Marine Stewardship Council

Consultation Document – MSC Mixed Fisheries modified assessment tree

Consultation Dates	1 August to 30 September 2016
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FOR CONSULTATION

1. Executive Summary

The MSC default standard for sustainable fishing may not be easily applied to mixed species fisheries, where many species are caught in the same place at the same time using the same gear. In highly diverse fisheries it is impractical, given resource constraints, to assess all species individually, either for their regular management or for an MSC assessment. The MSC has analysed best practices for managing such mixed species fisheries, compiling case studies from a number of fisheries globally. The MSC Technical Advisory Board (TAB) has advised the MSC Executive to proceed with development of an approach that is based on and generalises the mixed species assessment and management approach currently used for mixed stock fisheries in Western Australian demersal scalefish fisheries. The proposal and first draft for the development of such modified assessment tree for use in mixed fisheries was presented to the MSC's Technical Advisory Board Working Group (TAB WG) and Board of Trustees (BoT) in June 2016. This was subsequently prioritised and from July 2016 the MSC have started a full standard setting exercise (see Terms of Reference).

2. Purpose of the consultation

To solicit feedback from stakeholders; scientists, managers, fishery clients, industry representatives, eNGOs and others, on the applicability and appropriateness of the proposed modifications for mixed fisheries.

3. Background

Mixed fisheries present a particular challenge for fisheries science and management. Often in these fisheries, fish are caught by non-selective or less selective gear, meaning that a wide spectrum of sizes and species of fish are caught and utilised. It also means that if a fishery doesn't want to retain a specific species, and can't exclude it from the catch, the species of fish may be discarded overboard. Further, the large number of species caught together in mixed fisheries can increase the complexity of interactions with the ecosystem, for example through trophic level changes in competition and predation.

To date, there is no clear accepted best practice for assessing the sustainability of mixed fisheries. The current overarching best practice approach to fisheries management is to use single species, single-stock maximum sustainable yield assessments. Such maximum sustainable yield (MSY) is a theoretical value, the highest long-term average yield a stock can sustain indefinitely, calculated in isolation as if that stock is the only one harvested. Its calculation usually does not take into account the realities in mixed fisheries – such as the interactions of gears catching multiple sizes and species, nor the interactions between species (such as competition and predation).

The applicability of the MSC Fisheries Standard to mixed fisheries has been raised as an issue by stakeholders in the last few years, The MSC has followed up by conducting background research on the issue and holding discussions with targeted stakeholders. The MSC Fisheries Standard strives to provide a globally accessible approach for the assessment of sustainability in all wild capture fisheries. The standard is updated occasionally to reflect scientific developments and best practices in management. Reflecting such practices, the MSC Fisheries Standard is most easily applied to single-species, single-stock fisheries. However, many fisheries do target several species simultaneously and it is impractical, or impossible within realistic resources, to assess all of them individually. Further, it may not be expected or it may not be possible for all harvested stocks to be at or fluctuating around B_{MSY} or surrogate targets at all times, as required by the MSC Fisheries Standard. In addition to these real-world constraints, the single-species approach creates laborious and time consuming assessment processes, in which each Principle 1 (P1) candidate species must be assessed against the requirements for fisheries, increasing costs and effort in line with the number of

species. Furthermore, it can result in an artificial selection of P1 species – those that will pass P1 requirements rather than the entire suite of actual fishery-specific target species.

An MSC internal survey of global outreach staff conducted in 2015 identified that all regions have mixed fisheries interested in MSC assessment, and the development of an MSC Mixed Fisheries Standard could increase accessibility for approximately 20% of fisheries worldwide.

4. Considerations

The outcome of this work should be a significantly more efficient way for some mixed fisheries to access the MSC program. Use of this approach retains the normal outcome standard required of MSC fisheries, but allows that only certain index stocks are actually assessed in detail, while other more resilient (less vulnerable) stocks may still be certified given adequate information on their resilience characteristics and similar management. However, the proposed modification to the MSC Standard will still not be applicable to all mixed fisheries, and requires demonstrable outcomes.

5. Potential interactions with other work

This work potentially interacts with multiple other MSC policy improvement projects. These include the simplification for fishery assessments workstream, the aims of which should be considered within this development, and the continuing development of the risk-based framework and alternative data-limited assessment methods.

6. Next Steps

Following consultation, an amended draft of the requirements will be proposed to the MSC Technical Advisory Board for their input in December 2016. The updated standard will then be made available for another round of public consultation in 2017.

7. Who can comment? How do I give feedback?

This consultation is public and open to all interested parties.

Please refer to the modified assessment tree (Annex SE below) and provide any feedback to the following questions by completing this feedback survey:

1. Is the terminology used in the assessment tree clear?
2. Do you understand the different species designations? (i.e. Index species, non-index species, monitored species etc.)
3. Will this index species approach work in your fisheries? If not, what other mixed fisheries approaches should MSC also consider in future?
4. Will this approach achieve the intended goal of creating efficiencies in MSC assessments for fisheries with multiple target species?
5. Are the suggested requirements, new scoring issues and modified scoring issues appropriate? Are the modifications in the correct places?
6. Are there any missing considerations or any that should be removed?
7. Is there anything else you would like to feedback to the MSC about this consultation?

Annex SE: Modifications to the Default Assessment Tree for mixed fisheries – Normative

DRAFT FOR CONSULTATION 1 August - 30 September 2016

Guidance for use of this document

- All Annex SE requirements and guidance are new and specific to mixed fisheries assessments.
- In the Performance Indicator (PI tables):
    - Additions to existing MSC default assessment tree performance indicators or new requirements appear in red text.
    - Deletions from existing MSC default assessment tree performance indicators appear in ~~strikethrough~~.
- Consultation notes to stakeholders appear in grey comment balloons in the right margin.

Annex SE: Modifications to the Default Assessment Tree for mixed fisheries – Normative

Modifications to the default tree structure, including the PISGs for each of the three MSC Principles to be used in fishery assessments for mixed and multi-species fisheries (hereafter mixed fisheries). ‼

SE1 General

Note This approach to assessment allows for an entire suite of species to be assessed as Principle 1 species. It relies on **index species,** for which management is in place intended to achieve stock management objectives reflected in limit and target reference points. Any species that are shown to be less vulnerable than these can also be nominated as Principle 1 species. These less vulnerable species are termed **non-index** species and are not explicitly managed to achieve stock management objectives reflected in limit or target reference points. Some of the non-index species are monitored, however, to detect potential fishery-induced changes; these are termed non-index monitored species. Together the index species and non-index species (some of which are monitored, others not) comprise the P1 species suite that will be certified if it meets the requirements below.

SE1.1 In order to use this assessment tree the CAB shall verify that there is sufficient understanding of the fishery and its removal(s) to be confident that the index species assessed in Principle 1 adequately represent the risk to the removals of less vulnerable species.

SE1.2 To apply Annex SE in mixed fisheries CABs shall confirm the fishery under assessment adheres to the following characteristics:

a. all species can be identified;
b. annual catches for individual P1 species are available;
c. there is a specified fishing area;
d. all removals are known;
e. single jurisdiction or co-operating jurisdictions;
f. compliance program in place;
g. empirical performance history exists or the strategy has been evaluated (e.g. MSE).

SE1.3 The assessment team shall interpret key words and phrases used in Annex SE as shown in Table SE1.

SE1.4 Teams shall apply Annex SE as a supplement to Annex SA in fishery assessments of mixed fisheries.

SE1.5 Only additions or modifications to the default assessment tree and requirements in Annex SA are included in this Annex.

SE1.5.1 Unless specifically noted, all other Annex SA PISGs and requirements apply.

Table SE1: Terms and Definitions

Term	Definition
Indicator	A measure of some aspect of performance related to one or more objectives.
Index species	Management determining species. These species are selected for being the most vulnerable **of the proposed P1 species suite** (see definition below). One or more index species is used to evaluate the status of the entire suite of species. Even if only one of the index species has breached the threshold or limit level then the entire suite of species is deemed to have breached this level so would be subject to the same management response. In some contexts, index species are intended to be in some way representative or typical of a wider species group. In this mixed fisheries management approach, the selected species are not intended to be representative or typical of the properties of a group, but rather to exhibit some extremes of the group in being the most vulnerable to fishing impacts. Index species are managed. See also non-index species below.
Resilience	Resilience is characterised by one or both of the following criteria; i. The productivity of the species indicates that it is intrinsically of low resilience, for instance, if determined by the productivity part of a PSA that it has a score equivalent to low or medium productivity; or ii. Even if the species productivity is high, other factors such as the scale of fishing pressure or the species economic, recreational, social or cultural value indicate that its resilience is low.
Mixed fisheries	Fisheries where multiple species are caught in the same place, at the same time and with the same gear (also called multispecies fisheries in some regions and jurisdictions).

Monitored non-index species	Species that are less vulnerable than the index species, which fall in the 'species suite' and are monitored as representatives of the species suite to detect changes in stock size and/or composition.
Non-index species	Species that are less vulnerable than the index species, and makeup the remaining species in a suite. They are generally not explicitly assessed in a way that would generate estimates or proxies for B_{MSY} and F_{MSY}. Non-index can be either monitored or not-monitored.
Population	The entire set of potentially interbreeding individuals of a species. A population may have a number of sub-populations or stocks.
Principle 1 suite (P1 suite)	(see below for definition of species suite) The Principle 1 suite is the combination of index species and non-index species eligible to carry the ecolabel if the assessment is successful.
Vulnerability	Vulnerability is a measurement of a stock's productivity and its susceptibility to a fishery (Patrick et al. (2010), *Using productivity and susceptibility indices to assess the vulnerability of United States fish stocks to overfishing*, Fish. Bull. 108, 305–322). More broadly, vulnerability is related to the likelihood that a population, community, or habitat will experience substantial alteration from short-term or chronic disturbance, and the likelihood that it would recover and in what time frame. These are, in turn, related to the characteristics of the ecosystems themselves, especially biological and structural aspects. The vulnerability of populations, communities and habitats must be assessed relative to specific threats. Some features, particularly those that are physically fragile or inherently rare, may be vulnerable to most forms of disturbance, but the vulnerability of some populations, communities and habitats may vary greatly depending on the type of fishing

	gear used or the kind of disturbance experienced. (FAO (2009*), International guidelines for the management of deep-sea fisheries in the high seas*, http://www.fao.org/docrep/011/i0816t/i0816t00.htm) Vulnerability may be calculated by multiple methods, but should include consideration of both inherent productivity and susceptibility to fishing (e.g. r*q or PSA).
Stock	A functionally discrete population that is sufficiently distinct from other stocks or populations of the same species to achieve effective fisheries/resource management.
Species suite	The index species and all those less vulnerable non-index species whose assessment hinges on that of the index species shall comprise a species suite (i.e. the index species + non-index species = Species suite).

SE1.2 General requirements

SE1.2.1 In addition to the requirements in FCR 7.4.6-7.4.11, the Unit of Assessment shall be defined as follows:

SE1.2.1.1 The CAB shall list all species intended to be included in the Principle 1 species suite (and thus eligible to carry the ecolabel, hereafter referred to as the P1 species suite).

SE1.2.1.2 The CAB shall list all index species to be assessed in Principle 1 and their corresponding vulnerabilities (refer to Table SE1, hereafter index species).

SE1.2.1.3 The CAB shall list all non-index species to be included in Principle 1 and their corresponding vulnerabilities (hereafter non-index species).

a. All non-index species shall be less vulnerable than at least one of the index species listed (refer to Table SE1).
b. Non-index species shall be divided into monitored and non-monitored species (hereafter non-index monitored species and non-index unmonitored species).

SE 1.2.1.4 The following species shall be assessed in Principle 2:

a. ETP (Endangered, Threatened and Protected) species

b. Species classified as 'Out of scope' species (amphibians, reptiles, birds and mammals)
c. Species classified as 'more vulnerable' than any of the index species.

SE2 Principle 1

SE2.1 General requirements for Principle 1

SE2.1.1 In Principle 1, teams shall score the whole stock(s) of the index and non-index species selected for inclusion in the Unit of Assessment (UoA).

SE2.2 Stock status PI (PI 1.1.1)

Table SE1: PI 1.1.1 Stock status PISGs

Component	PI	Scoring issues	SG60	SG80	SG100
Outcome:	Stock status **1.1.1** The index species are at a level which maintains high productivity and has a low probability of recruitment overfishing. The non-index species are at a level which maintains high productivity	(a) Stock status relative to recruitment impairment.	It is **likely** that the index species are above the point where recruitment would be impaired (PRI).	It is **highly likely** that the index species are above the PRI.	There is a **high degree of certainty** that the index species are above the PRI
		(b) Stock status in relation to achievement of Maximum Sustainable Yield (MSY).		The index species are at or fluctuating around a level consistent with MSY.	There is a **high degree of certainty** that the index species have been fluctuating around a level consistent with MSY or has been above this level over recent years.
		(c) Stock status relative to recruitment impairment for non-	It is **likely** that the non-index P1 species are above the point where recruitment		

Consultation Note: NEW Scoring Issue (SI)

	and has a low probability of recruitment overfishing.	index P1 species.	would be impaired (PRI).		

Scoring stock status

SE2.2.1 Where fishing mortality rate and biomass estimates are both available they shall be used in tandem as a means for scoring stock status.

SE2.2.1.1 Where an estimate of biomass is not available, teams shall use a weight-of-evidence approach including F and other indicators such as, but not limited to, catch or effort time series or CPUE, to illustrate that the required biomass levels are likely to be met.

SE2.3 Stock rebuilding PI (PI 1.1.2)

SE2.3.1 When the status of the Index species is below the SG80 requirement of PI1.1.1, the assessment team shall score PI 1.1.2.

Table SE2: PI 1.1.2 Stock rebuilding PISGs

Component	PI	Scoring issues	SG60	SG80	SG100
Outcome	Stock Rebuilding 1.1.2 Where the index species are reduced, there is evidence of stock rebuilding within a specified timeframe.	(a) Rebuilding timeframes – Index species	A rebuilding timeframe is specified for the index species that is the **shorter of 20 years or 2 times its generation time**. For cases where 2 generations is less than 5 years, the rebuilding timeframe is up to 5 years.		The shortest practicable rebuilding timeframe is specified which does not exceed **one generation time** for the index species.
		(b) Rebuilding evaluation	Monitoring is in place to determine whether the rebuilding	There is **evidence** that the rebuilding strategies are rebuilding the	There is **strong evidence** that the rebuilding strategies are

		- Index species	strategies are effective in rebuilding the index species within the specified timeframe.	index species, **or it is likely** based on exploitation rates or previous performance that they will be able to rebuild the index species within the **specified timeframe**.	rebuilding the index species, **or it is highly likely** based on exploitation rates or previous performance that they will be able to rebuild the index species within the **specified timeframe**.
		(c) Rebuilding evaluation - non-index species		Monitoring is in place to determine whether the rebuilding strategies are effective in rebuilding non-index species	There is **evidence** that the rebuilding strategies are rebuilding non-index species, **or it is likely** based on exploitation rates or previous performance that they will be able to rebuild the suite within the **specified timeframe**.

Consultation Note: NEW SI: The default PIs are re-written to focus on index species. This new SI ensures monitoring is in place for the remainder of the species.

SE2.3.1 When the status of the index species is below the SG80 requirement of PI1.1.1, the assessment team shall score PI 1.1.2.

SE2.3.2 In scoring issue (c) the Assessment team shall consider other monitoring activities (e.g. of mean length, sex ratio) to meet the SG80 and SG100 level.:

SE2.4 Harvest strategy PI (PI 1.2.1)

Table SE3: PI 1.2.1 Harvest strategy PISGs

Component	PI	Scoring issues	SG60	SG80	SG100

Harvest strategy (management)	Harvest strategy **1.2.1** There is a robust and precautionary harvest strategy in place for index species, with explicit consideration of the entire Principle 1 species suite.	(a) Harvest strategy design	The harvest strategy is **expected** to achieve stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the index species and the elements of the harvest strategy **work together** towards achieving stock management objectives reflected in PI 1.1.1 SG80 for the entire P1 suite.	The harvest strategy is responsive to the state of the ~~stock~~ index species and is **designed** to achieve stock management objectives reflected in PI 1.1.1 SG80 for the entire P1 suite.
		(b) Harvest strategy evaluation	The harvest strategy works based on prior experience or plausible argument.	The harvest strategy ~~may not have been~~ has been fully **tested** ~~but~~ or empirical evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been **fully evaluated** and evidence exists to show that it is achieving its objectives including being clearly able to maintain the index species and the entire P1 suite at target levels.
		(c) Harvest strategy monitoring	Monitoring is in place for the index species that is expected to determine whether the harvest strategy is working.	Monitoring is in place for both index species and P1 non-index monitoring species that is expected to determine whether the harvest	

				strategy is working.	
		(d) Harvest strategy review		The harvest strategy and choice of P1 index species is periodically reviewed and improved as necessary	The harvest strategy and choice of P1 index and P1 non-index monitoring species, is periodically reviewed and improved as necessary
		(e) Shark finning	It is **likely** that shark finning is not taking place.	It is **highly likely** that shark finning is not taking place.	There is a **high degree of certainty** that shark finning is not taking place.
		(f) Review of alternative measures	There has been a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the ~~target stock~~ Principle 1 species.	There is a **regular** review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the ~~target stock~~ Principle 1 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 the ~~target stock~~ Principle 1 species and they are implemented, as appropriate.
		(g) Selection and appropriate-ness of index species	It is **likely** that the index species are appropriate based on available evidence.	There is **a scientific basis** for the selection of the index species.	There is a **robust scientific basis** for the selection of the index species.
		(h)		Monitored non-index	

Consultation Note: NEW Scoring Guidepost (SG) at 80 for scoring issues c and d.

Consultation Note: NEW SI

Consultation Note: NEW SI: Another critical element of this approach is the selection of monitored species.

		Selection and appropriate-ness of monitored non-index species		species are representative of the species suite.	

SE2.4.1 Teams shall ensure that the harvest strategy includes explicit means to ensure that the non-index species in the Principle 1 suite are measured for performance.

SE2.4.2 In scoring issue (b) at the SG 80 level, teams shall consider the following:

SE2.4.2.1 Fully tested refers to a management strategy evaluation or comparable exercise with similar intent and outcome; or

SE2.4.2.2 'Empirical evidence' shall be interpreted to mean a time series of at least 10 years.

SE2.4.3 In scoring issue (g) 'scientific basis' shall include consideration of the conservation, fishery management and stock assessment requirements.

SE2.5 Harvest control rules and tools PI (PI 1.2.2) ‼

Table SE4: PI 1.2.2 Harvest control rules and tools PISGs

Component	PI	Scoring issues	SG60	SG80	SG100
Harvest strategy	Harvest control rules and tools **1.2.2** There are well defined and effective harvest control rules (HCRs) in place for both index species	(a) HCRs design and application	**Well defined** HCRs are **in place** that **ensure** that the exploitation rate of index species and the P1 suite is reduced as the PRI is approached, and are expected to keep the stock **fluctuating around** a level consistent with (or above) MSY.	The HCRs are expected to keep the index species and the P1 suite **fluctuating at or above** a level consistent with MSY, or another more appropriate level taking into account the ecological role of the stock, **most** of the time.	

Consultation Note: UPDATED SI: The SG80 from the default tree was moved to the SG60 here, and the SG100 to SG80. Given not all species destined to carry the ecolabel will have full assessments, stronger HCR input controls are required to counter-balance the increased uncertainty in outcome status.

	and the P1 suite.	(b) HCRs robustness to uncertainty		The HCRs are likely to be robust to the main uncertainties.	The HCRs take account of a **wide** range of uncertainties including the ecological role of the stock, and there is **evidence** that the HCRs are robust to the main uncertainties.
		(c) HCRs evaluation	There is **some evidence** that tools used to implement HCRs are appropriate and effective in controlling exploitation.	**Evidence indicates** that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.	**Evidence clearly shows** that the tools in use are effective in achieving the exploitation levels required under the HCRs.

Consultation Note: UPDATED SI: 'Available' language removed

SE2.5.1 In scoring issue (a), the assessment team shall ensure that the HCRs for the non-index species (P1 suite) are based on both:

a. the status of the index species; and
b. some measure of direct relevance to the non-index species that constitute the suite (e.g. exploitation level of individual species or the entire suite.)

SE2.6 Information and Monitoring PI (PI 1.2.3)

Table SE6: PI 1.2.3 Information and Monitoring PISGs

Component	PI	Scoring issues	SG60	SG80	SG100
Harvest Strategy	Index species **1.2.3**	(a) Range of information	**Some** relevant information related to stock structure,	**Sufficient** relevant information related to stock structure,	A **comprehensive range** of information (on stock structure,

	Relevant Information is collected to support the harvest strategy		production and fleet composition is available to support the harvest strategy. Information is available for the index species.	production, fleet composition and other data are available to support the harvest strategy**.** Information is available for some P1 suite species.	production, fleet composition, abundance, UoA removals and other information such as environmental information), including some that may not be relevant to the current harvest strategy, **is available, including estimates of the impacts of fishery harvests on the entire P1 suite.**
		(b) Monitoring of index species	Index species are monitored with **sufficient frequency** to support the harvest control rules.	Index species are **regularly monitored at a level of accuracy and coverage consistent with the harvest control rules and their status** are available and monitored with sufficient frequency to support the harvest control rule.	**Index species are** monitored with high frequency ~~and a high degree of certainty~~, there is a good understanding of the inherent **uncertainties** in the information [data] and the robustness of assessment and management to this uncertainty.
		(c) Comprehensiveness of information	There is good information on removals of index species by all other fisheries.		

			species by the UoA.		
		(e) Monitoring of non-index species	Some data are collected which will likely indicate increases in risk to status of monitored non-index species.	Adequate data are collected to which will allow detection of increases in risk to status of monitored non-index species.	Comprehensive data are collected which will allow detection of increases in risk to status of all non-index species.

Consultation Note: NEW SG

Consultation Note: NEW SI

SE2.6.1 In scoring issue (a) relevant information shall include the risk profile related to natural productivity, susceptibility to fishing, with consideration of any fishery management systems that may be in place.

SE2.6.2 Where monitoring determines that the risk to non-index species, or their vulnerability to fishing, has increased, a review of the harvest strategy is required.

SE2.6.2.1 The performance of this review shall be scored according to PI 1.2.1 (d).

SE2.7 Assessment of stock status PI (PI 1.2.4)

Table SE7: PI 1.2.4 Assessment of stock status PISGs

Component	PI	Scoring issues	SG60	SG80	SG100
Harvest strategy	Assessment of stock status **1.2.4** There is an adequate assessment of the stock status for the index species.	(a) Appropriate-ness of assessment to stock under consideration		The assessment is appropriate for the stock and for the harvest control rule.	The assessment takes into account the major features relevant to the biology of the species and the nature of the UoA.
		(b) Assessment approach	The assessment estimates stock status relative to generic reference points	The assessment estimates stock status relative to reference points that are appropriate to	

			appropriate to the species category.	the index species ~~stock~~ and can be estimated.	
		(c) Uncertainty in the assessment	The assessment **identifies major sources** of uncertainty.	The assessment **takes uncertainty into account,** including uncertainty in the selection of index species.	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a **probabilistic** way.
		(d) Evaluation of assessment			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.
		(e) Peer review of assessment		The assessment of stock status is subject to peer review.	The assessment has been **internally and externally** peer reviewed.

SE2.7. In PI1.2.4, the team shall assess the index species against scoring issues (a)-(e)
1

Annex GSE: Guidance to the Modifications to the Default Assessment Tree for mixed fisheries

Mixed fisheries generally catch a suite(s) of species that occupy similar habitats for which assessments of all target and other species are not possible due to limits on management resources. To efficiently manage these resources, one or more index species may be used to monitor the status of the whole resource (Wise et al., 2007; Fletcher et al., 2010, 2012; DoF, 2011).

In an explicit index species based approach, the species selected to guide the management of the resource are those that are considered the most vulnerable to the fishing activities (DoF, 2011). If the stock status of the index species breaches a threshold or limit level, the entire resource is deemed to have breached this level and appropriate management actions are implemented across the entire resource. This precautionary, but practical approach recognises that, in many cases, fishing methods cannot selectively target individual species within the suite/resource. Thus, for example, to enable recovery of an overfished species often requires an overall reduction in fishing intensity across the entire suite/resource, as acknowledged for rebuilding of significant ground fish fisheries in the north-western Pacific, north Atlantic and Irish Sea region (Caddy and Agnew, 2004).

In the context of an MSC assessment, where the management determining [index] species are assessed as meeting the Principle 1 standard of Annex SE, any species in the suite/resource that are more resilient (less vulnerable) are also able to carry the ecolabel (Figure GSE1).

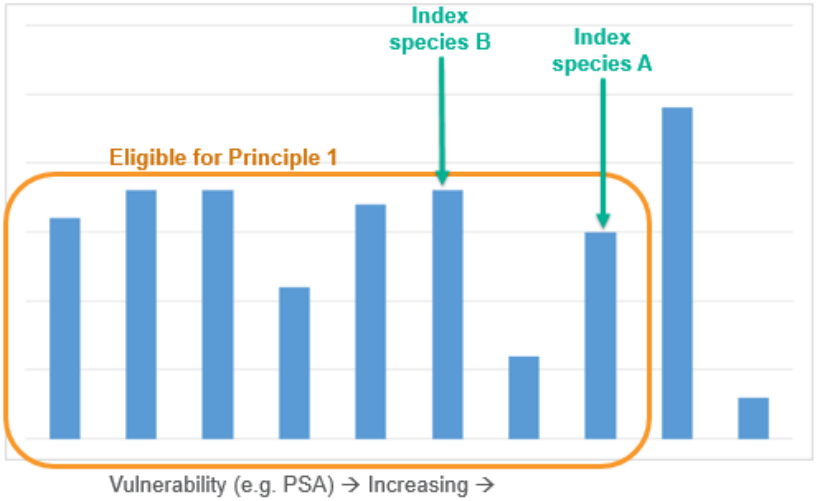

Figure GSE1: Schematic showing species abundance by vulnerability to the fishery. In this example, there are two index species, A and B which are assessed using a quantitative stock assessment, are monitored, and HCRs implemented in response to evidence of declining biomass. Index species A and B will be assessed in Principle 1. Any species in the resource that are less vulnerable than either of the index species (those to the left, in the orange box) are also eligible to carry the ecolabel if the fishery is certified. Those to the right of Index A are more vulnerable and not managed so will be assessed under Principle 2.

Box GSE1: Western Australia's Department of Fisheries approach to mixed fisheries.

Globally, there are hundreds and possibly thousands of exploited fish stocks for which there is insufficient information to estimate biomass or fishing mortality. Management of all these stocks against the internationally acknowledged principles of B_{MSY} or F_{MSY} is impossible. Many of these fisheries are small scale and/or so data poor that even proxies for B_{MSY} or F_{MSY} are impossible to generate with any degree of confidence. Thus, there are many cases where the gap between capacity to provide assessments and actual assessments remains a challenge (e.g. Dowling et al., 2014). For example, a review by Campbell (2010) noted that previous studies determined F_{MSY} as an appropriate LRP. However, determining what F_{MSY} is remains problematic for the majority of exploited species because there are insufficient data to estimate B_{MSY} and F_{MSY} for all but the species which dominate catches. Thus, this MSY-based approach is theoretically sound, but cannot be implemented for most stocks.

Campbell (2010) noted for western Pacific fisheries management that stocks typically had insufficient information on which to generate MSY-based reference points. They noted that alternative reference points not based on MSY would be more appropriate and that the reference points used should be, amongst other things, scientifically based and relevant to what managers need. Campbell also articulated that reference points developed for key species should be considered in a multi-species context.

While this currently remains a somewhat intractable problem for stocks that form part of multi-species fisheries with multiple sectors using different gears, or coming from different jurisdictions, the scope of the problem is reduced for single-gear fisheries operating under one jurisdiction. Furthermore, for fisheries with relatively selective methods, such as baited lines or traps, the range of species caught will usually exhibit generally similar lifestyles (e.g. reef associated carnivores) which may further reduce the complexity of developing multispecies reference points. The tree being proposed here aims to provide a mechanism to consider a multispecies approach to implementing reference points for mixed fisheries which aligns with the MSC use of the MSY principles.

The method applied in WA is to assess the status of key retained species and apply any management intervention to the whole resource (Wise et al., 2007; Fletcher et al., 2010, 2012; DoF 2011). The species selected as index species for the resource are those that are considered the most vulnerable to the fishing activities as determined by consideration of inherent productivity and susceptibility to capture (actual catch levels). If the sustainability status of the assessed species breaches a threshold or limit level, the entire resource is deemed to have breached this level and appropriate management arrangements across the resource are implemented. This precautionary approach recognises that in many cases fishing methods cannot target individual species within the suite/resource. Thus, for example, to enable recovery of an overfished species often requires an overall reduction in fishing intensity across the entire suite/resource, as acknowledged for rebuilding of significant ground fish fisheries in the north-western Pacific, north Atlantic and Irish Sea region (Caddy and Agnew, 2004).

A feature of this approach is that even if only one of the index species has breached the threshold or limit level, then the entire suite of species is deemed to have breached this level. This would require appropriate management arrangements to be implemented to adjust overall levels of effort. This is considered the most efficient method for dealing with these types of fisheries because it reduces the number of detailed assessments and management interventions that need to be undertaken. Furthermore, because the management response of lowering the overall effort on the suite to reduce the fishing mortality on the stock that is at unacceptable levels, it is also a precautionary approach because it minimises the opportunity for switching effort to less vulnerable species which could cause discard mortalities of the vulnerable species will affect recovery as may occur if a separate quota based management of the species was used. **(**see Fisheries Occasional Publication No. 85 for more details.)

GSE1.2 General requirements for species categorisation

Categorising species in the correct location for assessment is a critical part of an accurate assessment for mixed fisheries. Figure GSE1.2 illustrates under which Principle and which sub-category each component of the catch should be considered. Figure GSE1 describes the concept.

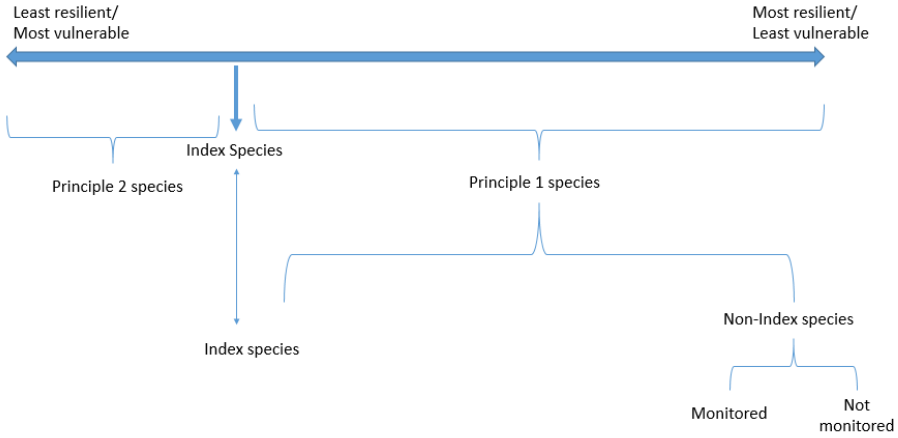

Figure GSE2: Schematic depicting species categories and sub-categories for assessment against Annex SE.

GSE1.2.1.3

Monitoring in the context of non-index species may include, but is not limited to CPUE, periodic age structure, etc (depending on the type and scale of fishery).

GSE2.2.2.1 Weight of evidence approach

A **weight of evidence approach** should be used to support stock status determination by considering a range of biological and fishery information. The approach should be a structured, scientific process that:

- Describes the attributes of the species and fishery
- Compiles lines of evidence to support the determination of stock status
- Determines status by weighting of all available relevant evidence

Lines of evidence used in the approach may include (but are not limited to):

- empirical information e.g. catch, effort, CPUE, size or age based indicators, spatial and temporal distribution of catches and proportion of species distribution fished
- Species characteristics e.g. longevity, age/size at sexual maturity, migration or known spawning aggregations, sex change
- Risk assessment either qualitative or semi-quantitative

- Fishery independent surveys
- Quantitative stock assessments
- Spatial and temporal distribution of the fishery
- Harvest strategies

In data-limited or small-scale fisheries, limited lines of evidence may be available, thus expert judgement plays an important role in stock status determination, with clear and concise documentation of the available lines of evidence and rationale for the decision an essential part of the process.

Example of weight of evidence approach for Pink Snapper (*Pagrus auratus*) in the South Coast Demersal Scalefish Fishery, Western Australia, Australia

Category	**Lines of evidence (Consequence/Status)**
Catch	Around 57% of the current total catch of snapper in the South Coast Bioregion (SCB) is taken by the commercial wetline sector, 25% by the commercial gillnet fishery, 3% by the estuarine net fishery, and 15% by the recreational and charter sector. Wetline catches were low from 1975 to 1995 before increasing to 30-50 t between 2000 and 2011. Catches have declined since then but remained within the historical range. Historical recreational catches prior to the recent estimates for boat based catches are unknown but are likely to have been restricted to similar or lower levels by the oceanic conditions and remoteness of this region. **There is no indication within the catch data of unacceptable stock depletion**.
Catch distribution	Most of the commercial wetline and recreational and charter catches are taken in the western sub-region. The spatial distribution of commercial wetline catches (noting the coarseness of these data due to 60' x 60' reporting blocks) has expanded slightly over the past 25 years but has been stable over the last decade. **There is no indication that catch levels have been maintained by a progressive shifting of the areas fished that would be indicative of unacceptable stock depletion**.
Catch rates	The coarseness and multi-species nature of the commercial data makes it uncertain how accurately and responsively the catch rates represent an index of abundance for this species. Standardised catch rates for both gillnet and wetline sectors have, however, remained stable since mid-1990s. **There are no indications from catch rates of unacceptable stock depletion during this period**.
Vulnerability (Productivity Susceptibility Analysis [PSA])	Snapper are long-lived (maximum recorded age 41 years). Individuals typically mature on the south coast at around 543 mm (TL) and 4.6 years of age and are selected by line fishing (the dominant fishing method for commercial and recreational sectors) at around 410-450 mm. With a productivity score of 1.86 and susceptibility score of 2.33, the derived PSA score is 2.98 (60<MSC SGA score<80).

	This level of vulnerability would indicate that unacceptable stock depletion would be possible if there was no management of the relevant fisheries across the region.
Length and/or age composition	Length composition of the commercial gillnet catch in 2013 and 2014 was slightly larger compared to observer data from 1994 to 1999 when a similar gillnet mesh size was used. This result is not consistent with unacceptable stock depletion having occurred over this period. The age composition considered the most representative for this stock (commercial wetline samples - western sub-region) had individuals of more than 20 years or age, which is also not consistent with unacceptable stock depletion having occurred. Furthermore, the distribution of the ages in these samples in general suggests there have been regular and consistent levels of annual recruitment into this stock over the last two decades. There are indications of strong year classes in 1996 and 1998. **Length and age composition data provide further evidence that an unacceptable stock depletion has not occurred over the last two decades, and the consistency of recruitment suggests robust spawning stock levels are being maintained.**
Fishing mortality (*F*)	Based on the age composition data considered the most representative of the snapper stock (commercial wetline, western sub-region), estimates of total mortality (*Z*) were 0.23-0.24. The associated estimates of fishing mortality (*F*) varied depending upon whether the estimate of natural mortality (*M*) was derived using Hoenig (1983) or the recently developed method of Then *et al*. (2014). Using simulated values of *M* uniformly distributed between the Hoenig and Then estimates, there was only a 25% chance of *F* estimates breaching the threshold while the limit level was never breached. **This indicates that an unacceptable level of stock depletion is unlikely to occur if historic levels of fishing are maintained.**
Index of spawning stock biomass (Spawning Potential Ratio [SPR])	Estimates of female SPR based on the most representative age sample and *F* estimates derived using values of *M* uniformly distributed between the Hoenig and Then estimates indicate a 21-43% chance of the breaching the threshold and a 0-9% chance of falling below the limit level. **This indicates that unacceptable stock depletion is unlikely if historic levels of fishing are maintained.**

Weight of Evidence Risk-based Stock Assessment – Snapper

All of the lines of evidence outlined above are combined within the Department's ISO 31000 based risk assessment framework (Fletcher, 2015) to determine the most appropriate combinations of consequence and likelihood to determine the overall current risk status of the stock.

C1 (Minimal Depletion – above target): **L2** – Based on the catch history, catch distribution time series, current age structure and fishing mortality estimates, there is an Unlikely likelihood

(L2) that the current level of stock depletion is above the target level. Only the length composition line of evidence is consistent with minimal depletion.

Snapper risk matrix

Consequence (stock depletion) Level	Likelihood					Risk Score
	L1 Remote (<5%)	L2 Unlikely (5-30%)	L3 Possible (30-50%)	L4 Likely (50-90%)	L5 Certain (90-100%)	
C1 Minimal		X				2
C2 Moderate				X		8
C3 High		X				6
C4 Major	X					4
C5 Catastrophic						na

C2 (Maximum Acceptable Depletion - above threshold): **L4 –** The catch distribution time series, age structure, F and SPR lines of evidence are consistent with a Likely (L4) likelihood that the snapper stock is now between the threshold and target levels and therefore at an acceptable level. The lines of evidence also suggest that if the current total levels of annual capture are maintained, the stock level is likely to remain within this band during the next five years. However, the level of fishing as measured by F and SPR suggest this is currently close to the maximum level to maintain the stock within this acceptable range.

C3 (Unacceptable Depletion – below threshold): **L2** – The catch, catch rates, catch distribution, current age structure, F and SPR lines of evidence are all consistent with an Unlikely (L2) likelihood that at the current (historic) levels of fishing that stock depletion has or will breach the threshold level to become unacceptably High within the next five years. While the range of SPRs did suggest a 21-43 % chance of breaching the threshold, all the other lines of evidence suggested this was unlikely, hence the lower end of this range was considered more appropriate.

C4 (Unacceptable - below limit): **L1 –** While the SPR analysis suggests a Remote (L1) likelihood that the stock has breached the limit level (C4), or will do so within 5 years, there are no other lines of evidence that are consistent with this scenario, including that recruitment levels have not been affected at any point over the past 20 years.

C5 (Catastrophic) – Not plausible under current circumstances.

Current Risk Status of the Stock

The maximum risk score for snapper is 8, based on a combination of C2 and L4. **This constitutes a Medium Risk, the maximum acceptable risk level**.

This score assumes the total catch will be maintained at near current levels which could require the development and implementation of a suitable set of management arrangements for all sectors to ensure this is maintained. Stock status will also need to be monitored at regular intervals into the future.

It should also be noted that the information in the lines of evidence for F and SPR presented in the above analyses indicate that a significant increase in annual catch levels would increase the likelihood of the stock declining below the threshold level.

Future Monitoring

Future assessments should be designed to specifically detect any change in the age composition of snapper. Such analyses would not only enable an update to the stock status but also provide information that may reduce the uncertainties in determining which method of estimating *M* is more appropriate.

To monitor the age structure of the stock into the future, based on the current analyses, a representative age sample could be obtained from just sampling the commercial wetline catch in the western sub-region (Albany).

Given the current status and longevity of this stock, an updated assessment could be completed in 5 years (2020/21) which would require age samples to be collected in one or more years in 2018-2019.

Finally, if new management arrangements with improved catch and effort reporting (daily/trip logbooks) are implemented, more informative catch rates may also become available for future assessments.

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