GREENPEACE Briefing

Western and Central Pacific Fisheries Commission

Tenth Regular Session of the Science Committee (SC10)

Majuro, Republic of the Marshall Islands, 6–14 August 2014

Greenpeace thanks the Western and Central Pacific Fisheries Commission (WCPFC) for the opportunity to participate as an observer in the Tenth Regular Session of its Science Committee (SC10).

The wide range of research papers being presented for review and discussion at the SC10 demonstrate the valuable work and high level of commitment that scientists have made in this region.

The incredibly poor state of bigeye and Pacific bluefin stocks is an obvious result of the failure by parties to the WCPFC to act upon scientific advice and in accordance with the very provisions of this Convention[1]. In light of this, the SC recommendations need to be as clear and robust as ever.

Based on the available information, Greenpeace would call on the SC to consider the following recommendations for the WCPFC:

- **Strengthen mandatory reporting requirements to ensure that fishing capacity and effort in all tuna fisheries under the remit of WCPFC are adequately measured and reported, so as to allow for the best performance of the scientific committee and a sound basis for WCPFC Conservation and Management Measures;**
- **Agree a new recovery plan for bigeye tuna that brings existing fishing capacity and effort into line with precautionary mortality limits to end overfishing and allow for the quickest possible recovery of the stock. Greenpeace believes that in order to achieve such objectives a full ban on the use of FADs, a reduction in longline effort, and the closure of the high seas pockets to all tuna fishing is required;**
- **Adopt a moratorium on targeted fishing for Pacific bluefin tuna;**
- **Agree urgent precautionary measures for the conservation and management of sharks;**
- **Finalise a complete set of limit reference points for all species caught in the WCPFC and interim target reference points for all tuna and billfish species.**

High tuna catches and fishing effort in 2013 driven by the purse seine fishery

The total reported catches for skipjack, yellowfin, bigeye and albacore in the Western and Central Pacific for 2013 (provisional estimate) were the **2nd highest on record** at 2,621,511 t, just 30,000 t below the record catch for 2012 (2,652,322 t).[2]

[1] In particular the provisions of article 6 of the Convention.

[2] Williams P, Terawasi P (2014). Overview of tuna fisheries in the western and central Pacific Ocean, including economic conditions. WCPFC-SC10-2014/GN-WP-01. https://wcpfc.int/node/18871.

This total catch record was partly driven by **record catches in the purse seine fleet** of 1,898,090 t which was over 60,000 t higher than the previous record in 2012 (1,836,295 t). Although the five main purse seine fleets (Japan, Korea, Chinese Taipai, USA and Pacific Islands) had lower catches than 2012, catches significantly increased for other fleets – the Indonesian catch, for example, more than doubled between 2012 and 2013.

The number of purse seine vessels in the tropical tuna fisheries reached an **all-time high of 297 vessels**, (excluding the Japanese offshore small purse seine fleet, and ringnet and small purse seine vessels of the Indonesian and Philippines domestic fleets). Total purse seine **effort was also at a record high** in terms of fishing days estimated from logbook and VMS data.

Current fisheries status and conservation measures for tropical tunas

Table1. Status of tropical tuna stocks based on new and improved 2014 assessments (data to 2012).
(SB: spawning biomass: F: fishing mortality; C: catch; PS: purse seine; LL: longline; YF: yellowfin; BE: bigeye)

	Bigeye tuna[3]	**Yellowfin tuna**[4]	**Skipjack**[5]
SB	SB was at **16% of the unfished stock size** by the end of 2012, which is a further decline from the 2008–11 average of 20%. **The stock is now believed to be in an overfished state.**	SB by the end of 2012 was at **38% of the unfished stock size**, a decline from the 2008–11 average of 42%. The stock is unlikely to be in an overfished state. However, **stock depletion is higher in some regions** – region 4 is at 31% of the unfished size and region 8 is at just 24%	SB by the end of 2012 was at **48% of the unfished stock size**, which is a further decline from the 2008–11 average of 52%. The stock is not believed to be in an overfished state.
F	F in 2008–11 ($F_{2008–11}$) is **1.57 times higher than rate that will support the MSY**, up from the 1.46 estimated in 2011.[6]	F is increasing but the average for 2008–11 ($F_{2008–11}$) is still below the rate that will support the MSY (F/F_{MSY}= 0.72).	F in 2008–11 ($F_{2008–11}$) is 0.62 times the rate that will support the MSY, much higher than the rate of 0.37 estimated in 2011.[7]
C[8]	2013 catch remained at about the 10-year average. LL catch was the lowest since 1996 (62,641 t), but **PS catch (82,151 t) was the highest on record.** This was the **first time the PS catch exceeded the LL catch by weight.** The PS fishery has caught more individual BE than the LL fishery for over a decade. The vast majority of the PS catch was in associated sets.	2013 catch was a significant drop from the 2012 record, but similar to catches for the last 15 years. PS catch (355,960 t) was about average, but LL catch (65,499 t) was the lowest since 1991. Lower catches are primarily due to lower-than-normal catches of large YF by PS setting on free schools due to the impact of La Niña conditions that make large YF more difficult to find.	**2013 catch was the highest on record** at 1,784,091 t, primarily due to the **record PS catch** of 1,455,786 t. The catch by weight was roughly shared between the associated-sets and free-schools sets, but associated sets take more skipjack by number as they catch smaller fish.

[3] Harley S, Davies N, Hampton J, McKechnie S (2014). Stock assessment of bigeye tuna in the western and central Pacific Ocean. WCPFC-SC10-2014/SA-WP-01. https://wcpfc.int/node/18975

[4] Davies N, Harley S, Hampton J, McKechnie S (2014). Stock assessment of yellowfin tuna in the Western and Central Pacific. WCPFC-SC10-2014/SA-WP-04. https://wcpfc.int/system/files/SC10-SA-WP-04%20YFT%20Assessment.pdf

[5] Rice J, Harley S, Davies N, Hampton J (2014). Stock assessment of skipjack tuna in the WCPO. WCPFC-SC10-2014/SA-WP-05. https://wcpfc.int/node/18998

[6] WCPFC (2011). Summary Report. WCPFC-SC 7. Pohnpei, Federated States of Micronesia.. https://wcpfc.int/meetings/7th-regular-session-scientific-committee

[7] WCPFC (2011). Summary Report. WCPFC-SC 7. Pohnpei, Federated States of Micronesia.. https://wcpfc.int/meetings/7th-regular-session-scientific-committee

[8] Williams P, Terawasi P (2014). Overview of tuna fisheries in the western and central Pacific Ocean, including economic conditions. WCPFC-SC10-2014/GN-WP-01. https://wcpfc.int/node/18871

Assessing conservation action on bigeye and yellowfin tuna

Conservation and Management Measure 2008-01 (CMM-2008-01) adopted in 2008 aimed to reduce the high fishing mortality on bigeye tuna by 30% from the 2001–2004 average level and limit yellowfin tuna fishing mortality to its 2001–2004 level, in order to prevent the stocks from falling below B_{MSY}. CMM-2008-01 included longline catch limits, purse seine effort limits, a partial ban on purse seine fishing using fish aggregation devices (FADs), and a closure of two high-seas pockets to purse seine fishing. Various exemptions or alternatives built into the measure were to be phased in over the period 2009–2011. Since then there have been a variety of amendments, most recently in CMM-2013-01, but the overall goals are still to reduce fishing effort for bigeye and ensure effort for yellowfin and skipjack does not result in F increasing above F_{MSY}.

Data presented at SC7, SC8 and SC9 made it clear that the CMM-2008-01 was unlikely to achieve its goals.[9, 10] The new stock assessments and other papers being presented at SC10 spell out the obvious failure of these management measures:

- Rather than a reduction in purse seine effort, there has been an **increase in both purse seine effort and capacity** since the introduction of CMM-2008-01. Effort in 2013 was at an all-time high, and the effectiveness of the effort has increased. Fishing capacity has continued to increase in terms of number of vessels. The number of FADs used has likely increased; however, this is not currently measurable due to lack of data on FAD deployment. Furthermore, there appears to have been a change in how days are reported – i.e. days that were previously reported as 'searching days' (counted as fishing days) are now reported as 'transit days' (counted as non-fishing days).

- The FAD closures have resulted in moderately reduced yellowfin and skipjack catches and strongly reduced bigeye catches during the closure periods. For all years, the average size of fish in the catches were higher for all species during the closures because of the larger fish caught in unassociated sets. **However, these closures have not limited catches overall due to increasing purse seine capacity and effort.** Bigeye catches by purse seiners using FADs were at an all-time high in 2013. The vast majority were juveniles resulting in a significant decrease in the potential yield of the bigeye fishery.

- Longline catches of bigeye have been reduced from the 2001–2004 average (83,923 t including recent revisions). The catch was 66,441 t in 2010, 67,557 t in 2011, 71,148 t in 2012, and 62,641 t in 2013. However, in the core area of the tropical longline fishery, catch reductions have occurred alongside a decline in catch-per-unit-effort (CPUE), and therefore **recent catch declines may be, at least in part, due to a further decline in the adult bigeye abundance rather than effort reduction**.

- Longline catches of yellowfin for 2010 and 2011 are close to the 2001–2004 average (75,712 t), but fell below this to 65,582 t in 2012 and 65,499 t in 2013.

Greenpeace believes that in order to significantly reduce the bigeye fishing rate so that the stock is allowed to recover, a full FAD ban is an absolutely necessary measure. A full ban would also help to address overcapacity, reduce catches of juvenile yellowfin tuna, and reduce bycatch of oceanic whitetip and silky sharks.

---

[9] Hampton J, Harley S, Williams P (2012). Review of the implementation and effectiveness of key management measures for tropical tuna. WCPFC-SC8-2012/MI-WP-06. http://www.wcpfc.int/node/5395

[10] Pilling G, Williams P, Hampton J, Harley S (2013). Analysis of the implementation and effectiveness of key management measures for tropical tunas (Rev 2). WCPFC-SC9-2013/MI-WP-01. https://wcpfc.int/node/3676

Given the poor state of the bigeye stock and continued failure of the WCPFC to address overfishing, the SC should recommend:

- **A new recovery plan for bigeye tuna that brings existing fishing capacity and effort in line with precautionary mortality limits that end overfishing and allow for the quickest possible recovery of the stock. To achieve such objectives a complete year-round ban on the use of FADs in association with purse seine fishing and additional measures to reduce longline effort are required, to ensure at a minimum a reduction in fishing mortality of bigeye by 50% from the levels reported in the 2014 assessment;**
- **The closure of all four high seas pockets to both longline and purse seine fishing;**
- **Clear regulations on how fishing days are reported in purse seine fisheries to improve consistency of effort data.**

Current fisheries status and conservation measures for temperate tunas

Table 2. Status of temperate tuna stocks. (SB: spawning biomass; F: fishing rate; ISC: International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean).

South Pacific albacore tuna	North Pacific albacore tuna	Pacific bluefin tuna
There is no new stock assessment this year; however, a compendium of fisheries indicators is provided[11] (catch and effort data, trends, etc), including 2013 data, and an analysis of the potential consequences of recent fishing patterns on the stock in the future. Projections, based on the 2012 assessment, show that there is a **30% chance that the stock will fall below the Limit Reference Point ($20\%SB_{F=0}$) by 2030** under recent fishing effort levels. They also show a 19% decline in vulnerable biomass for longline fisheries. The 2013 catch for this stock was the 3rd highest on record (84,698 t), with most of this catch taken in the WCP convention area (68,415 t).[12]	The 2014 assessment[13] is presented by the ISC. There are no reference points set for this stock, and the ISC uses an unusual reference point – $F_{SSB\text{-}ATHL}$ is the fishing mortality that results in future SB, over a 25 year projection period, falling below the average of the ten historical lowest estimated SBs (SB-ATHL) with 50% probability. It is unclear if this is a limit or target reference point. SB by the end of 2012 was at **35.8% of the unfished level**, and **fishing mortality was below all likely F-limit reference points,** including F_{MSY} ($F_{2010\text{-}2012}/F_{MSY}$: 0.52) and $F_{SB\text{-}ATHL}$ ($F_{2010\text{-}2012}/ F_{SB\text{-}ATHL}$: 0.72). Based on SB levels and likely F reference points, the stock is not likely to be overfished, or undergoing overfishing.	The 2014 assessment[14] presented by the ISC, confirms the findings of the 2012 assessment[15] – there has been a **catastrophic depletion of Pacific bluefin down to 4.2%** (range 3.1–5.4%) of the unfished biomass, with continued overfishing of all age-classes including an extremely high mortality rate for 1-year-old juveniles of 90%. Over 95% of the catch is composed of juveniles. Furthermore, the future projections show that the current conservation and management measures adopted at WCPFC (CMM 2013-09) and IATTC (C-13-02) are not expected to increase the stock SSB if the recent low recruitment continues, even if fully implemented.

[11] Pilling GM, Harley SJ, Williams P, Hampton J, WCPFC Secretariat (2014). Trends in the south Pacific albacore longline and troll fisheries. WCPFC-SC10-2014/SA-WP-07. https://wcpfc.int/node/19001

[12] Williams P, Terawasi P (2014). Overview of tuna fisheries in the western and central Pacific Ocean, including economic conditions. WCPFC-SC10-2014/GN-WP-01. https://wcpfc.int/node/18871

[13] ISC Albacore Working Group (2014). Stock assessment of albacore tuna in the North Pacific Ocean in 2014. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). WCPFC-SC10-2014/SA-WP-12. https://wcpfc.int/node/19202

[14] ISC Pacific Bluefin Tuna Working Group (2014). Stock assessment of Pacific bluefin tuna in 2014. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). WCPFC-SC10-2014/SA-WP-11. https://wcpfc.int/node/19201

[15] ISC Pacific Bluefin Tuna Working Group (2013). Stock assessment of Pacific bluefin tuna in 2012 (Rev 1). International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). WCPFC-SC9-2013/SA-WP-10. https://wcpfc.int/node/4731

Given the dire state of the Pacific bluefin tuna population, and the declining South Pacific albacore stock, the SC should recommend:

- **A moratorium on all targeted fishing for Pacific bluefin tuna until such time that a Pacific-wide management plan is agreed and implemented, and the stock has shown conclusive evidence of recovery to levels above an agreed biomass limit reference point.**
- **Appropriate limit, recovery and target reference points for bluefin and a co-ordinated Pacific-wide recovery plan.**
- **A reduction in effort for South Pacific albacore in line with target reference point that consider the economic viability of the fishery, especially the fleets of Pacific Islands Countries.**

Current status and conservation measures for sharks

There are no new assessments for silky, oceanic whitetip or south Pacific blue shark, but further work has been done on the assessment of North Pacific blue shark in 2014 by both the ISC and SPC. Other sharks are yet to be assessed. The SC will also consider data provision for shark catches; measures to reduce the catch of overexploited shark species; the effectiveness of the current 5% fin-to-carcass ratio for reducing shark finning; a range of bycatch mitigation measures; as well as proposed limit reference points for sharks.

Northern blue shark

Initial attempts to provide stock assessments for Northern blue sharks in 2013 highlighted the extremely poor data available on shark catches. There was not enough data available to provide an adequate assessment for the South Pacific stock in time for SC9 and results from one assessment of the North Pacific population shows such high uncertainty it was not possible to draw conclusions on stock status. However, several models indicated that this heavily exploited North Pacific stock may be in an overfished state.[16]

The new improved assessments presented in 2014[17, 18] suggests that the stock is rebuilding and that fishing mortality is declining; however, considerable uncertainty remains about the current status of the stock due to poor fisheries and biological data and there is a significant risk that the stock may be in an overfished state.

Shark management measures

In general, the greatest impact on sharks in the Pacific is attributed to longline fisheries; however, for some species, like silky sharks, there are also significant impacts from the associated purse seine fishery. Although sharks are often described as 'bycatch' in longline fisheries, it is clear from the common use of practices that deliberately increase sharks catches, such as the use of wire traces and bait that attracts sharks,[19] and crew payment structures that incentivise shark finning,[20]

---

16 Rice J, Harley S, Maunder M, Da-Silva AA (2013). Stock assessment of blue shark in the north Pacific Ocean using Stock Synthesis. WCPFC-SC9-2013/SA-WP-02. http://www.wcpfc.int/node/7483

17 Rice J, Harley S, Kai M (2014). Stock assessment of blue shark in the North Pacific Ocean using stock synthesis. WCPFC-SC10-2014/GN-WP-08. https://wcpfc.int/node/19004

18 ISC Shark Working Group (2014). Stock assessment and future projections of blue shark in the North Pacific Ocean. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). WCPFC-SC10-2014/GN-WP-14. https://wcpfc.int/node/19204

19 Bromhead D, Rice J, Harley S (2013). Analyses of the potential influence of four gear factors (leader type, hook type, "shark" lines and bait type) on shark catch rates in WCPO tuna longline fisheries. WCPFC-SC9-2013/EB-WP-02 rev 1. http://www.wcpfc.int/node/7581

that more longline fisheries should be described as 'mixed fisheries' targeting tuna, sharks, and billfish.

According to assessments in 2012 and 2013, two of the most commonly caught shark species, **oceanic whitetip sharks and silky sharks, are in a very poor state, with fishing rates well in excess of the F_{MSY} and with stock declines well below SB_{MSY}.**[21, 22, 23] The greatest impact on these shark stocks is attributed to bycatch from the longline fishery, but the associated purse seine fishery has a significant impact on silky sharks, and catches predominantly juveniles. The fishing mortality on silky sharks from the associated purse seine fishery alone is above $F_{MSY.}$

However, the situation for silky sharks in the Pacific may be worse than indicated in these assessments. Recent research in the Indian Ocean showed that there are hidden impacts on silky sharks that have not been considered in stock assessments. Silky sharks are entangled and killed in the netting that typically hangs below FADs in numbers that may be as much as 5–10 times higher than the known bycatch.[24] It is highly likely that significant mortality from FAD entanglement also occurs in the Pacific Ocean.

Given the importance of sharks in the Pacific ecosystem, and the continuing poor availability of data, SC should recommend a new CMM for sharks that includes:

- **A total prohibition of the retention, transhipment, storage, on-board sale and landing of silky sharks, oceanic whitetip sharks and blue sharks until such time that stock assessments are of sufficient quality to demonstrate healthy stock levels (>B_{MSY} or equivalent).**
- **The prompt and careful release of any captured silky sharks, oceanic whitetip sharks and blue sharks.**
- **A total ban on the use of FADs in association with purse seine fishing in order to help address bycatch of silky sharks and oceanic whitetip sharks.**
- **A ban on the use of wire traces on longlines.**
- **The urgent improvement to the quality and quantity of data recorded and reported for all shark catches, including animal condition on release (dead, injured, alive).**
- **The development of reference points, best practice bycatch mitigation measures, and management goals for all non-target species, especially sharks.**
- **Strengthening the current shark finning measure[25] from the 5% fin-to-carcass ratio requirement to a requirement to land all sharks with fins naturally attached. This will enable better data collection and enforcement of prohibitions on the retention of at-risk species, and is the approach recommended by the Memorandum of Understanding on the Conservation of Migratory Sharks.[26]**

---

20 Turagabeci I (2013). Sharks are target fisheries. The Fiji Times Online. 24 June 2013. http://www.fijitimes.com/story.aspx?id=237762

21 Rice J, Harley S (2012). Stock assessment of oceanic whitetip sharks in the western and central Pacific Ocean. WCPFC-SC8-2012/SA-WP-06. https://wcpfc.int/node/3235

22 Rice J, Harley S (2012). Stock assessment of silky sharks in the western and central Pacific Ocean. Eighth WCPFC-SC8-2012/SA-WP-07. https://wcpfc.int/node/3236

23 Rice J, Harley S (2013). Updated Stock assessment of silky shark in the western and central Pacific Ocean. WCPFC-SC9-2013/SA-WP-03. https://wcpfc.int/node/3685

24 Filmalter JD, Capello M, Deneubourg JL, Cowley PD, Dagorn L (2013). Looking behind the curtain: Quantifying massive shark mortality in fish aggregating devices. Frontiers in Ecology and the Environment; (electronic version). http://dx.doi.org/10.1890/130045

25 Conservation and management of sharks. CMM 2009-04. http://www.wcpfc.int/doc/cmm-2008-06/conservation-and-management-sharks-replaced-cmm-2009-04

26 http://sharksmou.org

Development of limit reference points, target reference points, and harvest control rules for the WCPFC

Scientists have presented and discussed a comprehensive set of papers each year since SC7 in 2011, with a further set to be presented this year at SC10, that explore the options available to the Commission for choosing and setting limit reference points[27, 28] (that correspond to the state of a stock that must be avoided with high probability), target reference points[29] (that indicate the ideal state in which a stock should be maintained according to a set of biological, ecological, economic and social goals) and the harvest control rules[30] that define in advance what actions must be taken to ensure that there is a very low risk that the fishery will exceed the limit reference points.

As well as reviewing current best practice for fisheries management and the best options available for tuna fisheries, the initial papers highlight two key issues:

1. Setting strong fisheries reference points and strict harvest control rules is a key part of implementing the FAO Code of Conduct for Responsible Fisheries[31] and the UN Fish Stocks Agreement.[32]

2. The current reference points still used by many fisheries managers for determining the 'relative health' of tuna fisheries – the maximum sustainable yield (MSY) and the corresponding biomass (B_{MSY}) and fishing mortality rate (F_{MSY}) – should be, at best, treated as limit reference points (to be avoided) according to the FAO Code and UN Fish Stocks Agreement. The SPC-OFP notes that: "given the uncertainties in assessing stock status and natural stock variability, practical experience and scientific analysis has shown that treating F_{MSY} as a target often results in depletion of fish stocks, and that recovery from over-depletion is difficult. The use of MSY as a target is also often sub-optimal economically." [33]

What has been agreed to date?

Limit reference points

The SC has proposed, and the Commission agreed, to use a hierarchical 3-level framework to define appropriate limit reference points (LRPs) for stocks based on the level of biological information available (see Table 3).[34]

---

27 Preece A, Hillary R, Davies C (2011). Identification of candidate limit reference points for the key target species in the WCPFC. WCPFC-SC7-2011/MI-WP-03. http://www.wcpfc.int/node/3522

28 Harley SJ, Berger AM, Pilling GM, Davies N, Hampton J (2012). Evaluation of stock status of south Pacific albacore, bigeye, skipjack, and yellowfin tunas and southwest Pacific striped marlin against potential limit reference points. WCPFC-SC8-2012/MI-WP-01_rev1. http://www.wcpfc.int/node/5390

29 Pilling GM, Harley SJ, Berger AM, Hampton J (2012). Consideration of target reference points for WCPO stocks with an emphasis on skipjack tuna. WCPFC-SC8-2012/MI-WP-02. http://www.wcpfc.int/node/5391

30 Berger AM, Harley SJ, Pilling GM, Davies N, Hampton J (2012). Introduction to harvest control rules for WCPO tuna. WCPFC-SC8-2012/MI-WP-03. http://www.wcpfc.int/node/5392

31 See Article 7.5.3 of FAO (1995). *Code of conduct for responsible fisheries*. Rome, Italy: Food and Agriculture Organisation of the United Nations. www.fao.org/fi/agreem/codecond/codecon.asp

32 Anon. (1995). Agreement for the implementation of the provisions of The United Nations Convention on the Law of the Sea of 10 December 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish stocks.

33 Pilling GM, Harley SJ, Berger AM, Hampton J (2012). Consideration of target reference points for WCPO stocks with an emphasis on skipjack tuna. WCPFC-SC8-2012/MI-WP-02. http://www.wcpfc.int/node/5391

34 Preece A, Hillary R, Davies C (2011). Identification of candidate limit reference points for the key target species in the WCPFC. WCPFC-SC7-2011/MI-WP-03.http://www.wcpfc.int/node/3522

For biomass, SB_{MSY} is used for level 1, while levels 2 and 3 use the depletion-based biomass limit reference point of $20\%SB_{current,\ F=0}$. This represents a stock level of 20% of the average theoretical level of spawning biomass that would be present during the 'recent' ten-year period (excluding the final year of assessment) if no fishing had occurred. This allows the use of average recruitment levels under current environmental conditions, rather than historical values that may no longer be relevant to the stock.[35]

With regard to fishing mortality, F_{MSY} was agreed for level 1. For level 2, an F-limit known as $F_{X\%SPRo}$ was agreed. This represents a fishing rate that would reduce the stock to a level that has X% of the spawning-potential-per-recruit of the unfished stock (calculated from the lifetime expectation of a single recruit's contribution to quantities such as yield, the spawning biomass, egg production or the number of spawning seasons an individual can expect to participate in). It was agreed that no F-based limit should be set for level 3.

There was considerable debate at SC8 and SC9 about the selection of a value of X for $F_{X\%SPRo}$ reference points and the accepted level of risk of exceeding LRPs (see below) that needs to be factored into the choice of X values for each stock. The SPC-OFP is presenting further analysis and guidance on these issues at SC10.

Table 3. Hierarchical limit reference points (LRPs) for target species in the WCPFC.

Level	LRPs	Data requirements	Species
1	B: B_{MSY} F: F_{MSY}	A reliable estimate of steepness is available (i.e. the relationship between adult biomass and corresponding recruitment at low levels of biomass, and the point at which recruitment overfishing would occur)	None at present
2	B: $20\%SB_{current,\ F=0}$ F: $F_{X\%SPRo}$	Steepness is not well-known, if at all, but key biological (natural mortality, maturity) and fishery (selectivity) variables are reasonably well estimated.	Yellowfin Bigeye Albacore Striped marlin
3	B: $20\%SB_{current,\ F=0}$ F: no F limit	The key biological and fishery variables are not well known.	Skipjack

SC10 will also consider a set of proposed LRPs for sharks, rays and chimeras (elasmobranchs) that are similar to those for tuna, but with more precautionary values.[36] A biomass limit of $30\%SB_{current,\ F=0}$ is proposed, and fishing mortality limits of F_{MSY}, or $F_{60\%SPRo}$ where the stock–recruitment relationship is highly uncertain. Where stock assessments are not available, risk based fishing mortality LRPs, such as those used in Australia, are recommended.

Acceptable risk levels

Stock assessments result in a range of possible biomass and fishing rate values, any of which could be the correct values. Setting 'acceptable risk' levels is essentially a way to define whether a LRP has been breached when a part of a range is close to, or overlapping, the LRP. Although there was considerable support for the SC8 to also make recommendations on the 'acceptable risk' levels for failing to maintain the stock above these limits – 10% for yellowfin and bigeye, and 5% for albacore and skipjack – this did not reach consensus. The final recommendations[37] were that:

[35] Berger AM, Pilling GM, Kirchner C, Harley SJ (2013). Determination of appropriate time-windows for calculation of depletion-based limit reference points. WCPFC-SC9-2013/MI-WP-02. http://www.wcpfc.int/doc/MI-WP-02/Determination-appropriate-time-windows-calculation-depletion-based-limit-reference-poin

[36] Clarke S, Hoyle S (2014). Development of limit reference points for elasmobranches. WCPFC-SC10-2014/MI-WP-07. https://wcpfc.int/node/19015

[37] WCPFC (2012). Summary Report. WCPFC-SC-8. Busan, Korea. Western and Central Pacific Fisheries Commission (WCPFC), Kolonia, Pohnpei. https://wcpfc.int/meetings/8th-regular-session-scientific-committee

- the probability of breaching a limit reference point should be very low;
- the allowable risk of breaching a limit reference point may be applied on a species-specific basis, e.g. higher risk for yellowfin and bigeye tunas but a more precautionary lower risk to skipjack and South Pacific albacore tuna;
- a range of risk levels of breaching the LRP were suggested with a majority recommending a 10% level and that a lower more precautionary value could be considered in some cases;
- the Management Objectives Workshop (MOW1) should review appropriate values for specifying the level of risk for individual species.

Target reference points and harvest control rules

No target reference points (TRP) and harvest control rules (HCR) have been agreed to date, although various options have been discussed at the MOW1 and MOW2 and presented to the Commission.

SC10 has been tasked with providing further advice to MOW3 with a view to informing the Commission's consideration and adoption of TRPs and HCRs at WCPFC 11. Key pieces of work that the SPC-OFP will present include evaluations of:

1. The impact of choosing different risk levels for exceeding limit reference points and the implications of choosing target reference points for south Pacific albacore. [38]
2. The skipjack stock status against candidate target reference points of 40%, 50% and 60% of unfished spawning stock size.[39]
3. The results of applying stock-wide harvest control rules to skipjack stocks and the robustness relative to the new stock assessment and major sources of uncertainty.[40]
4. A set of potential target reference points that consider fisheries across the full range of the yellowfin stock (i.e. including those at the edge of the range most impacted by range contractions as biomass declines).[41]
5. A set of potential target reference points that consider the economic performance of the south Pacific albacore fleets.[42]
6. A candidate target reference point for skipjack tuna consistent with PNA management objectives of maintaining effort at 2010 levels.[43]

What must be agreed at SC10?

The SPC-OFP will be presenting further analysis and guidance on appropriate values of X for defining $F_{X\%SPR_0}$ limit reference points for each level 2 species (bigeye, yellowfin, southern albacore and striped marlin) along with an evaluation of risk levels for exceeding limit reference points.[44]

---

[38] Pilling GM, Harley SJ, Hampton J (2014). Evaluation of risks of exceeding limit reference points for south Pacific albacore, bigeye, yellowfin and skipjack tunas with implications for target reference points: A case study using south Pacific albacore. WCPFC-SC10-2014/MI-WP-01. https://wcpfc.int/node/18513

[39] Kirchner C, Berger A, Pilling G, Harley S (2014). Management strategies (objectives, indicators, reference points and harvest control rules): The equatorial skipjack purse seine fishery as an example. WCPFC-SC10-2014/MI-WP-02. https://wcpfc.int/node/18514

[40] Kirchner C, Berger A, Pilling G, Harley S (2014). Management strategies (objectives, indicators, reference points and harvest control rules): The equatorial skipjack purse seine fishery as an example. WCPFC-SC10-2014/MI-WP-02. https://wcpfc.int/node/18514

[41] Pilling G, Harley S, Tremblay-Boyer L (2014). Potential target reference points that consider fisheries across the extent of the stock: Yellowfin fisheries as an example. WCPFC-SC10-2014/MI-WP-03. https://wcpfc.int/node/18515

[42] Berger A, Reid C, Pilling G, Imo R (2014). Potential target reference points that consider profitability of fleets: South Pacific albacore longlining as an example. WCPFC-SC10-2014/MI-WP-04. https://wcpfc.int/node/18516

[43] SFP-OFP, PNA (2014). Assessing a candidate target reference point for skipjack tuna consistent with PNA management objectives. SPC, Oceanic Fisheries Programme (OFP) and the Parties to the Nauru Agreement (PNA). WCPFC-SC10-2014/MI-WP-09. https://wcpfc.int/node/19088

[44] Pilling GM, Harley SJ, Hampton J (2014). Evaluation of risks of exceeding limit reference points for south Pacific albacore, bigeye, yellowfin and skipjack tunas with implications for target reference points: a case study using south Pacific albacore. WCPFC-SC10-2014/MI-WP-01. https://wcpfc.int/node/18513

SC10 has been tasked with agreeing the final recommendations on the fishing mortality reference points for presentation to the WCPFC this year. Limit reference points for sharks will be proposed.

SC10 will review the information presented by the SPC-OFP on TRPs and HCRs, and provide advice on these for the MOW3 and Commission's consideration.

Greenpeace would like to acknowledge the important work by SPC-OFP in this area, and urges the SC10 to finalize these important recommendations for limit and target reference points this year. Greenpeace accepts that ultimately the assurance that limit reference points are not breached and target reference points are maintained depends on strong harvest control rules and swift action by management. However, Greenpeace also believes that a 'sea change' in how managers (and industry) perceive and understand reference points is key to gaining agreement for significantly improving management of Pacific fisheries.

The SC10 should recommend:

- **Precautionary fishing mortality LRPs for level 2 tuna and billfish species using values of 30% or above for X in $F_{X\%SPR_o}$.**
- **In the absence of consensus, SC should select an interim value of 40% across all level 2 species, (i.e. $F_{40\%SPR_o}$), as recommended in the paper by Preece et al.**[45]
- **Precautionary LRPs for elasmobranchs of 30%$SB_{current, F=0}$ and F_{MSY} or $F_{60\%SPR_o}$ or risk based LRPs for species with no stock assessments.**
- **Interim precautionary TRPs of 50% unfished adult biomass for all tuna and billfish, and a 70% adult biomass for albacore that takes the economic viability of the fishery into account.**
- **The probability of breaching limit reference points should be set at 10% for all species.**

[45] Preece A, Hillary R, Davies C (2011). Identification of candidate limit reference points for the key target species in the WCPFC. WCPFC-SC7-2011/MI-WP-03. http://www.wcpfc.int/node/3522