken a number of management measures designed to limit fishing capacity for some fisheries: CPCs are to keep the number of vessels fishing for bigeye to less than the average number that fished during 1991 and 1992, China is to be limited to 45 longline vessels, Chinese Taipei to 60 longline vessels, Philippines to 8 longline vessels, and Panama to 3 purse-seine vessels.

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.

4.3. Compliance and enforcement

ICCAT has been one of the most active of the tuna RFMOs with respect to implementing measures to ensure compliance with certain of their conservation initiatives. Much of this action, which has been directed towards IUU fishing, is attributable to the aggressive stance that Japan took with respect to IUU fishing for Atlantic bluefin, and was the initial motivation for the introduction of trade sanctions against IUU fishing states. Several multilateral non-discriminatory trade sanctions have been applied against nations whose fleets have fished in contravention to ICCAT regulations, for example Panama, Bolivia, Georgia, and St. Vincent and the Grenadines. In most cases these sanctions, or threats of sanctions, have resulted in the offenders coming into compliance.

To coordinate its enforcement and compliance interests ICCAT formed a Conservation and Management Measures Compliance Committee. This Committee has taken the initiative to recommend to the plenary a series of measures designed to improve compliance; these include the establishment of a register of vessels authorized to fish in Convention waters, and the creation of an IUU vessel list.

In an attempt to enforce ICCAT management and conservation measures, a number of actions have been taken: a general prohibition on transshipping at sea, encouraging coastal states to assign a port inspector to monitor all tuna unloadings within their ports and report this information to ICCAT, encouraging vessel masters to report to ICCAT any vessels they observe that may be engaged in IUU fishing, and encouraging port states to prohibit all unloadings and transshipments of any vessels entering the ports that have been identified as IUU, or are otherwise guilty of infringement of ICCAT regulations.

4.4. Bycatch and discards

To facilitate the collection of discard and bycatch information for the tuna fisheries of the Atlantic Ocean, and to develop methods of mitigating them, ICCAT created the Sub-Committee on Ecosystems within the SCRS. This sub-committee has dealt with the issue of estimating the kinds and quantities of species making up bycatch and discards for the various types of fishing fleets operating in the Atlantic. The program has suffered from very low observer coverage for most of the fisheries, but some useful data have been collected.

A Spanish program placed observers on a number of trips by purse-seine vessels during 2001-2004, and data were collected from about 1,500 sets which captured 24 thousand tons of tuna. Estimates of discards and bycatch were reported. Many of the same species taken in the fishery of the Pacific were encountered in similar proportions in the Atlantic. Of the 1,500 observed sets, floating-object sets had about 150 times more finfish bycatch (2,500 tons), about 5 times more billfish (2,250 individuals), and 6 times more sharks (600) than did school sets.

As in other oceans, bycatch and discard data for longline fleets were much more sparse than for purse-seine fleets. Most of the available data come from nations with the smallest longline fleets, and most of the bycatch data reviewed by ICCAT are for seabirds and turtles. Dozens of species of seabirds have been found to interact with longline vessels in the Atlantic. Comprehensive quantitative data with which to assess the impact of the fishery on the various species of seabirds are not available; nevertheless, the sub-committee has used risk assessment analyses to examine the vulnerability of seabirds to mortality by longline gear, and has used the results to prioritize its efforts to collect and evaluate seabird interaction data.

The limited data available for longline suggest significant interactions with turtles. During 2005-2007, observers aboard Brazilian and Uruguayan longline vessels reported a total of 2,267 sea turtles captured. Since those two fleets account for less than 10 percent of the total longline effort expended in the Atlantic, the overall catches of all fleets combined are probably substantial.

One of the most significant actions taken to reduce bycatch was the industry initiative to close an area in the Gulf of Guinea to fishing on floating objects between November and January during 1997-1999; this was subsequently included as a conservation measure by ICCAT.

ICCAT scientists have been conducting studies of the behavior of aggregations of animals around floating objects, and the development of gear and fishing technique modifications to either avoid catching these unwanted species or remove them alive from the net after capture.

It is likely that the majority of turtle mortalities in purse seining result from entanglement in the netting that is hung under FADs. Scientists from the Spanish government have been experimenting with different types of materials for hanging under FADs. Preliminary results suggest that this type of mortality can be reduced significantly by selecting materials that do not entangle turtles.

The ecosystem sub-committee is encouraging CPCs to develop national plans of action for seabirds and turtles, to set conservation and management standards to mitigate the problems caused by fisheries interactions with bycatch species.

The ecosystem sub-committee has undertaken studies to assess the abundance of seabird populations that interact with the tuna fisheries; it has also set about prioritizing its future work on bycatch and ecosystem impacts, and will undertake an ecological risk assessment exercise recommended by the SCRS.

ICCAT has recently implemented a regulation requiring all longline vessels fishing south of 20ºS to use *tori* lines when laying out longlines during daylight hours. An analysis for the Brazilian longline fleet showed that the catch of birds was reduced by 64 percent when *tori* lines were used, and the catch of target species of fish increased by 15 percent.

The sub-committee found that circle hooks generally reduce the catch rates of incidentally-caught species such as turtles and marlins (and possibly seabirds) and increase their survival, and has encouraged their use for longline and handline fishing; it has also encouraged CPCs to undertake educational programs, including disbursing materials introducing these mitigation measures to their fishermen.

Two resolutions dealing with sharks were approved during 2008. One calls on all CPCs to require their vessels to release alive all bigeye thresher sharks taken during tuna-fishing operations, and the other calls on ICCAT to work jointly with the International Convention on Endangered Species (ICES) to assess the status of the porbeagle shark population in the Atlantic Ocean.

5. INDIAN OCEAN

Tuna catches in the Indian Ocean increased slowly until the French and Spanish purse-seine fleets transferred operations from the Atlantic to the Indian Ocean in the early 1980s. Catches increased from about 150 thousand tons in 1982 to about 800 thousand tons in 1994, and have continued to increase since 1994, but at a slower pace, reaching a peak of about 1,150 thousand tons in 2005; in 2007 the catch was about 910 thousand tons. During the last few years about 25 percent of the world production of tuna was from the Indian Ocean.

Purse-seine vessels account for about 40 percent of the catch, gillnets and longlines 20 percent each, pole-and-line about 12 percent, trolling and hand-lines about 4 percent, and the remainder by a variety of gears.

The Indian Ocean Tuna Commission (IOTC) is responsible for the management of tunas and tuna-like species in the Indian Ocean. Unlike the other tuna RFMOs, the IOTC was created within the framework of Article XIV of the FAO Constitution, which limits the ability of Chinese Taipei, a leading fishing nation in the Indian Ocean, to participate directly with the Commission. IOTC is currently examining means of restructuring to operate under a Convention independent of the FAO.

5.1. Species

5.1.1. Yellowfin

Yellowfin catches prior to 1984 were relatively minor, but by 1992 exceeded 300 thousand tons. In 2003 catches peaked at 497 thousand tons, and during 2004-2006 remained above 400 thousand tons; in 2007 they declined to 317 thousand tons. Purse seine accounts for about 45 percent of the catch, gill net about 20, longline about 20, and pole and line most of the rest.

The most recent assessment for yellowfin was in 2008. One of the key concerns in the analysis was to determine the reason for the extraordinarily high catches during 2003-2006. If these were due to increases in recruitment that resulted in an increase in biomass, then the stock was probably not being overfished; however, if recruitment during that time was average, but the fish were easier to catch, then biomass would have been driven down significantly by the high catches. The Scientific Committee of IOTC has examined environmental data, and favors the latter explanation.

Results of one modelling analysis indicate that recent levels of fishing mortality were at historically high levels, with overfishing occurring during 2003-2006. Depending on the shape of the stock recruitment curve, the MSY was estimated to vary between 250 and 300 thousand tons. For the lower values of assumed steepness the SSB is estimated to be below the MSY level and in an overfished state (SSB/SSB_{MSY}=0.94); however, for the higher values, biomass is estimated to be above the MSY level (1.13-1.03), and the stock is not in an overfished state. The lower from 1.0 the value of steepness, the greater is the relationship between spawners and recruits; however, for most tropical tunas there is little or no evidence to show that recruitment is related to the size of the spawning stock (steepness of 1.00) over the values that have been observed for most tuna fisheries.

Results from another modelling analysis estimated the MSY to be 300 thousand tons and the biomass to be above the MSY level however, there was a great deal of uncertainty concerning these results.

A simple surplus production model analysis indicated that the biomass is below the MSY level and the fishing mortality is slightly above the MSY level.

An age-structured production model analysis suggested that the yellowfin stock is now entering into an overfished condition after the high catches during 2003-2006, but if catches do not exceed the 2007 level of 316 thousand tons, it will recover to the MSY level within a few years.

The overall conclusion to be drawn from the above information is: 1) the stock of yellowfin tuna in the Indian Ocean is slightly above, or just below the MSY based reference points, suggesting it is close to or has recently entered an overfished state, and 2) estimates of current fishing mortality were above the MSY reference point in all but one of the cases examined, suggesting overfishing is likely occurring. The most likely MSY estimates ranged between 250 and 300 thousand tons, although some results suggested values as high as 360 thousand tons. The 2007 catch was very near the MSY, while catches during the 2003-2006 period were substantially higher than the MSY, assuming average recruitment during that period. Although there is some question as to whether the stock is in an overfished state currently, if the 2003-2006 and 2007 levels of fishing mortality continue, there is little doubt that the stock will be in an overfished state. Considering all of these above factors, from a precautionary point of view the stock is considered to be in an **overfished state**, and **overfishing of the stock is currently taking place**.

The next assessment of yellowfin by the WPTT will be later in 2009.

Until the recent assessment there was apparently no overfishing of yellowfin tuna, with the possible exception of reduced yield per recruit resulting from the FAD fishery; therefore, IOTC has taken very limited action with respect to the implementation of conservation and management measures for yellowfin in the Indian Ocean. In 2003 it approved a resolution recommending limitations on fishing capacity; although this was not a measure directed towards yellowfin, in theory it would impact that stock as well as others. The measures were updated in 2006, and are

to apply through 2009. In essence, there has been no directed management of yellowfin tuna in the Indian Ocean.

5.1.2. Bigeye

The total catch of bigeye by all gears peaked in 1999 at about 150 thousand tons, but has been declining somewhat since then; the 2007 catch was 136 thousand tons. A large number of nations are involved in the fishery, but two, Spain and France, account for most of the surface catch, while Chinese Taipei takes the overwhelmingly largest share of the longline catch.

The most recent series of assessments for bigeye in the Indian Ocean were completed in 2006, and updated in 2008. Several different models were used in the assessments. In each of the analyses using the different models, the ratio of current fishing mortality to fishing mortality corresponding to the MSY level was less than 1.00, and the ratio of current biomass to MSY biomass was greater than 1.00.

All of the analyses suggest that the stock of bigeye in the Indian Ocean **is not in an overfished state**, **nor is overfishing occurring**, but if fishing mortality increases to its 2004 level, the stock will decline to or below the MSY level within several years.

There is no schedule for the next bigeye assessment.

In 2001 the Commission called on non-members to limit their fishing effort on bigeye to 1999 levels, and to report to the Commission on the measures they have taken to comply with this request.

In 2005 the Commission agreed that CPCs shall limit their catch of bigeye to recent levels of catch, and to request Chinese Taipei to limit its annual bigeye catch in the Indian Ocean to 35 thousand tons.

5.1.3. Skipjack

Like skipjack in all other oceans, the stock of skipjack in the Indian Ocean is abundant and widely distributed, but for purposes of management is considered to be a single unit.

Catches of skipjack in the Indian Ocean averaged less than 50 thousand tons before 1984, but after the movement of Spanish and French purse-seine fleets into the area they jumped to over 113 thousand tons, and increased each year to a peak of more than 600 thousand tons in 2006; however, the catch dropped to about 436 thousand tons in 2007. A wide variety of fishing techniques are used to capture skipjack; purse-seine vessels take about 43 percent of the total catch, pole-and-line vessels about 24 percent, gill nets about 23 percent, and a multitude of other fishing techniques take the remaining 10 percent.

No comprehensive assessment has been made for the skipjack stock of the Indian Ocean. In lieu of an assessment, scientists examined a number of fishery indicators to gain insight into the status of the stock. Based on the biological characteristics of skipjack and these various fishery indicators, it was concluded that there is no immediate concern regarding the status of the skipjack stock. However, because it cannot be expected that skipjack catches will continue to increase indefinitely it has been recommended that the species be monitored on a regular basis. It is concluded that **the stock of skipjack in the Indian Ocean is not in an overfished state, nor is overfishing occurring**.

There is no schedule for the next skipjack assessment.

Because the IOTC considers that skipjack are not fully exploited, it has made no recommendations for conservation and management. Theoretically, the measures for limiting fishing effort and capacity mentioned earlier would affect the catches of skipjack, since most is taken in association with FADs and in schools mixed with yellowfin and bigeye.

5.1.4. Albacore

There is only one stock of albacore in the Indian Ocean. From 1950 to 1960 the catch increased rapidly to about 20 thousand tons, where it remained until 1985; it reached an all-time high of 41 thousand tons in 2002, but began to decline thereafter and averaged about 25 thousand tons during 2005-2007. Longlines account for about 92 percent of the total capture.

The stock assessment analyses were updated in 2008, and an age-structured production model was used to evaluate the interaction between age at selection by the fishery and age at maturity and the effect on stock status. Both analyses indicated that the stock was not in an overfished state, and that overfishing was not occurring. In the first analysis MSY was estimated to be 28,260, tons and in the second 34,415 tons. In both cases, catches during 1998-2001 were most likely in excess of MSY, but during 2003-2007 have been around 26 thousand tons, about equal to or less than MSY, so overfishing of the stock is probably not occurring. The mean weight of albacore in the catches has been stable over the past 50 years, and the catch rate has been stable over the past 20 years.

Based on all of the above information it is considered that **albacore in the Indian Ocean are not in an overfished state, nor is overfishing occurring**.

The IOTC Scientific Committee noted the preliminary nature of the albacore tuna assessment in 2008 but, based on the available stock status information and stable effort, considers that the status of the stock of albacore is not likely to change markedly over the next 2-3 years and, if the price of albacore remains low compared to other tuna species, no immediate action should be required on the part of the Commission. They also noted that greater emphasis should be placed on improving estimates of biological parameters such as growth, sexual maturity and natural mortality, as these are currently poorly estimated and lead to uncertainty in the results.

The Scientific Committee recommended that the next albacore assessment be no later than 2010.

There has been only one measure taken by IOTC that directly addresses the management of albacore. Specifically, all CPCs are requested to limit the number of their vessels greater than 24 meters, and less than 24 meters if they fish outside their EEZ for albacore in the IOTC area of competence, to the number of their vessels on the IOTC register of vessels for 2007.

5.2. Limiting fishing capacity

The first directed action to limit fishing capacity was undertaken by IOTC during 2003, when it approved a resolution directing CPCs with more than 50 large-scale tuna fishing vessels on the IOTC register of vessels to limit the number of their vessels to the number registered in 2003. In 2006, the 2003 resolution was updated and was to apply to 2007-2009.

In 2007 the Commission approved a resolution requiring all CPCs to limit the number of their vessels fishing in the IOTC area of competence for albacore and/or swordfish in 2007-2010 to the number on the IOTC register of vessels for 2007.

The purse-seine fleet operating in the Indian Ocean has continued to grow since first entering the fishery in the mid-1980s; by 1985 capacity had increased to 25 thousand tons, by 1990 to 35

thousand, by 1995 to 55 thousand, and currently capacity is at about 65 thousand tons. Although the IOTC has not carried out any quantitative studies of whether there is excess capacity in the tuna-fishing fleets in the Indian Ocean, outside sources have addressed the issue. The FAO Technical Advisory Committee on Fishing Capacity in 2005 undertook studies of fishing capacity which indicated that there was excess capacity in the purse-seine fleet in the Indian Ocean[2]. Additionally, the Organization for the Promotion of Responsible Tuna Fishing (OPRT) concluded that the capacity of large-scale longline fleets needed to be reduced by at least 20 percent.

The IOTC has implemented very few conservation and management measures, and it is difficult to evaluate the effectiveness of those that have been implemented. Data to monitor the number of vessels fishing in the IOTC area of competence are not readily available, so it is difficult to know if the measures are effective. Additionally, the stock assessment analyses do not provide enough detail to know if the apparent decline in stocks is a result of fishing and failure to enforce conservation measures or is due to other causes. In the case of bigeye, it does appear that CPCs complied with the measure to limit catches to recent levels. Total catches of bigeye during 2004-2007 are less than catches for 2000-2003, and the catch of Chinese Taipei in 2006 was only slightly greater than the assigned limit of 35 thousand tons.

One factor contributing to the difficulty in evaluating the effectiveness of the conservation measures is the limited comprehensive data for some fisheries such as the fresh fish longline fishery, the artisanal fisheries, and the fisheries of Chinese Taipei, Yemen, and Iran.

5.3. Compliance and enforcement

In 2002, the IOTC established a Compliance Committee whose functions are to review compliance with the conservation and management measures adopted by the Commission and to make recommendations to ensure their effectiveness, to review the implementation of measures for monitoring, control, surveillance, and enforcement, to develop and enhance the implementation of the IOTC control and inspection scheme, to review and recommend actions to control IUU fishing, and to consider the effectiveness of the IOTC statistical document program. At its most recent meeting the Compliance Committee noted that not all CPCs have approved national laws and regulations to enforce the recommendations of the Commission. It also recommended that all CPCs require that a logbook or fishing record be kept on each vessel fishing in the Indian Ocean, and that such records be made available to the Commission. A resolution was approved regarding the logbooks, and a sample logbook was included in the resolution.

The Commission maintains a “positive list” of vessels authorized by their governments to fish in the IOTC area. Any vessel that is not on the list that fishes in the area, or any vessel of a non-CPC that fishes in the area, or any vessel on the positive list that fishes in contravention to the conservation and management measures of IOTC, would be termed an IUU vessel and the intention would be to include it on the Commission’s “negative list.”

The IOTC has implemented a number of measures which, if followed, would ensure more effective compliance with the conservation measures. However, in its reviews, the Compliance Committee has indicated that many of the nations, both CPCs and non-CPCs, do not provide the types of information needed to monitor compliance. Furthermore, the Committee has noted that, for some fisheries, particularly the artisanal ones, there is limited information on size composition of the catch, and this can affect the stock assessment results. Although the IOTC has implemented a number of measures regarding enforcement and compliance which, if followed by

[2] Because of recent pirate activity in the Indian Ocean, purse-seine vessels have been moving to other oceans.

all CPCs, would ensure more effective management, the CPCs have been slow to enact them.

5.4. Bycatch and discards

At its first meeting held in 2005 the IOTC Working Party on Bycatch (WPBy) recognized that there were severe shortcomings in the availability of data on discards and bycatch, and noted that reliable quantitative estimates could not be made. The WPBy has expanded its efforts to compile information available in the archives of other organizations.

Most of the available data on bycatch and discards are from trips by Spanish, French and South African vessels. The results showed that many of the species in the bycatches are the same as those encountered in other oceans, although the rates differed quite significantly for some species.

At the 2007 meeting of the Commission, the name of the WPBy was changed to the Working Party on Ecosystems and Bycatch (WPEB), and its terms of reference were expanded. With these new terms of reference, the WPEB will concentrate greater effort over the short term in collecting bycatch information and evaluating the impact of bycatch on sharks, seabirds and turtles.

Overall, the availability of data on bycatch and discards for the Indian Ocean tuna fisheries is not good, especially when compared to that of the EPO. However, the IOTC recognizes these shortcomings in data and the need to improve them if the impact of bycatch on the various species is to be evaluated and mitigated, and has therefore directed a great deal of its efforts to improving this situation.

5.4.1. Measures taken to reduce bycatch and discards

One of the primary charges of the WPEB is to foster the development of means to reduce bycatch and discards, and it attempts to do this by encouraging, coordinating, and reviewing research to modify fishing gear and technology to be more effective in reducing bycatch and discards, by recommending measures that can prove useful in reducing bycatch and discards, and by promoting education and transfer of technology. Several research programs have been conducted by CPCs such as France, Spain, and Japan, and coordinated through the IOTC, whose aim has been to develop technology to lower bycatch rates.

The IOTC has expressed a great deal of concern over the bycatch of sharks, and has directed much of its effort towards dealing with this issue; it has also worked with the CPCs to encourage them to support the FAO International Plan of Action on Sharks (IPOA-Sharks). In 2005 it approved a resolution concerning the conservation of sharks caught in association with fisheries managed by IOTC. The resolution calls on CPCs to report catches of sharks annually, requests the Scientific Committee to provide preliminary advice on the status of key shark species and propose a research plan for comprehensive assessment of these stocks of sharks, calls on CPCs to undertake research to identify ways to make fishing gear more selective, calls for full utilization of captured sharks, and provides a number of guidelines regarding shark finning.

Respecting the bycatch and mortality of sea turtles, the Commission has called on all CPCs to require their fishermen to make every effort to avoid the incidental capture of turtles and, when captured, to release them alive, including resuscitation measures, and the maintenance onboard and the use of equipment appropriate for releasing incidentally-caught turtles.

The IOTC has given a great deal of attention to seabird mortality in tuna fisheries in the Indian Ocean, and in recent years has encouraged the development of programs among the CPCs di-

rected to the conservation of seabirds. Additionally, the IOTC has approved three resolutions dealing with the conservation of seabirds. One calls on CPCs to implement national plans of action for reducing incidental catches of seabirds in longlines, another notes that the ultimate aim of the IOTC and the CPCs is to achieve a zero bycatch of seabirds, especially threatened albatross and petrel species, in longline fisheries; the other requires longline vessels fishing south of 30°S to use any two of the following measures to reduce seabird bycatch: night setting, bird-scaring devices such as *tori* lines, weighted branch lines, blue-dyed bait, line shooting devices, and offal control. Longline vessels fishing north of that line are required to use only one of the methods.