ISSF Technical Report 2018-16

A PRE-ASSESSMENT OF THE SUSTAINABILITY OF GLOBAL TUNA FISHERIES RELATIVE TO MARINE STEWARDSHIP COUNCIL CRITERIA: PRINCIPLE 2

Photo: David Itano

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ISSF is a global coalition of scientists, the tuna industry and World Wildlife Fund (WWF) — the world's leading conservation organization — promoting science-based initiatives for the long-term conservation and sustainable use of tuna stocks, reducing bycatch and promoting ecosystem health. Helping global tuna fisheries meet sustainability criteria to achieve the Marine Stewardship Council certification standard — without conditions — is ISSF's ultimate objective. ISSF receives financial support from charitable foundations and industry sources.

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Foreword

The primary objectives of ISSF is to improve the sustainability of global tuna stocks by developing and implementing verifiable, science-based practices, commitments and international management measures that result in tuna fisheries meeting the Marine Stewardship Council (MSC) certification standard without conditions.

The MSC is a global certification program. To date, close to 300 fisheries, including several tuna fisheries, have been certified under the MSC standards. ISSF has been actively involved as a stakeholder in MSC tuna fishery assessments and resulting certifications since 2011 in order to provide comment so that the assessments appropriately interpret the scoring guidance, to improve the MSC guidance and to aid in improving the consistency among assessments.

Since 2013, we have contracted experienced MSC assessors to score 19 tuna stocks against the MSC standards for Principle 1 and certain elements of Principle 3 using the MSC indicators of sustainability and the guideposts to take a global, comprehensive approach for consistent scoring. These reports, updated annually, focus on stock status (MSC Principle 1) and the international management aspects relevant to Regional Fishery Management Organizations (RFMOs) (elements of MSC Principle 3). The reports have become a useful source document in tuna certifications and help ISSF prioritize its advocacy positions at RFMOs as well as its work to improve tuna fisheries globally. The latest version of the report is available here.

This year we are releasing on a complementary report, contracting experienced MSC assessors to score all major fishing gear types against MSC Principle 2 which addresses the environmental impact of a fishery. The amount of work carried out by the experts was huge, involving 166 “Units of Assessment” (for this report, these are gear-RFMO-target tuna combinations) and 592 species. This first release of the report is a draft evaluation and we invite you to comment on any aspect of the work, including methodology, scores and justification. We will incorporate comments received during 2018 in the 2019 update of the report.

We invite you to read A Pre-Assessment of the Sustainability of Global Tuna Fisheries Relative to Marine Stewardship Council Criteria: Principle 2, by Medley et al. and submit any comments you have to Victor Restrepo (vrestrepo@iss-foundation.org).

Susan S. Jackson

President, ISSF

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Introduction

The Marine Stewardship Council (MSC) has established a program whereby a fishery may be certified as being sustainable. The sustainability of a fishery is defined by MSC criteria which are embodied in three Principles: relating to the status of the stock (P1), the ecosystem of which the stock is a member (P2) and the fishery management system (P3). Each of these Principles is evaluated in relationship to Performance Indicators (PIs) within each Principle. Additionally, the MSC has established rigorous Guidelines for scoring fisheries (MSC Fishery Standard Principles and Criteria for Sustainable Fishing, Version 2.0 – effective 1 April 2015; http://www.msc.org/).

This report is focused on Principle 2:

- Principle 2 (P2): Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

This Principle 2 relates to the performance of the specific fishery relative to all wider ecological impacts. However, in the new MSC CR2.0 methodology, impacts of all MSC certified fisheries can accumulate in some status performance indicators, so the wider impacts of fleets may need to be considered. Unlike P1 and P3 certifications, P2 performance reflects the behaviour of the fleet being assessed. Clearly, in this report, it is not possible to assess all fleets in all areas, so a broader approach has been adopted. This, by necessity, considers general performance of gears and fleets within various regions based on information obtain from the RFMOs.

The approach adopted here uses the MSC definition of a unit of assessment (UoA), which is the combination of the fish stock (biologically distinct unit) with the fishing method (vessel(s) targeting that stock) in a specific area. In total, 166 UoAs have been identified for these pre-assessments.

The development of these Principle 2 pre-assessments serves two purposes:

1. Provide an interpretation of the MSC certification requirements for tuna fisheries to promote consensus and harmonise assessments as well as lead to improvements in MSC methodology, at least as it applies to tuna fisheries.
2. Provide information useful for pre-assessments and full assessments that enables a more rigorous MSC assessment within the limited time available to teams.

While every effort has been made to apply the MSC methdology as rigorously as we can, the wide number of fisheries and lack of specific data available to us have limited this endeavour. The result is that the scoring provided is only indicative and identifies potential problems that tuna fisheries may face in achieving MSC certification. To make the assessment as rigorous as possible, our approach has been to deal with cross-cutting issues, such as the use of FADs, bycatch by species and bait use, and apply them across fisheries as defined by the target stock, gear type and management authority.

This is the first version of this type of assessment. We welcome comments and information that will lead to improvements in accuracy and usefulness of these assessments in future versions. To submit any comments or suggestions, please contact Victor Restrepo (vrestrepo@iss-foundation.org).

MSC Certification Requirements

The MSC Standard has gone through a number of revisions in its history. The latest version of the Fisheries Certification Requirements (FCR v2.0) (MSC 2014a) was released in October 2014 and has been used in this pre-assessment.

This methodology focuses on the certification requirements in Principle 2, which assess the unit of assessment's (UoA) impact on non-target species; endangered, threatened, or protected (ETP) species; habitats; and ecosystems. The major differences between the old requirements (v1.3) and FCR v2.0 within Principle 2 are as follows (see Table 1):

- The terms "retained" and "bycatch" species have been replaced with "Primary" and "Secondary" species. These divide up non-Principle 1 species in different ways.
- The FCR v2.0 definition of ETP species has been expanded to include additional binding agreements and out-of-scope species (e.g., bird, mammals) categorized as vulnerable, endangered, or critically endangered on the IUCN Red List.
- The cumulative impacts of MSC certified fisheries on Primary and Secondary species must be assessed in certain situations.
- Additional relevant terms (main, less resilient, considerable catch, out-of-scope species, point of recruitment impairment [PRI], and MSC UoA) have been introduced.

Table 1. Important definitions and categorizations for Principle 2 species (compiled from MSC 2014a).

DEFINITIONS OF PRINCIPLE 2 SPECIES AND CATEGORIES	"MAIN" THRESHOLD	"LESS RESILIENT" THRESHOLD	"CONSIDERABLE CATCH" THRESHOLD	"CUMULATIVE IMPACTS" THRESHOLD
Primary species: A species that is caught but is not the target species, that is within scope of the MSC program (i.e., not an amphibian, reptile, bird, or marine mammal), and that has management tools and measures in place.	Catch of a species by the UoA is 5% or more by weight of the total catch of all species by the UoA. OR Species is classified as less resilient. OR Exceptionally large catch occurs (see definition below).	Catch of a species is 2% or more by weight of the total catch of all species by the UoA.	NA	*Only for species that is below PRI:* All MSC UoAs that categorize the species as Main Primary.
Secondary species: A species that is not considered Primary or is a species that is out of scope (i.e., amphibian, reptile, bird, or marine mammal) but is not ETP (see ETP definition below).	*For in-scope species:* Catch of a species by the UoA is 5% or more by weight of the total catch of all species by the UoA. OR Species is classified as less resilient. OR Exceptionally large catch occurs (see definition below). *For out-of-scope species:* Species that is non-ETP but is out of scope.	Catch of a species is 2% or more by weight of the total catch of all species by the UoA.	A Main Secondary species that comprises more than 10% of the total catch by weight of the UoA.	*Only for Main Secondary species that is outside a biologically based limit and catch is "considerable":* All MSC UoAs that have "considerable catch" of that Secondary species.

DEFINITIONS OF PRINCIPLE 2 SPECIES AND CATEGORIES	"MAIN" THRESHOLD	"LESS RESILIENT" THRESHOLD	"CONSIDERABLE CATCH" THRESHOLD	"CUMULATIVE IMPACTS" THRESHOLD
ETP species: A species recognized by national ETP legislation; species listed in a binding international agreement (see below for the list of relevant binding international agreements); or out-of-scope species that are listed in the IUCN Red List as vulnerable, endangered, or critically endangered.	NA – All ETP species encountered by the UoA are to be assessed independent of amounts.	NA	NA	*Only in cases where there are national and/or international set limits:* All MSC UoAs encountering the species.

OTHER RELEVANT DEFINITIONS	
Less resilient:	When the productivity of the species indicates that it is intrinsically of low resilience (which can be determined by the productivity part of the Productivity Susceptibility Analysis [PSA]) or when its resilience has been lowered by anthropogenic or natural changes to its life history. Species with low resilience are assumed here to have PSA productivity score greater than or equal to 2.0.
Exceptionally large catch:	Take account of the relative catches of both the target and Principle 2 species and determine whether the risk to the population of the impacted Principle 2 species is significant enough to warrant a designation as "Main". In the absence of full information, a catch by the UoA of 400,000t of the target species is "exceptionally large".
MSC UoAs:	Those UoAs that are in assessment or certified at the time the UoA in question announces its assessment or reassessment on the MSC website.

Units of Assessment

The MSC defines a unit of assessment (UoA) as the combination of the fish stock (biologically distinct unit) with the fishing method (vessel(s) targeting that stock). This assessment includes landings data from all tuna fisheries in all regions and has taken a broad approach to include species likely to have Principle 2 designations in future MSC assessments. We recognize that other species may occur as Principle 2 for some UoAs, and that many of the species in this assessment may not occur as Principle 2 for other UoAs. Currently 166 UoAs have been identified (Table 2).

Table 2. Summary of the different Units of Assessment identified for this report as the combination of the management unit, target tuna species, and fishing method.

RFMO	TARGET TUNA	GEAR										
		Gill or drift net	Longline	Pelagic Trawl	Pole & Line FADs	Pole & Line Free School	Purse Seine FADs	Purse Seine Free School	Purse Seine Mammal/ Shark set	Troll/ handline FADs	Troll/ handline Free School	Total
IATTC	Eastern Pacific Bigeye		1		1	1	1	1		1	1	7
	Eastern Pacific Skipjack	1	1		1	1	1	1		1	1	8
	Eastern Pacific Yellowfin	1	1		1	1	1	1	1	1	1	9
	North Pacific Albacore	1	1		1	1	1	1		1	1	8
	South Pacific Albacore		1		1	1				1	1	5
ICCAT	Atlantic Bigeye	1	1	1	1	1	1	1		1	1	9
	Atlantic Yellowfin	1	1	1	1	1	1	1		1	1	9
	Eastern Atlantic Skipjack	1	1	1	1	1	1	1		1	1	9
	Mediterranean Albacore	1	1	1				1		1	1	6
	North Atlantic Albacore	1	1	1	1	1	1	1		1	1	9
	South Atlantic Albacore	1	1		1	1	1	1		1	1	8
	Western Atlantic Skipjack	1	1	1	1	1	1	1		1	1	9
IOTC	Indian Ocean Albacore	1	1				1	1		1	1	6
	Indian Ocean Bigeye	1	1	1	1	1	1	1		1	1	9
	Indian Ocean Skipjack	1	1	1	1	1	1	1		1	1	9
	Indian Ocean Yellowfin	1	1	1	1	1	1	1		1	1	9
WCPFC	North Pacific Albacore	1	1		1	1	1	1		1	1	8
	South Pacific Albacore		1		1	1				1	1	5
	Western Pacific Bigeye	1	1		1	1	1	1		1	1	8
	Western Pacific Skipjack	1	1		1	1	1	1		1	1	8
	Western Pacific Yellowfin	1	1		1	1	1	1		1	1	8
Total		18	21	9	19	19	18	19	1	21	21	166

Defining Species Elements

A primary task of this assessment was to scope species elements relevant to these tuna fisheries. To achieve this, species have been identified from various regional fishery management organization (RFMO) sources that may be caught in tuna fisheries. Consistent with a risk assessment approach, a relatively complete list of 592 species has been compiled, but this list will likely continue to increase. Each species is considered an “element” in scoring.

Element-based scoring can be applied to all Principle 2 performance indicators (PIs). However, element scoring is only used directly in scoring non-ETP species status PIs. Otherwise it has been used to inform other PIs in more general ways.

Each species element is defined as Primary, Secondary, or ETP. Primary species are in-scope and managed and therefore generally have high commercial value. ETP are endangered, threatened, or protected species either identified as needing protection internationally or under national protection. In this case, international protection is most important since national issues are not covered in this pre-assessment. Secondary species are all other species that are not Primary or ETP. Justifications have been provided for the designation of each species.

The choice of which species are Primary or ETP, and therefore by default which are Secondary, is important because it potentially impacts the overall scoring of a species in significant ways. It is also important to ensure that tuna UoAs do not achieve higher scores by virtue of not managing stocks that should be managed (i.e., species being designated as Secondary simply because they are not currently managed).

Primary Species

Primary species are defined as managed species or stocks. However, there are numerous species that are landed intentionally for commercial (not subsistence) purposes but are not necessarily managed or have known reference points. Additionally, FCR v2.0 clause SA3.1.3.3 says that where a species would be classified as Primary due to the management measures of one jurisdiction but not another that overlaps with the UoA that species shall still be considered as Primary. This is important in the context of RFMOs. An RFMO may not specify management measures for a species, but management measures may be put in place for that species by one or more national agencies on the portion of the stock under their jurisdiction. Therefore, the designation of Primary species in the case of the tuna fisheries may not necessarily be restricted to just those species for which the RFMOs have management measures.

In general, we followed the MSC definitions and guidance to make our Primary species designations; however, as noted below, our decision making was generally more inclusive and hence precautionary. For example, where there was some uncertainty about whether a species should be Primary or Secondary, we generally opted for Primary. It should also be noted that our Primary species definition is in line with the expectation that it should be possible to move a species from Primary to target (Principle 1) through an MSC expedited audit. Moving a Secondary species to target species should generally be much more difficult.

Primary species are defined in the following way:

1. All tuna species under RFMO management that are not a target species in a specific MSC assessment are Primary species by definition because they are managed by the RFMO.
2. Species that are mentioned in the text of an RFMO convention or management document (e.g., conservation measure, resolution, or recommendation).
3. Species that are managed in the sense that RFMOs imply, by their actions, that they are responsible for the species in some way.
4. Species that have some sort of stock assessment. The act of conducting a stock assessment or targeted data

collection program implies that management has responsibility for the stock and could consider intervening in a fishery if it was necessary, even if there was no current intervention.

5. Otherwise, our general rule was if a species had commercial value and was a strong candidate for management and MSC Certification then it should be Primary, even if it does not currently have a stock assessment or reference points. To develop a systematic process, we used a fisheries management process, identifying why some stocks should be managed even if they may not be currently.

For defining the criteria for species management irrespective of whether it was managed or not, we used the U.S. National Standard Guidelines[1], which is influential in international management systems. The main consideration in the Guidelines is that any stocks predominately caught in federal waters that are overfished or subject to overfishing, or likely to become overfished or subject to overfishing, require conservation and management. Beyond this, the Guidelines set out a series of factors that may be considered when deciding whether additional stocks require conservation and management:

i. The stock is an important component of the marine environment.

ii. The stock is caught by the fishery.

iii. Whether a fishery management plan (FMP) can improve or maintain the condition of the stock.

iv. The stock is a target of a fishery.

v. The stock is important to commercial, recreational, or subsistence users.

vi. The fishery is important to the Nation or to the regional economy.

vii. The need to resolve competing interests and conflicts among user groups and whether an FMP can further that resolution.

viii. The economic condition of a fishery and whether an FMP can produce more efficient utilization.

ix. The needs of a developing fishery, and whether an FMP can foster orderly growth.

Secondary Species

Secondary species are defined as all other species that are impacted by the fisheries but are not Primary species or ETP.

ETP Species

To determine whether a species should be designated as ETP, we used the definition in Table 1 in addition to the following guidance provided by the MSC:

- Species that are recognized by national ETP legislation
- Species that are listed in the following binding international agreements:
    - Convention on International Trade in Endangered Species (CITES), Appendix 1

[1] http://www.nmfs.noaa.gov/sfa/laws_policies/national_standards/documents/redline-final-rule-10.12.16-final.pdf

- Binding agreement concluded under the Convention on the Conservation of Migratory Species of Wild Animals (CMS), including:
    - Agreement on Conservation of Albatross and Petrels (ACAP), Annex 1
    - African-Eurasian Migratory Waterbird Agreement (AEWA), Table 1 Column A
    - Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS)
    - Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea, and Contiguous Atlantic Area, Annex 1
    - Wadden Sea Seals Agreement
    - Any other binding agreement that lists relevant ETP species concluded under CMS

- Species classified as "out of scope" (amphibians, reptiles, birds, and mammals) that are listed in the IUCN Red List as vulnerable (VU), endangered (EN), or critically endangered (CE)

The following points were also followed to ensure an appropriate level of inclusion and precaution when categorizing a species as ETP:

- Consistent with the MSC definition of ETP, we designated species on CMS Appendix I as ETP because the CMS Appendix is considered a binding agreement (Species listed on CMS Appendix II were not included.)
- If the species was ETP for one target tuna UoA, it was ETP for all tuna UoAs and included in the list of ETP species, irrespective of gear type or RFMO.
- If there was any potential overlap between a target tuna UoA and an ETP species, it was included in the list of ETP species, particularly if the ETP species was known to be vulnerable to bycatch in similar gear types.
- RFMO reports, existing MSC assessments, and the agreements identified above were consulted to identify potential ETP species for inclusion in this assessment.
- Where the information was readily available (e.g., through the IUCN Red List species pages), national protections were included. We also consulted the U.S. Endangered Species Act, but no attempt was made to refer to all national legislation so the precise ETP list of any future full assessment would vary according to the jurisdiction of the UoA and the fleet flag state.

Catch Profile

Fishery-Specific Landings

A catch profile is required for each fishery (target stock and gear combination) to determine the relative impact of the fishery on all species that are caught. The information available in this case was limited to public data provided by the RFMOs on landings. The number of landings of those species are derived for the last five available years from landings data broken down by gear type and target stock. Although landings are reported, public data are not very precise. In particular, these data do not include discards, meaning the fishing mortality of some species may be severely underestimated or misidentified.

For ICCAT and IOTC, reported catch areas were very broad, but landings were finely divided by species. For WCPFC and IATTC, landings were reported by catch area more precisely, but the number of species covered is limited. Landings allocation to each target stock was approximate with the main division being by latitude between albacore-directed fisheries and the tropical tunas. Ideally, this would be done on a trip-by-trip basis, but such data were not available and would not likely be form part of a pre-assessment. Instead, landings data were allocated to each target stock as finely as possible dependent on the area reporting.

The assessment allows for fairly finely divided gear types. For example, purse seine set on fish aggregating devices (FADs), free schools and dolphins were separated. However, reported purse seine catches have not always been divided into different set types, and where they have, details may be missing. For the Pacific RFMOs, purse seine data are reported as "associated" and "unassociated" sets depending on whether the sets occurred on FADs. These have been coded as "sets on FADs" and "free-school" sets. It is also possible some of the free-school sets were made on other species, such as large sharks or marine mammals, but as this has not been differentiated in the data, we were unable to evaluate this effect on bycatch. In other cases, all purse seine sets have been combined. The result is catch profiles are as accurate as possible given the limitations of the data but do not align precisely with ideal gear and fishery definitions.

However, in most cases details of fishing operations are missing which could significantly impact scoring. For example, deep vs shallow set longlines are not separated, and neither are day vs night setting. These factors can have significant impact on bycatch, in particular. The information in this pre-assessment, which we might expect to be available to a full assessment, did not support this level of detail.

Although the general approach described above was applied to each source of data, in practice the data processing to move from the various RFMO source data sets to the data used for this assessment was complex. As data and transparency improve, data provided by the RFMOs may change. To aid both transparency and processing, the process was scripted in R using RMarkdown in RStudio and the Tidyverse package (see Groleman and Wikham 2017). The R code in this notebook form provides a precise and transparent definition of the process that can also be adapted easily to future data releases should they change.

Grouped Catch Data

While many landings records apply to individual species, some have been recorded by species groups. As reporting improves, such groups are declining, but they still exist in records. They indicate landings that have not been separated by species and may only be reported by genus, family, or some other grouping. "Other" species was a large component of reported Pacific catches, for example. In order to account for more than one species in a group and make the landings statistics comparable to single species landings, the relative size of the multispecies landings needs to be adjusted to represent a single species.

For a catch of grouped species, neither an equal proportional allocation among all species (best case) nor almost all catch being allocated to a single species (worst case) is plausible. We use a simple common pattern observed in species abundances in catches to identify the plausible worst-case dependent on the number of species in the group.

Common patterns have been identified among species abundances that suggest that ranked species abundances would be approximately linear on a log-scale (Magurran, 1988), which might be approximated using a geometric series. While the geometric series is not likely an accurate model for multispecies fish catches, it is a simple function that captures the major change in relative abundance among species. The most widely used species abundance model, the log-normal, would most likely be a better basis for species abundance in the majority of cases where incomplete data might be modelled approximately as linear on the log-scale (Taylor 1978). However, the geometric series is the least diverse model so is likely overestimating the abundance in the highest ranked species (Magurran 1988) and therefore for our purposes is the plausible worst case and precautionary.

For the geometric series, the proportion of the catch that would be the k^{th} species in rank of abundance would be:

$$\mathrm{C}_k = \mathrm{C}\, r^k$$

Where r = proportional reduction in abundance for each rank ($0 < r < 1$), C = total catch, and C_k = catch allocated to the k^{th} species.

$$\sum_{k=1}^{n} r^k = \frac{r(1-r^n)}{1-r} = 1$$

The value for r quickly converges to 0.5 for larger numbers of species, and the number of species in groups above five suggests 50% of the total catch would be the maximum allocation to a single species (Table 3). Otherwise, all species that are listed without recorded catches but could have a non-zero catch are listed as Minor.

Table 3. Proportion of species in the highest abundance as a function of the number of species

Number of species	R
1	1.0000
2	0.6180
3	0.5437
4	0.5188
5	0.5087
6	0.5041

Main and Minor Species

Designation of Main versus Minor species has a significant impact on scoring elements. In general, only "Main" species can result in scores below 80. For in-scope species, ideally catches, but more often landings, are the primary source of information to make the Main/Minor designation for each species. As noted in Table 1, more resilient species are designated Main if they are at or above 5% of the catches or 2% for less resilient species.

Non-ETP out-of-scope species are automatically considered main, irrespective of their proportional contribution to the catch.

Additionally, FCR v2.0 guidance clause GSA3.4.2 allows for the designation of Main for species not meeting the 2% or 5% threshold: "In all cases, teams may still designate species as main, even though it falls under the designated weight thresholds of 5% or 2%, as long as a plausible argument is provided as to why the species should warrant that consideration." We have not applied this guidance in this case, but it remains open to define more in-scope species as Main based on more general vulnerability.

These MSC rules are potentially problematic, primarily because of the uncertainty in the data that are required for the evaluation outlined above. In the case of tuna RFMOs, public landings data are most likely incomplete. Whereas ICCAT and IOTC publish individual species landings, WCPFC and IATTC do not but instead focus on reporting catch by area (1-degree square) but only report selected species catch. This inconsistency makes it difficult to define precise Main/Minor designations, and this is before even attempting to consider additional issues like discarding. Therefore, while we have applied the MSC rules as defined above as far as possible, the primary objective was to scope out the scoring issues, so all scoring elements have been addressed rather than provide final accurate scoring, and we have reported information on both Main and Minor species.

Approach to Scoring

Primary Species Status (PI 2.1.1)

For status determination of Primary species, element scoring was applied. Stock status was determined according to stock assessments, where they were available. Generally speaking, stock assessments are available for the more heavily exploited Primary species, notably tunas, but are not available for the some of the other species classified as Primary or any of the Secondary species. Where a stock assessment was available, it was used to score the species element. Where it was not available, scoring was based on Productivity Susceptibility Analysis (PSA). All Primary species had a PSA performed for comparison even if this was not used for scoring.

Secondary Species Status (PI 2.2.1)

For status determination of Secondary species, element scoring was also applied. For Secondary species, there is no stock assessment, so the score is determined by PSA.

"Hindering Recovery" and Cumulative Impacts

For Primary and Secondary species where a stock is likely below the PRI or demonstrated to be high risk according to PSA, the MSC Standard requires that the contribution and likely impact of the UoA are considered to determine whether it is likely to hinder the recovery of the species. In order to determine this, the landing proportion of the species by the gear and the UoA's contribution to overall catches of the species within the area were considered.

An advantage of considering all tuna fisheries together is that we were able to apply these rules for harmonization where it was relevant. The cumulative impacts rule (Table 1) implies that the UoAs that separately catch 10% or more of a species would collectively be responsible for its status. This combined "considerable catch" may prevent recovery if the status was poor. This rule was applied only to tuna fishery landings, not other fisheries or discards, and applied as though all tuna fisheries are certified. This is the most precautionary application of the MSC criteria.

Where the species catch of the MSC UoAs is less than 30% of the total catch of that species, the UoAs are not likely to hinder recovery (FCR v2.0 guidance section GSA3.4.6). However, in this case, total catches of species did not include non-tuna UoAs. This is only important in that, if such data were obtained, it might be possible to use MSC guidance to show that some species bycatch in tuna UoAs would not hinder any recovery or is not the main risk to the stock. In this case, this pre-assessment would potentially score the tuna UoAs lower than an MSC full assessment might.

ETP Status (PI 2.3.1)

ETP PIs were not scored by element; however, the justifications are broken down by generic species group (e.g., whales, seabirds) when possible. An element list of all relevant ETP (and other) species elements that overlap with each fishery was developed. However, it is difficult to use risk assessments to assess status because it fails to discriminate between different risks for different species adequately. In general, ETP species are almost by definition special cases that have attracted special protection. Instead of using something like the PSA, a general approach to scoring has been applied at this stage that identifies important known risks to ETP species by stock area and gear type.

Other PIs

For all other Principle PIs (2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.2, 2.3.3, and PI groups 2.4 and 2.5), scoring was carried out in the non-element way. In these cases, scores and scoring justifications are provided on a case-by-case basis. This is consistent with the approach used for Principle 1 and Principle 3 pre-assessments.

Scoring and justification has been carried out on a concern-by-concern basis rather than a UoA-by-UoA basis. For example, a concern that might apply to FADs used to catch tropical tunas will have the same justification and effect on scoring of all fisheries on tropical tunas using FADs (i.e., purse seine, troll, or pole and line using FADs in any ocean) and would be included in the assessment of each of these fisheries. For a particular scoring issue, if there are several different concerns raised, the one resulting in the lowest scoring guidepost attainment will define the result for that scoring issue.

Other MSC Assessments

To provide more support for the scores and justifications, those from the Public Certification Reports from the 16 MSC-certified tuna fisheries were used to corroborate our scoring and strengthen our justifications in a process similar to harmonization. A certified tuna fishery was considered when the target species, gear type, and/or management area overlapped with the UoA in question. Since these pre-assessments are using FCR v2.0, only the six fisheries certified under v2.0 were used for scoring issues that were new or that have changed substantially from v1.3 to v2.0 (e.g., PI 2.3.2e, PI 2.4.1a). In cases where the scoring issue language had not changed substantially, all relevant certified tuna fisheries were used.

Productivity and Susceptibility Analysis (PSA)

The PSA is a method for assessing the vulnerability of a fishery species or stock when a stock assessment is not available, using a set of predetermined measurable attributes and score rankings. The PSA forms part of the MSC Risk-Based Framework (RBF), but it is important to note it is much more widely used than this, with various alterations and adaptations to particular circumstances (e.g., see http://nft.nefsc.noaa.gov/PSA_pgm.htm). The approach described here broadly follows the MSC RBF implementation. However, there are significant departures from MSC's PSA methodology primarily because information was unavailable to score particular attributes as described in the MSC methodology.

The primary aim of the PSA may not be to provide an absolute risk score but rather to obtain an assessment of relative risk between species. To achieve this, there must be discrimination among species in scoring. Therefore, it is important to score as many attributes as possible. Where an attribute cannot be scored, it automatically defaults to high risk. However, while this might be considered precautionary, it really only results in a failure of the method. Therefore, for example, the invertebrate-specific productivity attribute based on density-dependent reproduction was not scored as this attribute would be automatically "high risk" for all invertebrates due to a lack of information.

The PSA used here assumes the level of vulnerability depends on two dimensions: the productivity of a species, which determines the rate at which it can sustain or recover from fishery-related impacts, and the susceptibility of the species or stock to fishing activities. Species included in this PSA are scored based on stock overlap and by tuna fishery gear type.

The most important use of this approach is for the large number of in-scope Secondary species. Although the PSA can be carried out, it does not appear particularly suitable in its current form for out-of-scope species as it cannot discriminate effectively between risk levels for these species without direct observations. Currently, for many out-of-scope species, information is incomplete, and additional work may be required to assess their status adequately.

Productivity Scoring

The PSA is made up of productivity attributes and susceptibility attributes that are used to infer the level of risk a UoA places on a species. Each attribute is scored a 1 for low risk, a 2 for medium risk, or a 3 for high risk.

The majority of in-scope elements were scored using rules based on species attributes (e.g., their length, growth rate, and depth distribution). The score for each PSA attribute has been given a justification, including where there was a departure from the rules. The standard MSC PSA methodology is applied for converting the PSA score to an MSC score and in combining elements into a single score for a PI.

In most cases, productivity information was obtained from Fishbase (http://www.fishbase.org) and the IUCN Red List (http://www.iucnredlist.org/) for fish and shark species and derived from various other internet resources for invertebrates, seabird, sea turtles, and marine mammals where possible.

Note that primary sources were not sought in scoring species. As a result, it is possible that errors are present in the secondary source used. Errors will be removed when they have been identified, and the PSA method is relatively robust to inaccurate or uncertain information. In addition, an information quality index is used to indicate, among other things, whether a particular score has been reviewed or not. As the information is reported and checked, such reviewing should progressively improve information accuracy and reliability.

Seven productivity attributes were scored (Table 4). Where information directly relevant to an attribute was available, it was used to score it. Almost all species listed in Fishbase have estimates of maximum length (attribute 4) and trophic level (attribute 7). In most cases, reproductive strategy (attribute 6) could be inferred from observations on the egg types and other information if not directly provided. Size at maturity (attribute 5) was often but not always available. However, in many cases the score could be inferred from maximum length. For example, a maximum length less than the upper medium-level risk for average size at maturity would mean that the average size at maturity would score at most 2. Similarly, for fecundity (attribute 3), while information does exist for many species, it needs to be inferred for many more. For most fish species, a minimum fecundity would likely still be greater than 100 so they would score at worst 2.

Table 4. PSA productivity attributes risk scores from low (1) to high (3) (compiled from MSC 2014a, Table PF4), excluding the "density dependence" attribute, which only applies to invertebrates and for which no information was available. Alternative scoring based on growth rate K is indicated for age-based attributes.

	ATTRIBUTE	1	2	3
1	Average age at maturity	<5 years or K>0.183	5-15 years 0.183>K>0.061	>15 years or 0.061>K
2	Average max age	<10 years or K>0.3	10-25 years or 0.3>K>0.12	>25 years or 0.12>K
3	Fecundity	>20,000 eggs/year	100-20,000 eggs/year	<100 eggs/year
4	Average max size	<100 cm	100-300 cm	>300 cm
5	Average size at maturity	<40 cm	40-200 cm	>200 cm
6	Reproductive strategy	Broadcast spawner	Demersal egg layer	Live bearer
7	Trophic level	<2.75	2.75-3.25	>3.25

For the age-based scoring (average age at maturity [attribute 1] and average maximum age [attribute 2]), information on ages was almost never available. However, growth rate K (parameter for the von Bertallanffy growth function) was often estimated for species. Growth rate K could be used to provide an alternative scoring based on common life history patterns (see Froese and Binohlan 2000) and converting the age-based benchmarks (5-15 and 10-25 years medium risk for age at maturity and longevity respectively) to K benchmarks (Table 4). Firstly, longevity is approximately related to K as:

$$K = {}^{3}/_{(t_{max} - t_0)}$$

where t_{max} = maximum average ages (10 and 25 years) and t_0 defines the size at age zero. Here we assume t_0=0, as it should usually be close to zero, is often not available and is rarely estimated accurately.

Secondly, most fish mature at around 60% of their maximum size. Using the von Bertallanffy growth function, we can obtain K that achieves the required age benchmarks:

$$K = -\text{Ln}(1 - 0.6)/(t_{mat} - t_0)$$

where t_{mat} = age at maturity (5 and 15 years) and t_0 defines the size at age zero. Again, we assume t_0=0.

While these relationships are not accurate, the original ages do not have any strong theoretical foundation but are themselves set at arbitrary but reasonable levels. Similarly, the K benchmarks achieve the objective of indicating progressively higher risks for more slow-growing species and can be applied consistently at least for most in-scope vertebrates.

For any species or species group missing information on a PSA attribute, the maximum attribute score for species belonging to the same family were used. If there was no other species with a score available from that family, the high-risk score was allocated.

Susceptibility Scoring

Susceptibility comprises four attributes consisting of areal overlap, encounterability, selectivity, and post-capture survival (see FCR v2.0 section PF4.4). Different gear types are likely to have different susceptibility attributes within the PSA and are therefore scored separately. However, under the cumulative impacts requirements of the MSC, fisheries with different gears may have to consider joint impacts, but it is unclear how this would be done using the PSA in this case. In all cases, the scoring rules can be overridden with a specific score and justification, and these cases are documented.

Areal overlap: Descriptions of species distributions were used to define overlap with tuna stocks. In almost all cases, overlap between the footprint of the UoA and the population within each area was assumed to be high (score 3); although where there was plausible argument to support a lower risk score, it was allocated to help the methodology discriminate relative species risks. Short justifications and references for any lowering of susceptibility scores (whether based on plausible argument or referenced evidence) were captured. Further work on this aspect would be informative, but area distributions for many species are uncertain so overlap cannot be determined accurately.

The areal overlap attribute was also used to define the species element list for each UoA based on its overlap with the Principle 1 stock.

Encounterability: Following Kirby and Hobday (2007), we calculated a depth overlap index to measure encounterability.

$$Depth\ overlap\ index = 100 * \frac{gear\ maximum\ depth - species\ maximum\ depth}{species\ maximum\ depth - species\ minimum\ depth}$$

Maximum gear depth was defined as 400 m for longline and 100 m for all other "surface" gears. The species depth for finfish and sharks is often provided by Fishbase. A depth overlap index of less than 10% was considered low risk and of 10-30% was medium risk. All indices >30% were high risk (FCR v2.0 Table PF5).

After scoring based on depth, the score was further adjusted based on species habitat requirements. Specifically, if a species was described as demersal or reef associated, the risk score was lowered by 1. This was because, for the tuna species being considered, the fishery targeting them would likely operate well away from the seabed or reefs. For all baitfish species, encounterability was scored at 3 as this is a target species for the associated bait fishery. The minimum risk score was 1 for all species included, even in those cases where catch might be considered negligible.

It should be noted that for out-of-scope species, this approach does not work well. Marine mammals and turtles, for instance, must come to the surface for air so are likely to encounter gear at some point. Birds will still get caught on a hook regardless of depth because they will go for the bait during setting.

Selectivity: This attribute scores the probability of capturing a fish or other animal once it comes into contact with the gear. This primarily reflects "catchability" rather than "selectivity".

The MSC guidance (see FCR v2.0 section PF4.4) was not useful in this assessment. It refers to information on catch species maturity that is generally not available and it is clear this would lead to appropriate risk scores. Therefore, as with encounterability, a simple rule-based system was used to apply and adjust risk scores based on common attributes of the species and gear.

The objective here was to obtain scores that reflect the effectiveness of the gear at catching the species concerned. To do this, a length overlap index was calculated for each species based on its maximum length and the maximum length of the target tuna.

$$Length\ overlap\ index = 100 * \frac{species\ maximum\ length}{target\ tuna\ maximum\ length}$$

These assumptions were also used in scoring selectivity:

1. For tropical longline (deep water gear), the target tuna maximum length was taken as 239 cm (i.e., the maximum length of yellowfin tuna).
2. For all other tropical gears, such as purse seine, pole and line, and troll, the skipjack maximum length of 110 cm was used as the target species length.
3. For fisheries in temperate waters targeting albacore, the albacore maximum length of 140 cm was used.

As with encounterability, an overlap of less than 10% was considered low risk and of 10-30% was medium risk. All indices >30% were high risk.

Selectivity score adjustments were also made. The score was reduced by 1 for pole and line gear because the nature of the gear implies that when tuna is feeding on live bait the gear can exclude other species. This means that bycatch is low even if species are present in the vicinity. For baited gears, the risk score of species with a trophic level less than 3.5 was reduced by 1. Tuna have a trophic level of 4.5 so it was assumed the bait should be less attractive to species with trophic level at least 1 less than tuna.

As with encounterability, species used as bait were automatically given a high-risk score, and scores could not be less than 1.

Post-capture mortality: Direct information on post-capture survival is usually necessary to support lower risk scores, and such direct information was not available. Therefore, a high-risk score was given by default in almost all cases because at this time no evidence of post-capture survival was identified. This issue may be important in assessing the risk for out-of-scope species for which the PSA has not been used.

Results: Principle 2 Pre-Assessment

A pre-assessment report has been produced for each of the 166 Units of Assessment (Table 2 and Table 5). We recommend that you download a compressed folder [Download the RAR file here] that contains:

- The 166 UoA reports (in Word), where full details and justifications of the score of each Performance Indicator is presented for every UoA individually.
- A P2 scoring overview summary table (in Excel). Similarly to Table 5, this file includes an overview of the score of each P2 Performance Indicator for every UoA. In addition, you can find the links to the individual UoA reports.
- A PSA scores summary table (in Excel). The Productivity and Susceptibility Scores with justifications are given in each report but, if you are interested in the whole PSA scores summary of all in-scope species for each fishing gear that are included in this Pre-Assessment, you can also access this table.

Table 5. List of the 166 UoAs covered in this Pre-Assessment with the summary of the score for each Performance Indicator of Principle 2.

Units of Assessment	Performance Indicators*														
	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3
Mediterranean Albacore Gill or drift net, ICCAT	70	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Mediterranean Albacore Longline, ICCAT	70	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Mediterranean Albacore Purse Seine Free School, ICCAT	70	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Mediterranean Albacore Pelagic Trawl, ICCAT	70	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Mediterranean Albacore Troll/handline Free School, ICCAT	70	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Mediterranean Albacore Troll/handline FADs, ICCAT	70	85	85	90	50	70	60	70	70	100	80	85	80	80	80
North Atlantic Albacore Gill or drift net, ICCAT	75	75	85	90	50	70	65	75	70	100	85	85	80	80	85
North Atlantic Albacore Longline, ICCAT	75	75	85	90	50	70	65	75	70	100	85	85	80	80	85
North Atlantic Albacore Pole and Line Free School, ICCAT	75	75	85	90	60	70	65	75	70	85	70	75	60	65	70
North Atlantic Albacore Pole and Line FADs, ICCAT	75	75	85	90	60	70	60	70	70	80	70	75	60	65	70
North Atlantic Albacore Purse Seine Free School, ICCAT	75	75	85	90	50	70	80	75	70	100	85	85	80	80	85
North Atlantic Albacore Purse Seine FADs, ICCAT	75	75	85	90	50	70	60	70	70	85	80	85	80	80	80
North Atlantic Albacore Pelagic Trawl, ICCAT	75	75	85	90	50	70	80	75	70	100	85	85	80	80	85
North Atlantic Albacore Troll/handline Free School, ICCAT	75	75	85	90	50	70	65	75	70	100	85	85	80	80	85
North Atlantic Albacore Troll/handline FADs, ICCAT	75	75	85	90	50	70	60	70	70	100	80	85	80	80	80
South Atlantic Albacore Gill or drift net, ICCAT	75	75	85	90	50	70	65	75	70	100	85	85	80	80	85
South Atlantic Albacore Longline, ICCAT	75	75	85	90	50	70	65	75	70	100	85	85	80	80	85

Units of Assessment	Performance Indicators*														
	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3
South Atlantic Albacore Pole and Line Free School, ICCAT	75	75	85	90	60	70	65	75	70	85	70	75	60	65	70
South Atlantic Albacore Pole and Line FADs, ICCAT	75	75	85	90	60	70	60	70	70	80	70	75	60	65	70
South Atlantic Albacore Purse Seine Free School, ICCAT	75	75	85	90	50	70	80	75	70	100	85	85	80	80	85
South Atlantic Albacore Purse Seine FADs, ICCAT	75	75	85	90	50	70	60	70	70	85	80	85	80	80	80
South Atlantic Albacore Troll/handline Free School, ICCAT	75	75	85	90	50	70	65	75	70	100	85	85	80	80	85
South Atlantic Albacore Troll/handline FADs, ICCAT	75	75	85	90	50	70	60	70	70	100	80	85	80	80	80
Indian Ocean Albacore Gill or drift net, IOTC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Indian Ocean Albacore Longline, IOTC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Indian Ocean Albacore Purse Seine Free School, IOTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Indian Ocean Albacore Purse Seine FADs, IOTC	95	85	85	90	50	70	60	70	70	85	80	85	80	80	80
Indian Ocean Albacore Troll/handline Free School, IOTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Indian Ocean Albacore Troll/handline FADs, IOTC	95	85	85	90	50	70	60	70	70	100	80	85	80	80	80
North Pacific Albacore Gill or drift net, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
North Pacific Albacore Gill or drift net, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
North Pacific Albacore Longline, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
North Pacific Albacore Longline, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
North Pacific Albacore Pole and Line Free School, IATTC	95	85	85	90	60	70	65	75	70	85	70	75	60	65	70
North Pacific Albacore Pole and Line Free School, WCPFC	95	75	85	90	60	70	65	75	70	85	70	75	60	65	70

Units of Assessment	Performance Indicators*														
	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3
North Pacific Albacore Pole and Line FADs, IATTC	95	85	85	90	60	70	60	70	70	80	70	75	60	65	70
North Pacific Albacore Pole and Line FADs, WCPFC	95	75	85	90	60	70	60	70	70	80	70	75	60	65	70
North Pacific Albacore Purse Seine Free School, IATTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
North Pacific Albacore Purse Seine Free School, WCPFC	95	75	85	90	50	70	80	75	70	100	85	85	80	80	85
North Pacific Albacore Purse Seine FADs, IATTC	95	85	85	90	50	70	60	70	70	85	80	85	80	80	80
North Pacific Albacore Purse Seine FADs, WCPFC	95	75	85	90	50	70	60	70	70	85	80	85	80	80	80
North Pacific Albacore Troll/handline Free School, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
North Pacific Albacore Troll/handline Free School, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
North Pacific Albacore Troll/handline FADs, IATTC	95	85	85	90	50	70	60	70	70	100	80	85	80	80	80
North Pacific Albacore Troll/handline FADs, WCPFC	95	75	85	90	50	70	60	70	70	100	80	85	80	80	80
South Pacific Albacore Longline, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
South Pacific Albacore Longline, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
South Pacific Albacore Pole and Line Free School, IATTC	95	85	85	90	60	70	65	75	70	85	70	75	60	65	70
South Pacific Albacore Pole and Line Free School, WCPFC	95	75	85	90	60	70	65	75	70	85	70	75	60	65	70
South Pacific Albacore Pole and Line FADs, IATTC	95	85	85	90	60	70	60	70	70	80	70	75	60	65	70
South Pacific Albacore Pole and Line FADs, WCPFC	95	75	85	90	60	70	60	70	70	80	70	75	60	65	70
South Pacific Albacore Troll/handline Free School, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
South Pacific Albacore Troll/handline Free School, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85

Units of Assessment	Performance Indicators*														
	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3
South Pacific Albacore Troll/handline FADs, IATTC	95	85	85	90	50	70	60	70	70	100	80	85	80	80	80
South Pacific Albacore Troll/handline FADs, WCPFC	95	75	85	90	50	70	60	70	70	100	80	85	80	80	80
Atlantic Bigeye Gill or drift net, ICCAT	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Atlantic Bigeye Longline, ICCAT	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Atlantic Bigeye Pole and Line Free School, ICCAT	95	75	85	90	60	70	65	75	70	85	70	75	60	65	70
Atlantic Bigeye Pole and Line FADs, ICCAT	95	75	85	90	60	70	60	70	70	80	70	75	60	65	70
Atlantic Bigeye Purse Seine Free School, ICCAT	95	75	85	90	50	70	80	75	70	100	85	85	80	80	85
Atlantic Bigeye Purse Seine FADs, ICCAT	95	75	85	90	50	70	60	70	70	85	80	85	80	80	80
Atlantic Bigeye Pelagic Trawl, ICCAT	95	75	85	90	50	70	80	75	70	100	85	85	80	80	85
Atlantic Bigeye Troll/handline Free School, ICCAT	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Atlantic Bigeye Troll/handline FADs, ICCAT	95	75	85	90	50	70	60	70	70	100	80	85	80	80	80
Indian Ocean Bigeye Gill or drift net, IOTC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Indian Ocean Bigeye Longline, IOTC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Indian Ocean Bigeye Pole and Line Free School, IOTC	95	85	85	90	60	70	65	75	70	85	70	75	60	65	70
Indian Ocean Bigeye Pole and Line FADs, IOTC	95	85	85	90	60	70	60	70	70	80	70	75	60	65	70
Indian Ocean Bigeye Purse Seine Free School, IOTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Indian Ocean Bigeye Purse Seine FADs, IOTC	95	85	85	90	50	70	60	70	70	85	80	85	80	80	80
Indian Ocean Bigeye Pelagic Trawl, IOTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Indian Ocean Bigeye Troll/handline Free School, IOTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85

Units of Assessment	Performance Indicators*														
	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3
Indian Ocean Bigeye Troll/handline FADs, IOTC	95	85	85	90	50	70	60	70	70	100	80	85	80	80	80
Eastern Pacific Bigeye Longline, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Eastern Pacific Bigeye Pole and Line Free School, IATTC	95	85	85	90	60	70	65	75	70	85	70	75	60	65	70
Eastern Pacific Bigeye Pole and Line FADs, IATTC	95	85	85	90	60	70	60	70	70	80	70	75	60	65	70
Eastern Pacific Bigeye Purse Seine Free School, IATTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Eastern Pacific Bigeye Purse Seine FADs, IATTC	95	85	85	90	50	70	60	70	70	85	80	85	80	80	80
Eastern Pacific Bigeye Troll/handline Free School, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Eastern Pacific Bigeye Troll/handline FADs, IATTC	95	85	85	90	50	70	60	70	70	100	80	85	80	80	80
Western Pacific Bigeye Gill or drift net, WCPFC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Pacific Bigeye Longline, WCPFC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Pacific Bigeye Pole and Line Free School, WCPFC	95	85	85	90	60	70	65	75	70	85	70	75	60	65	70
Western Pacific Bigeye Pole and Line FADs, WCPFC	95	85	85	90	60	70	60	70	70	80	70	75	60	65	70
Western Pacific Bigeye Purse Seine Free School, WCPFC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Western Pacific Bigeye Purse Seine FADs, WCPFC	95	85	85	90	50	70	60	70	70	85	80	85	80	80	80
Western Pacific Bigeye Troll/handline Free School, WCPFC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Pacific Bigeye Troll/handline FADs, WCPFC	95	85	85	90	50	70	60	70	70	100	80	85	80	80	80
Eastern Atlantic Skipjack Gill or drift net, ICCAT	70	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Eastern Atlantic Skipjack Longline, ICCAT	70	75	85	90	50	70	65	75	70	100	85	85	80	80	85

Units of Assessment	Performance Indicators*														
	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3
Eastern Atlantic Skipjack Pole and Line Free School, ICCAT	70	75	85	90	60	70	65	75	70	85	70	75	60	65	70
Eastern Atlantic Skipjack Pole and Line FADs, ICCAT	70	75	85	90	60	70	60	70	70	80	70	75	60	65	70
Eastern Atlantic Skipjack Purse Seine Free School, ICCAT	70	75	85	90	50	70	80	75	70	100	85	85	80	80	85
Eastern Atlantic Skipjack Purse Seine FADs, ICCAT	70	75	85	90	50	70	60	70	70	85	80	85	80	80	80
Eastern Atlantic Skipjack Pelagic Trawl, ICCAT	70	75	85	90	50	70	80	75	70	100	85	85	80	80	85
Eastern Atlantic Skipjack Troll/handline Free School, ICCAT	70	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Eastern Atlantic Skipjack Troll/handline FADs, ICCAT	70	75	85	90	50	70	60	70	70	100	80	85	80	80	80
Western Atlantic Skipjack Gill or drift net, ICCAT	70	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Atlantic Skipjack Longline, ICCAT	70	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Atlantic Skipjack Pole and Line Free School, ICCAT	70	75	85	90	60	70	65	75	70	85	70	75	60	65	70
Western Atlantic Skipjack Pole and Line FADs, ICCAT	70	75	85	90	60	70	60	70	70	80	70	75	60	65	70
Western Atlantic Skipjack Purse Seine Free School, ICCAT	70	75	85	90	50	70	80	75	70	100	85	85	80	80	85
Western Atlantic Skipjack Purse Seine FADs, ICCAT	70	75	85	90	50	70	60	70	70	85	80	85	80	80	80
Western Atlantic Skipjack Pelagic Trawl, ICCAT	70	75	85	90	50	70	80	75	70	100	85	85	80	80	85
Western Atlantic Skipjack Troll/handline Free School, ICCAT	70	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Atlantic Skipjack Troll/handline FADs, ICCAT	70	75	85	90	50	70	60	70	70	100	80	85	80	80	80
Indian Ocean Skipjack Gill or drift net, IOTC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Indian Ocean Skipjack Longline, IOTC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85

Units of Assessment	Performance Indicators*														
	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3
Indian Ocean Skipjack Pole and Line Free School, IOTC	95	85	85	90	60	70	65	75	70	85	70	75	60	65	70
Indian Ocean Skipjack Pole and Line FADs, IOTC	95	85	85	90	60	70	60	70	70	80	70	75	60	65	70
Indian Ocean Skipjack Purse Seine Free School, IOTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Indian Ocean Skipjack Purse Seine FADs, IOTC	95	85	85	90	50	70	60	70	70	85	80	85	80	80	80
Indian Ocean Skipjack Pelagic Trawl, IOTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Indian Ocean Skipjack Troll/handline Free School, IOTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Indian Ocean Skipjack Troll/handline FADs, IOTC	95	85	85	90	50	70	60	70	70	100	80	85	80	80	80
Eastern Pacific Skipjack Gill or drift net, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Eastern Pacific Skipjack Longline, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Eastern Pacific Skipjack Pole and Line Free School, IATTC	95	85	85	90	60	70	65	75	70	85	70	75	60	65	70
Eastern Pacific Skipjack Pole and Line FADs, IATTC	95	85	85	90	60	70	60	70	70	80	70	75	60	65	70
Eastern Pacific Skipjack Purse Seine Free School, IATTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Eastern Pacific Skipjack Purse Seine FADs, IATTC	95	85	85	90	50	70	60	70	70	85	80	85	80	80	80
Eastern Pacific Skipjack Troll/handline Free School, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Eastern Pacific Skipjack Troll/handline FADs, IATTC	95	85	85	90	50	70	60	70	70	100	80	85	80	80	80
Western Pacific Skipjack Gill or drift net, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Pacific Skipjack Longline, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Pacific Skipjack Pole and Line Free School, WCPFC	95	75	85	90	60	70	65	75	70	85	70	75	60	65	70

Units of Assessment	Performance Indicators*														
	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3
Western Pacific Skipjack Pole and Line FADs, WCPFC	95	75	85	90	60	70	60	70	70	80	70	75	60	65	70
Western Pacific Skipjack Purse Seine Free School, WCPFC	95	75	85	90	50	70	80	75	70	100	85	85	80	80	85
Western Pacific Skipjack Purse Seine FADs, WCPFC	95	75	85	90	50	70	60	70	70	85	80	85	80	80	80
Western Pacific Skipjack Troll/handline Free School, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Pacific Skipjack Troll/handline FADs, WCPFC	95	75	85	90	50	70	60	70	70	100	80	85	80	80	80
Atlantic Yellowfin Gill or drift net, ICCAT	70	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Atlantic Yellowfin Longline, ICCAT	70	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Atlantic Yellowfin Pole and Line Free School, ICCAT	70	75	85	90	60	70	65	75	70	85	70	75	60	65	70
Atlantic Yellowfin Pole and Line FADs, ICCAT	70	75	85	90	60	70	60	70	70	80	70	75	60	65	70
Atlantic Yellowfin Purse Seine Free School, ICCAT	70	75	85	90	50	70	80	75	70	100	85	85	80	80	85
Atlantic Yellowfin Purse Seine FADs, ICCAT	70	75	85	90	50	70	60	70	70	85	80	85	80	80	80
Atlantic Yellowfin Pelagic Trawl, ICCAT	70	75	85	90	50	70	80	75	70	100	85	85	80	80	85
Atlantic Yellowfin Troll/handline Free School, ICCAT	70	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Atlantic Yellowfin Troll/handline FADs, ICCAT	70	75	85	90	50	70	60	70	70	100	80	85	80	80	80
Indian Ocean Yellowfin Gill or drift net, IOTC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Indian Ocean Yellowfin Longline, IOTC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Indian Ocean Yellowfin Pole and Line Free School, IOTC	95	85	85	90	60	70	65	75	70	85	70	75	60	65	70
Indian Ocean Yellowfin Pole and Line FADs, IOTC	95	85	85	90	60	70	60	70	70	80	70	75	60	65	70

Units of Assessment	Performance Indicators*														
	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3
Indian Ocean Yellowfin Purse Seine Free School, IOTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Indian Ocean Yellowfin Purse Seine FADs, IOTC	95	85	85	90	50	70	60	70	70	85	80	85	80	80	80
Indian Ocean Yellowfin Pelagic Trawl, IOTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Indian Ocean Yellowfin Troll/handline Free School, IOTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Indian Ocean Yellowfin Troll/handline FADs, IOTC	95	85	85	90	50	70	60	70	70	100	80	85	80	80	80
Eastern Pacific Yellowfin Gill or drift net, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Eastern Pacific Yellowfin Longline, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Eastern Pacific Yellowfin Pole and Line Free School, IATTC	95	85	85	90	60	70	65	75	70	85	70	75	60	65	70
Eastern Pacific Yellowfin Pole and Line FADs, IATTC	95	85	85	90	60	70	60	70	70	80	70	75	60	65	70
Eastern Pacific Yellowfin Purse Seine Free School, IATTC	95	85	85	90	50	70	80	75	70	100	85	85	80	80	85
Eastern Pacific Yellowfin Purse Seine Mammal/Shark set, IATTC	95	85	85	90	50	70	50	50	70	100	85	85	80	80	80
Eastern Pacific Yellowfin Purse Seine FADs, IATTC	95	85	85	90	50	70	60	70	70	85	80	85	80	80	80
Eastern Pacific Yellowfin Troll/handline Free School, IATTC	95	85	85	90	50	70	65	75	70	100	85	85	80	80	85
Eastern Pacific Yellowfin Troll/handline FADs, IATTC	95	85	85	90	50	70	60	70	70	100	80	85	80	80	80
Western Pacific Yellowfin Gill or drift net, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Pacific Yellowfin Longline, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Pacific Yellowfin Pole and Line Free School, WCPFC	95	75	85	90	60	70	65	75	70	85	70	75	60	65	70
Western Pacific Yellowfin Pole and Line FADs, WCPFC	95	75	85	90	60	70	60	70	70	80	70	75	60	65	70

Units of Assessment	Performance Indicators*														
	2.1.1	2.1.2	2.1.3	2.2.1	2.2.2	2.2.3	2.3.1	2.3.2	2.3.3	2.4.1	2.4.2	2.4.3	2.5.1	2.5.2	2.5.3
Western Pacific Yellowfin Purse Seine Free School, WCPFC	95	75	85	90	50	70	80	75	70	100	85	85	80	80	85
Western Pacific Yellowfin Purse Seine FADs, WCPFC	95	75	85	90	50	70	60	70	70	85	80	85	80	80	80
Western Pacific Yellowfin Troll/handline Free School, WCPFC	95	75	85	90	50	70	65	75	70	100	85	85	80	80	85
Western Pacific Yellowfin Troll/handline FADs, WCPFC	95	75	85	90	50	70	60	70	70	100	80	85	80	80	80

** Principle 2: Minimising environmental impact [**2.1 Primary Species** (2.1.1 Outcome Status, 2.1.2 Management strategy, 2.1.3 Information) – **2.2 Secondary Species** (2.2.1 Outcome Status, 2.2.2 Management strategy, 2.2.3 Information)– **2.3 ETP Species** (2.3.1 Outcome Status, 2.3.2 Management strategy, 2.3.3 Information)– **2.4 Habitats** (2.4.1 Outcome Status, 2.4.2 Management strategy, 2.4.3 Information/Monitoring)– **2.5 Ecosystem** (2.5.1 Outcome Status, 2.5.2 Management strategy, 2.5.3 Information/Monitoring)].*

Summary for Primary Species: In general, tuna fisheries score well on Primary species. With some exceptions, information is relatively good and stocks are managed to maintain them above their PRI. For Atlantic stocks, Primary species status (PI2.1.1) scores below 80 because a main bycatch, Atlantic bigeye, is considered likely rather than very likely above its PRI and this is likely caused by the combined tuna fisheries. Otherwise, some fisheries score poorly on evidence that management will work, usually based on stocks where management has not been effective.

Summary for Secondary Species: Tuna fisheries, with the exception of status, generally score poorly on Secondary species bycatch. Secondary species, like Primary species, are scored on a species-element basis, so all bycatch species are included. Fisheries score well on status, but this is primarily because all Secondary species are considered Minor based on their catch proportion, which may be unreliable. This uncertainty in status is reflected in the information PI2.2.3 since on the whole we are not convinced that the data are sufficient to support any sort of strategy to limit Secondary species bycatch. Finally, management of bycatch is perhaps the worst performance indicator. Apart from potential concerns with shark finning and discarding, there are also no general measures to reduce bycatch in tuna fisheries, only specific responses to perceived problems (often for ETP). This, together with the limited available information, suggests tuna fisheries may not be successfully controlling bycatch sufficiently well to meet minimum MSC requirements. It should be noted that in general, pole and line should score better than other gears on these performance indicators as its bycatch is very low, although any live bait capture will need to be taken into account.

Summary for Endangered Threatened or Protected Species: Tuna fisheries generally score poorly on ETP performance indicators. The status performance indicator scoring reflects in each case fisheries may interact with ETP and the evidence, or lack of it, as to whether the level interaction might prevent a recovery in the ETP. Note however, that, unlike for Primary and Secondary species, this pre-assessment does not apply species element scoring. In terms of ETP management, the lack of a regular review of alternative measures to reduce interactions with ETP may result in a condition for many tuna fisheries, as will the lack of effective management of FADs in fisheries where they are used. In terms of information on

ETP interactions, these are not routinely reliably recorded in most tuna fisheries, so all fisheries may struggle to meet SG80 unless this has been addressed.

Purse seine sets on dolphins in the East Pacific represents a special case. In our view, this fishery can not meet the MSC requirements. Although in general purse seine sets made on ETP may struggle to show any impact is not preventing recovery, the East Pacific shows best practice in attempting to monitor dolphin populations and could meet SG60. However, any intentional set made on ETP cannot be minimising the mortality, and therefore PI2.3.2.a SG60 cannot be met even in this case.

Summary for Habitat and Ecosystem: As might be expected tuna fisheries score generally well on these performance indicators compared to other fisheries. The primary concern might be with pole and line bait collection activities. Where these occur in pelagic waters, pole and line is likely to score as well as other tuna fisheries. But where collection occurs near VMEs, such as coral reefs, or collection is uncontrolled on key low trophic species, additional issues may be raised for this gear.

Caveats and Challenges

An MSC assessment is an evidence-based audit. In any auditing scheme, it is part of the responsibility of the audited party (in this case, the client for the UoA) to record adequate information to demonstrate compliance with the requirements of the Standard. A wide-ranging MSC pre-assessment such as this, which seeks to score a number of species, gear types, and ecosystems, may not be able to draw on a comprehensive evidence base that would be available in a more tightly focused and in-depth full MSC assessment. However, the evidence developed here is wider ranging than that available to individual assessments, and it is hoped this information may prove useful to provide better context for individual fisheries, which is useful particularly for harmonization.

Individual assessments may reasonably come to conclusions different from those in this report. There are a number of reasons scores may change or be different in any particular case. These reasons include:

- The information available may change over time and for each location. Some further relevant information could become publicly available and could be included in future pre-assessments. However, at this time, information that might be available to a full assessment and affect scoring but was not available to this assessment may include:
    - National information on national laws and regulations, data, and other fishery activities
    - Other international fishery data, from FAO FishStat for example
    - Observer data on actual vessel activity at sea, including discarded bycatch
    - Public consultation information required for full assessments
- Expert judgment may vary to some extent between experts
- Narrower UoAs may score differently because they have different attributes than the broader UoAs considered here
- Differences in the MSC methodology and guidance

In the meantime, a precautionary approach to scoring has been adopted here to identify the plausible worst case as the basis for scoring. On the whole, where information is lacking, this will result in a higher risk score. In some cases, this may indicate that a UoA may not currently meet the MSC Standard, even where this is a reflection on the lack of information rather than an inherent lack of sustainability. However, the information in this generic pre-assessment will provide a starting point for improving MSC assessments using FCR v2.0.

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Appendix 1. Version Log

VERSION NUMBER	AUTHORS	RELEASE DATE
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