OPAGAC tuna purse seine MSC pre-assessment: update and expansion of Principle 2

Jo Gascoigne, 23 September 2015

FINAL

Contents

1 Introduction

This report is a review and expansion for MSC Principle 2 of a pre-existing MSC pre-assessment for the Spanish tuna fishery by members of OPAGAC (Organización de Productores Asociados de Grandes Atuneros Congeladores), under the MSC Standard version 1.3 (MRAG 2014). This report expands the analysis of P2 in MRAG (2014) to include more differentiation between different types of set and between oceans, where possible, and updates it to the MSC standard version 2.0. The OPAGAC fleet operates in the Atlantic, Indian and Pacific Oceans and targets skipjack, yellowfin and bigeye tuna using purse seine gear. Purse seines are set on free schools of tuna ('free sets'), Fish Aggregating Devices (FADs; rafts made of bamboo, palm leaves and net with a location pinger) and natural 'FADs' (trees, vegetation mats and other debris, whales, whale sharks) ('associated sets'). The majority of catches made by the OPAGAC fleet are taken via associated sets.

The terms of reference for this study can be summarised as follows:

- Expand the rationales and scoring for Principle 2 of MRAG 2014 so that fishing on free schools and via associated sets are separated (i.e. two sets of scores and rationales);
- Evaluate differences between oceans as far as possible given the data available;
- Update the scores and rationales to version 2.0 of the MSC standard;
- Review the updated scores and rationales in relation to existing MSC-certified fisheries which overlap with the OPAGAC fishery, as well as with the WWF approach to scoring for these PIs which may be more precautionary;
- Identify (in general terms) possible actions for improvement for PIs which score less than 80.

The report provides background on the fishery only to the extent required to set out and explain the data and analyses used to fulfil the requirements set out above; for more general background the reader is referred to MRAG (2014) which includes a very thorough analysis of the P2-related management measures in each ocean.

As required by the terms of reference, the report separates scoring of associated sets and free sets (as far as possible – see below). The question arises as to how to define sets on natural FADs (debris, whales and whale sharks). The MSC assessment of the PNA free-school skipjack fishery (Banks et al. 2011) includes everything other than sets on artificial FADs (i.e. sets on natural debris, cetaceans and whale sharks are included), while the MSC assessment of the Echebastar free-school fishery (FCI 2015) specifically excludes sets on whales and whale sharks from the UoA. In this report, we use 'free sets' to describe only sets made where there is no visible item on the surface – sets on FADs, natural debris and other animals are included in the 'associated sets' category. Note, however, that within this category, some distinctions may be made in scoring where necessarily / possible.

The sources of data used in the analysis were the following:

- Some information provided by AZTI, OPAGAC's scientific advisors, including a list of species encountered in the observer reports, and some synthesis of observer data, but not any observer reports themselves;
- MRAG 2014 and references cited therein;
- Other similar fisheries in the MSC programme (i.e. the PNA and Echebastar free-school fisheries);
- Reports from tuna RFMOs and other published scientific reports;
- A review of some unpublished observer reports, the source of which has to remain confidential – it is therefore unfortunately not possible to specify which fishery or ocean they come from.

Pre-assessment reports sometimes provide an anticipated outcome in terms of score category (i.e. <60, 60-80, >80 – usually interpreted as red, orange and green) and sometimes try to estimate actual numerical scores to the nearest 5 points (see contrasting strategies in MRAG 2010 and MRAG 2014). The experience of the author suggests that the predictions made in pre-assessments, on the basis of limited data, are not usually accurate enough to make it worthwhile to try and estimate quantitative scores – indeed, the category classifications are often uncertain (and sometimes turn out to be wrong). Therefore, for this study, the category system has been used. Note that this means that SG100 does not need to be considered, since this only intervenes for scores which have already been determined to be in the highest (green) category.

2 Summary of results

PI #	PI title		Proposed outcome				MRAG 2014 (v1.3)	Existing MSC-certified fisheries (non-FAD) (v1.3)		MRAG 2010 (Ecuador purse-seine pre-assessment) (v1.3)		MRAG 2015 (Ecuador pre-assessment skipjack only) (v1.3)		Reason for differences in this study (summary)
	v1.3	v2.0	This study (v2.0)											
			Associated		Free			PNA	Echebastar (not final)	FAD	free-school	FAD	free-school	
2.1.1	Retained spp. - outcome	Primary spp. – outcome					80	80	80*					
2.1.2	- management						90	80	80					bigeye (P1 vs P2)
2.1.3	- information						90	80	75					
2.2.1	Bycatch spp. – outcome	Secondary spp. – outcome	IATTC IOTC ICCAT	WCPFC			80	80	100					silky sharks (FADs; IOTC, IATTC) (considered as ETP elsewhere); whale sharks (ICCAT not ETP)
2.2.2	- management		IATTC IOTC ICCAT	WCPFC			80	75	90					
2.2.3	- information		IATTC IOTC	WCPFC ICCAT			80	90	80					
2.3.1	ETP spp. – outcome		IOTC	ICCAT WCPFC IATTC			80	70	85*					silky sharks (FADs, WCPFC, ICCAT), Arabian Sea humpback whale (FAD, IOTC)
2.3.2	- management					ICCAT	75	85	85					code of good practice only verified in Atlantic; removal of all entangling FADs needs to be formalised / verified
2.3.3	- information						85	85	75					FAD entanglement, impact on cetaceans
2.4.1	Habitats – outcome						100	100	100					
2.4.2	- management						100	100	100					
2.4.3	- information						95	100	85					
2.5.1	Ecosystem – outcome						70	80	80					The role of FADs in the ecosystem
2.5.2	- management						90	95	80					
2.5.3	- information						90	95	80					

3 Background

3.1 Associated vs. free-school sets

As noted in the introduction and as set out clearly by OPAGAC in their response to the first draft of this report, the distinction between an 'associated set' and a 'free set' is not as binary as the analysis in this report might suggest. Purse-seiners set nets around FADs – i.e. human-made rafts of bamboo or PVC and net, with or without a location beacon – and around free-schools with no surface indicator except birds, but also around naturally drifting objects such as branches, mats of vegetation, stray buoys etc., as well as whales and whale sharks (usually without causing injury). (Often, natural objects are reinforced with some net, palm leaves or other convenient substance, and a pinger may be added, presumably turning it into a FAD.) It is not, however, completely clear whether such sets on branches and whales /whale sharks should be considered to be associated sets or free sets. The situation is even more unclear if FAD sets are considered to include sets in the vicinity of FADs – Adam et al. (2015) notes that if you take a 5nm exclusion zone around FADs to define a free-school set[1], and consider natural objects and whales/whale sharks as FADs, then there are not likely to be many/any free-school sets at all.

Nevertheless, it is clarified here that separating scoring by associated and free sets was a requirement of the terms of reference, and therefore is maintained here despite OPAGAC's (justified) reservations. It is worth noting that both MSC assessments of tuna purse seine fisheries have made this distinction (Echebastar, PNA), although in different ways. In the comments received on the first draft of this report, one set argued strongly that any natural item (including an animal) was equivalent to a FAD, while the other argued just as strongly that only man-made objects should be considered in the definition of associated sets – illustrating nicely the difficulties of definition. For the purposes of this report, and as requested by WWF, sets on FADs, natural debris and animals are considered 'associated sets' (Table 1).

Table 1. Definition of set types used in this report

Associated sets are sets on …	Free sets are on
• FADs • natural debris (mats of vegetation, branches, trees, weed) • cetaceans • whale sharks	• schools of tuna with no visible markers at the surface except splashing, birds etc.

3.2 MSC versions 1.3 vs. 2.0

In relation to P2, the key differences between MSC versions 1.3 and 2.0 are as follows:

- Primary and secondary species: Instead of making a distinction between retained and discarded bycatch species (2.1 vs. 2.2) it makes a distinction between 'primary' and 'secondary' bycatch species, the difference being whether or not they are managed in relation to reference points. In some tuna fisheries this might have the effect, for example, of moving species which are sometimes retained (e.g. the smaller tunas) from 2.1 to 2.2 – in this fishery, however, catches of species other than the three main tuna species (i.e. skipjack, yellowfin

[1] although this distance seems a bit arbitrary

and bigeye; all considered under P1) are too small to count as 'main' bycatch species (see below), so the issue does not really arise.

- Definition of 'main' bycatch species: The cut-off threshold of >5% of the total catch to define a 'main' primary or secondary species has been formalised; a threshold of >2% has been added for species which are considered vulnerable (value is no longer a criterion). It is still, however, possible for an assessment team to promote species making up a smaller proportion of the catch to 'main' at their discretion, if they can make a 'plausible argument' as to why it should be (WWF 2015). This has been invoked below for some species which are formally protected (i.e. ETP) in some oceans but not others, to give some consistency across assessments in different areas.
- Definition of ETP species: The criteria which can be used to define a species as ETP have been somewhat broadened, although in this particular case it has not made much difference. There are still (in the author's opinion) likely to be differences in interpretation of what constitutes an ETP species – for example when a species is banned from capture under fisheries regulations. For the purposes of this assessment, any species which is protected in some way under regulations which are binding on the fishery, including EU regulations and regulations from RFMOs, have been included as ETP. This gives a wider definition of ETP than in MRAG (2014), and one which leads to inconsistencies between oceans (notably in relation to sharks).
- Cumulative impacts: Version 2.0 includes consideration of cumulative impacts of all MSC UoAs on the scoring element in question, which is problematic for a pre-assessment in that it is impossible to predict which fisheries might be MSC certified by the time the fishery in questions reaches the point of full assessment. In practice, however, much of the scoring is derived from studies considering purse seine fisheries in general, so this has not been too much of a problem.

Note further to comments on the first draft: In their comments on the first draft of this report, OPAGAC disagreed with the approach here in defining primary vs. secondary vs. ETP species, preferring the approach of MRAG (2014). However, it is important to note that MSC sets out guidance as to which species should be considered in which category – therefore this is not a matter of choice for either the client or the MSC assessment team. As will be clear from the analysis below, MSC guidance is not always 100% clear, but this report attempts to follow it, and to set out the steps used to determine the species list in each case.

4 Identification of 'main' primary and secondary species and ETP species

Note: In order to evaluate what are the species to be considered under Principle 2, it is first necessary to know what are the target species of the MSC assessment (i.e. those to be considered under Principle 1). For the purposes of this study, it has been assumed that Principle 1 will include skipjack, yellowfin and bigeye tuna, and these species have been excluded from the analysis below (except for the purpose of working out percentages of the overall catch). All other species are included. This follows the structure of MRAG (2014).

4.1 Main primary and secondary species

To undertake a pre-assessment, it is only necessary to identify 'main' primary and secondary species, since these are the only species that intervene for the scoring of SG60 and SG80 for these PIs (see discussion above).

4.1.1 Total rates of bycatch in tropical tuna purse seine fisheries

Amandé et al. (2010) analysed 27 observer reports coming from the French and Spanish purse seine fishery in the Atlantic Ocean. Taking both techniques together, they found that bycatch (including some small or low quality skipjack) was ~7.5% of the total catch (reportedly higher for associated than free sets although figures are not given). A similar analysis for the Indian Ocean (Amandé et al. 2012) suggested that bycatch (including again some discarded target species) made up overall 4.7% of the total catch. Taking associated and free sets together, Ardill et al. (2013) estimated based on observer reports from the French and Spanish purse seine fishery in the Indian Ocean that bycatch makes up ~3.55% of the catch from purse seiners, of which just over 50% is tuna of various species. The Echebastar MSC assessment (FCI 2015) evaluates retained and discarded bycatch based mainly on these sources, although the report presents data for retained species (i.e. from landings records or logbooks) which also suggests that the proportion of species other than the three Principle 1 tuna species in the retained catch is very small[2].

4.1.2 Bycatch of other tuna species

AZTI provided a synthesis of OPAGAC / ANABAC observer reports, but unfortunately no analysis has yet been done to separate associated from free sets. An analysis of the confidential observer reports can, however, give an approximate idea of the bycatch of FAD vs free-school sets (with sets on debris, cetaceans and whale sharks included in 'free-school' in this case). These observer reports come from a confidential source, and therefore it is not possible to provide any information on the fleet or ocean concerned. From these reports, the proportion of tuna in the catch other than the three main species is ~0.5% for free-school / whale / whale shark sets and ~1-1.5% for FAD sets. The species concerned are albacore, little tunny, bullet tuna and frigate tuna (*Thunnus alalunga*, *Euthynnus alleteratus*, *Auxis rochei* and *A. thazard)*. Since none of these species are particularly vulnerable, then it is not likely that in these proportions they would be considered 'main' bycatch species.

For the Atlantic specifically, according to Amandé et al (2010), little tunny is the dominant bycatch species by weight, making up ~two thirds of the bycatch for free-school sets and ~a quarter for FAD sets (where the bycatch was more diverse). On this basis, it is possible that little tunny might reach the 2% threshold on occasion, but it is not likely to be considered 'vulnerable' and would therefore not constitute a 'main' bycatch species in any case. For the Indian Ocean (Amandé et al. 2012), the relative importance of the small tunas seems to be reversed, with frigate tuna the most important in bycatch and little tunny the least. Again, however, it would not constitute a 'main' bycatch species from these figures. It does not appear from Banks et al. (2011) that bycatch of these species is significant in the western Pacific either.

4.1.3 Non-tuna bycatch – FAD vs. free-school

From the analysis of observer reports, the bycatch of non-tuna species in FAD sets vs. free-school sets (including debris and cetaceans / whale sharks) is given in Figure 1 (note that FAD fish bycatch extends off the top of y-axis by two orders of magnitude).

[2] It is always recorded as albacore, but experience suggests that it may include other tuna species.

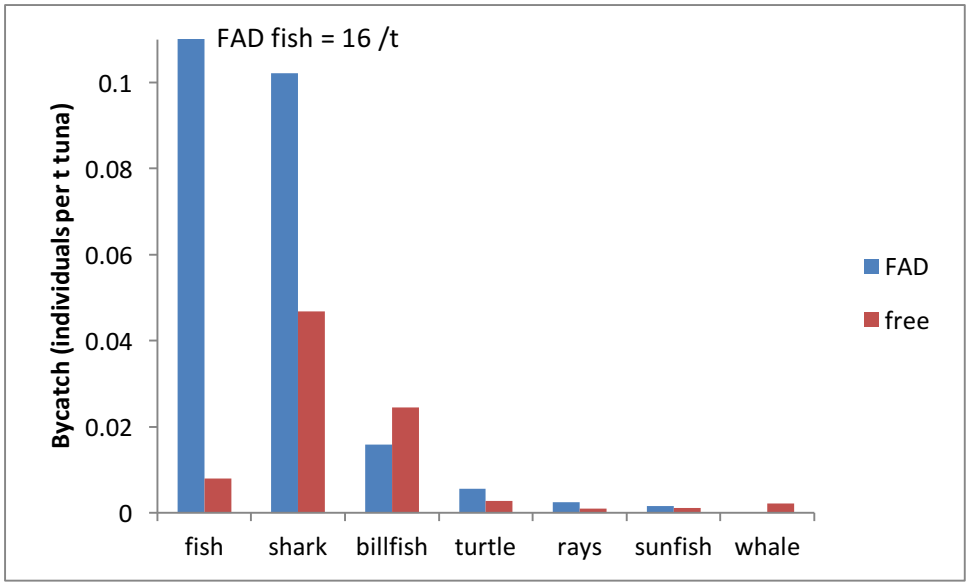

Figure 1. Bycatch from FAD and free-school sets from an analysis of 21 purse seine observer reports, expressed as individuals per tonne of tuna. Note that (non-tuna) fish bycatch from FAD sets was 16 individuals per t, but the y-axis has been truncated so that the other categories show up. FAD = human-made FADs; other set types included in 'free'. Source: analysis of confidential observer reports

From these data, the most significant difference between FAD and free-school sets (in terms of bycatch) is the quantity of fish – ~1600 individuals per 100 tonnes of tuna for FAD sets, vs. 1 individual per 100 tonnes (i.e. more or less none) for free-school sets; note, however, that even the FAD sets have a pretty low bycatch rate overall. The fish species concerned (in this case) were for the most part various species of triggerfish and runners, and were generally retained for sale or consumption. This fish bycatch in FAD sets is by far the most significant in terms of quantity for any taxon, but is still far below the MSC thresholds for defining 'main' primary or secondary species.

Clearly, therefore, the main questions in relation to an MSC assessment are likely to be: i) which of the above species can be classified as ETP; and ii) for any which are not ETP, should they be included as 'main' bycatch species on the basis of 'plausible argument'?

4.2 Identifying ETP species

4.2.1 Which species count as ETP under version 2.0?

Turtles and baleen whales are all considered ETP, because of their listing on CITES Appendix I (no change from version 1.3).

Some toothed whales come under CITES Appendix I, but most (e.g. false killer whale, dolphins),are listed under Appendix II and therefore on this basis would not qualify as ETP. The EU list of protected species[3], however, includes all cetaceans, and these species would therefore presumably qualify as ETP for this fishery on this basis.

For sharks, the situation is complex. There are some sharks (great white shark, devil and manta rays) which are protected under EU fisheries regulations (EU 2015); these would thus presumably qualify as ETP for this fleet in all oceans. Other species of shark are protected under CMMs / Resolutions / Recommendations in different tuna RFMOs, and since these are all binding on contracting and

[3] See http://www.biodiversityplanningtoolkit.com/stylesheet.asp?file=613_full_list_of_european_protected_species

cooperating parties to the RFMO (including the EU in all cases), then these presumably constitute 'binding international agreements'. Therefore, different subsets of shark species are would logically be considered 'ETP' in different oceans, as set out in Table 2. This may result in an anomalous situation whereby fisheries taking place in areas with stricter shark protection policies fare worse under an MSC assessment because more shark species will be designated as ETP, rather than main or minor bycatch species (but this is not a new problem for MSC). (Reportedly MSC is working on providing a more consistent framework.)

This has been dealt with in this report by considering the option for some shark species of making a 'plausible argument' that they should be 'main' bycatch species – this means that unless the data suggest otherwise, a similar species list (taking main bycatch species and ETP species together) is considered in each ocean.

(Note that although it is possible (even likely) that bycatch species composition varies by ocean, the data is sufficiently limited that it is not possible to say whether differences in bycatch come from real differences in the ecosystem, or from a different 'subsample' of the total bycatch being given in the data for each ocean.)

Table 2. Sharks protected under binding resolutions, recommendations or CMMs in the different tuna RFMOs and the EU

Organisation	Convention Area	ETP shark species
WCPFC	Western and Central Pacific	oceanic whitetip shark, silky shark, whale shark
IATTC	Eastern Pacific	devil and manta rays ('mobulid rays'), whale shark
IOTC	Indian Ocean	oceanic whitetip shark, whale sharks, thresher sharks
ICCAT	Atlantic Ocean	oceanic whitetip shark, bigeye thresher shark, silky shark, hammerhead sharks (except bonnethead shark *S. tiburo*)
EU	All EU fleets	devil and manta rays, great white shark

4.2.2 Species list from AZTI

AZTI provided a list of the species encountered and released during 12 trips with observers on board OPAGAC and ANABAC in the Atlantic Ocean, December 2014-June 2015, as per Table 3. For the Indian Ocean, data were only available from one trip, with 68 encounters with silky shark and none of other species. For the Pacific, no data were available.

In order to scale up the data in Table 3 to encounters per year, at least approximately, the number of trips per year by OPAGAC vessels was estimated as follows: 34 vessels in the association[4] x average of 7 trips per year (estimated from other purse seine fleets). Note that this assumes that the encounters in the Atlantic Ocean are representative of trips in other oceans, which is not necessarily the case – but data from the other oceans has reportedly not yet been analysed.

It is also important to note that these are encounters, not mortalities. According to Goñi et al 2015, nearly all of these animals are released according to best practice, as agreed with ISSF (ranging from

[4] according to http://iss-foundation.org/2011/03/10/opagacagac-and-issf-sign-deal/

94% for sharks to 100% for turtles). Mortality rates for animals who have been accidently surrounded by the net will therefore most likely be low to zero, although there may be some mortality for those who are found entangled in FADs (see below).

Table 3. List of species and number of individuals encountered according to observer reports for 12 trips in the Atlantic Ocean by OPAGAC vessels from December 2014. Information provided by Nicolas Goñi, AZTI.

Taxa	Species		Number of encounters in 12 trips, Atlantic Ocean	Scaled up to estimated encounters by OPAGAC vessels per year
Sharks	blue shark	*Prionace glauca*	1	20
	bignose shark	*Carcharhinus altimus*	5	100
	silky shark	*Carcharhinus falciformis*	194	3840
	oceanic whitetip shark	*Carcharhinus longimanus*	6	120
	shortfin mako	*Isurus oxyrinchus*	1	20
	scalloped hammerhead	*Sphyrna lewini*	15	300
	smooth hammerhead	*Sphyrna zygaena*	20	400
	hammerheads (other)	Sphyrnidae	1	20
Turtles	leatherback turtle	*Dermochelys coriacea*	5	100
	olive ridley turtle	*Lepidochelys olivacea*	25	500
	kemps ridley turtle	*Lepidochelys kempii*	1	20
	hawksbill turtle	*Eretmochelys imbricata*	5	100
	loggerhead turtle	*Caretta caretta*	28	550
	green turtle	*Chelonia mydas*	3	60
	unidentified turtles	Testudinata	2	40
Rays	pelagic stingray	*Dasiatys violacea*	10	200
	spinetail devil ray	*Mobula japanica*	9	180
	giant devil ray	*Mobula mobular*	3	60
	Chilean devil ray	*Mobula tarapacana*	6	120
	unidentified devil ray	*Mobula* spp.	2	40

Which of these species are 'ETP' under the MSC definition? All turtles are listed on CITES Appendix I, and are therefore ETP under a 'binding international agreement'. For the rays, devil rays (*Mobula* spp.) are protected by EU fisheries regulations, but pelagic stingrays are not protected under any national or international regulations, so are not ETP. For the sharks, cross-referencing Table 3 and Table 2, the list of ETP sharks in each ocean is given in Table 6 at the end of this section.

4.2.3 **Other sources of data on ETP species**

Atlantic: Amandé et al. (2010) states that juvenile green turtles are the main ETP species caught as bycatch, and they are almost always taken associated with (resting on) FADs (human-made or natural). They speculate that in fact, entanglement in FADs is a more important, although unquantified, source of mortality for turtles than direct capture (see below). In relation to sharks, their figures suggest that ~90% of sharks are taken on FAD sets and ~10% on free-school sets. (Note: This is a higher difference than that noted above in the analysis of observer reports (Figure 1); it agrees with an analysis for the Indian Ocean, and is considered to be more probable than the ~2:1 ratio given in Figure 1.)

Interestingly, none of the data sources about the Atlantic specifically (including the species list from OPAGAC observer reports) mention any interactions with cetaceans other than baleen whales (i.e. with toothed whales and dolphins) although they are known to be important in the Pacific.

Indian Ocean: The Echebastar MSC report notes the potential for interaction with the ETP species listed in Table 4 below: in essence, turtles, whales, whale sharks and manta rays. Ardill et al. (2013) estimate a total annual shark catch in the Indian Ocean by purse seiners of ~~1,000 t per year, of which most (~80%) are silky sharks, followed by oceanic whitetip sharks (~10%); and with 97% of this case coming from FAD sets according to this data set. MRAG cite Anderson (2014) who notes the possibility of rough-tooth dolphin (*Steno bredanensis*) becoming entangled in FADs, although he considers that mortality rates are low.

Western Pacific: The PNA assessment of the free-school skipjack fishery in the Western Pacific considered ETP species as shown in Table 4: only false killer whale and whale shark.

SPC (SPC-OFP 2012) estimated interaction and mortality rates of tuna purse seine fisheries in the WCPFC area with cetaceans and whale sharks, as summarised in Table 5. The encounter rate was highest for whale sharks and false killer whales (~one every 100 sets), but the mortality rate per set was highest for dolphins and false killer whales. Evaluating the potential overall impact of the fishery on these species requires a comparison of the estimated mortality with the overall population size in the Western and Central Pacific – but for most of these species, this is not known.

MRAG (2014) cite this study as a reference for the statement that the most significant interactions with ETP species are with false killer whales and sei whales. On the face of it this seems strange, but presumably they included sei whales since they are the only species on the list which is IUCN red-listed as vulnerable, endangered or critically endangered (endangered, to be specific); although encounters with other species are more common and more likely to result in mortality, these are perhaps less likely to be significant at the population level (all the other out-of-scope species being either 'least concern' or 'data deficient'). This is a reasonable way of narrowing down the possibilities for the purposes of a pre-assessment (although it illustrates why pre-assessments can easily be proved wrong when more fishery-specific data are provided).

In contrast to the Atlantic Ocean, IATTC (2006) notes that olive ridley turtles are the most likely to be taken as bycatch in tuna purse seine fisheries, but not much detail is given as to the set types concerned, although bycatch rates seem to be low.

Eastern Pacific: The interaction of dolphins and tuna, and setting of purse seines on dolphins, has been a long story in the eastern Pacific, but according to MRAG (2010) the measures put in place over the last two decades have drastically reduced mortality rates and have allowed the populations concerned to recover. Overall, it seems that the Eastern Pacific is the most data-poor area in terms of tuna-related bycatch (although this may be because much of the relevant information is in Spanish); it is assumed here that the situation is broadly similar to the Western Pacific.

Table 4. ETP species considered during the MSC assesments of the Echebastar and PNA free-school purse seine fisheries (FCI 2015, Banks et al. 2011). (Note that these species may not have been included in the list of ETP species for this fishery specifically, but are mentioned in the discussion as having a possible association with the purse seine fishery in general in that area.)

Assessment / Ocean	Species	Basis for considering as ETP
Echebastar / Indian	olive ridley and hawksbill turtles	recorded by observers in free-school and FAD sets; CITES App. I
	green and loggerhead turtles	recorded by observers but only in FAD sets; CITES App. I
	fin whale, sei whale, Bryde's whale, minke whale, pygmy blue whale, false killer whale	sets recorded by observers or reported anecdotally to be made on these species; CITES App. I (Note: fin and minke whales are mainly cold temperate / arctic species, although they do occasionally stray into warmer waters – however, their overlap with this fishery is most likely negligible and they are not considered further here)
	whale sharks	protected in Seychelles waters
	giant manta rays	protected by EU Regulations
PNA / Western and Central Pacific	false killer whale (*Pseudorca crassidens*)	recorded in logbooks for free-school sets but not for FAD sets; basis given is CITES (but note App. II) – but also EU protected species
	whale shark	recorded in logbooks for free-school sets but not for FAD sets; basis given CITES (but note App. II) – but also protected by WCPFC

Table 5. Estimates of encounter rates, mortality rates and estimated total mortality (2009) of ETP species with the WCPFC purse seine fishery. From SPC-OFP 2012.

Species common name	Scientific name	Sets	% sets encountered	Number	Encounter rate (no. / 1,000 sets)	% Dead	Mortality rate (no. / 1,000 sets)	Estimated Mortality in 2009
BALEEN WHALES								
BRYDE'S WHALE	Balaenoptera Edeni	3	0.010%	3	0.15	67%	0.10	4
BALEEN WHALES NEI	Mysticeti	18	0.090%	21	1.04	0%	0.00	0
SEI WHALE	Balaenoptera borealis	2	0.010%	2	0.10	0%	0.00	0
BALEEN WHALES		23	0.120%	26	1.36	8%	0.10	5
WHALE SHARK								
WHALE SHARK	Rhincodon typus	168	0.830%	211	10.43	12%	1.29	56
TOOTHED CETACEANS								
DOLPHIN, BOTTLENOSE	Tursiops truncatus	18	0.090%	110	5.44	62%	3.36	148
DOLPHIN, COMMON	Delphinus delphis	8	0.040%	61	3.02	95%	2.87	126
DOLPHIN, INDO-PACIFIC BOTTLENOSE	Tursiops aduncus	14	0.070%	131	6.48	71%	4.60	202
DOLPHIN, LONG-BEAKED COMMON	Delphinus capensis	2	0.010%	40	1.98	8%	0.15	7
DOLPHIN, RISSO'S	Grampus griseus	9	0.040%	40	1.98	100%	1.98	87
DOLPHIN, ROUGH-TOOTHED	Steno bredanensis	15	0.070%	103	5.09	71%	3.61	158
DOLPHIN, SPINNER	Stenella longirostris	13	0.060%	68	3.36	82%	2.77	122
DOLPHIN, SPOTTED	Stenella attenuata	1	0.000%	6	0.30	100%	0.30	13
DOLPHIN, STRIPED	Stenella coeruleoalba	2	0.010%	8	0.40	100%	0.40	17
DOLPHINS / PORPOISES (UNIDENTIFIED)	Delphinidae	1	0.000%	1	0.05	100%	0.05	2
FALSE KILLER WHALE	Pseudorca crassidens	42	0.210%	216	10.68	51%	5.44	239
MELON-HEADED WHALE	Peponocephala electra	2	0.010%	2	0.10	50%	0.05	2
PYGMY KILLER WHALE	Feresa attenuata	1	0.000%	1	0.05	100%	0.05	2
SHORT-FINNED PILOT WHALE	Globicephala macrorhynchus	6	0.030%	11	0.54	27%	0.15	7
TOOTHED CETACEANS		134	0.700%	798	41.70	65%	27.23	1,195

4.2.4 **ETP species impacted via FAD entanglement**

A MSC assessment of the associated fishery would need to consider 'bycatch' via mortality from entanglement in human-made FADs. Presumably this would also come under the scope of ETP species, since it is unlikely to be enough to constitute a 'main' primary or secondary species (5% or 2% of the total 'catch'). Filmalter et al. (2013) used a combination of satellite tagging and underwater observations of a FAD to estimate a mortality of silky sharks considerably in excess of direct estimates of bycatch (~0.5-1 million silky sharks per year in the Indian Ocean, with an average overall survival time for a silky shark of 300 days before entanglement – note, however, that this is extrapolated from quite small sample sizes). Mortality of turtles (the other main concern) seems to be smaller (IATTC 2006) but does not appear to have been investigated as systematically; Amandé (2010) note that entanglement might be more significant than direct bycatch for turtles as well as sharks. No information could be found for cetaceans.

OPAGAC (along with ANABAC) have put in place a voluntary code of good practice for their purse seine fishery in all oceans, which includes a transition to non-entangling FADs, and release of any entangled animals following best handling practice. It is also reported that any entangling FADs encountered are removed and replaced with a non-entangling version (J. Moron, pers. comm.), although this is not an explicit part of the code of good practice. The code of practice is verified via an observer programme and analysis by AZTI; Goñi et al. (2015) note that as of mid-2015 '*a majority of vessels* (are) *displaying a level of compliance superior to 80% for non-entangling FADs and reaching 100% for fauna release operations*'.

4.3 **Main primary or secondary species via 'plausible argument'**

The out-of-scope species (turtles and cetaceans) can be evaluated as ETP as noted above. However, for the sharks, there are gaps where no 'binding international agreement' is available to categorise them as ETP, while the (known) bycatch is not large enough for them to be classed as 'main' primary or secondary species under the normal 2% or 5% catch thresholds. Under these circumstances, an assessment team would have the ability to make a 'plausible argument' as to why these species should be considered main despite catches lower than the threshold (WWF 2015).

In this fishery, the biggest gap in ETP protection seems to be for silky sharks. Silky sharks are clearly the most important shark species taken as bycatch; FAD entanglement may also remain significant although it is clear that OPAGAC is working towards eliminating this issue. Silky sharks are protected (and can therefore be evaluated as ETP) in the Western and Central Pacific and the Atlantic (by WCPFC and ICCAT) but not in the Indian Ocean or Eastern Pacific (IOTC, IATTC) (Table 2). It would seem appropriate for these areas to promote silky sharks to 'main' primary or secondary species. The next question is whether silky sharks should be considered 'main' species for associated sets alone, or for free sets as well. Published data (Amandé et al. 2010, Ardill et al. 2013) suggest that at least for the Atlantic and the Indian Ocean, silky sharks are taken overwhelmingly in associated sets. The analysis of the observer data (Figure 1) suggests something more like a 2:1 split, but this is based on a small sample size, and also includes debris, cetacean and whale-shark sets in the 'free-school' category (which does not follow the definition used here).

Oceanic whitetip sharks are another possible candidate for promotion by 'plausible argument'. They are reported to be the second commonest bycatch species in the Indian Ocean (Ardill et al. 2013) although perhaps not in the Atlantic (Amandé 2010). They are protected by WCPFC, ICCAT and IOTC but not IATTC, and an argument could be made that they should also be a 'main' primary or secondary species in the Eastern Pacific (if for no other reason than consistency with the requirements in the other oceans). Logically, however, that the argument would be the same as silky shark but a lot less certain, and hence overall the outcome of the pre-assessment would not change if this species was also considered 'main'. However, this species has been borne in mind in considering possible FIP activities (see Section 5 below); what helps silky sharks will presumably also help other species with similar ecology.

Another gap is whale sharks, which are protected under IOTC, WCPFC and IATTC rules (i.e. in the Indian Ocean and Pacific) but not in the Atlantic. SFP-OFP (2012; Table 5) consider that sets on whale sharks may be significantly under-estimated, since the presence of one or several whale sharks may not be immediately apparent. This being the case, it seems also possible to make a 'plausible argument' for promoting whale sharks to 'main' species in ICCAT. Since setting on whale sharks forms part of our definition of an 'associated set', then logically they are promoted to 'main' for associated sets only.

Although preliminary stock assessments have been attempted for Pacific and Indian Ocean[5] silky sharks (Aires da Silva et al. 2013), they are highly uncertain, and the stocks are not therefore managed using reference points etc. They would therefore be considered main secondary species rather than primary species. There does not appear to be any information on stock status for whale sharks, which would likewise be considered as main secondary species.

The MSC assessment of the PNA free-school fishery (Banks et al. 2011) also included blue marlin as 'main' bycatch species on the basis of vulnerability. Given that Pacific blue marlin is estimated to be approximately at MSY levels and not overfished (Billfish Working Group of ISC, 2013), there does not, however, seem to be any longer much justification for including it on this basis.

4.4 Summary of main primary and secondary and ETP species

The overall species list for 'main' primary and secondary species and ETP species is given below and compared with MRAG 2014 (Table 6).

Differences arise mainly from the fact that this study has been (at the request of WWF) slightly more conservative in including any ETP species which are mentioned in a source as potentially interacting with the fishery in one way or another, rather than trying to make a judgement as to whether

[5] Available at http://www.iotc.org/science/status-summary-species-tuna-and-tuna-species-under-iotc-mandate-well-other-species-impacted-iotc

interactions are likely to be significant. A problem in reviewing MRAG's approach is that they do not include a section in the report which 'shows their working' in detail as to how they arrive at the list of ETP species for each ocean, although they do cite extensive references. Differences may also arise from the inclusion in this report of more recent regulation from RFMOs and the EU (e.g. EU 2015).

Table 6. Main primary and secondary species and ETP species for the OPAGAC fleet for each ocean, as identified by the analysis above ('this study') and in MRAG (2014). Differences are highlighted in bold where they occur.

Species			**This study**		**MRAG 2014**
			free	**associated**	
Main primary species (v2.0) / main retained species (v1.3)			None (assuming the same approach to P1 as MRAG)		None (skipjack, yellowfin and bigeye considered under P1)
Main secondary species (v2.0) / main bycatch species (v.1.3)			None	**Whale shark**: ICCAT (plausible argument); **Silky shark**: IOTC and IATTC (plausible argument)	None
ETP spp.	Pacific	WCPFC	rays: manta ray, **devil ray** turtles	baleen whales: sei whale, Bryde's whale toothed whales: false killer whale, dolphins rays: manta ray, **devil ray** sharks: whale shark, **oceanic whitetip shark, silky shark, great white shark** rays: manta ray, **devil ray** turtles	false killer whale, sei whale, whale shark, manta rays, turtles
		IATTC	rays: manta ray, **devil ray** turtles	baleen whales: sei whale toothed whales: false killer whale, dolphins sharks: **great white shark, whale shark** rays: manta ray, **devil ray** turtles	
	Atlantic		rays: devil ray, manta ray turtles	baleen whales: **Bryde's whale, sei whale, humpback whale** toothed whales: **sperm whale, dolphins** sharks: oceanic whitetip shark, hammerhead sharks (except bonnethead), **bigeye thresher shark, silky shark** rays: devil ray, manta ray turtles	devil ray, manta ray, turtles, oceanic whitetip shark, hammerhead shark
	Indian		rays: devil ray, manta ray turtles	baleen whales: Bryde's whale, sei whale, **pygmy blue whale** toothed whales: **false killer whale**, rough-tooth dolphin sharks: **whale shark**, **thresher shark,** oceanic whitetip shark rays: devil ray, manta ray turtles	manta ray, oceanic whitetip shark, turtles, Bryde's whale, sei whale, fin whale, rough-tooth dolphin

5 Conclusions and next steps

The scores and rationales for Principle 2 (free-school and FAD) are given in Appendix 1 below. In this section, the outcome of the pre-assessment are summarised, differences with the previous assessment evaluated and some steps towards a possible FIP are set out.

5.1 Conclusions of the pre-assessment

The conclusions are summarised in table form in Section 2 near the start of the report. Note that conclusions are uncertain since they are not for the most part based on data specific to OPAGAC (aside from Goñi et al. 2015, the species list in Table 3 and the information included in MRAG 2014). They agree to large extent, however, with the conclusions of MRAG 2014, although an attempt has been made to provide separate results by ocean and by associated / free sets.

5.1.1 Associated sets

No pre-conditions are identified for FAD sets, but a variety of possible conditions are identified on either secondary species outcome, management and information or ETP species outcome, management and information – this varies by ocean according to whether silky sharks (and potentially ecologically-similar species such as oceanic whitetips) are protected under a binding agreement in the RFMO concerned. The key issues are the following:

- Mortality of sharks (mainly silky) in FADs, via direct bycatch and entanglement may be having an impact on these populations. Although OPAGAC vessels are moving towards deploying only non-entangling FADs – and reportedly removing entangling FADs where they are found – AZTI still notes quite a significant number of encounters with silky sharks, although the shark may be released unharmed in most cases (this is unclear).
- The same applies to mortality of turtles; it is clear that good handling practices are being put in place for turtles but since these populations are very depleted in some areas, the fishery will have to demonstrate negligible rates of mortality or injury in all areas.
- In order to evaluate impacts on turtles, cetaceans and elasmobranchs, some population-level data is required, and this is lacking for important bycatch species in many areas (e.g. silky sharks nearly everywhere, turtles in some areas, some cetaceans).
- This is (possibly a remote) possibility of mortality or injury of the very rare Arabian Sea humpback whales via purse seine sets. In fact, a closer analysis of this question is probably required, to determine the overlap of this population with the OPAGAC fishery specifically, and to evaluate the policy of all OPAGAC member vessels in relation to setting on whales. Anecdotally, a review of the distribution of purse seine effort compared to humpback whale satellite tracks (given in Minton et al. 2015) suggests that the overlap of the fishery with this population is limited. Even if interactions leading to injury or death are likely to be extremely rare, however, the depleted state of this population (estimated to be ~80 individuals) is such that even interactions rates of <<1 per year may not be acceptable.
- In relation to cetaceans in general, the possibility of sets on cetaceans (accidental or deliberate) was noted, as well as the fact that the code of good practice does not apply to cetaceans.
- The ecosystem consequences of deploying many thousands of FADs in the world's oceans is not known. It is assumed that FADs will have ecosystem-level impacts, via, for example, changing the behaviour of many species (not just tunas), potentially changing predator-prey interactions by bringing these species together more easily, depleting some species via entanglement or bycatch, changing the size-frequency of tunas in the catch and so on. The

scientific working groups of some RFMOs are starting to consider these questions but there has been as yet no comprehensive research on the topic as far as is known.

- The OPAGAC code of good practice has so far only been verified in the Atlantic Ocean.

5.1.2 Free sets

For free sets, no conditions or pre-conditions were identified for P2.

5.2 Comments on MRAG 2014

Overall, MRAG 2014 is a good document, which provides in particular a very thorough review of the available data and management measures for each of the RFMOs. Where it might have been improved would have been to provide a little more analysis in relation to which species are identified as 'main' bycatch and ETP species, and on what basis – this is often crucial to the outcome of MSC (pre) assessments, and as is clear from this report is to some extent open to interpretation (in both version 1.3 and version 2.0).

Differences in conclusions between this document and MRAG 2014 mainly result from a more precautionary approach being taken here, at the request of WWF. Somewhat more emphasis has been laid here on the potential impact of entanglement in FADs, and the OPAGAC policy of moving towards deployment of non-entangling FADs has been viewed more cautiously (since it is not part of the formal code of good practice) – not because there is any reason to doubt OPAGAC's good faith but rather because an MSC assessment requires auditable data to support scoring. The Arabian Sea humpbacks are poorly known and hence this is an issue which is easy to overlook (e.g. see FCI 2015, which makes no mention of this population); it may on closer inspection of OPAGAC data (observer reports) turn out to be irrelevant in any case.

Overall, the author does not have the impression from this exercise that the use of version 1.3 vs. version 2.0 has made a great deal of difference to the scoring – differences have arisen mainly from the interpretation of which species are relevant to consider for each PI.

5.3 Moving towards a FIP plan

As far as Principle 2 is concerned, the planning for a FIP for this fishery would need to consider the following general elements:

- What is the OPAGAC approach to entangling FADs? Although they are moving towards eliminating the deployment of entangling FADs, will the fishery continue to fish opportunistically on these FADs? It is reported that this is not the case, but it is not part of the code of good practice at present.
- The consequences of setting nets on baleen whales or other cetaceans needs to be carefully evaluated to ensure that it does not result in any mortality, injury or stress; or otherwise this practice needs to be eliminated. In the northwest Indian Ocean it needs to be eliminated in areas where there is any risk of interaction with Arabian Sea humpback whales. The code of good practice should perhaps be extended to cetaceans.
- Bycatch of other protected species (such as turtles, manta and devil rays and sharks) needs to be evaluated in detail from OPAGAC observer reports for oceans other than the Atlantic to ensure that it is within acceptable limits; impacts of FAD entanglement need to be included if relevant.
- For species where there is some significant mortality (relative to the population, which may not be large in some cases), some population level data is required to evaluate trends – silky sharks are likely to be a candidate for this.
- The ecosystem consequences of deploying and fishing on FADs needs investigation, in all oceans.

- Ensure that the code of good practice is verified in all oceans, and the data are regularly reviewed to evaluate how unwanted catch can be reduced.

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Appendix 1: Likely scores and rationales for Principle 2

Evaluation Table for PI 2.1.1 – Primary species outcome

PI 2.1.1		**The UoA aims to maintain primary species above the PRI and does not hinder recovery of primary species if they are below the PRI.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Main primary species stock status			
	Guide post	Main primary species are **likely** to be above the PRI OR If the species is below the PRI, the UoA has measures in place that are **expected** to ensure that the UoA does not hinder recovery and rebuilding.	Main primary species are **highly likely** to be above the PRI OR If the species is below the PRI, there is either **evidence of recovery** or a demonstrably effective strategy in place **between all MSC UoAs which categorise this species as main**, to ensure that they collectively do not hinder recovery and rebuilding.	There is a **high degree of certainty** that main primary species are above the PRI **and are** fluctuating around a level consistent with MSY.
b	Minor primary species stock status			
	Guide post			For minor species that are below the PRI, there is evidence that the UoA does not hinder the recovery and rebuilding of minor primary species
Supporting information		No 'main' primary species have been identified for either free-school or FAD sets. This means that this PI would score at least 80.		
OVERALL PERFORMANCE INDICATOR SCORE:				
Associated			**Free**	
References:				

Evaluation Table for PI 2.1.2 – Primary species management strategy

PI 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.		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	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 above the point where recruitment would be impaired.	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 point where recruitment would be impaired.	There is a **strategy** in place for the UoA for managing main and minor primary species.
b	Management strategy evaluation			
	Guide post	The measures are considered **likely** to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/species).	There is some **objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the fishery and/or species involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly about the fishery and/or species involved.
c	Management strategy implementation			
	Guide post		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			
	Guide post	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.
e	Review of alternative measures			
	Guide post	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.
Supporting information		No 'main' primary species have been identified, so scoring issues a-c and e would score at least 80 for free-school and FAD. Shark finning is not permitted on EU vessels (Regulation 605-2013), so presumably scoring issue d is also met at least at the 80 level.		
OVERALL PERFORMANCE INDICATOR SCORE:				
Associated			**Free**	

PI 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.
References:	

Evaluation Table for PI 2.1.3 – Primary species information

PI 2.1.3		**Information on the nature and extent of primary species is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage primary species**		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impact on main species			
	Guide post	Qualitative information is **adequate to estimate** the impact of the UoA on the main primary species with respect to status. OR If RBF is used to score PI 2.1.1 for the UoA: Qualitative information is adequate to estimate productivity and susceptibility attributes for main primary species.	Some quantitative information is available and is **adequate to assess** the impact of the UoA on the main primary species with respect to status. OR If RBF is used to score PI 2.1.1 for the UoA: Some quantitative information is adequate to assess productivity and susceptiblity attributes for main primary species.	Quantitative information is available and is **adequate to assess with a high degree of certainty** the impact of the UoA on main primary species with respect to status.
b	Information adequacy for assessment of impact on minor species			
	Guide post			Some quantitative information is adequate to estimate the impact of the UoA on minor primary species with respect to status.
c	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage **main** primary species.	Information is adequate to support a **partial strategy** to manage **main** Primary species.	Information is adequate to support a **strategy** to manage **all** primary species, and evaluate with a **high degree of certainty** whether the strategy is achieving its objective.
Supporting information		No main primary species are identified, so this PI would score at least 80.		
OVERALL PERFORMANCE INDICATOR SCORE:				
Associated			**Free**	
References:				

Evaluation Table for PI 2.2.1 – Secondary species outcome

PI 2.2.1		**The UoA aims to maintain secondary species above a biological based limit and does not hinder recovery of secondary species if they are below a biological based limit.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Main secondary species stock status			
	Guidepost	Main Secondary species are **likely** to be within biologically based limits. OR If below biologically based limits, there are measures in place expected to ensure that the UoA does not hinder recovery and rebuilding.	Main secondary species are **highly likely** to be above biologically based limits OR If below biologically based limits, there is either **evidence of recovery** or a **demonstrably effective partial strategy** in place such that the UoA does not hinder recovery and rebuilding. AND Where catches of a main secondary species outside of biological limits are considerable, there is either evidence of recovery or a, demonstrably effective strategy in place between those MSC UoAs that also have considerable catches of the species, to ensure that they collectively do not hinder recovery and rebuilding.	There is a **high degree of certainty** that main secondary species are within biologically based limits.
b	**Minor secondary species stock status**			
	Guidepost			For minor species that are below biologically based limits', there is evidence that the UoA does not hinder the recovery and rebuilding of secondary species
Rationale		Free sets: No 'main' secondary species Associated sets: For ICCAT, whale shark is identified as a 'main' secondary species on the basis of 'plausible argument' (vulnerability plus deliberate or accidental setting of nets on whale sharks). There is likely one Indo-Pacific and one Atlantic stock of whale sharks, with no formal stock assessment available for either, although the evidence seems to point to a global decline in recent years; IUCN rank the species as 'vulnerable' throughout its range on this basis (Norman 2005). WCPFC estimated a total mortality of 75 individuals in the period 2007-2010 (i.e. an average of ~19		

PI 2.2.1	The UoA aims to maintain secondary species above a biological based limit and does not hinder recovery of secondary species if they are below a biological based limit.
	individuals/year), but this is likely an underestimate given that it does not include those which were alive on release but may have died later, nor does it include any mortality which was unnoticed or unreported (Rice and Harley 2012). OPAGAC in their code of good practice provide detailed instructions to skippers as to how whale sharks are to be released under different circumstances. Goñi et al. (2015) review implementation of these practices in the Atlantic Ocean, and note that in nearly all cases (97%) the cork line (top of the net) is pushed under the water to allow the shark to swim out; the fate of the other 3% is unclear, but presumably, under these circumstances, mortality and injury rates are likely to be very low. As long as OPAGAC can continue to demonstrate that this is the situation (via the forms given in Goñi et al. which record accidental capture and handling), then this should constitute a 'partial strategy' to meet at least SG80. It is most likely effective, but this is not completely clear from the information available, hence a precautionary score of 60 has been given. Since there are no MSC-certified UoAs in the Atlantic at present, the second part of scoring issue a) does not apply. For WCPFC, IATTC and IOTC, whale sharks are protected and are therefore considered under ETP. No main secondary species have been identified, so this PI would score at least 80. For IOTC and IATTC, silky shark is identified as a 'main' secondary species on the basis of 'plausible argument' (vulnerability plus unknown entanglement mortality from FADs). IOTC give Indian Ocean silky shark stock status as uncertain, but note that there is anecdotal evidence of a decline in recent years. The species has slow growth and reproduction and is vulnerable to purse seine, longline and gillnet fisheries. Overall, it is not clear whether the population is within biologically-based limits or not. The OPAGAC code of good practice provides detailed information about how to release sharks, and OPAGAC is also in the process (nearly complete) of converting to use of only non-entangling FADs; it is also reported that other entangling FADs are removed when encountered (although this is not included in their code of good practice). On this basis, the mortality and injury rate of silky sharks should be reduced to close to lowest possible level for this type of fishery. This would most likely meet the requirements of SG60 and constitute a 'partial strategy' as required by SG80a, but it is not clear whether it would be considered 'demonstrably effective' – more information would be required on encounter and entanglement rates as well as population status and trends in the Indian Ocean specifically before this could be said with any confidence. IATTC: The population in the Eastern Pacific is likewise uncertain – a recent attempt at a stock assessment was inconclusive (Aires da Silva et al. 2013), although it does not appear that fishery impacts are as significant as in the Indian Ocean. Trends in CPUE in the northern East Pacific are declining, but those in the southern East Pacific are stable – this may reflect two different stocks. Overall, the stock assessment team tentatively concluded that '*the current fishing mortality rates are predicted to allow the stock size to increase in the future*'. This suggests that either the stock is 'likely' to be within biologically-based limits (>60% probability), or that the fishery (including the UoA) is not hindering recovery; this, along with the 'partial strategy' of OPAGAC means that SG60a is met. As for the Indian Ocean, the question under SG80a is whether the partial strategy is 'demonstrably effective'; this depends on the view an assessment team takes of the stock assessment.

PI 2.2.1	**The UoA aims to maintain secondary species above a biological based limit and does not hinder recovery of secondary species if they are below a biological based limit.**

Here, because of the requirement to be precautionary, it is assumed that it is not met in full.

For WCPFC, silky shark is protected and is therefore considered under ETP species; there are therefore no 'main' secondary species for this area, and the score would therefore be at least 80.

Scoring summary:

RFMO area	Set type	Main secondary species	Proposed score	Reason
WCPFC	free	none	>80	no 'main' secondary spp
	assoc	none	>80	
IATTC	free	none	>80	
	assoc	silky shark	60-80	silky shark impacts
IOTC	free	none	>80	no 'main' secondary spp
	assoc	silky shark	60-80	silky shark impacts
ICCAT	free	none	>80	no ‘main’ secondary spp
	assoc	whale shark	60-80	possible impacts on whale sharks

OVERALL PERFORMANCE INDICATOR SCORE:			
Associated	**IOTC, IATTC, ICCAT** **WCPFC**	**Free**	
References:	Norman 2005, Rice and Harley 2012, WCPFC CMM 2012-04, IATTC CMM 13-04, IOTC resolution 13/05, MRAG 2014, Aires da Silva et al. 2013, OPAGAC 2012, Goñk et al. 2015 www.iotc.org/sites/default/files/documents/.../Silky%20shark.pdf		

Evaluation Table for PI 2.2.2 – Secondary species management strategy

PI 2.2.2		**There is a strategy in place for managing secondary species that is designed to maintain or to not hinder rebuilding of secondary species and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch.**		
Scoring Issue		SG 60	SG 80	SG 100
a	**Management strategy in place**			
	Guide post	There are **measures** in place, if necessary, which are expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be within biologically based limits or to ensure that the UoA does not hinder their recovery.	There is a **partial strategy** in place, if necessary, for the UoA that is expected to maintain or not hinder rebuilding of main secondary species at/to levels which are highly likely to be within biologically based limits or to ensure that the UoA does not hinder their recovery.	There is a **strategy** in place for the UoA for managing main and minor secondary species.
b	Management strategy evaluation			
	Guide post	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			
	Guide post		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 objective as set out in scoring issue (a).
d	Shark finning			
	Guide post	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.
e	Review of alternative measures to minimise mortality of unwanted catch			
	Justification	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of **unwanted** catch of main secondary 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 secondary 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 secondary species, and they are implemented, as appropriate.
Supporting information		Free-school sets: No main secondary species have been identified, so scoring issues a-c and e would score at least 80. Shark finning is banned on EU vessels, and this can be verified via observer reports, so d is met at at least the 80 level. Associated sets:		

PI 2.2.2	**There is a strategy in place for managing secondary species that is designed to maintain or to not hinder rebuilding of secondary species and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch.**

For ICCAT, whale shark are a main secondary species. As noted above, there is a partial strategy (code of good practice) in place which seems likely to avoid most mortality (SG60a) – i.e. detailed handling practices and the introduction of non-entangling FADs, although it is not completely clear without more detailed data that the requirements of SG80a are met. Verification is providing an objective basis for confidence that it will work (SG80b) and evidence that it is being implemented in the Atlantic, although not yet in the other oceans (SG80c not yet met). AZTI's analyses also provide a process of review in relation to progress on unwanted catch, and ISSF (OPAGAC vessels are on the PVR) also provide up-to-date information on bycatch avoidance measures (SG80e). Shark finning is not permitted by EU fleets (Regulation 605-2013) (SG80d) and there is 100% observer coverage for verification.

IOTC and IATTC: There are some measures in place to reduce shark mortality (e.g. a ban on shark-finning for all EU vessels; SG80d) and OPAGAC have a code of good practice in place and are converting to non-entangling FADs. As long as this includes removing and replacing the entangling FADs encountered, as reported by OPAGAC, then this should constitute a partial strategy (SG80a). There are, however, still quite a lot of interactions between OPAGAC vessels and silky sharks according to Table 3; how many of these interactions result in mortality is not known – estimates from the Indian Ocean (Ardill et al. 2013) suggest most, but OPAGAC is following better handling practices than the majority. Whether the partial strategy is 'demonstrably effective' depends on this point as well as the status of the Atlantic stock of silky shark, which is not known.

AZTI verification of the code of good practice provides evidence that SG80b and c are met, as above.

(Note: MRAG 2014 also cite other measures such as the FAD closures in the Atlantic – however, this is in place not to protect sharks but to reduce effort on tuna stocks, and if entanglement is the biggest problem, it won't help much.)

For ICCAT and WCPFC, silky shark is protected and is therefore considered under ETP species; for ICCAT, the conclusions for whale shark are the same as for free-school sets above.

For WCPFC there are no 'main' secondary species.

For scoring issue e) the development of the code of good practice has presumably been based on a review of methods for avoiding (or mitigating) bycatch, so SG60e is met; there is no information as to whether this is a regular process or not (SG80e not met).

Scoring summary:

RFMO area	Set type	Main secondary species	Proposed score	Reason
WCPFC	free	none		no 'main' secondary species
	assoc	none		
IATTC	free	none		
	assoc	silky shark		silky shark impacts, review of measures
IOTC	free	none		no 'main' secondary species
	assoc	silky shark		silky shark impacts, review of measures
ICCAT	free	none		no 'main' secondary species
	assoc	whale shark		possible impacts on whale sharks, review of measures

PI 2.2.2	**There is a strategy in place for managing secondary species that is designed to maintain or to not hinder rebuilding of secondary species and the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of unwanted catch.**		
OVERALL PERFORMANCE INDICATOR SCORE:			
Associated	**IATTC, IOTC, ICCAT**	**free**	
	WCPFC		
References:	EU 2013, MRAG 2014, Ardill et al. 2013, Goñi et al. 2015, OPAGAC 2012, MRAG 2014		

Evaluation Table for PI 2.2.3 – Secondary species information

PI 2.2.3		**Information on the nature and amount of secondary species taken is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage secondary species.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impacts on main secondary species			
	Guide post	Qualitative information is **adequate to estimate** the impact of the UoA on the main secondary species with respect to status. OR **If RBF is used to score PI 2.2.1 for the UoA:** Qualitative information is adequate to estimate productivity and susceptibility attributes for main secondary species.	Some quantitative information is available and **adequate to assess** the impact of the UoA on main secondary species with respect to status. OR **If RBF is used to score PI 2.2.1 for the UoA:** Some quantitative information is adequate to assess productivity and susceptibility attributes for main secondary species.	Quantitative information is available and **adequate to assess with a high degree of certainty** the impact of the UoA on main secondary species with respect to status.
b	**Information adequacy for assessment of impacts on minor secondary species**			
	Guide post			Some quantitative information is adequate to estimate the impact of the UoA on minor secondary species with respect to status.
c	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage **main** secondary species.	Information is adequate to support a **partial strategy** to manage **main** secondary species.	Information is adequate to support a **strategy** to manage **all** secondary species, and **evaluate** with a **high degree of certainty** whether the strategy is **achieving its objective**.
Supporting information		Free-school sets: No main secondary species have been identified, so this PI would score at least 80. Associated sets: ICCAT: Whale sharks are identified as main secondary species. Goñi et al. (2015) review implementation of the code of good practice for whale sharks (sharks in general), based on reporting by observers (special forms used). Hence quantitative information is apparently available (SG80a), which is adequate to support a partial strategy as described in 2.2.2.with a logic and score the same as for free-school sets above. IOTC and IATTC: Silky sharks have been identified as a main secondary species. The magnitude of direct bycatch of silky sharks can most likely be estimated at least semi-quantitatively, since observer reports provide information on the quantity of bycatch and its state on discard (live vs. dead) – there are also estimates of discard mortality, although they might be an over-estimate for this fleet. A bigger problem is to estimate the mortality from FAD entanglement – one study suggests this may be very large, but with high uncertainty, and it presumably varies significantly by FAD design. It is also different to evaluate with any certainty what is the actual footprint of a FAD, or how many FADs are present in each ocean, or		

PI 2.2.3	**Information on the nature and amount of secondary species taken is adequate to determine the risk posed by the UoA and the effectiveness of the strategy to manage secondary species.**

what kinds of FADs are fished on by OPAGAC vessels (noting that this is not the same question as 'what kind of FADs are deployed'). The code of good practice does not explicitly require entangling FADs deployed by other fleets to be removed, although it is reported by OPAGAC that this is what occurs. The observer reports may include this information, but the AZTI report (Goñi et al. 2015) only includes information about FADs deployed. Without seeing observer reports, it is not clear what information exists, so a precautionary assessment would be that there is qualitative but not quantitative information available to evaluate this issue with respect to OPAGAC (which is, note, better than for most purse seine fleets at present).

WCPFC: Silky sharks and whale sharks are protected and are therefore considered under ETP species. There are no 'main' secondary species identified, so this PI would score at least 80.

Scoring summary:

RFMO area	Set type	Main secondary species	Proposed score	Reason
WCPFC	free	none	>80	no 'main' secondary species
	assoc	none	>80	
IATTC	free	none	>80	observers; AZTI
	assoc	silky shark	60-80	silky shark FAD mortality
IOTC	free	none	>80	no 'main' secondary species
	assoc	silky shark	60-80	silky shark FAD mortality
ICCAT	free	none	>80	observers; AZTI
	assoc	whale shark	>80	

OVERALL PERFORMANCE INDICATOR SCORE:			
Associated	**IOTC and IATTC** **WCPFC and ICCAT**	**Free**	
References:	Filmalter et al. 2013, Ardill et al. 2013, Adam et al. 2015, MRAG 2014		

Evaluation Table for PI 2.3.1 – ETP species outcome

PI 2.3.1		The UoA meets national and international requirements for the protection of ETP species The UoA does not hinder recovery of ETP species		
Scoring Issue		SG 60	SG 80	SG 100
a	Effects of the UoA on population/stock within national or international limits, where applicable			
	Guidepost	Where national and/or international requirements set limits for ETP species, the effects of the UoA on the population/stock are known and **likely** to be within these limits.	Where national and/or international requirements set limits for ETP species, the **combined effects of the MSC UoAs** on the population/stock are known and **highly likely** to be within these limits.	Where national and/or international requirements set limits for ETP species, there is a **high degree of certainty** that the **combined effects of the MSC UoAs** are within these limits.
b	Direct effects			
	Guidepost	Known direct effects of the UoA are likely to not **hinder recovery** of ETP species.	Known direct effects of the UoA are **highly likely** to not **hinder recovery** of ETP species.	There is a high degree of confidence that there are no significant detrimental direct effects of the UoA on ETP species.
c	Indirect effects			
	Guidepost		Indirect effects have been considered and are thought to be **highly likely** to not create unacceptable impacts.	There is a high degree of confidence that there are no significant detrimental indirect effects of the fishery on ETP species.

Supporting information

ETP species are as follows:

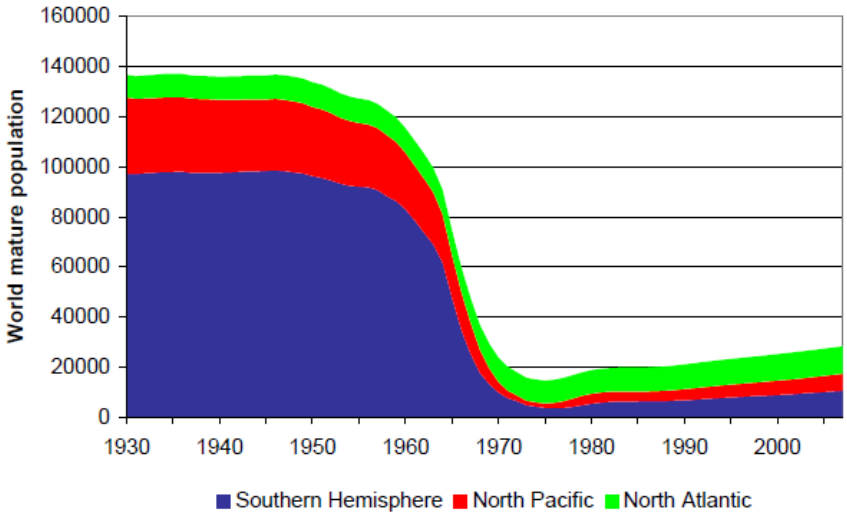
taxon	ocean	set type
baleen whales	all oceans (but pygmy blue whale only occurs in the Indian Ocean)	associated
toothed whales / dolphins	all oceans except Atlantic	associated
great white sharks	all oceans	associated
whale sharks	WCPFC, ICCAT, IATTC	associated
silky sharks	WCPFC and ICCAT	associated
oceanic whitetip sharks	WCPFC, ICCAT and IOTC	associated
hammerhead shark	ICCAT	associated
thresher sharks	ICCAT and IOTC	associated
devil and manta rays	all oceans	both
turtles	all oceans	both

Baleen whales:

Note that the OPAGAC code of good practice does not include cetaceans (only elasmobranchs and turtles).

PI 2.3.1	The UoA meets national and international requirements for the protection of ETP species The UoA does not hinder recovery of ETP species
	ETP species have been (tentatively) identified as sei whales, Bryde's whale, humpback whale and pygmy blue whale. It is clear from observer reports and from SPC (2012) that most interactions with whales come from deliberate setting of the seine on whales, but usually do not cause death or injury to the whale. SPC estimate a total mortality of 5 baleen whales in the WCPFC area, 2007-2010. This was the only data set where mortality was observed, with all mortality being of Bryde's whales (but given the small sample size, this may just be coincidence). IWC (https://iwc.int/estimate) provide population size estimates for some populations of Bryde's and humpback whales as follows: Bryde's whale – NW Pacific – 21,000 individuals humpback whale – W. Africa – 9,800 (increasing 4-5%/yr); East Africa – 14,000; North Pacific – 22,000; Arabian Sea – 80 For Bryde's whale, assuming mortality rates comparative to those observed in WCPFC, then it is reasonable to say that the impacts of purse seining (in general – i.e. cumulative) is not likely to breach international rules or hinder population recovery, therefore overall SG80 is met. For humpback whales, this is also true, except in for the Arabian Sea population which is isolated and highly threatened (Minton et al. 2015), with even individual mortalities potentially having a population-level impact. The spatial overlap of the fishery with this population is not known (to the author), but the fishery would have to demonstrate that it is not having any impact. MRAG (2014) provide a relatively extensive review which does not mention humpback whales, but fishery-specific information (e.g. individual observer reports) would be required to be sure. For the moment, it is not clear whether SG60a and b are met for this population. Pygmy blue whales are essentially the Indian Ocean population of blue whales (Reilly et al. 2008a). Population estimates are not available, but IUCN suggest that the population is in the 100s in the southern Indian Ocean, and most likely somewhat bigger in the northern Indian Ocean. On this basis, interactions resulting in mortality or injury would only be acceptable at a very low level (<<1 individual per year) – however, FCI (2015) note that interactions of the fishery with this species are very rare and anecdotal, so this may be the case (they do not, however, evaluate these interactions in relation to MSC because they exclude whale sets from the UoC); likewise the review in MRAG (2014) does not mention this species. Without better data, a score is very hard to evaluate. Sei whales: In order to estimate depletion / recovery rates (a requirement for IUCN categorisation), Reilly et al. (2008b) have modelled global sei whale populations as in the figure below. The populations were massively depleted by whaling during the 1960s and 70s and since then are predicted to have recovered slowly. The current global population size estimate (very uncertain) is of the order of 30,000 individuals. The evaluation for sei whales in all oceans is similar to that for pygmy blue whales in the Indian Ocean – i.e. only very low levels of mortality would be acceptable, and without better data from OPAGAC, it is difficult to know what the score would be. MRAG (2014) conclude that whale mortality in general is very low to negligible, but this is somewhat contradicted by SPC (2012), who estimate that there is some mortality, albeit perhaps a few individuals a year.

PI 2.3.1	**The UoA meets national and international requirements for the protection of ETP species** **The UoA does not hinder recovery of ETP species**



Toothed whales and dolphins:

Note that the OPAGAC code of good practice does not include cetaceans.

False killer whale: According to the PNA free-school purse-seine PCR, free-school sets have a low bycatch and FAD sets a negligible bycatch; >90% are observed to be alive on release. (NB: This suggests that whale-associated sets are included in the PNA definition of 'free-school', unlike for Echebastar.) SPC estimated a total mortality of false killer whale via purse seiners in the WCPFC area of 239 in 2009. IUCN (Taylor et al. 2008) provides some abundance estimates for the Pacific as follows: coastal waters of China and Japan – 16,000; Hawai'i EEZ – 268; eastern tropical Pacific – 39,800. Assuming a similar population size in the western tropical Pacific, this suggests (approximately) that the purse seine fishery in general takes <<1% of the population per year, which would most likely be within acceptable limits even for the fishery as a whole, and would not be likely to hinder recovery, hence SG80 is probably met (this conclusion agrees with the PNA assessment as well as those of the review in MRAG 2014).

Dolphins: SPC estimate a total mortality of toothed cetaceans for 2009 (excluding false killer whales) of ~1000, nearly all of which are dolphins of a variety of species. It is clear that where dolphins are associated with tuna (mainly the eastern Pacific but perhaps elsewhere), mortality rates associated with purse seining have been massively reduced over the last two decades or so.

Sharks:

Silky, oceanic whitetip and hammerhead sharks seem to be taken mainly (although not 100%) in FAD sets – there is also the issue of FAD entanglement. Of these, the most significant in terms of bycatch is silky sharks. According to IUCN, silky sharks populations are declining in all areas for which data exist, although a recent (attempted) stock assessment for the eastern Pacific was more optimistic (Bonfil et al. 2009, Aires da Silva et al. 2013). Filmalter et al. (2013) estimated entanglement mortality of half a million silky sharks in the Indian Ocean, which is of a similar order to estimated bycatch in the longline fishery and catch in some directed fisheries, according to IUCN. OPAGAC, however, have a code of good practice in place which includes eliminating the use of entangling FADs – compliance as of mid-2015 was estimated to be >80% (Goñi et al. 2015) – reportedly this also includes removing other entangling FADs from the water, although this is not explicitly included in the code of good practice. Overall, there remains a risk that the FAD fishery is contributing to the decline (or hindering the recovery) of silky sharks (and possibly also the other species).

PI 2.3.1	The UoA meets national and international requirements for the protection of ETP species The UoA does not hinder recovery of ETP species

Great white sharks: There was a small bycatch of great white sharks in the non-OPAGAC observer data, taken only in FAD sets. Great white sharks, although having a cosmopolitan distribution, are more abundant in temperate zones, particularly in the southern hemisphere. The overlap of their range with this fishery is therefore limited, and it does not seem likely that this fishery (and the tropical tuna purse seine fishery in general) is having any impact on populations.

Whale shark: Bycatch of whale shark may be a significant issue for associated sets. WCPFC, IATTC and IOTC have banned deliberate setting on whale sharks (MRAG 2014) but Amandé et al. (2010) notes that a set which is apparently a free-school set can be subsequently found to include whale sharks. The PNA assessment provides a mortality estimate of 1.36 per 1000 sets, which agrees largely with the SFP estimate for 2009 (1.29). According to ISSF, there are 678 active large tropical tuna purse seiners; taking information on the number of positive sets from observer reports, this equates to ~120,000 sets/yr or a total mortality of 150-200 whale sharks per year over all oceans. OPAGAC, however, have included detailed instructions for removing whale sharks from the net under different circumstances, which, if being followed, should reduce whale shark mortality to minimal levels. It is probably reasonable to assume on these grounds that the fishery is 'likely' not to have an impact on these populations (SG60 is met), and perhaps 'highly likely' (SG80), but on the information provided this is not completely clear. This agrees with the scoring of 2.2 above for ICCAT.

Devil and manta rays:

These taxa are protected under EU fisheries regulations, which requires them to be discarded alive if possible. Goñi et al. (2015) note that the implementation of the OPAGAC code of good practice has been particularly successful in the case of rays.

Turtles:

The data from AZTI, as well as the (non-OPAGAC) observer data shows that all turtles were discarded alive, but given the small sample size, this cannot be guaranteed always to be the case, although good handling practices are followed in most cases (Goñi et al. 2015). There is also the issue of unobserved mortality (e.g. injury, FAD entanglement). Some turtle populations, however, are very depleted, such that small amounts of bycatch can still have a population-level impact. The specifics of scoring for turtles depends on what species are taken in what areas, the status of these populations and the level of post-release mortality, none of which are known at present (to the author). It is likely, however, that the implementation and verification of the code of good practice at least ensures that SG60 is met for turtles.

Scoring summary:

RFMO area	Set type	Proposed score	Reason
WCPFC	free	?	turtles?
	assoc	?	silky sharks? (other shark spp.?) sei whales?
IATTC	free	?	turtles?
	assoc	?	turtles? sei whales?
IOTC	free	?	turtles?
	assoc	?	turtles? Arabian Sea humpbacks? (NB: probably not likely but no information)
ICCAT	free	?	turtles?
	assoc	?	silky sharks? (other shark spp.?) sei whales?

PI 2.3.1	**The UoA meets national and international requirements for the protection of ETP species** **The UoA does not hinder recovery of ETP species**		
OVERALL PERFORMANCE INDICATOR SCORE:			
Associated	**WCPFC, IATTC, ICCAT?** **IOTC ??**	**Free**	**?**
References:	SPC 2012, Minton et al. 2015, Reilly et al. 2008a,b, Banks et al. 2011, Taylor et al. 2008, Anderson et al. 2015, MRAG 2014, MRAG 2010, Bonfil et al. 2009, Aires da Silva et al. 2013, Filmalter et al. 2013, Amandé et al. 2010, Banks et al. 2011, Marshall et al. 2011, EU 2015, OPAGAC 2012, Goñi et al. 2015 https://iwc.int/estimate http://iss-foundation.org/purse-seine/		

Evaluation Table for PI 2.3.2 – ETP species management strategy

PI 2.3.2		The UoA has in place precautionary management strategies designed to: • **meet national and international requirements;** • **ensure the UoA does not hinder recovery of ETP species.** **Also, the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of ETP species.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place (national and international requirements)			
	Guide post	There are **measures** in place that minimise the UoA-related mortality of ETP species, and are expected to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **strategy** in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to be **highly likely to achieve** national and international requirements for the protection of ETP species.	There is a **comprehensive strategy** in place for managing the UoA's impact on ETP species, including measures to minimise mortality, which is designed to **achieve above** national and international requirements for the protection of ETP species.
b	Management strategy in place (alternative)			
	Guide post	There are **measures** in place that are expected to ensure the UoA does not hinder the recovery of ETP species.	There is a **strategy** in place that is expected to ensure the UoA does not hinder the recovery of ETP species.	There is a **comprehensive strategy** in place for managing ETP species, to ensure the UoA does not hinder the recovery of ETP species
c	Management strategy evaluation			
	Guide post	The measures are **considered likely** to work, based on **plausible argument** (e.g., general experience, theory or comparison with similar fisheries/species).	There is an **objective basis for confidence** that the measures/strategy will work, based on **information** directly about the fishery and/or the species involved.	The strategy/comprehensive strategy is mainly based on information directly about the fishery and/or species involved, and a **quantitative analysis** supports **high confidence** that the strategy will work.
d	Management strategy implementation			
	Guide post		There is some **evidence** that the measures/strategy is being implemented successfully.	There is **clear evidence** that the strategy/comprehensive strategy is being implemented successfully and is achieving its objective as set out in scoring issue (a) or (b).
e	Review of alternative measures to minimize mortality of ETP species			
	Guide post	There is a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species and they are	There is a **biennial** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality ETP species, and they are

PI 2.3.2	**The UoA has in place precautionary management strategies designed to:** • **meet national and international requirements;** • **ensure the UoA does not hinder recovery of ETP species.** **Also, the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of ETP species.**		
		implemented as appropriate.	implemented, as appropriate.
Supporting information	MRAG (2014) provide a detailed review of the various management measures pertaining to different ETP species which are in force in each ocean – this is not repeated here. As part of the code of good practice, OPAGAC vessels provide identification sheets for ETP species, training in good handling practices and have 100% observer coverage. This could in general terms constitute a 'strategy' for dealing with ETP species, as required by SG80a, which is evaluated by AZTI via observer reports (SG80d), but only for the Atlantic so far. The development and implementation of the code of good practice is evidence of a review of measures to minimise ETP mortality, but it is not clear whether this is 'regular' (SG80e) – i.e. whether the code of good practice is reviewed and updated periodically. ISSF, however, provide training on up-to-date practices, and OPAGAC skippers have received ISSF training; again, however, it is not clear whether this is an ongoing thing. Free sets: For turtles, mortality seems to be more associated with FADs, and good handling practices such as are in place in this fishery will minimise mortality. The verification of the code of good practice provides a means by which unwanted bycatch is reviewed and practices can be evaluated and updated as required. SG80 is most likely met for all scoring issues. Associated sets: Mortality rates associated with setting purse seines on baleen and toothed whales and dolphins seem to be pretty small, and presumably where good handling practices are introduced and enforced, will be lower than the average. However, cetaceans are not included in the code of good practice, and hence the concern remains, particularly in relation to Indian Ocean humpbacks, where there can be argued to be measures (general training on good handling etc.) but perhaps not an explicit strategy for avoiding mortality, and where any mortality or injury (even one every few years) must be considered serious for the population. For FAD sets, the key species of concern are clearly sharks, and particularly silky shark (WCPFC and ICCAT – elsewhere they are considered under secondary species). As part of the code of good practice, OPAGAC are moving towards the use of non-entangling FADs, and have good shark handling practices in place; OPAGAC report that they also remove other entangling FADs when encountered, although this is not explicitly part of the code of good practice. This would most likely meet SG80 (an objective basis for confidence that the strategy will work), as long as it is verified and evaluated by AZTI. The same argument would apply to other shark species and to entanglement of turtles, although it is important to note with turtles that it is not always appropriate to write off small amounts of mortality (e.g. 1-10 individuals / year) as negligible, because the effective size of some populations of turtles in some areas is very small (e.g. see MSC assessment of the Cook Islands longline fishery). Scoring summary:		

RFMO area	Set type	Proposed score	Reason
WCPFC	free		No verification on the code of good practice available as yet
	assoc		
IATTC	free		
	assoc		

PI 2.3.2	**The UoA has in place precautionary management strategies designed to:** • **meet national and international requirements;** • **ensure the UoA does not hinder recovery of ETP species.** **Also, the UoA regularly reviews and implements measures, as appropriate, to minimise the mortality of ETP species.**

IOTC	free	??	verification of code of good practice, Arabian Sea humpback whales??
	assoc		need verification of code of good practice
ICCAT	free		code of good practice verified – also assuming that it is periodically updated
	assoc		entanglement of silky sharks in FADs – need to verify that any entangling FADs encountered are removed (not in code of good practice)

OVERALL PERFORMANCE INDICATOR SCORE:			
Associated		**Free**	**ICCAT**
References:	MRAG 2014, FCI 2015, Banks et al. 2011, SPC 2012, Gascoigne et al. 2015, OPAGAC 2012, Goñi et al. 2015)		

Evaluation Table for PI 2.3.3 – ETP species information

PI 2.3.3		**Relevant information is collected to support the management of UoA impacts on ETP species, including:** • **Information for the development of the management strategy;** • **Information to assess the effectiveness of the management strategy; and** • **Information to determine the outcome status of ETP species.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Information adequacy for assessment of impacts			
	Guide post	Qualitative information is **adequate to estimate** the UoA related mortality on ETP species. OR If RBF is used to score PI 2.3.1 for the UoA: Qualitative information is **adequate to estimate productivity and susceptibility** attributes for ETP species.	Some quantitative information is **adequate to assess** the UoA related mortality and impact and to determine whether the UoA may be a threat to protection and recovery of the ETP species. OR If RBF is used to score PI 2.3.1 for the UoA: Some quantitative information is adequate to assess productivity and susceptibility attributes for ETP species.	Quantitative information is available to assess with a high degree of certainty the **magnitude of UoA-related impacts, mortalities and injuries and the consequences for the status** of ETP species.
b	Information adequacy for management strategy			
	Guide post	Information is adequate to support **measures** to manage the impacts on ETP species.	Information is adequate to measure trends and support a **strategy** to manage impacts on ETP species.	Information is adequate to support a **comprehensive strategy** to manage impacts, minimize mortality and injury of ETP species, and evaluate with a **high degree of certainty** whether a strategy is achieving its objectives.
Supporting information		Fishery-level information: OPAGAC reportedly have 100% observer coverage in all oceans, and this information (if provided to an MSC team) should be sufficient for at least SG60 to be met, except for questions of FAD entanglement (see below). Population-level information: SG80 requires population-level as well as fishery-level information (SG80a: '… *to determine whether the UoA may be a threat to the protection and recovery of ETP species*') Baleen whales: IWC provide population estimates for some, but not all populations (see above). The most difficult to evaluate (as for 2.3.1 above) is sei whales – without detailed observer data (which would show whether or not mortality rates are negligible), it is not clear if SG80 would be met or not. Toothed whales and dolphins: Again, this is difficult to evaluate because multiple populations of different species are involved. It appears that for the most part, interactions with dolphins are only significant in the Pacific (although not necessarily zero elsewhere; Anderson 2015); the PNA assessment notes that no population-level information for false killer whales is available, although it considers that mortality rates are sufficiently low in the PNA fishery (2-3 per year) to meet the 80		

PI 2.3.3	**Relevant information is collected to support the management of UoA impacts on ETP species, including:** • **Information for the development of the management strategy;** • **Information to assess the effectiveness of the management strategy; and** • **Information to determine the outcome status of ETP species.**
	level without this information; however, SFP estimates a total mortality for the WCPFC fishery in 2009 of 239; clearly the impact of this level of mortality cannot be assessed without some population-level information, so SG80 may not be met on this basis. FAD entanglement: It is questionable whether the fishery data available will be sufficient to evaluate the impact of the fishery via entanglement in FADs – information on the deployment of different types of FADs is available, but an MSC assessment team will also have to verify whether entangling FADs are used in fishing, and whether they are taken out of the water and replaced with non-entangling FADs, as reported by OPAGAC. On this basis, the assumption is made for the moment that in terms of total mortality on sharks and turtles, and in particular on the silky shark, qualitative but not quantitative data would be available. Free sets: Although the bycatch of turtles and rays is most likely small in free sets, there is an issue in that the population size and trends of these species are poorly known in many areas (turtles in the Indian Ocean in particular; rays nearly everywhere). Also for some turtle management units, effective population sizes are very small so very little additional mortality can be supported. Better data (e.g. from observer reports) which allow bycatch to be partitioned into free and associated sets may, however, demonstrate that there is no issue. RBF: A PSA has not been attempted for all these species because of lack of detailed information about the footprint of the fishery. However, given the low productivity scores of all of them, experience suggests that the outcome would be a fail for most.
OVERALL PERFORMANCE INDICATOR SCORE:	

Associated		**Free**	
References:	Anderson 2015, Banks et al. 2011, SPC 2012 https://iwc.int/estimate		

Evaluation Table for PI 2.4.1 – Habitats outcome

PI 2.4.1		**The UoA does not cause serious or irreversible harm to habitat structure and function, considered on the basis of the area(s) covered by the governance body(s) responsible for fisheries management.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Commonly encountered habitat status			
	Guide post	The UoA is **unlikely** to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.	The UoA is **highly unlikely** to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to reduce structure and function of the commonly encountered habitats to a point where there would be serious or irreversible harm.
b	VME habitat status			
	Guide post	The UoA is **unlikely** to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.	The UoA is **highly unlikely** to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to reduce structure and function of the VME habitats to a point where there would be serious or irreversible harm.
c	**Minor habitat status**			
	Guide post			There is **evidence** that the UoA is highly unlikely to reduce structure and function of the minor habitats to a point where there would be serious or irreversible harm.
Supporting information		The approach taken by MRAG (to consider that impacts on the 'pelagic habitat' are negligible and to consider FAD 'habitats' under ecosystem) seems completely reasonable and is followed here.		
OVERALL PERFORMANCE INDICATOR SCORE:				
Associated			**Free**	
References:				

Evaluation Table for PI 2.4.2 – Habitats management strategy

PI 2.4.2		**There is a strategy in place that is designed to ensure the UoA does not pose a risk of serious or irreversible harm to the habitats.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place, if necessary, that are expected to achieve the Habitat Outcome 80 level of performance.	There is a **partial strategy** in place, if necessary, that is expected to achieve the Habitat Outcome 80 level of performance or above.	There is a **strategy** in place for managing the impact of all MSC UoAs/non-MSC fisheries on habitats.
b	Management strategy evaluation			
	Guide post	The measures are **considered likely** to work, based on plausible argument (e.g. general experience, theory or comparison with similar UoAs/habitats).	There is some **objective basis for confidence** that the measures/partial strategy will work, based on **information directly about the UoA and/or habitats** involved.	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on **information directly about the UoA and/or habitats** involved.
c	Management strategy implementation			
	Guide post		There is **some quantitative evidence** that the measures/partial strategy is being implemented successfully.	There is **clear quantitative evidence** that the partial strategy/strategy is being implemented successfully and is achieving its objective, as outlined in scoring issue (a).
d	**Compliance with management requirements and other MSC UoAs'/non-MSC fisheries' measures to protect VMEs**			
	Guide post	There is **qualitative evidence** that the UoA complies with its management requirements to protect VMEs.	There is **some quantitative evidence** that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant.	There is **clear quantitative evidence** that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/non-MSC fisheries, where relevant.
Supporting information		No significant habitat impacts; management not required		
OVERALL PERFORMANCE INDICATOR SCORE:				
Associated			**Free**	
References:				

Evaluation Table for PI 2.4.3 – Habitats information

PI 2.4.3		**Information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Information quality			
	Guide post	The types and distribution of the main habitats are **broadly understood**. OR If CSA is used to score PI 2.4.1 for the UoA: Qualitative information is adequate to estimate the types and distribution of the main habitats.	The nature, distribution and **vulnerability** of the main habitats in the UoA area are known at a level of detail relevant to the scale and intensity of the UoA. OR If CSA is used to score PI 2.4.1 for the UoA: Some quantitative information is available and is adequate to estimate the types and distribution of the main habitats.	The distribution of all habitats is known over their range, with particular attention to the occurrence of vulnerable habitats.
b	Information adequacy for assessment of impacts			
	Guide post	Information is adequate to broadly understand the nature of the main impacts of gear use on the main habitats, including spatial overlap of habitat with fishing gear. OR **If CSA is used to score PI 2.4.1 for the UoA:** Qualitative information is adequate to estimate the consequence and spatial attributes of the main habitats.	Information is adequate to allow for identification of the main impacts of the UoA on the main habitats, and there is reliable information on the spatial extent of interaction and on the timing and location of use of the fishing gear. OR **If CSA is used to score PI 2.4.1 for the UoA:** Some quantitative information is available and is adequate to estimate the consequence and spatial attributes of the main habitats.	The physical impacts of the gear on all habitats have been quantified fully.
c	Monitoring			
	Guide post		Adequate information continues to be collected to detect any increase in risk to the main habitats.	Changes in habitat distributions over time are measured.
Supporting information		No significant habitat impacts; information not required		

PI 2.4.3	Information is adequate to determine the risk posed to the habitat by the UoA and the effectiveness of the strategy to manage impacts on the habitat.		
OVERALL PERFORMANCE INDICATOR SCORE:			
Associated		**Free**	
References:			

Evaluation Table for PI 2.5.1 – Ecosystem outcome

PI 2.5.1		**The UoA does not cause serious or irreversible harm to the key elements of ecosystem structure and function.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Ecosystem status			
	Guide post	The UoA is **unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	The UoA is **highly unlikely** to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.	There is **evidence** that the UoA is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm.
Supporting information		MRAG (2014) provide an excellent review of the state of knowledge on ecosystem impacts of tuna fisheries in each ocean which is not repeated here. The logic of their scoring is that the impact of the presence of FADs remains unclear; they conclude that they are 'unlikely' to cause serious or irreversible harm, but given the present state of knowledge cannot necessarily be argued to be 'highly unlikely' to cause harm. They note that more information is required on the role that FADs play in the ecosystem and in particular the impact of entangling vs non-entangling FADs. This analysis seems appropriate.		
OVERALL PERFORMANCE INDICATOR SCORE:				
Associated			**Free**	
References:		MRAG 2014		

Evaluation Table for PI 2.5.2 – Ecosystem management strategy

PI 2.5.2		**There are measures in place to ensure the UoA does not pose a risk of serious or irreversible harm to ecosystem structure and function.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Management strategy in place			
	Guide post	There are **measures** in place, if necessary which take into account the **potential impacts** of the fishery on key elements of the ecosystem.	There is a **partial strategy** in place, if necessary, which takes into account **available information and is expected to restrain impacts** of the UoA on the ecosystem so as to achieve the Ecosystem Outcome 80 level of performance.	There is a **strategy** that consists of a **plan**, in place which contains measures to **address all main impacts of the UoA** on the ecosystem, and at least some of these measures are in place.
b	Management strategy evaluation			
	Guide post	The **measures** are considered likely to work, based on plausible argument (e.g., general experience, theory or comparison with similar fisheries/ ecosystems).	There is **some objective basis for confidence** that the measures/partial strategy will work, based on some information directly about the UoA and/or the ecosystem involved	**Testing** supports **high confidence** that the partial strategy/strategy will work, based on information directly about the UoA and/or ecosystem involved
c	**Management strategy implementation**			
	Guide post		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 objective as set out in scoring issue (a).
Supporting information		Again, MRAG provide an analysis of measures in place in the various oceans (stock assessments, attempts to control effort, protection of certain species and so forth). In relation to FADs specifically, there are attempts to control FADs in some areas (e.g. FAD management plans in the Pacific, the FAD closed area in the Atlantic); the extent to which this will work in terms of controlling the impact of FADs on the ecosystem depends to some extent on what these impacts are (which is not yet very clear). Since the ecosystem 80 level of performance is not met, it is hard to argue that SG80a is met here for the FAD fishery.		
OVERALL PERFORMANCE INDICATOR SCORE:				
Associated			**Free**	
References:		MRAG 2014		

Evaluation Table for PI 2.5.3 – Ecosystem information

PI 2.5.3		**There is adequate knowledge of the impacts of the UoA on the ecosystem.**		
Scoring Issue		SG 60	SG 80	SG 100
a	Information quality			
	Guide post	Information is adequate to **identify** the key elements of the ecosystem.	Information is adequate to **broadly understand** the	

PI 2.5.3		There is adequate knowledge of the impacts of the UoA on the ecosystem.		
			key elements of the ecosystem.	
b	Investigation of UoA impacts			
	Guide post	Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, but **have not been investigated** in detail.	Main impacts of the UoA on these key ecosystem elements can be inferred from existing information, and **some have been investigated in detail**.	Main interactions between the UoA and these ecosystem elements can be inferred from existing information, and **have been investigated in detail**.
c	Understanding of component functions			
	Guide post		The main functions of the components (i.e., P1 target species, primary, secondary and ETP species and Habitats) in the ecosystem are **known**.	The impacts of the UoA on P1 target species, primary, secondary and ETP species and Habitats are identified and the main functions of these components in the ecosystem are **understood**.
d	Information relevance			
	Guide post		Adequate information is available on the impacts of the UoA on these components to allow some of the main consequences for the ecosystem to be inferred.	Adequate information is available on the impacts of the UoA on the components **and elements** to allow the main consequences for the ecosystem to be inferred.
e	Monitoring			
	Guide post		Adequate data continue to be collected to detect any increase in risk level.	Information is adequate to support the development of strategies to manage ecosystem impacts.
Supporting information		Since 2.5.1 and 2.5.2 are scored <80 based largely on the lack of information available on the impacts of FADs of various kinds on the ecosystem, it is perverse to score this PI any higher (although the MSC standard is not completely immune from perverse outcomes). Specifically, the issue would be that adequate information may not be available on, for example, the unseen impacts of entangling FADs, to allow their consequences for the ecosystem to be inferred.		
OVERALL PERFORMANCE INDICATOR SCORE:				
Associated			**Free**	
References:				