A preliminary evaluation of the environmental impact of fishing for global tuna fisheries relative to Marine Stewardship Council criteria

A Report Prepared for ISSF

By

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Foreword

The primary objective of the International Seafood Sustainability Foundation (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.

Since 2013, we decided to ask two experienced MSC assessors to score 19 tuna stocks against the MSC standards for Principles 1 and 3 (at the regional fishery management organization [RFMO] level) using the very same indicators of sustainability and the guideposts provided by the MSC to take a global, comprehensive approach for consistent scoring (see Powers and Medley 2016). That report (a) provides a basis for comparing between stock scores that are assigned by the same experts, (b) becomes a useful source document in future tuna certifications or in the establishment of tuna fishery improvement projects (FIPs), (c) gives a "snapshot" of the current status of the stocks and the strengths and weaknesses of RFMOs, and (d) prioritizes our projects and advocacy efforts for those initiatives that will improve low performance indicator (PI) scores.

In this new project, we intend to complement the work of Powers and Medley (2016) by carrying out a pre-assessment for tuna fisheries focusing specifically on Principle 2 species across tuna-RFMO areas and gear types. This is a huge undertaking that involves hundreds of species and over 70 RFMO-gear combinations.

At this point, we consider the Principle 2 work to be preliminary, and we are seeking comments from experts that will help us finalize a product that we hope will be as useful as the report on tuna scores for Principles 1 and 3. We invite you to read this report, which focuses on the methodology used, and the acompanying Productivity Susceptibility Analysis (PSA) scores. You can provide us with your input through a survey by following this link.

We expect to take this work a step further later in 2017, once we have received public input on the approach being followed so that we can produce Principle 2 scores for different RFMO-gear units of assessment (UoAs).

This work is being undertaken by a group of experts including Paul Medley, Tristan Southall, and a team from MRAG Americas (Jodi Bostrom, Erika Zollett, Robert Trumble, Amanda Stern-Pirlot, and Graeme Parkes).

Susan Jackson

ISSF President

Methodology

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. Although there have been some previous MSC assessments of tuna fisheries, they were done against previous versions of the standard.

This assessment focuses on the certification requirements in Principle 2, which assess the UoA's impact on non-target species; endangered, threatened, or protected (ETP) species; habitats; and ecosystems. The major differences between the old Certification Requirements (CR 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.
- 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 Redlist.
- The cumulative impacts of MSC 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 (consolidated from MSC FCRv2.0)

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.,	*For in-scope species:* Catch of a species by the UoA is 5% or more by weight of	Catch of a species is 2% or more by weight of the total catch of all	A main secondary species that comprises more than	*Only for main secondary species that is outside a biologically*

Definitions of Principle 2 Species and Categories	"Main" Threshold	"Less Resilient" Threshold	"Considerable Catch" Threshold	Cumulative Impacts Threshold
amphibian, reptile, bird, or marine mammal) but is not ETP (see ETP definition below).	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.	species by the UoA.	10% of the total catch by weight of the UoA.	*based limit and catch is "considerable":* All MSC UoAs that have "considerable catch" of that secondary species.
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 Redlist 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) or when its resilience has been lowered by anthropogenic or natural changes to its life history.				
Exceptionally large catch: Take account of the relative catches of both target and the 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 400,000 mt 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.				

Assessment Approach and Selection of Stocks

The MSC defines a 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. It has taken a broad approach to include species likely to have Principle 2 designations in future MSC assessments. The assessment team recognizes 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. All gear types that have the potential to catch tuna were also included in this assessment.

Defining Catch Composition According to MSC Terminology

The initial task is simply to identify the species that may be caught in tuna fisheries and subsequently to determine whether these species will be considered as primary, secondary or ETP and, in the case of primary and secondary, whether main or minor.

Table GSA2 in the FCR v2.0 guidance (MSC 2014b) indicates that primary species are usually of commercial value and have management tools controlling exploitation with reference points in place. By inference (and as stated), secondary species are those not managed according to reference points. However, the examples given for secondary species (paraphrasing: to be used either as bait or as food for the crew or for other subsistence uses, or represent incidental catches that are undesired but somewhat unavoidable in the fishery) provide a precautionary window for inclusion of species that do not fall squarely in one category or the other. There are numerous species that are landed intentionally for commercial (not subsistence) purposes but are not (yet) managed with 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. The designation of primary species in the case of the tuna fisheries should not necessarily be restricted to just those species for which the RFMOs have management measures. Therefore, for this exercise, we classified a species as primary if target or limit reference points are in place or if it is listed in an RFMO's convention as a species over which the RFMO has responsibility and should be managed.

The choice of which species are primary and which are secondary is important because it potentially impacts the overall scoring of a PI. However, both primary and secondary species receive a full and rigourous evaluation under the MSC standard and certification requirements. Readers may be concerned that tuna UoAs could be achieving higher scores by virtue of "not managing" Principel 2 species stocks because they would then fall into the secondary species category. However, the default assessment tree is designed such that there are no perverse incentives generated to have preference for secondary vs. primary species designation and hence not manage a stock that shuold be managed. This is because the scoring criteria for secondary species are nearly identical to those for primary species (FCR v2.0 sections SA3.6 and SA3.7).

In general, we followed the MSC definitions and guidance to make our primary and secondary 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.

Primary Species

Tuna species under RFMO management that are not included in a UoA in a specific MSC assessment are primary species by definition (because they are managed), but there are other species that either are managed or should be managed (as described above). As stated above, our general rule of thumb was if a species "looks like" a potential target species then it should be primary, even if it does not currently have reference points. We note that this is in line with the expectation that it

should be possible to move a species from primary to target through an MSC expedited audit. Moving a secondary species to target species would generally be much more difficult.

Given the large number of species, we concluded an inclusive and precautionary approach for determining primary was necessary. Therefore, the following points were also followed:

- If the species was primary for one target tuna UoA, it was considered primary for all tuna UoAs, irrespective of gear type or RFMO.
- If the species was mentioned in the text of an RFMO convention or management document (e.g., conservation measure, resolution, or recommendation), and/or data were collected for the species, it was considered a primary species. Each Convention has a statement on applicable species. For example, the Convention of the Western and Central Pacific Fisheries Commission (WCPFC) states that it "applies to all stocks of highly migratory fish within the Convention Area except sauries."

Table 2 shows our list of main primary species, excluding likely target tuna species (i.e., yellowfin, albacore, and skipjack).

Table 2 Main primary species for all tuna UoAs as designated by the criteria noted above (IATTC = Inter-American Tropical Tuna Commission, ICCAT = International Commission for the Conservation of Atlantic Tunas, IOTC = Indian Ocean Tuna Commission, and WCPFC = Western and Central Pacific Fisheries Commission)

Code	Species	English Name	Source
WAH	*Acanthocybium solandri*	Wahoo	IATTC/ICCAT/IOTC/WCPFC
BLT	*Auxis rochei*	Bullet tuna	WCPFC
FRI	*Auxis thazard*	Frigate tuna	ICCAT/IOTC/WCPFC
DOL	*Coryphaena hippurus*	Common dolphinfish	IOTC/IATTC/WCPFC
KAW	*Euthynnus affinis*	Kawakawa	IOTC/ICCAT/WCPFC
LTA	*Euthynnus alletteratus*	Little tunny	ICCAT
DOT	*Gymnosarda unicolor*	Dogtooth tuna	IOTC/WCPFC
SFA	*Istiophorus platypterus*	Indo-Pacific sailfish	IATTC/IOTC/WCPFC/ICCAT
SMA	*Isurus oxyrinchus*	Shortfin mako	IATTC/ICCAT/IOTC/WCPFC
BUM	*Makaira nigricans*	Blue marlin	IATTC/ICCAT/IOTC/WCPFC
BON	*Sarda sarda*	Atlantic bonito	ICCAT
BRS	*Scomberomorus brasiliensis*	Serra Spanish mackerel	ICCAT
KGM	*Scomberomorus cavalla*	King mackerel	ICCAT
COM	*Scomberomorus commerson*	Narrow-barred Spanish mackerel	IOTC/WCPFC
GUT	*Scomberomorus guttatus*	Indo-Pacific king mackerel	CODE
SSM	*Scomberomorus maculatus*	Atlantic Spanish mackerel	ICCAT
AMX	*Seriola rivoliana*	Longfin yellowtail	IATTC/IOTC/WCPFC
DGS	*Squalus acanthias*	Picked/spiny dogfish	ICCAT/WCPFC
BLF	*Thunnus atlanticus*	Blackfin tuna	ICCAT
BET	*Thunnus obesus*	Bigeye tuna	IOTC
PBF	*Thunnus orientalis*	Pacific bluefin tuna	IOTC/WCPFC
BFT	*Thunnus thynnus*	Atlantic bluefin tuna	ICCAT/IOTC/WCPFC
LOT	*Thunnus tonggol*	Longtail tuna	IOTC/WCPFC
SWO	*Xiphias gladius*	Swordfish	IATTC/ICCAT/IOTC/WCPFC

Secondary Species

To ensure an appropriate level of inclusion and precaution, if the species was secondary for one target tuna UoA, it was secondary for all tuna UoAs, irrespective of gear type or RFMO. As noted in Table 1, non-ETP, out-of-scope species are always main secondary, irrespective of their proportion of the catch. Again given the large number of species, in-scope species below the 2% threshold were not categorized. Table 3 shows our list of main secondary species.

Table 3 Main secondary species for all tuna UoAs as designated by the criteria noted above

Code	Species	English Name	Source
NA_	*Ardenna carneipes*	Flesh-footed shearwater	WCPFC
NA_	*Ardenna griseus*	Sooty shearwater	WCPFC
CYO	*Centroscymnus coelolepis*	Portuguese dogfish	WCPFC/ICCAT
NA_	*Daption capense*	Cape petrel	WCPFC
NA_	*Pelamis platurus*	Yellow-bellied seasnake	WCPFC
BTF	*Pterocaesio chrysozona*	Goldband fusilier	IPNL
NA_	*Pterodroma macroptera*	Great-winged petrel	WCPFC
RHT	*Rhizoprionodon terraenovae*	Atlantic sharpnose shark	ICCAT
SYC	*Scyliorhinus canicula*	Small-spotted catshark	ICCAT

Main and Minor Species

As noted in Table 1, more resilient species are designated main if they are at or above 5% of the catch, and less resilient species are "main" if they make up 2% of the catch. Since our categorization of "main" vs. "minor" was inclusive and precautionary, we applied the MSC's 2% catch threshold instead of the standard 5% threshold, regardless of whether the species was less resilient. Further, if a species was designated as main for one target tuna UoA, it was also main for all others. Given the large number of species (more than 400) that interacts with the target tuna species, those species below the 2% threshold were not categorized.

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." In future assessments of specific tuna UoAs, additional species may reach the 2% threshold of catch for a fishery even though they did not reach that threshold for the cumulative catch across all tuna fisheries. Table 4 lists species that do not reach the 2% threshold for this exercise but based on project team consensus are likely of particular interest or concern (e.g., public interest) and/or have the potential to meet the threshold once a specific UoA is assessed.

Table 4 Other species of interest

Code	Species	English Name	Source
PTH	*Alopias pelagicus*	Pelagic thresher shark	IATTC/ICCAT/IOTC/WCPFC
BTH	*Alopias superciliosus*	Bigeye thresher shark	IATTC/ICCAT/IOTC/WCPFC
ALV	*Alopias vulpinus*	Common thresher/thintail thresher	IATTC/ICCAT/IOTC/WCPFC
CNT	*Canthidermis maculata*	Oceanic triggerfish/spotted triggerfish	IOTC/WCPFC/IATTC
FAL	*Carcharhinus falciformis*	Silky shark	WCPFC/ICCAT/IATTC/IOTC
OCS	*Carcharhinus longimanus*	Oceanic whitetip shark	IATTC/ICCAT/IOTC/WCPFC
RRU	*Elagatis bipinnulata*	Rainbow runner	IATTC/IOTC/WCPFC

Code	Species	English Name	Source
BLM	*Istiompax indica*	Black marlin	ICCAT/IOTC/WCPFC
LMA	*Isurus paucus*	Longfin mako	ICCAT/IOTC/WCPFC
WHM	*Kajikia albida*	Atlantic white marlin	ICCAT
MLS	*Kajikia audax*	Striped marlin	IATTC/IOTC
POR	*Lamna nasus*	Porbeagle	ICCAT/IOTC/WCPFC
PLS	*Pteroplatytrygon violacea*	Pelagic stingray	IATTC
SPK	*Sphyrna mokarran*	Great hammerhead shark	IATTC/ICCAT/IOTC/WCPFC
SPJ	*Sphyrna tiburo*	Bonnethead shark	ICCAT
SPZ	*Sphyrna zygaena*	Smooth hammerhead	IATTC/ICCAT/IOTC/WCPFC

ETP Species

To determine whether a species should be designated as ETP, we used the definition in Table 1 in addition to the following definition guidance provided by the MSC FCR v2.0:

- 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
    - 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 Redlist 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 (Table 5):

- 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 Redlist 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.

257 **Table 5** ETP species for all tuna UoAs as designated by the criteria noted above

Species	English Name
Alca torda	Razorbill
Arctocephalus forsteri	New Zealand fur seal
Arctocephalus pusillus	Australian fur seal
Arctocephalus townsendi	Guadalupe fur seal
Balaenoptera acutorostrata	Minke whale
Balaenoptera borealis	Sei whale
Balaenoptera edeni	Bryde's whale
Balaenoptera musculus	Blue whale
Balaenoptera physalus	Fin whale
Berardius bairdii	Baird's beaked whale
Callorhinus ursinus	Northern fur seal
Carcharodon carcharias	Great white shark
Caretta caretta	Loggerhead turtle
Chelonia mydas	Green turtle
Delphinus delphis	Short-beaked common dolphin
Dermochelys coriacea	Leatherback turtle
Diomedea amsterdamensis	Amsterdam albatross
Diomedea antipodensis	Antipodean albatross
Diomedea dabbenena	Tristan albatross
Diomedea epomophora	Southern royal albatross
Diomedea sanfordi	Northern royal albatross
Diomedea exulans	Wandering albatross
Dugong dugon	Dugong
Eretmochelys imbricata	Hawksbill turtle
Eschrichtius robustus	Gray whale
Feresa attenuata	Pygmy killer whale
Fratercula arctica	Atlantic puffin
Globicephala macrorhynchus	Short-finned pilot whale
Globicephala melas	Long-finned pilot whale
Grampus griseus	Risso's dolphin
Kogia breviceps	Pygmy sperm whale
Kogia sima	Dwarf sperm whale
Lagenorhynchus acutus	Atlantic white-sided dolphin
Lagenorhynchus albirostris	White-beaked dolphin
Lagenorhynchus obliquidens	Pacific white-sided dolphin
Lagenorhynchus obscurus	Dusky dolphin
Lagenodelphis hosei	Fraser's dolphin
Larus marinus	Great Black-backed gull
Lepidochelys kempii	Kemp's Ridley turtle
Lepidochelys olivacea	Olive Ridley turtle
Macronectes giganteus	Southern giant-petrel
Macronectes halli	Northern giant-petrel
Manta alfredi	Reef manta ray
Manta birostris	Giant manta ray
Megaptera novaeangliae	Humpback whale
Mesoplodon densirostris	Blainville's beaked whale
Mesoplodon europaeus	Gervais' beaked whale

Species	English Name
Mesoplodon mirus	True's beaked whale
Mobula eregoodootenkee	Pygmy devil ray
Mobula hypostoma	Atlantic devil ray/Lesser devil ray
Mobula japanica (=*rancurelli*)	Spinetail devil ray
Mobula kuhlii	Shortfin devil ray
Mobula mobular	Giant devil ray
Mobula munkiana	Munk's devil ray
Mobula rochebrunei	Lesser Guinean devil ray
Mobula tarapacana	Chilean devil ray
Mobula thurstoni	Bentfin devil ray/ Smoothtail devil ray
Monachus monachus	Mediterranean monk seal
Morus capensis	Cape gannet
Natator depressus	Flatback turtle
Orcinus orca	Killer whale
Peponocephala electra	Melon-headed whale
Phocarctos hookeri	Hooker's sea lion
Phocoena phocoena	Harbor porpoise
Phoebastria albatrus	Short-tailed albatross
Phoebetria fusca	Sooty albatross
Phoebastria immutabilis	Laysan albatross
Phoebastria irrorata	Waved albatross
Phoebastria nigripes	Black-footed albatross
Phoebetria palpebrata	albatross
Physeter macrocephalus	Sperm whale
Prionace glauca	Blue shark
Procellaria aequinoctialis	White-chinned petrel
Procellaria cinerea	Grey petrel
Procellaria conspicillata	Spectacled petrel
Procellaria parkinsoni	Black petrel
Procellaria westlandica	Westland petrel
Pseudorca crassidens	False killer whale
Pterodroma externa	Juan Fernandez petrel
Pterodroma phaeopygia	Dark-rumped petrel
Pterodroma sandwichensis	Hawaiian petrel
Puffinus creatopus	Pink-footed shearwater
Puffinus heinrothi	Heinroth's shearwater
Puffinus mauretanicus	Balearic shearwater
Puffinus newelli	Newell's shearwater
Pseudobulweria macgillivrayi	Fijian petrel
Rhincodon typus	Whale shark
Sousa chinensis	Indo-Pacific humpback dolphin
Sphyrna lewini	Scalloped hammerhead shark
Stenella attenuata	Pantropical spotted dolphin
Stenella longirostris spp.	Spinner dolphin
Stenella coeruleoalba	Striped dolphin dolphin
Steno bredanensis	Rough-toothed dolphin
Synthliboramphus craveri	Craveri's murrelet
Thalassarche bulleri	Buller's albatross
Thalassarche carteri	Indian yellow-nosed albatross

Species	English Name
Thalassarche cauta	Shy Albatross
Thalassarche chlororhynchos	Atlantic yellow-nosed albatross
Thalassarche chrysostoma	Grey headed albatross
Thalassarche eremita	Chatham albatross
Thalassarche impavida	Campbell albatross
Thalassarche melanophrys	Black-browed albatross
Thalassarche salvini	Salvin's albatross
Thalassarche steadi	White-capped albatross
Tursiops truncatus	Common bottlenose dolphin
Ziphius cavirostris	Cuvier's beaked whale

Approach to Scoring

Primary and Secondary Outcome Stock Status

Stock status is determined according to stock assessments, where available and scored in the Outcome PI (PI 2.x.1). Generally speaking, stock assessments are available for the more heavily exploited primary species, notably tunas, but are not available for some of the other species classified as primary or any of the secondary species. Where a stock assessment is available, the MSC standard's default assessment tree is typically used to score PI 2.x.1 for primary and secondary species; future MSC assessment teams will need to consider the date of each assessment and determine if it is current. For this assessment, the primary, secondary, and ETP species were scored using the PSA since the intent was to be precautionary. It is likely that in a full assessment of specific UoAs enough information would exist on some specific species-area-gear combinations that the PSA would not be necessary.

Catches grouped together in the RFMO data as "not elsewhere included" (nei) did not reach the 2% threshold for scoring. However, in most cases a similar species did reach the threshold and was included in the scoring.

ETP Scoring

Stock status is determined according to stock assessments, where available and scored in the Outcome PI (PI 2.3.1). However, stock assessments are typically less available for ETP species; therefore, the PSA was used to score ETP species (see below).

PSA

The MSC utilizes a set of precautionary risk-based methodologies for the assessment of data-deficient fisheries. One of these methodolgies, the PSA, was adapted by the MSC for application for diverse, global fisheries; this methodology is used to assess the vulnerability of a species or stock when a stock assessment is not available, using a set of predetermined measurable attributes and score rankings. The PSA is used where stock status cannot be determined through more traditional assessment methods. The approach assumes the level of vulnerability (or risk) depends on two characteristics: 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 by fishing area, depending on whether the species is present in a region, and by gear type. Due to the number of fisheries and species being assessed, scores are not provided by gear type for a specific area. Instead, an overall, general score taking the most precautionary considerations is provided. Future assessments could divide the tuna fisheries into more distinct UoAs, and PSA scores could be developed to reflect particular national level management or particular fleet operational characteristics. In particular, variations in national level

management (both in terms of vessel flag state and fishing jurisdiction) in future full assessments would result in more local and regional detail, which is not captured in this exercise.

The PSA is made up of productivity 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. (Refer to Appendix 1 for the MSC scoring tables for the productivity and susceptibility attributes.) These attribute scores yield a PSA score, which is then converted into a corresponding MSC score. The MSC score and subsequent risk category are based on the general MSC scoring principle of <60 is high risk (i.e., a failing score), 60-80 is medium risk (i.e., a conditional passing score), and >80 is low risk (i.e., an unconditional passing score). All main primary and main secondary species stated in Table 2 and Table 3 were scored using the PSA. The "other species of interest" in Table 4 were also scored using the PSA. Refer to this link for these scores. The PSA and MSC scores and risk categories for these species are for example only because:

1. Scoring was only done for longline, pole and line, and purse seine. In an attempt to display scoring clearly, the scored attributes for each gear type were color coded (blue = longline, orange = pole and line, purple = purse seine).
2. Scoring was not done for all ocean regions. As a default, sub-tropical north Pacific was used for scoring the areal overlap attribute (see more detail below) since most species occur in that region. If a species was not present in that region, another Pacific region was used (e.g., sub-tropical south Pacific). If the species did not exist anywhere in the Pacific, sub-tropical north Atlantic followed by another Atlantic region (e.g., sub-tropical south Atlantic) were used. The exact region used for the PSA scoring is highlighted in pink.

Productivity is comprised of eight attributes (see FCR v2.0 section PF4.3): average age at maturity, average maximum age, fecundity, average maximum size, average size at maturity, reproductive strategy, trophic level, and density dependence (only scored for invertebrate species). For this assessment, productivity information was obtained from Fishbase (http://www.fishbase.org) and the IUCN Redlist (http://www.iucnredlist.org/) for fish and shark species and derived from various other internet resources for seabird, sea turtles, and marine mammals, including the IUCN Redlist. Where no such productivity data were available, a variety of approaches was used to derive estimates, ranging from referencing data from other species within the same taxon and similar size to more empirical techniques. For example, where maximum age and age at maturity were not reported on Fishbase or available elsewhere, but the von Bertalanffy growth rate parameter (K) was, the maximum age was determined based on simple life-history relationships (Froese and Binohlan 2000). Some of the productivity scores may therefore be of variable quality, and further verification of these scores would increase accuracy of findings. Nonetheless, productivity scores are considered adequate for this assessment, and where there is uncertainty, higher risk scores have been used.

Susceptibility is comprised of four attributes, which are described below(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. For this assessment, the high risk scores given for these attributes are likely the result of limited information. When a detailed assessment is done for a specific fishery, the quality of information will likely differ. Assessors would take data quality into account when determining the risk scores, which will help them better understand if a species is high risk due to lack of data (hence precaution) or because it truly is known to be high risk.

Areal overlap: Broad regions of the oceans were used to define the areas for this assessment (Pacific and Atlantic for the East, West, North, and South; the Mediterranean; the tropical Indian Ocean; tropical and subtropical regions; and the southern Indian Ocean). 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 plausibe argument or referenced evidence) were captured in the database. Further work on this aspect, specifically fishery-specific UoAs, would be informative, but area distributions for many species are uncertain so overlap cannot be estimated accurately.

Encounterability: More than 30% overlap between species vertical distrbution and depth of fishing is considered high risk, and less than 10% is low risk (FCR v2.0 Table PF5). The minimum risk score is 1 for all species included, even in those cases where catch might be considered negligible. For all baitfish species, encounterability was scored at 3 as this is a target species for the bait fishery. As with many portions of this assessment, a precautionary approach was taken. That is, if there was a chance of overlap (encounterability) due to the gear and species being pelagic in nature, a higher encounterability score was given. Marine mammals and turtles, for instance, must come to the surface for air so are likely to encounter gear at some point, even if they also spend time near the bottom. Birds and sharks will still get caught on a hook regardless of how many hooks are being fished because they will attempt to prey on the bait. Actual bycatch may be lower with fewer hooks, but the overlap (encounterability) would not be.

Selectivity: This attribute scores the probability of capturing a fish once it comes into contact with the gear. Where there is an argument that the gear is not suited to the capture of the species, lower scores have been allocated. The MSC guidance includes consideration of the likely size/age profile targeted by the gear relative to maturity (FCR v2.0 section PF4.4). Risk may be lowered if catches consist only of animals above size when they become mature. In most cases, no information was available on size so risk scores could not be reduced on this basis. Size composition for a number of species is routinely collected, and for these, the information could be examined to determine whether a lower risk score is merited. In general, probability of capture irrespective of maturity determines the score allocated in most cases. Selectivity will also depend on if any bycatch mitigation measures are used in a fishery, which will be fishery dependent, and on the type and dimensions of gear used (e.g., type of hook for sea turtles). Assessments of specific UoAs can better take this information into account and yield more accurate information on a fishery-specific measure.

Post-capture mortality: Direct information on post-capture survival is usually necessary to support lower risk scores, and such direct information is only rarely available. We assumed that post-capture mortality was high risk (score of 3) in all cases except where information was readily available to warrant a lower risk score. This also reflects the likely low impact of any interactions even if fishing is occurring within the vicinity of non-target species. It is worth nothing the interrelationship between post-capture mortality and selectivity. If a broader notion of selectivity is used in the sense that the selectivity risk score is lowered due to better size selectivity, then the post-capture mortality score would be higher as a result. This would be due to the fact that more of what is caught is killed and/or kept. The reverse is also true—if a species selectivity is used regardless of the subset of individuals that are actually caught, then a lower post-capture mortality risk score is potentally warrented if those less desired sizes are released alive. Post-capture mortality risk will also depend on if there is a market or subsistence use for a species. For instance, sharks caught may not be target species but may be finned or retained (where permitted) and lead to increased mortality.

Post-capture mortality may also depend in some circumstances on use of mitigation measures such as the backdown procedure in purse seine fisheries, which allows captured marine mammals out of gear or de-hooking techniques to safely remove hooks from sea turtles. As with selectivity, assessments of specific UoAs will yield more accurate information at the fishery level.

Application of the PSA to ETP Species Scoring

Given the large number of ETP species (Table 5), a subset of these species was scored using the PSA to provide an example of scoring for these species. Refer to this link for these scores. The relative impacts of tuna fisheries on the susceptibility attributes, based on gear types and areas fished, were determined from the same RFMO catch data in addition to other sources of information (e.g., IUCN Redlist, species- or gear-specific bycatch literature) to improve understanding of the likelihood of capture. Overall, a precautionary approach was taken when scoring the PSA attributes since information was often lacking or unclear. This approach was done even though in some cases a species may be less susceptible to a fishery's impact if there is less overlap between the UoA and species or if a mitigation measure is used. Additionaly, it is likely that in a full assessment of specific UoAs the PSA would not need to be used for some of the ETP species.

Cumulative Impacts and "Hindering Recovery"

Where a stock is likely below the PRI based on stock assessments or demonstrated to be high risk according to the PSA, the MSC standard requires that the contribution and likely impact of the UoA is considered to determine whether it is likely to hinder the recovery of the species. In order to determine this, the catch percent of the species by the gear and the UoA's contribution to overall catches of the species within the area is considered.

Where the species catch of the UoA is less than 30% of the total catch of that species, the UoA is not likely hinder recovery (FCR v2.0 guidance section GSA3.4.6). However, in this case, total catches of non-tuna species (including from non-tuna UoAs) are not currently available so the overall catch of those species within the area cannot be determined (although we are seeking to obtain this additional data). If available, it might be possible to use MSC guidance to show for some species that the species bycatch in tuna UoAs is not hindering any recovery or is not the main risk to the stock.

In addition, where catches of a species outside of biological limits are considerable (i.e., over 10% of the overall catch), there is also a requirement to assess the cumulative impact of MSC UoAs that also have considerable (10%) catches of the species to ensure they collectively do not hinder recovery and rebuilding (i.e., are within the 30% threshold of total catches; see Table 1).

Scoring the Remaining Principle 2 PIs

For the remaining Principle 2 PIs, where scoring is less likely to be empirically determined (i.e., for the managament and information PIs as well as all PIs for habitats and ecosystem), scoring justifications were written in an information input form in MS Word, which was designed to be a source for later report generation. To avoid repetition of the same scoring jusitifcations for different UoAs (and different combinations of species, gears, and areas), statements of scoring justifications and resulting scores were seperated according to the applicable area code and gear code. For example, an introductory generic statement refering to overall RFMO approaches, or tuna UoAs in general, would be identified with all gear codes and all area codes and scored appropriately. This statement would then be included within the final justification. Subsequent statements of justifcation add increasing levels of detail (and different scores) but apply to a smaller number of UoAs. For example, a statement about a particular gear type may apply across all areas, and a subsequent statement may add further detail for a particular gear type within a particular area whereas other justification statements may apply to all gears but only a particular RFMO. The final scoring justification for a given UoA would therefore comprise all of the justifications that apply to that UoA, and the score would be the lowest given for any of the justifications that are applicable to that UoA.

The project team collated scoring justifications for the Management PIs (PI 2.x.2), scoring issue "a" for primary species, secondary species, and ETP species from a number of MSC assessments (Appendix 2). The Management PI contains five scoring issues, but only scoring issue "a" (management strategy in place) was sufficiently broad based for treatment in this document. (See

Appendix 3 for an example Management PI scoring table.) The other scoring issues were dominated by fishery-specific input that varied among the assessments. Note that "management strategy in place" deals with shark finning requirements, while "shark finning" deals with the actual practices of the fishery. This management review did not consider bait as a primary or secondary species, as the management is localized; management depends on species and information that is mostly specific to each fishery.

We selected up to three MSC-certified fisheries by gear for each RFMO region. For the International Commission for the Conservation of Atlantic Tunas (ICCAT), this included North West Atlantic Canada longline swordfish, U.S. North Atlantic swordfish (longline), and North Atlantic albacore artisinal (troll). For the Inter-American Tropical Tuna Commission (IATTC), troll fisheries included AAFA and WFOA North Pacific albacore and CHMSF British Columbia albacore North Pacific. For WCPFC, troll fisheries included AAFA and WFOA South Pacific albacore, CHMSF British Columbia albacore South Pacific, and New Zealand albacore tuna troll; purse seine fisheries included PNA Western and Central Pacific skipjack and yellowfin (free school purse seine), Tri Marine Western and Central Pacific skipjack and yellowfin (free school purse seine), and Solomon Islands skipjack and yellowfin tuna (free school and anchored FAD), and longline included SZLC, HNSFC, and FZLC Cook Islands south Pacific albacore longline; Walker Seafood Australian albacore, yellowfin, and swordfish longline; and Fiji albacore longline. For the Indian Ocean Tuna Commission (IOTC), this included Maldives pole and line tuna. All of these fisheries used an older version of the MSC certification requirements (usually CR v1.1, 1.2, or 1.3). Therefore, some requirements of FCR v2.0 were not addressed, and all used the older categorization of "retained" and "bycatch" rather than "primary" and "secondary". The project team redistributed species to primary and secondary using the distinctions described in the Assessment Approach section above. This redistribution did not take into account score changes that could result from cumulative impacts if assessed under FCR v2.0.

These MSC assessments treated management strategy differently in two ways: some considered only or primarily national strategies while others considered RFMO and national strategies. MSC is currently preparing guidance for scoring fisheries with different jurisdictional levels (e.g., national, subregional, or regional). The project team recommends that fishery assessment teams consider the range of management jurisdictions and how each plays a role in determining the management of Principle 2 species.

All of the assessments reviewed considered that scoring issue "a" was met at the scoring guidepost (SG) 80 level, except that one assessment considered that the partial strategy did not sufficiently apply to one species. (See Appendix 4 for MSC's definitions of "measures", "partial strategy", "strategy", and "comprehensive strategy".) This resulted in that species having only measures in place, although all other species in the fishery met the partial strategy. Therefore, scoring distinctions occurred between partial strategy and strategy for primary and secondary species and between strategy and comprehensive strategy for ETP species (i.e., between SG80 and SG100).

Pole and line and troll fisheries are the most consistent in scoring justifications across RFMO areas. The Canadian swordfish harpoon fishery has similar characteristics and scores to the pole and line and troll fisheries, so was not addressed separately here. In every case, the scoring justifications relied on the very low rate of interactions documented for non-target species and the ability to release with minimal harm any species not retained (whether voluntary or mandatory). The difference in scoring generally reflected whether the assessment determined that no main species occurred in the fishery and defaulted to SG80 or specified species-specific management for a range of species to score all or a portion at SG100.

Certified purse seine fisheries occur only in the WCPFC region; all fish on free schools (unassociated) with the addition of anchored FADs in the Solomon Islands fishery. Of the three purse seine fisheries considered, all score 80 for "management strategy in place" for primary, secondary, and ETP species.

The PNA assessment has the main primary species as bigeye tuna, silky shark, and blue marlin; the Tri Marine Western and Central Pacific skipjack and yellowfin fishery has bigeye tuna as main primary, and the Solomon Islands fishery has no main primary species. The fisheries refer to WCPFC conservation and management measures (CMMs) as justification for reaching SG80, except in cases of no main species or species above PRI (blue marlin). CMM 2008-01 controls the overall level of purse seine effort and the impact of associated sets; very few bigeye tuna are caught in unassociated purse seine sets. There are measures in CMM 2014-01 that are mainly aimed at fishing on FADs and longline fishing, and ongoing monitoring of the status of bigeye tuna and the proportion of the total catch that the UoCs represents. CMM 2006-05 (amended in 2008 [CMM 2008-06], 2009 [CMM 2009-04], and 2010 [CMM 2010-07]) is specific to shark bycatch management (CMM 2010-07 for sharks, CMM 2011-07 for oceanic whitetip sharks, CMM 2014-04 for whale sharks, and CMM 2013-08 for silky sharks). These presently include a policy of non-retention on oceanic whitetip sharks. The PNA has also raised the issue of finning through WP9 – Application of Management Arrangements for Sharks. No main secondary species occurred in these fisheries. ETP species are treated inconsistently in the three assessment reports. PNA considers whale shark and false killer whales as ETP and scores them at SG100 based on prohibition of setting on whale shark and infrequent interactions with false killer whales. Tri Marine Western and Central Pacific skipjack and yellowfin recognizes sharks and seabirds as ETP. Justification for scoring SG80 uses CMMs with specific measures for sharks (CMM 2010-07), silky sharks (CMM 2013-08), oceanic whitetip sharks (CMM 2011-04), and whale sharks (CMM 2012-04), as well as CMMs for cetaceans (CMM 2011-03) and CMM 2008-03 plus minimal interactions for turtles. ETP interactions are rare in the Solomon Islands free school and anchored FAD fisheries, with cetaceans and sea turtles identified as ETP. The assessment references CMM 2011-03 for the protection of cetaceans and CMM 2008-03 plus minimal interactions for turtles as justification for scoring SG80.

Longline fisheries are certified for swordfish in the ICCAT region and for tuna in the WCPFC region. Longline fisheries catch a wide range of species and have a correspondingly wide range of management measures. The U.S. North Atlantic swordfish longline fishery references the U.S. fishery management plan for highly migratory species as justification that primary species score 100, specifying closed areas; prohibition of commercial retention and sale of billfish species and night, longfin mako, bigeye thresher, and scalloped hammerhead sharks; use of circle hooks; requirement for de-hooking equipment on board; and implementation of outreach programs encouraging safe release methods and gears. The North West Atlantic Canada longline swordfish fishery scores 80 for main primary species except for porbeagle shark, for which the partial strategy does not address the poor stock status of this stock. The fishery references demonstrably effective measures such as time/area closures, catch monitoring, and Canadian quotas for most species linked with ICCAT assessment which inform the harvest control rules; for specific species, bluefin tuna requires daily catch notification and reduction of dead Bluefin tuna discards, yellowfin tuna requires effort reduction, sharks require 5% fin-to-carcass ratio requirements and catch limits or quotas to restrict catch, and blue and white marlin require release.

WCPFC fisheries include Cook Islands, Walker, and Fiji. The Cook Islands assessment addresses bigeye tuna as main primary, even though the catches are small, referencing CMM 2013-01 with measures on FAD reduction, effort control, catch limits, and capacity management. At the Cook Islands level, there is no targeted fishery for bigeye. The fishery scores 80. The Walker assessment identifies bigeye tuna and striped marlin as main primary. These species score 80 based on conservative Australian quotas that do not hinder either species. The Fiji longline assessment identifies yellowfin tuna, bigeye tuna, sharks, and billfish as main primary. Yellowfin and bigeye have a partial strategy of CMM 2008-01 to control the overall level of purse seine effort and the impact of associated sets, although not directed at longlines. CMM 2006-05 (amended in 2008 [CMM 2008-06], 2009 [CMM 2009-04], and 2010 [CMM 2010-07]) is specific to shark bycatch management. Fiji applies country-specific gear limitations to reduce shark impacts. Swordfish and blue marlin are

within biological limits and do not require a management strategy. The Cook Islands assessment does not identify main secondary species so defaults to a score of 80. The Walker assessment identifies mahi mahi as main secondary; there is no evidence that the fishery is impacting the mahi mahi stock at present so it is not deemed necessary to put measures in place. The Fiji assessment identifies only opah as main secondary, which is not considered a species of concern at either national or regional level, and there are no management measures in place. Assessments for all three fisheries identifies seabirds, sea turtles, and cetaceans. Cook Islands and Walker further identify sharks as ETP. All assessments for seabirds refer to National Plan of Action-Seabirds and CMM 2007-04 to reach the SG80 level. Walker and Fiji reach SG100 on the basis of country-specific requirements, such as at least one assembled tori line on board, weighted swivels, partial ban of offal discharge while setting or whilst hauling (Walker) and a deep setting line shooter; and most sets commenced between the hours of 4-5 in the morning before it is light (Fiji). All assessments for sea turtles reference CMM 2008-03, aiming primarily at shallow-set longlines rather than deep-set albacore fisheries and country-specific requirements such as de-hooking devices. Cook Islands and Fiji score 80, but Walker scores 100 on the basis of large circle hooks, line-cutters, and de-hookers to aid the safe release of live turtles. For cetaceans, CMMs do not address longline fishing, but in-country requirements generally call for requires fishers to avoid the capture and release unharmed to the extent practicable, non-retained species, and many require line cutters and de-hookers, thus reaching an 80 score. Fiji scores 100 because whale species are protected by CITES in Fijian waters, thus restricting (but not stopping) trade of this animals in Fiji. At present, given the types of interaction of this fishery with cetaceans (e.g., depredation of caught tuna), there are no specific management measures in place to protect these species. Shark species considered as ETP are managed under the same measures described for primary and secondary (i.e., CMMs and country-specific management).

Data 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 focussed and in-depth full MSC assessment. Therefore, scoring includes an element of expert judgment based on the available evidence so any determination made here may differ from the conclusions in a full assessment. There may be some unforeseen additional issues that arise once the public consultation is undertaken as part of any full assessment. 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. As noted above, for this assessment, many of the high risk scores given for the susceptibility attributes are likely the result of limited information. When a detailed assessment is done for a specific fishery, the quality of information will likely differ. 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 future MSC assessments using FCR v2.0; individual assessments may reasonably come to conclusions different from those in this report.

The primary source of empirical evidence for this Principle 2 assessment is based on tuna RFMO landings data. The amount of catches of those species are derived for the last five available years from landings data (2008-2012 for WCPFC, IATTC and IOTC, and 2007-2011 for ICCAT) broken down by gear type and area. However, although landings are reported, public data are not very precise. In particular, these data do not include discards. This means the fishing mortality of some species may be severely underestimated or misidentified.

583 Data challenges arose in matching catch reporting areas to the areas used for this assessment.
584 Furthermore, not all catches are reported to species level with "other" often being a large
585 component of reported catch. Other species are grouped within the landings data. In this case, an
586 attempt has been made to determine the amount of species within the group and subsequently the
587 maximum proportion of the catch for the group that might be allocated to a single species. For a
588 catch of grouped species, neither an equal proportional allocation among all species (best case) or
589 almost all catch being allocated to a single species (worst case) are plausible. We use a simple
590 common pattern observed in species abundances in catches to identify the plausible worst case.
591 (Refer to Appendix 5 for more details on common patterns.)

592 Another challenge is that, in some cases, reported purse seine catches are divided into associated
593 and unassociated sets depending on whether the sets occur on fish aggregating devices (FADs).
594 These were coded as "sets on FADs" and "free-school" sets. It is possible some of the free-school
595 sets were made on other species, such as large sharks or marine mammals. Elsewhere, it was not
596 possible to differentiate catches between FAD and non-FAD purse seine sets, and the PSA results do
597 not reflect different set types. Although western Pacific reported data for "associated" and
598 "unassociated" sets, data were only available for major tuna species. Western Pacific purse seine
599 "associated" sets could be treated as FAD sets (coded as PSF in the spreadsheet). Unassociated sets
600 as defined for the western Pacific are equated to free schools (coded as PSB) set on birds, for
601 example. Sets associated with marine mammals or large sharks (coded as PSD) are not legal in the
602 western Pacific, and such associations are rare in the western Pacific. A landings group of "other"
603 species was defined, but this was undifferentiated. Pilling *et al.* (2013) gives estimates of the main
604 non-target species catch, but these are not broken down by set type (although the model they use
605 could does this). The Pilling *et al.* (2013) estimates were used for the western Pacific, but these data
606 could be greatly improved. In this assessment, we have not attempted to determine the cumulative
607 impact of the tuna UoAs on non-target species or to differentiate FAD (unassociated) sets from Free
608 School (unassociated) sets. The large dataset, different UoA specifics, and data and scoring
609 uncertainties make such an exercise extremely difficult and likely uninformative. Such consideration
610 of cumulative impacts would need to occur for a full MSC assessment.

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628 ## Appendix 1: MSC Productivity and Susceptibility Attribute Scoring Tables

629 **Table 6** Productivity attributes and scores (Table PF4 from MSC 2014a)

Productivity Attribute	High productivity (Low risk, score=1)	Medium productivity (medium risk, score=2)	Low productivity (high risk, score=3
Average age at maturity	<5 years	5-15 years	>15 years
Average maximum age	<10 years	10-25 years	>25 years
Fecundity	>20,000 eggs per year	100-20,000 eggs per year	<100 eggs per year
Average maximum size (not to be used when scoring invertebrate species)	<100 cm	100-300 cm	>300 cm
Average size at maturity (not to be used when scoring invertebrate species)	<40 cm	40-200 cm	>200 cm
Reproductive strategy	Broadcast spawner	Demersal egg layer	Live bearer
Trophic Level	<2.75	2.75-3.25	>3.25
Density dependence ‼ (to be used when scoring invertebrate species only)	Compensatory dynamics at low population size demonstrated or likely	No depensatory or compensatory dynamics demonstrated or likely	Depensatory dynamics at low population sizes (Allee effects) demonstrated or likely

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631 **Table 7** Susceptibility attributes and scores (Table PF5 from MSC 2014a)

Susceptibility attribute	Low susceptibility (Low risk, score=1)	Medium susceptibility (medium risk, score=2)	High susceptibility (high risk, score=3
Areal overlap (availability) Overlap of the fishing effort with a species concentration of the stock	<10% overlap	10-30% overlap	>30% overlap
Encounterability The position of the stock/species within the water column relative to the fishing gear, and the position of the stock/species within the habitat relative to the position of the gear	Low overlap with fishing gear (low encounterability)	Medium overlap with fishing gear	High overlap with fishing gear (high encounterability) Default score for target species (P1)
Selectivity of gear type Potential of the gear to retain species	a Individuals < size at maturity are rarely caught	a Individuals < size at maturity are regularly caught	a Individuals < size at maturity are frequently caught
	b Individuals < size at maturity can escape or avoid gear	b Individuals < half the size at maturity can escape or avoid gear	b Individuals < half the size at maturity are retained by gear
Post-capture mortality (PCM) The chance that, if captured, a species would be released and that it would be in a condition permitting subsequent survival	Evidence of majority released postcapture and survival	Evidence of some released postcapture and survival	Retained species or majority dead when released Default score for retained species (P1 or P2)

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Appendix 2: Comparison of Scoring Issue "A" for Primary Species, Secondary Species, and ETP Species for Selected MSC Assessments in the ICCAT, IATTC, WCPFC, and IOTC Regions[1]

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
2.1.2a	P&L	**North Atlantic albacore artisanal (80)** – The high selectivity of this gear is the main strategy for managing retained species. The small proportion of retained species in the nominal catch (1.8% by weigh of total catch in 2013) means that gear itself can be considered a partial strategy in place.	**AAFA and WFOA North Pacific albacore; CHMSF British Columbia albacore North Pacific (80)** – No main bycatch species in the fishery.	**AAFA and WFOA South Pacific albacore; CHMSF British Columbia albacore South Pacific (80)** – No main bycatch species in the fishery. **New Zealand albacore troll (80)** – The main strategy for managing retained species is an operational one – the near-clean nature of the fishing method. Of the small proportion of retained species in the reported catch (<1% by weight), the majority are the subject of analytical stock assessments performed within New Zealand or at the WPCFC, management advice is based upon biological reference points and management plans are under development. The highly migratory species management is based on internationally agreed stock status assessments and agreed approaches to management. However, not all retained species are subject to such detailed plans, but are the subject of TACC limits against which catches are monitored on an on-going basis. This strategy applies to a very small proportion of the overall catch.	**Maldives pole and line albacore and yellowfin (80)** – There is a partial strategy to maintain catches of yellowfin and bigeye tuna that are considered as main species according to the MSC approach, which is to maintain the status quo.
2.1.2a	PS	None	None	**PNA Western and Central Pacific skipjack and yellowfin free schools (80) –** There are measures and a partial strategy in place to constrain effort and reduce juvenile bigeye mortality from FAD use. **Bigeye:** There is a partial strategy in place based on the	None

[1] Text is abridged from text in the assessment or surveillance reports. Assessors are cautioned to refer back to original reports for complete language.

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
				various elements of CMM 2008-01 to control the overall level of purse seine effort and the impact of associated sets. However projections show that these measures will not maintain the stock within biologically-based limits over time. For the unassociated schools, due to the limited impact of this fishery on the bigeye tuna stock, there are no measures necessary, although monitoring of set activity in compliance with CMM 2009-02 is required. **Silky shark:** CMM 2006-05 (amended in 2008 [CMM 2008-06], 2009 [CMM 2009-04], and 2010 [CMM 2010-07]) is specific to shark bycatch management. It specifies binding and non-binding measures for CCMs. The PNA has also raised the issue of finning through WP9 – Application of Management Arrangements for Sharks. **Blue marlin:** At present this species is not considered to be outside of biologically-based limits and thus, considering the low levels of bycatch from these two fisheries, no bycatch strategy is currently considered necessary. **Tri Marine Western and Central Pacific skipjack and yellowfin (free school purse seine) (80)** – The main measure that ensures that the fishery does not hinder the recovery of bigeye tuna is the prescribed fishing method for the UoC. Very few bigeye tuna are caught in unassociated purse seine sets. There are measures in CMM 2014-01 that are mainly aimed at fishing on FADs and longline fishing, and ongoing monitoring of the status of bigeye tuna and the proportion of the total catch that the UoC represents. This system of ongoing monitoring and assessment, which includes observer coverage, is considered to constitute a strategy for the management of the impact of the fishery on bigeye	

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
				tuna. At present this strategy is effective in minimising the marginal contribution of the fishery to the total mortality of bigeye tuna, which is not currently within biologically based limits, predominantly because of the catch by other gears and fishing methods. **Solomon Islands skipjack and yellowfin (free school and anchored FAD) (80) –** Main bycatch species do not occur in the anchored FAD and unassociated fisheries, therefore reaching the SG80 by default. Silky shark is the most commonly caught bycatch species, but at low levels. WCPFC gives special consideration to sharks through several CMMs. WCPFC shark measures include CMM 2010-07 (sharks) and CMM 2011-07 (oceanic whitetip sharks), CMM 2014-04 (whale sharks), and CMM 2013-08 (silky shark). These presently include a policy of non-retention on oceanic whitetip sharks, now a CITES Appendix II listed species, and silky sharks (CMM 2013-08). For other species, CMM 2010-07 implements a 5% fin-to-carcass weight ratio. The Solomon Islands prohibits retention and requires release with minimal damage, and National Fisheries Development policy complies with an ISSF resolution for prohibition of shark finning and retention of useable species. A National Plan of Action-Sharks is drafted and undergoing finalization. There is also management of bigeye tuna, a minor species, at the WCPFC level (CMM 2014-01).	
2.1.2a	LL	**U.S. North Atlantic swordfish (100) – Blue marlin, white marlin/roundscale spearfish, west Atlantic sailfish, blue shark, night shark, longfin mako shark, bigeye thresher shark, scalloped hammerhead sharks, pelagic**	None	**SZLC, HNSFC, and FZLC Cook Islands south Pacific albacore (80) –** Bigeye (as is yellowfin) is managed through CMM 2013-01. The CMM recognises that bigeye is currently subject to overfishing and seeks to reduce fishing mortality (F) so that the stock is - at a minimum - maintained at MSY. The CMM includes measures on FAD reduction, effort control, catch limits	None

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
		stingray: Management measures implemented under HMS FMP and associated amendments represent a strategy for minimising bycatch of all species and include measures directed specifically at reducing bycatch of billfish and sharks to ensure that the fishery does not hinder recovery. The bycatch reduction plan incorporated within the U.S. HMS FMP represents a cohesive and strategic arrangement, comprising a number of measures aimed specifically at managing impacts of the fishery on all bycatch species. Measures include those expected to minimise bycatch (e.g. Florida East Coast closed area) and minimize the mortality of bycatch that cannot be avoided, e.g. prohibition of commercial retention and sale of **billfish** species and **night, longfin mako, bigeye thresher,** and **scalloped hammerhead sharks**; use of circle hooks; requirement for de-hooking equipment on board; and implementation of outreach programmes encouraging safe release methods and gears. **North West Atlantic Canada longline swordfish (75)** –		and capacity management. At the Cook Islands level, there is no targeted fishery for bigeye at present. The Cook Islands is meeting its obligations under CMM 2013-01 on this basis (in actual fact, the Cook Islands EEZ is outside the core range of bigeye tuna in any case, which is a more equatorial species). The catch of bigeye of the UoC is negligible compared to the overall catch of fisheries targeting the stock (~0.1%). Overall, the team concluded that these measures (CMM 2013-01, Cook Islands policy) form a partial strategy for bigeye. **Walker Seafood Australian albacore, yellowfin, and swordfish (80)** – **Bigeye tuna:** The stock abundance is at or below Blim. However, the Australian fishery is constrained such that it is not hindering recovery and rebuilding, based on a fixed TACC which accounts for ~0.7% of the total catch on the stock (WCPFC catch 2013: 150,000 t, ETBF TACC: 1056 t). The Australian system therefore has a partial strategy in place. **Striped marlin:** The ETBF striped marlin catch is managed using a TACC. At present, Australia is still using the striped marlin harvest strategy to set TACCs on an annual basis but TTRAG have limited confidence on how effective the harvest strategy is for managing fishing mortality within region 5 at current levels, since ETBF catch has dropped below 50% of the total region 5 catch in recent years (2012 – 41.5%; average 47% over last 5 years). Considering that the TACC is set according to a precautionary decision rule based on standardised CPUE for the fishery (a data set that is also incorporated into the stock assessment), the team considered that while the Australian harvest strategy may have limited utility in controlling the overall exploitation rate on the stock, it was nevertheless able to maintain the exploitation rate of the ETBF such that it is not	

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
		Porbeagle: A partial strategy exists (see 80 score below) except that it does not address the overfished stock status of porbeagle shark. **(80) – Bluefin, yellowfin, albacore:** The Canadian Integrated Management Plan describes measures interpreted as at least a partial strategy of demonstrably effective measures e.g. time/area closures, Canadian quota set based on ICCAT Recommendation linked with ICCAT assessment which informs the HCR, plus daily catch notification for BFT and reduction of dead BFT discards. As a result, the SG80 is met. Y**ellowfin:** Similar to bluefin, yellowfin and albacore, but no Canadian quota determined; rather, Canada has implemented effort limitation consistent with ICCAT recommendation. **Shortfin mako, blue sharks:** In addition to the monitoring and reporting requirements of the tuna species previously discussed, these species have 5% Fin to carcass ratio requirements and catch limits or quotas to restrict catch. As for the tuna species, this represents a partial strategy.		hindering recovery. There is therefore a partial strategy in place for this species. **Fiji albacore longline (80) – Yellowfin:** There is a partial strategy in place based on the various elements of CMM 2008-01 to control the overall level of purse seine effort and the impact of associated sets. Overfishing is not occurring and the stock is not overfished. Bigeye: Overfishing is occurring. There is a partial strategy in place based on the various elements of CMM 2008-01 to control the overall level of purse seine effort and the impact of associated sets. The 2011 SC recommended a minimum of 32% reduction in fishing mortality from the average levels for 2006-2009. **Sharks:** CMM 2006-05 (amended in 2008 [CMM 2008-06], 2009 [CMM 2009-04], and 2010 [CMM 2010-07]) is specific to shark bycatch management. It specifies binding and non-binding measures for CCMs. The Fiji Fisheries Department has diligently communicated the requirements of these CMMs to the UoC and shark gear is banned on Fijian domestic vessels as a license condition. The FTBOA makes active efforts to reduce shark bycatch by utilizing monofilament traces (wire traces are banned) that results in most sharks in biting through the line and escaping before being brought alongside the boat. In additional all the client fleet uses small (size 13 - 14 'D' shaped hooks that tend to have lower shark catch rates. As the fishery tends to operate at greater depths then at where most sharks are found, shark bycatch tends to occur only on the branch lines adjacent to the floats. **Billfish:** At present neither swordfish nor blue marlin is considered to be outside of biologically-based limits and thus, considering the low levels of bycatch from this fishery, no bycatch strategy is currently considered	

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
		Blue marlin, white marlin: In addition to the monitoring and reporting requirements of the tuna species previously discussed, Canada requires release of live marlin, based on ICCAT assessment.		necessary.	
2.2.2a	P&L	**North Atlantic albacore artisanal (80)** – No primary species. The troll gear was considered to constitute an operational strategy for minimizing bycatch species as it is clearly designed for and is successful at catching albacore rather than other species. Fishermen discern if a targeted albacore shoal is comprised of fish that are too small to be retained for economic or regulatory reasons even though there is no minimum size. If so, the vessel moves to find another shoal containing larger, marketable albacore. The fishing strategy ensures that the fishery does not pose the risk of causing serious or irreversible harm to bycatch populations.	**AAFA and WFOA North Pacific albacore; CHMSF British Columbia albacore North Pacific (80)** – No main secondary species.	**AAFA and WFOA South Pacific albacore; CHMSF British Columbia albacore South Pacific (80)** – No main secondary species. **New Zealand albacore troll (80)** – Species outside the QMS are considered to have a low risk of being overfished. As a result, substantial catches of non-QMS species has usually resulted in a change to QMS status. This represents a partial strategy, since if bycatch species consistently reached 'main' levels (>5% of the catch), it would likely (but not always) be moved into the QMS. Furthermore, the framework of continual monitoring of bycatch through the (limited) observer programme, and the noting of species catches within vessel logbooks if they represent the top five species caught in a fishing event, provides a basis for simple assessments of the impact of the fishery on these species or species groups. Issues with recording small proportions of bycatch species within logbooks have been noted.	**Maldives pole and line albacore and yellowfin (80)** – The partial strategy is to maintain the current fishing practises. On that basis it is considered highly likely that the bycatch will not increase and that the limited numbers of species taken will be within biologically based limits or in the case that the status of a species requires recovery the P&L fishery will not hinder that recovery.
2.2.2a	PS	None	None	**PNA Western and Central Pacific skipjack and yellowfin free schools (80)** – No main secondary species. **Tri Marine Western and Central Pacific skipjack and**	

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
				yellowfin (free school purse seine) (80) – No main secondary species. **Solomon Islands skipjack and yellowfin (free school and anchored FAD) (80)** – There are no main species for the anchored FAD and unassociated fisheries, so default to SG80. A partial strategy occurs through an observer program, on-board and port sampling and VMS.	
2.2.2a	LL	**U.S. North Atlantic swordfish (80)** – **Dolphinfish:** The SAFMC FMP for dolphin and wahoo fishery in the Atlantic represents a strategy that provides a framework for the implementation of measures expected to maintain the species at levels within biologically based limits. Annual catch limits and accountability measures for dolphinfish further support the strategy. **North West Atlantic Canada longline swordfish (80)** – No main species. A partial strategy exists similar to that of primary species.	None	**Walker Seafood Australian albacore, yellowfin, and swordfish (80)** – **Mahi mahi:** Analysis showed no evidence that the ETBF is impacting the mahi mahistock at present. Based on this, it was not deemed necessary to put measures in place. However, AFMA have set in motion a process which will incorporate mahi mahi into the harvest strategy process including standardising CPUE for mahi mahi, and evaluating how the harvest strategy can best be applied to this species. **Lancetfish and snake mackerel:** They were considered by the stakeholders to be of highest risk in the fishery. According to logbook records, neither species is main. **SZLC, HNSFC, and FZLC Cook Islands south Pacific albacore (80)** – Based on 2013 observer data, none of the bycatch species could be qualified as 'main'. SG80 is therefore met by default. The 2005 Resolution on Non-Target Fish Species (Resolution-2005-03) is the main instrument through which bycatch is managed. **Fiji albacore longline (80) – Opah:** Given that opah is not considered a species of concern at either national or regional level, there are no management measures in place. This is supported by the consistent CPUE and size at capture information.	None

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
2.3.2a	P&L	**North Atlantic albacore artisanal (80)** – The nature of the fishery, including the gear type in use and the method of working the gear, provides sufficient information to infer that the fishery under assessment almost no risk to ETP species. Troll gear was considered to constitute an operational strategy for managing bycatch species on the grounds that the gear is clearly designed for and is successful at catching albacore rather than other species. The Spanish Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad protects among other all species included in Appendix I of CITES. Additional regulation for ETP sharks is provided by the Orden ARM/1647/2009, de 15 de junio, in which highly migratory species are regulated, prohibiting the capture, possession on board, landing or marketing of swordfish and pelagic shark by any vessel that is not included in the census unified surface longline. This regulation and the features of the fishery are considered to constitute a strategy for managing the fishery's impact on ETP species	**AAFA and WFOA North Pacific albacore; CHMSF British Columbia albacore North Pacific (80)** – The pole and troll albacore fishery is highly selective with the gear always being attached and actively worked in very close proximity to the vessel, while the gear is retrieved as soon as anything is hooked and barbless hooks are used. The lines are short and loss of fishing gear is likely to be relatively rare, with any lost gear likely to quickly drop to the seafloor. These features of the fishery minimise the potential for any direct interactions with ETP species, while also minimising the potential for mortality in the event that anything was hooked but subsequently released. The rare likelihood of gear loss minimise the potential for indirect impacts. **CHMSF British Columbia albacore North Pacific (100)** – SARA requires recovery strategies and management plan, mandatory logbooks, and provision of data on ETP species. Under SARA, a recovery strategy has been implemented for the	**AAFA and WFOA South Pacific albacore; CHMSF British Columbia albacore South Pacific (80)** – The pole and troll albacore fishery is highly selective with the gear always being attached and actively worked in very close proximity to the vessel, while the gear is retrieved as soon as anything is hooked and barbless hooks are used. The lines are short and loss of fishing gear is likely to be relatively rare, with any lost gear likely to quickly drop to the seafloor. These features of the fishery minimise the potential for any direct interactions with ETP species, while also minimising the potential for mortality in the event that anything was hooked but subsequently released. The rare likelihood of gear loss minimise the potential for indirect impacts. **New Zealand albacore troll (100)** – The main strategy is operational. The trolling approach does not attract birds or other ETP species to the gear, hence appearing to eliminate interactions. Key legislation for ETP species includes the Fisheries Act (1996), Wildlife Act (1953), Marine Mammals Protection Act (1978), and specific regulations for birds (relating to bycatch mitigation approaches). Combined with the requirement to report injury or mortality of protected species to the Department of Conservation (without offence), and the observer programme, these provide a strategy to monitor and hence implement the legislation. National Plans of Action have been developed (but not yet implemented) for birds and sharks. An environmental risk assessment process is being performed, which aims to support the revision of New Zealand's National Plan of Action – Seabirds by identifying those species most at risk from fisheries from additional mortality above natural levels.	**Maldives pole and line albacore and yellowfin (80)** – Due to the negligible levels of interaction or impact, there is no requirement for a fishery specific strategy to reduce the level of ETP interaction or mortality. There is a partial strategy of maintaining the status quo (i.e. the operations of the vessels will not change) while there are national laws and IOTC regulations in place to protect the key endangered and threatened species.

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
		that is highly likely to achieve national and international requirements for the protection of ETP species.	leatherback turtle, the fin, blue and sei whales, and the short-tailed albatross, blue whale and the Northern right whale. Commercial fishing licences specify mitigation measures for Basking shark in accordance with SARA permit requirements. Codes of Conduct for Shark Encounters reduce the mortality of Basking Shark. These guidelines include boat handling procedures during visual encounters with Basking Sharks and best practices for handling Canadian Pacific shark species during entanglement encounters. No ETP species catch has been reported in mandatory logbooks or independent observer reports, but the possibility of incidental occurrences of ETP species catch in the fishery is not discounted. If incidental catches of ETP species occur, the animal may be returned to the water alive with high survival due to the characteristics of the fishing.		
2.3.2a	PS	None	None	**PNA Western and Central Pacific skipjack and yellowfin (100)** – **False killer whale**: Given the low interaction of these fisheries with false killer whales, there are no specific management measures in place to protect these species. **Whale shark:** PNA has agreed a ban on the setting on	None

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
				whale sharks and is in the process of setting the rule parameters to control this. Management of non-target species taken in fisheries for target stocks is addressed through the WCPFC-2 Resolution on Non-Target Fish Species that includes the preparation of risk assessments at regional level as well as within the PICT EAFM reports that allow the identification of management measures if deemed necessary by the Ecosystems and Bycatch Specialist Working Group. This is also supported by the recently increased observer coverage of 100% in the purse seine fisheries. CMM 2008-03 is applied to **turtles**, but encounters are extremely rare. **Tri Marine Western and Central Pacific skipjack and yellowfin (free school purse seine) (80)** – The CMMs (and matching U.S. regulations) in place require measures to reduce mortality of **sharks** generally (CMM 2010-07), CMMs with specific measures for **silky sharks** (2013-08), **oceanic whitetip sharks** (CMM 2011-04), and **whale sharks** (CMM 2012-04), as well as CMMs for **cetaceans** (2011-03), and for **turtles** (CMM 2008-03). These are considered to constitute a comprehensive strategy to manage the fishery's impact of ETP species. The design of this strategy is considered highly likely to achieve the national and international requirements for protection. It is not, however, assessed as being designed to achieve above these requirements. This meets the requirements of the SG 60 and SG 80 levels but not the SG 100 level for each of these elements. For **seabirds**, no direct management strategy is required because PS interactions are so rare and the potential effects are indirect. **Solomon Islands skipjack and yellowtail (free school**	

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
				and anchored FAD) (80) – The anchored FAD and unassociated fisheries have minimal interactions with ETP species. The WCPFC has implemented CMM 2011-03 for the protection of **cetaceans**, prohibiting setting on mammals, requiring release of mammals from nets as quickly as practicable with minimum damage, and report in interactions. The WCPFC has issued measures under CMM 2008-03, on the conservation and management of **sea turtles**, requiring the implementation of the FAO Guidelines to Reduce Sea Turtle Mortality in Fishing Operations and to ensure the safe handling of all captured sea turtles, in order to improve their survival. The Solomon Islands, as a condition of permit, has implemented these measures for the purse seine fisheries. Together, this constitutes a strategy to minimize mortality for the anchored FAD, unassociated, and pole and line fisheries.	
2.3.2a	LL	**U.S. North Atlantic swordfish (80) – Sea Turtles:** A strategy for managing fishery impacts on sea turtles species exists under mechanisms promulgated through the MSFCMA and the Endangered Species Act (e.g. generation of BiOps, resulting RPAs and 3 yearly ITS). Since measures brought in as a result of the last BiOP in 2004 have been implemented, there have been reductions in the number of estimated interactions between longline gear and both species of sea turtles across the entire US pelagic longline fishery. **Marine Mammals:** Elements of	None	**SZLC, HNSFC, and FZLC Cook Islands south Pacific albacore – Seabirds (80):** Cook Islands implemented an NPOA-Seabirds consistent with the IPOA-Seabirds, which requires vessels to record any encounters with seabirds (live or dead) and report this to the MMR. WCPFC seabird CMM 2007-04 applies to fisheries operating south of 30 degrees South and north of 23 degrees North and does not apply to the Cook Islands EEZ. A more precautionary CMM, applying to additional risk areas from 25°S-30°S and 20°N-40°N is under consideration. **Turtles (80):** At regional level, the WCPFC CMM 2008-03 covers numerous measures including mitigation methods to reduce the capture of sea turtles and to increase post-release survival chances as well as reporting requirements and a provision for CCMs to carry out research on mitigation methods. The CMM has been adopted though its NPOA-Sea turtles and by	None

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
		the marine mammal strategy consist of stock assessments, Take Rduction Teams, health and stranding response plan, conservation plan, ecosystem science, and Internation Plan of Actions for marine mammals. The pelagic longline TRP implemented for pilot whales and Risso's dolphin a special research area, 20 nmi maximum groundline length, and placards for handling and release requirements. Non-regulatory requirements called for increased observer coverage int the area frequented by pilot whales and Risso's dolphin, and encouragement for vessels to communicate among themselves on locations of pilot whales and Risso's dolphins. **Seabirds:** An NPOA provides a precautionary strategy for seabirds. If protective or recovery measures were necessary for seabirds impacted by the pelagic longline fishery, the plan would form the basis for those actions. No actions are currently necessary. **North West Atlantic Canada longline swordfish (80)** – The strategy in place for managing		the Regional Action Plan for Sea Turtle By-Catch Mitigation implemented by FFA member. The NPOA sets out to improve knowledge of fishing practices and interactions through collection and monitoring of fishery data, research and trials of mitigation measures, and establishes current "best practice" mitigation methods for implementation, and adopted through the Cook Islands longline Fishery Plan. **Sharks (100):** Four management levels for sharks occur for the UoC: 1) at WCPFC level: CMM 2010-07 on sharks; CMM 2011-04 on oceanic white-tips and CMM 2013-08 on silky sharks; 2) at national level via the overarching Shark Sanctuary Regulations; 3) at national level via the NPOA-sharks and 4) at company level through the LTFV policy on sharks; aim for zero capture and retention of any shark or ray species, with maximisation of the survival of any shark that does get caught. **Cetaceans (80):** They are not specifically addressed in WCPFC CMMs for longline fisheries, but are generally covered under the Cook Islands' Marine Resources (Longline Fishery) Regulations 2008, which states that requires fishers to avoid the capture, and release unharmed, to the extent practicable, non-retained species. Cetacean interactions in the fishery are considered rare. **Walker Seafood Australian albacore, yellowfin, and swordfish** – Annual strategic assessments of the fisheries every year ensure ecological sustainability to gain export approval by SEWPAC under Wildlife Trade Operation and considers a variety of impacts from hazard analysis and takes the highest-risk species into further analyses and provides an overarching strategy. **Turtles (100):** WCPFC has issued measures under CMM	

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
		the fishery's impact on certain ETP species (leatherback turtles, loggerhead turtles, northern bottle nose whales), includes measures to minimize mortality, that is designed to be highly likely to achieve national requirements for species listed under SARA and international requirements for the protection of ETP species. Canada does not allow domestic or international trade of ETP species listed under CITES and recovery plans have been adopted for those species listed under SARA. There is an objective basis for confidence that the strategy will work, e.g. the Gully MPA has been implemented and vessel activity is monitored through VMS. Information is available for the assessed fishery and for the species involved. Loggerhead sea turtles initially had a condition for 2.3.2a, but it was closed in the third surveillance, resulting in SG80 for all species.		2008-03, on the conservation and management of sea turtles, and Australia put in place a turtle mitigation plan. These constitute a comprehensive management strategy for turtles as it operated on a trigger system, including large circle hooks, line-cutters and de-hookers to aid the safe release of live turtles. SG100 is therefore met. **Seabirds (100):** In compliance with the WCPFC CMM for seabirds, the ETBF set the following management measures as mandatory in 2013: at least one assembled tori line on board; weighted swivels; partial ban of offal discharge while setting or whilst hauling. A Threat Abatement Plan for the incidental catch of seabirds meets the requirements of a National Plan of Action (NPOA). A recovery plan for albatross and giant petrels was implemented in 2001. These constitute comprehensive strategies for the managing of fishery impacts on seabirds. SG100 is therefore met. **Marine mammals (80):** No CMMs addressing marine mammals exist for longline fisheries at the regional level. All interactions must be recorded in vessel logbooks and submitted to AFMA, and then subsequently to the Department of Sustainability, Environment, Water, Population and Communities at three-month intervals. Compulsory line cutters and de-hookers onboard help safely release hooked or entangled cetaceans. Operators in the ATBF are also encouraged to trial marine mammal bycatch mitigation. Recovery plans were also developed for blue, fin, sei, humpback and southern right whales for 2005 – 2010. These were due to undergo review in 2010, but as yet, no updated plan is available. Marine mammals are also specifically addressed in the ETBF Management Plan: "all reasonable steps are taken to minimise interaction with seabirds, marine reptiles, marine mammals".	

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
				Elasmobranchs (80): Management measures include a bycatch limit 20 sharks per trip (although must be balanced by 20 quota species) and a ban on wire traces. Porbeagle, shortfin mako, longfin mako sharks caught alive must be released with only dead sharks retained. Management measures brought into the ETBF include a bycatch limit of 20 sharks per trip (which must be balanced by 20 individuals of one or more quota species) and a ban on wire traces. Level 3 risk analysis on four species of ETP shark led to the downgrading of 'high risk' ETP shark species to medium, due to the ban on wire traces having reduced gear selectivity for catching sharks. Longfin mako was the only ETP shark species to remain high risk and this was due to insufficient population data. Mandatory line cutters and dehookers aid shark bycatch mitigation. Identification guides and shark handling training has also been included in the fishery to aid skipper and crew awareness. Porbeagle, shortfin mako, longfin mako sharks caught alive must be released with only dead sharks retained. **Fiji albacore longline – Sea turtles (80):** CMM 2008-03 is applied to turtles but is aimed primarily at shallow-set longlines, rather than deep-set albacore fisheries like the one under assessment. At a national level, the 'Fiji Sea Turtle Recovery Plan' includes 'assessing and mitigating bycatch' (Component 1b). At an industry level there have been regular efforts to mitigate sea turtle mortality by ensuring that de-hooking and other tools are both available on vessels and that crew are sensitised and trained in their use. **Cetaceans (100):** A number of whale species are protected by CITES in Fijian waters, thus restricting (but not stopping) trade of this animals in Fiji. At present,	

PI	Gear	ICCAT Fishery	IATTC Fishery	WCPFC Fishery	IOTC Fishery
				given the types of interaction of this fishery with cetaceans (e.g. depredation of caught tuna), there are no specific management measures in place to protect these species. **Seabirds (100):** CMM 2007-04 requires CCMs to implement IPOA-Seabirds in Longline Fisheries (IPOA-Seabirds) if they have not already done so, report to the Commission the status of their National Plans of Action for Reducing Incidental Catches of Seabirds in Longline Fisheries, and encourages longline vessels fishing in areas north of 30°S to employ one or more of a number of listed seabird mitigation measures; fleet under assessment employs a deep setting line shooter and most sets are commenced between the hours of 4-5 in the morning before it is light, although setting may continue into daylight hours.	

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638 ## Appendix 3: Example MSC Scoring Table

639 **Table 8** Scoring table for primary species management PI (Table SA11 from MSC 2014a)

Component	PI	Scoring issues	SG60	SG80	SG100
Primary species	Management strategy **2.1.2** There is a strategy in place that is designed to maintain or to not hinder rebuilding of primary species; and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch.	(a) Management strategy in place	There are **measures** in place for the UoA, if necessary, that are expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are likely to be above the PRI.	There is a **partial strategy** in place for the UoA, if necessary, that is expected to maintain or to not hinder rebuilding of the main primary species at/to levels which are highly likely to be above the PRI.	There is a **strategy** in place for the UoA for managing main and minor primary species.
		(b) Management strategy evaluation	The measures are considered **likely** to work, based on plausible argument (e.g., general experience, theory or comparison with similar UoAs/ species).	There is some **objective basis for confidence** that the measures/ partial strategy will work, based on some information directly about the UoA and/or species involved.	**Testing** supports **high confidence** that the partial strategy/ strategy will work, based on information directly about the UoA and/or species involved.
		(c) Management strategy implementation		There is **some evidence** that the measures/ partial strategy is being **implemented successfully**.	There is **clear evidence** that the partial strategy/ strategy is being **implemented successfully and is achieving its overall objective as set out in scoring issue (a).**
		(d) Shark finning	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.

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		(e) Review of alternative measures	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species and they are implemented as appropriate.	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of all primary species, and they are implemented, as appropriate.

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Appendix 4: MSC Management Definitions and Definition Guidance

The following definitions are quoted from MSC 2014a Table SA8:

- "**Measures**" are actions or tools in place that either explicitly manage impacts on the component or indirectly contribute to management of the component under assessment having been designed to manage impacts elsewhere.
- A "**partial strategy**" represents a cohesive arrangement which may comprise one or more measures, an understanding of how it/they work to achieve an outcome and an awareness of the need to change the measures should they cease to be effective. It may not have been designed to manage the impact on that component specifically.
- A "**strategy**" represents a cohesive and strategic arrangement which may comprise one or more measures, an understanding of how it/they work to achieve an outcome and which should be designed to manage impact on that component specifically. A strategy needs to be appropriate to the scale, intensity and cultural context of the fishery and should contain mechanisms for the modification fishing practices in the light of the identification of unacceptable impacts.
- A "**comprehensive strategy**" (applicable only for ETP component) is a complete and tested strategy made up of linked monitoring, analyses, and management measures and responses.

The definitions are accompanied by the following MSC guidance (quoted from MSC 2014b Table GSA3):

- "**Measures**" could include the closure of an area that was primarily been put in place to avoid the catch of juvenile target species and enhance target species sustainability, but also has a beneficial effect on the unwanted catch of sensitive species such as other juvenile finfish.
- For a "**partial strategy**", specific measures may not have been designed to manage the impact on that component specifically, but if such a measure/ measures are effective in assisting the UoA to achieve the SG80 level for the primary or secondary species Outcome PI then this could be considered as a management measure under the primary or secondary species Management Strategy PI.
- A "**strategy**" could include voluntary or customary arrangements, agreements or practices, codes of practice (if they can be demonstrated to be working).
- For a "**comprehensive strategy**" to be achieved information is required to ensure and continue to confirm that the UoA has no impact upon that component.

Appendix 5: Common Patterns

Common patterns have been identified among sberspecies 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 fish communities, it is a simple function that captures the major change in relative among species. The most widely used species abundance model, the log-normal, would likely be a better basis for species abundance, 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 over estimating the abundance in the highest ranked species (Magurran 1988), and therefore for our purposes is precautionary and is the plausible worst case.

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 number of species in groups above five suggests 50% of the total catch would be the maximum allocation to a single species (Table 9). Otherwise, all species that are listed without recorded catches but could have a non-zero catch are listed as minor.

Table 9 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