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DRAFT SCIENTIFIC ASSESSMENT OF PROGRESS TOWARDS THE ACHIEVEMENT OF AICHI BIODIVERSITY TARGET 6

Note by the Executive Secretary

1. In decision XIII/9, the Conference of the Parties to the Convention on Biological Diversity welcomed the report of the Expert Meeting on Improving Progress Reporting and Working Towards Implementation of Aichi Biodiversity Target 6, held in Rome, from 9 to 11 February 2016, and encouraged Parties, other Governments, the Food and Agriculture Organization of the United Nations and regional fishery bodies to consider the results of this meeting as a basis for their collaboration and cooperation towards accelerating and monitoring the progress in the implementation of Target 6.

2. In decision XIII/28, the Conference of the Parties invited Parties, other Governments, the Food and Agriculture Organization of the United Nations and regional fishery bodies to consider the results of the above-noted meeting, and invited the further development of this framework.

3. Pursuant to this request, the Secretariat commissioned a study by the Fisheries Experts Group of the IUCN Commission of Ecosystem Management to build on the work of the above-noted meeting and develop a scientific assessment of progress towards the achievement of Aichi Biodiversity Target 6 as information for participants in the twenty-second meeting of the Subsidiary Body on Scientific, Technical and Technological Advice.

4. The document is being circulated in the form and language in which it was received by the Secretariat.

AICHI BIODIVERSITY TARGET 6: SCIENTIFIC ASSESSMENT OF PROGRESS TOWARDS TARGET 6[1]

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Abstract

Aichi Biodiversity Target 6, adopted by the Conference of the Parties (COP) to the Convention on Biological Diversity, focuses on achieving sustainable fisheries by 2020. This paper summarizes the analysis of the components of Target 6 focusing on the explicit and implicit requirements it establishes for fisheries. It further highlights the links between these requirements and indicators and narratives that are used or might be generated in fisheries management, the underlying concepts, criteria, reference values and potential availability. Addressing actions (in the legal, policy, and management frames) as well as the outcomes of such actions, it illustrates what might be expected as a result, at the global level, using available information and offering a tentative outlook. As most of the timeframes of Target 6-related indicators available in the literature do not go beyond 2013, this paper does not draw any firm conclusions regarding the potential achievement of fisheries in relation to Target 6 by 2020. Some projections are available and some statistical extrapolations as examples, to be considered with caution. While many trends during the current decade result from actions taken well before the adoption of the Aichi Targets, significant progress has been made in mainstreaming biodiversity concerns in fisheries, assessment methodology and coverage, institutional capacity, international collaboration, stock rebuilding processes and related policy and legal frameworks. The existing reporting capacity should allow a good level of reporting on target and non-target stocks, threatened species and vulnerable marine ecosystems, including in terms of final outcomes. Progress is needed in better defining Significant Adverse Impacts (SAIs) and Safe Ecological Limits (SELs) for which international consensus would be needed to facilitate coherent assessments and consistent reporting. There are challenges of environmental, technological, economic, social (including governance) and informational nature that can only be slowly overcome. While knowledge on quantitative outcomes are essential to judge progress on Target 6, the importance of qualitative outcomes and progress in policy and legal frameworks cannot be overstated. In that respect, the responses of countries to CBD, FAO, and other relevant agencies will be fundamental.

[1] A paper prepared for presentation at the 22nd meeting of the CBD Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA)

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ACRONYMS AND ABBREVIATIONS

AHTEG	Ad-Hoc Technical Expert Group
B_{lim}	Level of biomass below which reproduction might be threatened
B_{MSY}	Level of biomass at which the long-term MSY may be produced
CBD	Convention on Biological Diversity
CCRF	Code of Conduct on Responsible Fisheries
CECAF	Commission for Eastern Central Atlantic Fisheries
CITES	Convention on international trade in endangered species of wild flora and fauna
COFI	Committee on Fisheries
CoP	Conference of the Parties
EAF	Ecosystem Approach to Fisheries
EBSA	Ecologically or Biologically Significant Marine Area
EIA	Environmental Impact Assessment
ERA	Ecological Risk Assessment
EEZ	Exclusive Economic Zone
ESF	Ecosystem Structure and Function
FAO	Food and Agriculture Organization of the United Nations
FIRMS	Fisheries and Resources Monitoring System
GBO	Global Biodiversity Outlook
GFCM	General Fisheries Commission for the Mediterranean
IUCN	International Union for Conservation of Nature
LDC	Least-developed country
LOSC	Law Of the Sea Convention
MCS	Monitoring, Control and Surveillance
MSY	Maximum Sustainable Yield
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non-Governmental Organisation

RFB	Regional Fishery Body
RFMO/A	Regional Fishery Management Organisation or Arrangement
SAI	Significant Adverse Impact
SIDS	Small Island Developing States
SBL	Sustainable Biological Level
SCBD	Secretariat of the Convention on Biological Diversity
SDG	Sustainable Development Goal
SEL	Safe Ecological Limit
SIDS	Small Island Developing States
SOFIA	State of Fisheries and Aquaculture
SSF	Small-Scale Fishery
UNCED	United Nations Conference on Environment and Development (1992)
UNCLOS	United Nations Convention on the Law of the Sea
UNDS	United Nations Development Summit (1995)
UNEP	United Nations Environment Programme
UNFSA	United Nations Fish Stock Agreement
UNGA	United Nations General Assembly
VME	Vulnerable Marine Ecosystems
WCSD	World Conference on Sustainable Development (2012)
WSSD	World Summit on Sustainable Development (2002)

Introduction

In 2010, the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) addressed the question of fisheries sustainability in its Strategic Plan for Biodiversity 2011-2020 and its Aichi Targets. Target 6 sets out a broad agenda for fisheries, the resources they use and the ecosystem within which they operate. Because of the unavoidable lag times between an action and its outcomes, the results achieved during the current decade (2010-2020) depend on actions taken during that decade but also before it. Moreover, the achievement of Target 6 depend also in part on actions and achievements in relation to the Aichi Targets that are of a more cross-sectoral nature, such as: Target 4, focused on *sustainable production and consumption* and governance systems able to keep *the impacts of use of natural resources well within safe ecological limits*; Target 7*,* to sustainably manage agriculture (of which fisheries is a sub-sector) and aquaculture (with which coastal fisheries interact strongly), *ensuring conservation of biodiversity;* Target 10*,* aimed at *minimizing the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification… so as to maintain their integrity and functioning* (which affects fisheries productivity)*;* Target 11*,* on marine protected areas and *other effective area-based conservation measures* (for the same reason as Target 10)*;* Target 12, on the protection of *threatened species* (as the threat may originate in, or the threatened status may interfere with fishing operations)*;* and Target 14*,* on *restoration and safeguard of ecosystems* and their services (as these support fisheries production).

In 2016, the Expert Meeting on Improving Progress Reporting and Working Towards Implementation of Aichi Biodiversity Target 6 (hereafter referred to as the 2016 Expert Meeting), jointly organized by FAO, SCBD and IUCN-CEM-FEG in Rome (Italy) (**FAO et al., 2016**), developed a draft conceptual framework that could be used as guidance by CBD Parties in reporting on Aichi Target 6. The meeting identified a set of actions and potential indicators and discussed ways to further the coordination among CBD, FAO and Regional Fishery Bodies with regards to reporting.

In its Decision XIII/28, CBD COP13 (Mexico, 2016) welcomed the report of the 2016 Expert Meeting, its framework and indicators, inviting CBD Parties, other Governments, the FAO and regional fishery bodies, to further develop it in collaboration with the Executive Secretary. It also stressed: (i) the properties that were required for the indicators (§ 4, 5); (ii) the potential use of the indicators (§6); (iii) the variety of approaches usable by CBD Parties for building their report (§7); and (iv) the advantages of aligning the indicators of Aichi and SDG targets (§9); (v) the potential role of the FAO Questionnaire on Implementation of the Code of Conduct for Responsible Fisheries (hereafter the CCRFQ) in reporting against Target 6 (§11).

This paper offers additional reflections in these respects, with examples of relevant current situations and trends, mostly at global level, taken from the scientific or grey literature and websites. It is not an advanced synthetic assessment of achievements on Target 6, which could only be produced after all the expected reports and publications on the subject will become available, probably 2-3 years after the end of the current decade, because of the time lags referred to above.

In **Section 1** of the paper, the possible reporting framework is examined decomposing Target 6 in four main "Elements" for which different actions, measures, outcomes, indicators and criteria for evaluation may be required. In **Sections 2 to 6** each Element is examined clarifying its content, the concepts involved, the potential indicators, and eventual reporting challenges, with examples of current situations, trends and outlook (when possible) as illustrations of possible outcomes. **Section 7** provides some conclusions regarding the present situation, trends, main challenges and outlook to 2020 and beyond.

1. The reporting framework

Target 6 describes the medium-term goal assigned to fisheries: *by 2020, all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem-based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.*

To facilitate guidance and reporting, the 2016 Expert Meeting, decomposed Target 6 in Elements for which the Target, implicitly or explicitly, sets different evaluation standards (cf. Elements 6A to 6D in **Table 1**). Element A defines the overall scope, the overarching expectation of Target 6 (sustainable harvest of all species and taxa, avoiding overfishing) and serves as a chapeau for the Target. Elements B and C and address some specific vulnerable or threatened components of biodiversity (depleted, bycatch and endangered species as well as vulnerable habitats) that need special attention to match the overarching requirement. Element D wraps all preceding elements together in an ecosystem-wide limit of fisheries impact within a safe ecological limit. These Elements are examined in more detail in **Sections 2** to **6**.

The 2016 Expert Meeting suggested that reporting should refer not only to the outcomes expected in Target 6 but also to the actions taken –from legislation to policy development and management plans– towards these outcomes even though the outcomes might not be delivered yet in 2020. A challenge is that in complex systems, with changing environments and score of measures continuously taken, there is no guaranty that actions will always produce the expected outcome, that more action produces more outcomes, or that the causal links between the two are linear or easily identified *ex-ante* or even *ex-post* (**Garcia and Charles, 2007**; **Anderson et al., 2015**). In addition, outcomes emerging or strengthened during the current decade (2010-2020) may also be the result of action taken before adoption of Target 6[2]. Nonetheless, there should always be a logical link between the action reported and its expected outcome.

Table 1. Elements of Target 6 to be considered for reporting. Examples of intermediate and final outcomes (based on FAO et al., 2016: Fig. 1)

Target 6 Elements		Types of Actions (intermediate outcomes)			Expected final states and outcomes
		Laws	Policies	Plans	
A	All target stocks Fish, invertebrates, plants	Fishery Act; Adoption of international agreements (UNFSA, PSMA); Rebuilding and conservation laws	Rebuilding & protection goals & strategies; Capacity-building;	Approach; Measures; Roles; MCS Deadlines; Benchmarks ; Evaluation	Sustainably harvested Legally harvested Overfishing is avoided
B	Depleted target and non-target species				Recovery plans & measures in place for depleted stocks; Non-target species not being depleted or else have recovery plans
C	Threatened species; Vulnerable ecosystems				No Significant Adverse Impact (SAIs)
D	Ecosystem structure and function				Within safe ecological limits (SELs)

[2] For example: the 1982 LOSC; the 1995 UNFSA; the 2003 Compliance Agreement; the 2009 PSMA; the 1992 UNCED Agenda 21; The 2002 WSSD Plan of Implementation, the 2012 UNSCD (Rio+20) Agenda (The Future We Want); and the 2015 Sustainable Development Goals (SDGs) of the 2030 Agenda of the UN High Level Political Forum on Sustainable Development.

It should be noted that, in **Table 1,** the actions (laws, policies and plans) are not specified by Elements because many of them contribute to enabling many Elements or the entire implementation framework. For that reason, legal and policy framework will be addressed together, first (in **Section 2**) and additional Element-specific legal and policy actions might be referred to in the appropriate **Sections 3** to **6**.

1.1 Relations between Target 6 and fishery concepts

Target 6 refers to species but fisheries assessment and management focus on stocks as proxies for populations, a finer degree of resolution. This document refers therefore to species whenever referring to Target 6, to maintain the original language and to stocks when referring to fishery matters.

1.1.1 International standards for fisheries

Fisheries stocks status references are often model-based. Despite its recognized limitations when considering multi-species relationships and uncertainties (natural variability, measurement errors, management uncertainties and climate change) the biomass (B) or fishing mortality (F) of individual stocks at MSY (e.g. B/B_{MSY} and F/F_{MSY}), or at any formally adopted related level, is still used to define their state. When B and F data are not available, catch trends analyses may provide an assessment of the state of fisheries, e.g. as developing (sometimes subdivided in undeveloped and developing), mature and senescent (**Figure 1A**). If catches have not been constrained by management, socioeconomic drivers or climate, these states may be considered as proxies the state of the underlying resources as underfished (sometimes subdivided in underfished and moderately fished), fully fished and overfished[3]. If the required data is available (catch, effort, catch structure, population parameters) conventional synthetic or analytical assessments models and simulations are used to directly assess the state of stocks (see **Figure 1B and C**).

In theory, stocks can be sustainably harvested (i.e. maintaining some catch level in the long term) at various levels of fishing mortality, including under fishing pressure above F_{MSY}, as illustrated by the parabola[4] in (**Figure 1B**). In practice, however, the risk of collapse for biological or climatic reasons increases with fishing pressure, and the LOSC and UNFSA require maintaining stocks of harvested (target) species at their MSY biomass level (or above), with a fishing mortality equal to F_{MSY} (or below). **B_{MSY} and F_{MSY} are therefore the references used for fishery management and form the basis for the standard that will be used to report on sustainable fisheries harvest within Target 6** (see **Table 2**).

[3] The use of catch trends alone to assess fish stocks (usually when more complete data on the fishery and the stock are not available to make a conventional stock assessment) has been controversial (**e.g. Pauly et al., 2013**), but reliable estimates can be obtained combining catch trends and additional population and fishery parameters (**Branch et al.; Costello et al, 2012)**

[4] Many other non-symmetric versions of the model exist.

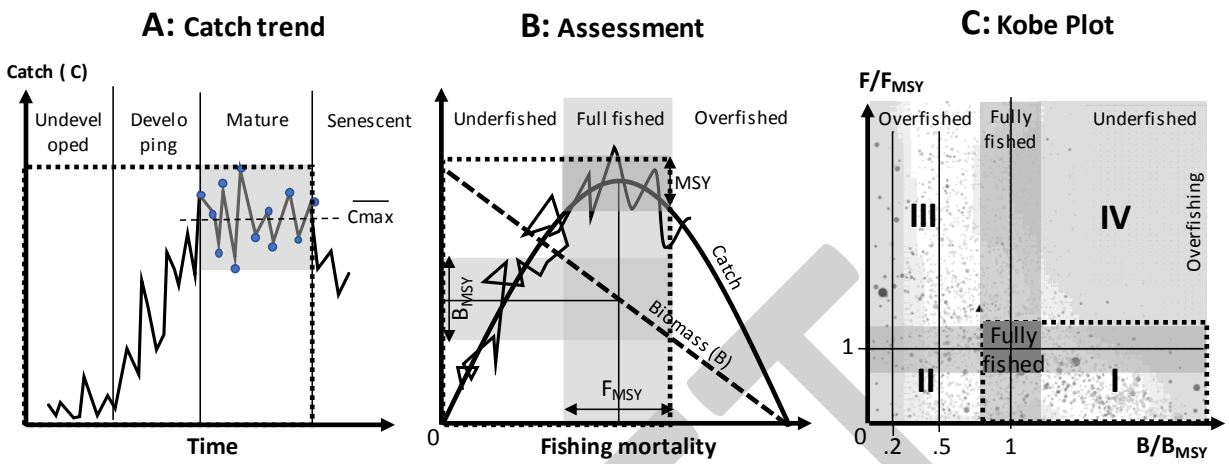

Figure 1. Different ways to assess and represent sustainability in fisheries. A: using catch trends; B: using conventional Schaefer model. C: "Kobe Plot" used to track the state of a stock across time or to display the state of many different stocks on a standardized plot (modified from Costello et al., 2016). In a deterministic frame, B/B_{MSY}=1 and F/F_{MSY}=1 are sustainability reference values below which stocks are considered overfished. Below B/B_{MSY}=0.5 stocks are often considered *depleted.* Below B/B_{MSY}=0.2 stocks are often considered *collapsed*. Lightly shaded bands (on all panels) materialize variability in the MSY-related reference values. On Panel C the confidence limits (grey bands) have been set at B_{MSY} and F_{MSY} +/20% (from 0.8 to 1.2) following on FAO (2011; 2016) (see text). The darker shaded area on Panel C indicates the locus of strictly *fully fished stocks.* The dotted rectangle in all panel indicates the minimal area in which stocks meet Target 6A requirements (see text).

The system most used recently to graphically represent stock status is a "precautionary plot" (**Garcia and De Leiva Moreno, 2000; 2005**) now referred to as "Kobe plot"[5] (**Figure 1C**). On such a plot, the state of one or many stock at a given time (stock status), or at different times (stock trajectory), may be represented on a standardized set of F/F_{MSY} and B/B_{MSY} coordinates to illustrate their situation in relation to MSY-related reference values for biomass and fishing mortality reference values. All things being perfectly known and stable, stocks would be strictly exploited at MSY level when their F/F_{MSY} and B/B_{MSY} are equal to 1. In relation to these two reference lines, four quadrants can be identified:

- F/F_{MSY} <1 and B/B_{MSY} >1: the stock is <u>underfished</u>. They are *sustainably* harvested but could produce more food if fishing effort is increased, and still be sustainably harvested.
- F/F_{MSY} <1 and B/B_{MSY} <1: the stock has been <u>overfished</u> in the past but fishing pressure has been reduced so at present overfishing is being avoided. As long as F/FMSY is kept 1, this aspect of Target 6 will continue to be met. . However B must be allowed to increase until B/BMSY >1, either through recovering "naturally" or through a formal rebuilding plan with stock enhancement measures, which become mandatory if B is depleted (See Section 1.1.2).
- F/F_{MSY} >1 and B/B_{MSY} <1: the stock is under active <u>overfishing</u> and <u>overfished</u>. These stocks require an immediate reduction of fishing pressure, depending on how far below 1 B/B_{msy} is, a rebuilding plan may also be required (**See Section1.1.2**)
- F/F_{MSY} >1 and B/B_{MSY} >1: Fishing pressure is excessive, but stocks are not (yet) depleted. This situation is <u>unstable</u> in the long term and results from one or more of: (i) the fact that fishing has recently increased, and the stock has not yet adjusted to its final and lower size; (ii) natural variability; (iii) assessment errors.

[5] Probably in reference to the first meeting of tuna RFMOs in Kobe, Japan (2007) where this plot was used for common reporting by Tuna RFMOs

When B/B_{MSY}< 0.5 stocks are often conventionally considered as below safe *biological* limit[6] (B_{lim}). These are the stocks which, in the overfished category tend to be referred to as depleted and may formally require special rebuilding plans (cf. **Section 4**). Below B/B_{MSY}=0.2 depleted stocks are referred to as collapsed. Rebuilding Plans are mandatory and require more drastic measures than for depleted stocks. In some countries, species at risk of extinction processes may be applied to populations reduced this greatly, and the jurisdiction may designate the populations as *threatened* (cf **Section 5)**.

The correspondence with the catch-based classifications given above does not appear immediately as in a deterministic Kobe Plot stocks can only be either overfished or underfished and never "fully-fished", i.e. fished around MSY[7]. Very few stocks fall right on the intersection of the B/B_{MSY} and F/F_{MSY} reference lines (**Figure 1C**). However, in nature, biomass and productivity are affected by natural variability, measurement error and model assumptions (e.g. on stock -recruitment relationship). All modelling and assessment outcomes (including reference values and lines) should be surrounded by confidence limits which are often not available or not given[8]. **Thorson et al. (2015)** simulations of the management of a large range of stock-types indicate that even for stocks with reasonably good data and management system, aiming at B/B_{MSY}=1, the biomass ratio might range roughly between 0,5 and 1.5 B_{MSY}. The range would moreover depend on species and be larger in species with high natural mortality under strongly variable climate (e.g. small pelagic species in upwelling areas) and smaller for species with opposite characteristics (e.g. North Sea plaice). The proportion of fully fished, underfished and overfished stocks will depend on the confidence interval used and there is not yet any international agreement on that subject. The narrower the limit, the more conservative the statement, and using different limits in different places complicates communication and coherent compilation of responses at regional or global levels. **Branch et al. (2011)** used +/-50% confidence limits. The same convention is used in New Zealand (**Ministry of Primary Industries. 2017**), Australia and USA (Hilborn, personal communication). In SOFIA **FAO (2016**), more precautionary confidence limits of +/- 20% (B/B_{MSY} ranging from 0.8 to 1.2) have been adopted for "*fully fished*" stocks to reflect this problem (as shown in **Figure 1C**) and this is the convention is used in this paper (cf. **Table 2).**

1.1.2 Correspondence between Target 6 Elements and fishery concepts

Figure 1 and **Table 2** contain the elements needed to connect the Target 6 elements to fisheries and stocks state categories and reference values, as they are used today, relating their current biomass B to their biomass at MSY (B_{MSY}), accounting for confidence limits (see also **Garcia et al., 2018** for a review and the **Glossary** in this paper).

[6] In this report in will be important to be aware of the distinction between "safe *biological* limit" – a well-established single-population term, and "safe *ecological* limit" a newer term explored in Section 6.

[7] The same reasoning would apply if a different reference value was used such as MEY, 0.8MSY etc. It is also valid when considering the "collapse" limit at $0.2B/B_{MSY}$

[8] It has been demonstrated, for example, by simulation and fossil records, that stocks may even collapse under continuous no-fishing conditions (**Laurec et al., 1980; Baumgartner et al., 1992; Thorson et al., 2015; McClatchie et al., 2017**).

Table 2: Categories of state of stocks and fisheries, B/B_{MSY} reference values (top rows) and corresponding Target 6 Elements (bottom rows) and criteria.

SPECIES/STOCKS								ECOSYSTEM	
Target				Target/non-target			Threatened Protected spp	VMEs	Ecosystems
Categories	Under fished	Develo-ping	Fully fished	Overfished	Depleted	Collapsed			
Metric (B/B_{MSY})	>2.0	2.0-1.2	1.2-0.8	0.8-0.5	0.5-02 <Blim	< 0.2	Jurisdictional designation <0.2	Density of vulnerable spp.	Structure & function
Goal	Maintain at target level			Rebuild to target level				Protect/Maintain/restore	
	No significant adverse impact (SAI)								*Within SEL*
Main measures	Conventional controls of fishing mortality level and distribution (fishing pattern)			More stringent reduction of fishing pressure and protection of recruitment		Strict protection Fishing moratoria and stock enhancement measures		Move-on rules Protected areas	Meet 6A-6C. Maintain Structure & function
	Management plan			Rebuilding plans (RP)		Mandatory RP?		Restoration plans?	
T6 Element	6A -sustainably harvested			6B-Depleted			6C-Threatened spp. & Vulnerable ecosystems		6D-Safe Ecological Limits

*Using the confidence limits of the fully-fished category adopted in FAO reports (FAO, 2011, 2016)

Target 6, **Table 1** and **Table 2** contain terms which may need some clarification. The terms "target species" and "non-target species" are used neither in the LOSC nor in the CBD. However, they are solidly established in fishery science and management and cannot be avoided when reporting on fisheries. The concepts of "*Significant Adverse Impact*" (SAI) and "*Safe Ecological Limit* (SEL) are newer concepts both in biodiversity conservation and fishery management and tend to be used in ecosystem contexts; whereas the concept of biologically safe limit is commonly used in fisheries, and usually applied for individual stocks. It is important to understand the correspondence between these terms for a consistent interpretation and consolidation of the reports (**Figure 2)**.

The LOSC refers to *harvested species* –that must be maintained or restored to the level at which they can produce MSY (§ 61.2)– and to species *associated with and dependent upon harvested species* –which should be maintained or restored above the level at which their reproduction becomes seriously threatened (LOSC § 61.4). Fishery science and management usually refer to these two categories as *target species* and *non-target species.*

Target species (Elements 6A and 6B) are specifically sought and caught. The degree to which they are monitored, assessed and managed depends on the commercial importance and size of the resource, the type of fishery and the country's capacity. Small-scale fisheries are less covered than commercial ones and may be delegated to communities. In 2020, target species may be *sustainably fished* (Element 6A), *overfished* but not yet depleted (still Element 6A) but requiring a reduction in fishing pressure; *depleted* (Element 6B) and requiring a specific rebuilding programme; or possibly designated as "threatened" by a jurisdiction and requiring even more stringent protection measures (Element 6C).

The term "depleted", in natural resources conservation, is used for a resource that has been (and may still be) consumed *faster than it can be replenished*, thereby its abundance has been reduced to a level where its productivity is impaired and its ability to supply future yield is largely exhausted. From that angle, the fishery development process, which necessarily reduces stocks' abundance to extract food, is a "controlled partial depletion" process. Fisheries management intends to regulate the process in ways that take advantage of density-dependent processes that allow productivity to increase at low to moderate levels of reduction in

abundance. This is embodied in the goal to maintain stocks at or above their highest level of productivity (MSY) as provided in the LOSC, but not at their unexploited biomass (B_0).

Non-target species are species with no current commercial interest. They include bycatch species (accidentally taken) and other species that may be impacted only indirectly by fisheries, e.g. through the food chain. Target 6 does not set benchmarks for all non-target species, as 6A explicitly applies to "all fish and invertebrate *stocks".* However, 6B equally explicitly refers to "all *species".* Consequently, if bycatches have caused any non-target species to reach a level considered "depleted", Target 6B requires a plan and measures for its recovery. Should a non-target species be designated as *threatened* by a competent jurisdiction, 6C would also apply and the species should be protected from *Significant Adverse Impact* (SAI).

The ecosystem-level conservation is dealt with in Elements 6C and 6D. 6C addresses specifically *vulnerable* ecosystems (including VMEs) which should be protected from serious adverse impacts, and 6D addresses all ecosystems more generally, specifying they should be maintained *within safe ecological limits*. In fisheries, the term VME initially referred primarily to living (biogenic) habitats like cold corals and sponge reefs in the deep-sea threatened by bottom-impacting fishing gear. In Target 6, and increasingly within national fisheries jurisdictions, the term refers more generally to all ecosystems with a similar degree of vulnerability to fishing, such as coastal coral reefs, algal or sea-grass beds and kelp forests. Element 6D is the overarching standard, calling for impacts of fishing (on species, stocks and ecosystems) to be kept within safe ecological limits.

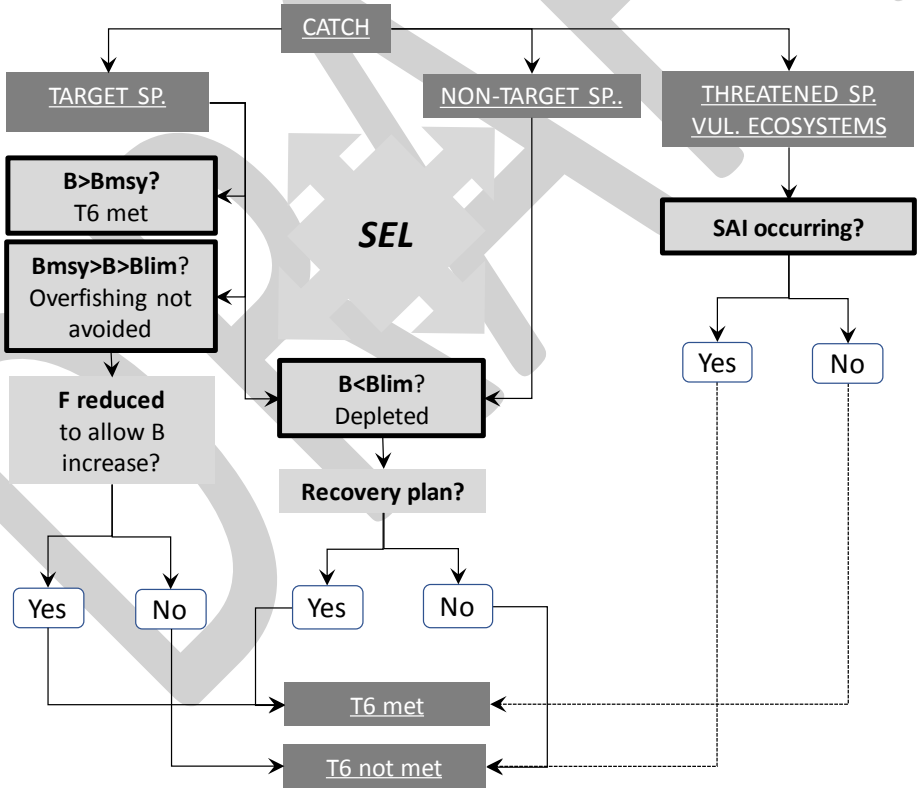

Figure 2. Relations between the terms used in fisheries management and biodiversity conservation. BMSY is the level of biomass corresponding to the Maximum Sustainable Yield (MSY) and Blim the level below which reproduction may be threatened. SAI stands for Significant Adverse Impact.

It has been argued that the concepts of sustainability, significant adverse impacts (SAIs) and safe ecological limits (SELs) have ambiguous meanings, and lack universal agreement on measurement methods and indicators,

challenging the need for consistent reporting and meaningful aggregation of Parties' responses at regional or global level (**Donohue et al., 2016**)[9]. Sustainability has several dimensions (ecological, social, economic and governance) and may refer to stocks, species, multispecies assemblages, and the social-ecological system. Avoiding SAIs requires ensuring that 'threatened species' and 'vulnerable ecosystems' get a high degree of protection to prevent any further harm from fishing and allow recovery, without being able to *ensure* recovery will occur because factors other than fishing may be contributing to the degraded status of the stock, species or ecosystem. Maintaining the ecosystem within SELs might be interpreted as requiring the persistence of their overall structure and functions, e.g. maintaining impacts below some thresholds and balancing all other requirements. **Reporting implies therefore translating the undefined terms in Target 6 into measurable elements, as those just mentioned above**.

Figure 2 illustrates also the important fact that the distinct Elements identified within the complex Target 6 to facilitate analyses and reporting, are inter-dependent and functionally linked. Species may move between Elements. A species classified as "Other species" (not directly affected by fishing) may become a bycatch species if fishing strategies or areas change, and even a target species if demand arises. It might then be sustainably harvested, depleted and even threatened if poorly managed. Moreover, all species are inter-connected in multispecies assemblages that may use "vulnerable ecosystems" in their life cycle and require an ecosystem "at safe ecological limit" to thrive.

The important implication is that while the Elements might be examined separately in terms of their situation and trends in 2020, the challenge will be to combine all the information on all elements into one overall sustainability performance assessment. It is difficult to imagine how all the assessments on these Elements be combined into one composite indicator that would communicate in a meaningful way the degree to which all the fisheries in a reporting jurisdiction are "sustainable". This paper does not present a full answer to that question, but should inform discussions of possible approaches that might be feasible and meaningful.

1.2 Suggested indicators

CBD Parties have the responsibility to report on progress made on all Aichi Targets and implementation of their National Biodiversity Strategy and Action Plans (NBSAPs), although final decisions on what and how to report is a State's responsibility.

Target 6 indicators should be: (i) clearly connected to Target 6 elements as shown in **Table 1**; (ii) actionable and achievable with the means available; (iii) based on science and local knowledge; (iv) robust to uncertainty (precautionary); (v) meaningful and understandable (communicable) to users and actors concerned; (vi) ideally, co-developed; and (vii) timely. The last point is a real challenge for the 2020 reporting. Indicators should also be accompanied by information on their scope (species, fishery, sector, EEZ, region, global); the methodology used for calculation, and a key to interpretation of their variations (when not obvious).

Two important considerations are specific to the Target 6 reporting process: (1) Considering the number of Aichi Targets to be reported on, only a small number of indicators would be manageable for each target; (2) Considering that 2020 is "around the corner" the indicators of interest need to be practically already available or in the process of being elaborated. Whatever set will finally be used for reporting in 2020 might be expanded for successive reporting exercises.

CBD AHTEG mentioned the following indicators with regards to Target 6, each of which presents substantial problems of interpretation: (i) Marine Trophic Index (although its changes, when referring to catches, cannot be easily interpreted because of both the multiple possible causes of any change, and because improvements

[9] The argument is a "double edged sword". It is therefore advisable to have both conceptual goals and measurable targets.

in fisheries management can cause the index to either increase or decrease, depending on the nature of the fisheries); (ii) Proportion of fishery products derived from sustainable sources (which might be confusing when catches are reduced to increase biological sustainability or socio-economic performance); and (iii) Trends in abundance and distribution of selected species (that may be affected by fishing but also by climatic factors and cannot be extrapolated to non-target and other species). The proportion of overexploited or collapsed stocks/species (only reliable for well-assessed species). Catch trends might be used in data-limited situations, but variations may be due to management or climate as well as fishing. Additional information may often be useful for a correct interpretation of trends

The 2016 Expert Meeting agreed that (i) the indicators to be collected within means available should be prioritized using at least a qualitative risk-based framework; (ii) effective reporting on such a complex target required capacity-building in many parts of the world; (iii) shared, straddling and high seas stocks present specific challenges; and (iv) a disciplinary consensus was needed on how ecosystem benchmarks should be defined and calculated (e.g. in relation to SAIs and SELs). It also agreed that it was necessary to report on actions taken, stressing the logical link with the expected outcomes (with the caveats mentioned in the introduction of **Section 1**.)

The complete list of indicators addressed respectively by the 2016 Expert Meeting and in COP decision XIII/28 are given in **Annex 1 and 2** respectively for easy reference and some of these are listed in **Table 3** with some comments of their potential availability. Values and trends in some of them are reported in sections on Target 6 Elements, below.

Table 3: Target 6 indicators welcomed in Decision XIII/28 (reorganized). Bold: metrics assumed to be available in some form. Italic bold: metrics assumed to be possibly available with additional work. The exact formulation of the metrics may be adapted. Parties are the primary sources of information in all cases. Mention of institutions does not imply any endorsement.

Indicator	Metrics of state and trends	Potential sources*
Certified fisheries	**N° of MSC-certified stocks/fisheries**	**MSC**
Depleted spp. with recovery plans	***N° of countries formally requiring recovery plans***	**FAO?**
	% of known depleted stocks with recovery plans in place	
Threatened species and populations (Th. Spp.). Extinction risk of target (T) and non-target (NT) species (bycatch species)	**Red List (RL) Index (Harvested aquatic species)**	**IUCN & national Red Lists**
	N° of policies aiming to minimize impact on Th. spp.	**CITES/FAO/MSC**
	% countries reporting on Th. spp.	**FAO? IUCN? CITES?**
	% Th. Spp. with decreasing mortality rates	WWF & Zoo. Soc. London?
	N° of policies securing fishing mortalities within SBLs	**FAO**
	% stocks within Safe Biological Limits (SBLs; B_{lim}) (SDG 14)	
	Trends in population of NT sp. affected by fisheries	?
	Living Planet Index (trends in target and bycatch spp.)	**WWF?**
Fishing practices	**Implementation of the IPOA-IUU (and PSMA) (SDG 14)**	**FAO**
	Global effort in bottom trawling	UBC, IOF, UW?
	Amount of fishing in vulnerable habitats	?
	N° countries assessing ecological impact (ERA, EIA?)	**FAO CCRFQ. RFMOs.?**
	N° countries protecting VMEs, Ecosystem S&F	
	% fisheries effectively managing bycatch and discards	
	N° & % of stocks with adaptive management plans	?
	CPUE (catch and fishing effort)	UBC, IOF?
SSFs (Not Target 6)	Progress in ensuring SSFs access rights (SDG 14)	?

Some of the indicators above may never be collected worldwide and continuously and some may be correctly interpreted only with significant additional information. In terms of fisheries management effectiveness, there

are three attributes influence success: (i) the quality and coverage of stock assessment; (ii) the extent to which fishing pressure is effectively limited; and (ii) the comprehensiveness and deterrence of enforcement programs (**Melnychuk et al., 2017**). These elements are notably absent from the list of indicators above even though they may intervene indirectly in some of them.

Quantitative indicators with reference values facilitate monitoring, reporting and the elaboration of "dashboards". However, because of the lack of quantitative information on many useful indicators (particularly of action), CBD Parties' reporting will unavoidably take also the form of narrative indicators. This issue was not discussed in any detail in the 2016 Expert Meeting. However, with serious limitations in solely quantitative indicator-based reporting emerging in almost every section of this WP, advice may be needed on the basis on which reporting institutions can construct "narratives" that can be meaningfully summed-up (aggregated at global level) by SCBD later. The development of global indicators and trends will largely depend on the data collected by or submitted to specialized agencies like CBD, FAO, IUCN, CITES, as well as academics and NGOs. Regular data collection and reporting systems on the state of fisheries and stocks exist in FAO. RFMOs have their own mandatory reporting systems. Tuna-RFMOs have a common reporting system developed by ISSF[10]. Market information is also available through the FAO FISH INFOnetwork[11] coordinated by GLOBEFISH at FAO. This economic information is important for development and management and may contribute to assessing sustainability, but is not (or rarely) used to monitor the state of stocks.

1.3 International collaboration on reporting

While the main source of information remains the CBD Parties' reports, international collaboration with specialized agencies and conventions with a central role in fisheries and biodiversity conservation is essential in the process of producing global, regional or species-specific assessments. Collaboration among IUCN, CITES, CMS, UNEP and environmental NGOs sharing concerns on conservation and sustainable use of biodiversity has developed during the last 2-3 decades (**Friedman et al., 2018**).

The long-standing and growing collaboration between CBD and FAO with regards to fishery-related biodiversity issues has allowed, *inter alia* the development of joint considerations on Target 6 reporting at the 2016 Expert Meeting, e.g. on interpretation of Target 6, potential indicators and their availability, additional efforts needed, and the potential use of the CCRFQ. FAO and CBD Parties are practically the same and Target 6 requirements overlap very closely with CCRF requirements on target and non-target resources and habitats. Consequently, responses to the CCRFQ (by fishery authorities) may complement CBD Parties' responses (by environmental authorities) on their implementation of Target 6. To enhance this opportunity, complementary questions have been identified in collaboration between FAO, CBD and IUCN-CEM-FEG and added to the CCRFQ. The summaries of responses to these new questions will be available for the next COFI meeting in July 2018. It should be noted that supplementary questions have also been added to the CCRFQ to better contribute to the analysis of progress made on the SDG indicator 14.6.1 on combatting IUU-fishing (**Camilleri, pers. Com**.). Since 2013, versions of the FAO Questionnaire also exist for RFBs and INGOs, 26 and 10 of which, respectively responded in 2015 for COFI 2016. The 2015 responses to the CCRFQ (as compiled in **FAO, 2016, 2016a**) have been analyzed and distributed, below, on the pertinent sections related to Target 6 Elements A to D. Although the responses are mainly declarative, they provide a "panoramic" perspective on Parties buy-in, intentions, actions, claimed achievements, and problems and solutions, even though data on performance may not (yet) be available.

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[10] Accessible at https://iss-foundation.org/about-tuna/status-of-the-stocks/interactive-stock-status-tool/

[11] INFOPESCA in Latin America and the Caribbean**,** INFOFISH in Asia and the Pacific Region, INFOPECHE in Africa**,** INFOSAMAK in the Arab Region, EASTFISH/EUROFISH in East and Central Europe and INFOYU in China (http://www.fao.org/fishery/topic/16133/en).

1.4 Connections between Target 6 and SDGs targets

COP Decision XIII/28 requested (§ 6c) mainstreaming of Aichi Targets in the process of implementation of the United Nations 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs) (cf. United Nations, 2017). In that Agenda, SDG 14 aims to Conserve and sustainably use the oceans, seas and marine resources for sustainable development and is obviously the most relevant and comprehensive SDG for marine fisheries. This section examines the correspondence between Aichi Target 6 and the SDG 14, and its targets and indicators (see Annex 3 for the relevant original texts). It is important to note that SDG 14 addresses a much broader set of issues and priorities than Target 6.

SDG Target 14.4 aims, by 2020, to effectively regulate harvesting and end overfishing, IUU-fishing and destructive fishing practices and to implement science-based management plans to restore fish stocks in the shortest time feasible, at least to levels that can produce MSY. The indicator (14.4.1) is the proportion of fish stocks within biologically sustainable levels. The target is very similar to Target 6 and the indicator is one of those retained for Aichi Target 6A and 6B on sustainable harvest of target species (sustainably harvested or depleted).

SDG Target 14.6 aims, by 2020, to eliminate the fisheries subsidies as a key driver of overcapacity, overfishing and IUU fishing, and to refrain from introducing new ones. The indicator (14.6.1) focuses on progress by countries in the degree of implementation of international instruments aiming to combat IUU-fishing. As such this SDG Target may be related to the action implicitly needed under Aichi Target 6A and 6B to achieve sustainable harvests and rebuild depleted stocks. Its broad drafting, however relates it the legal actions needed across all Target 6 Elements to maintain sustainable fisheries.

SDG Target 14.7 aims, by 2030, to increase the economic benefits to SIDS and LDCs from the sustainable use of marine resources, including through sustainable fisheries. The indicator (14.7.1) is the relative contribution of sustainable fisheries to GDP of these countries. There is no echo of this socio-economic concern in Target 6.

SDG Target 14b aims to provide access of small-scale artisanal fishers to marine resources and markets. The indicator (14.b.1) is the progress in the degree of application of a legal, regulator, policy or institutional framework which recognizes and protects access rights for small-scale fisheries. Target 6 has no reference to small-scale fisheries or access to resources and markets. It could be very indirectly related to Aichi Target 6 through its legal thrust but with a socio-economic rationale that is missing in Target 6.

SDG Target 14c aims to ensure the full implementation of international law for the conservation and sustainable use of oceans and their resources by their parties. The indicator (14.c.1) is the number of countries making progress in ratifying, accepting and implementing ocean-related instruments that implement international law, as reflected in the United Nations Convention on the Law of the Sea. This SDG Target also refers to law but contrary to the preceding, with an environmental rationale directly related to Aichi Target 6, particularly 6A.

The SDG targets above are closely related, therefore to Aichi Target Elements 6A and 6B on sustainably harvested stocks or overfished (depleted) stocks in terms of requiring legal fishing operations (complying with the LOSC and related regimes), ending overfishing, requiring management plans and rebuilding of depleted stocks to MSY. The SDGs address subsidies, small-scale fisheries access rights to resources and markets, small island developing States (SIDS) and least developed countries (LDCs) which are not explicitly mentioned in Target 6.

For fisheries, Aichi Target 6 and SDG 14 Targets are complementary with strong overlap on target resources. Target 6 is more concerned than SDG 14 by the broader impact of fishing on the ecosystem and biodiversity. The SDG 14 better addresses the socioeconomic and equity issues in fisheries. One could always argue that things are not explicitly states may be implicit. In fact, healthy ecosystems are obviously needed for SDGs to be

reached (Schultz et al., 2016), accepting not significantly adverse impact on biodiversity. Similarly, achieving Aichi Target 6 requires local communities buy-in and hence a degree of satisfaction of food security and livelihoods needs. But the lack of explicit recognition of these trade-offs may also reflect the fact that some core goals of Aichi Target 6 (the protection of biodiversity from fishing collateral impact) could be considered a constraint in the SDG 14 framework (on sustainable development) and, vice-versa Error! Reference source not found.).

2. Progress on legal and policy frameworks

The legal, policy and planning frameworks are referred to in Element 6A which requires that *All fish and invertebrate stocks and aquatic plants [be] managed and harvested (i) sustainably, (ii) legally and (iii) applying ecosystem-based approaches*. The adequacy of these frameworks is fundamental for enabling action and achievements in all Target 6 Elements.

For sustainable harvesting, a complex set of actions is needed in the legal and policy frameworks (and governance) to translate international instruments into a national enabling environment of legislation, regulations and policies, e.g.: (i) Adoption of a fishery act and effective processes of governance. This is a long-term process which started usually long before 2010 and continues to evolve at different paces in different countries. The most strategic, structural elements have been already adopted in most countries but improvements are always necessary in a developing world; (ii) Formal adoption of the criteria and related benchmarks of the LOSC (e.g. MSY) and CBD (e.g. SAIs; SELs); (iii) Formal adoption of the Precautionary Approach to Fisheries (PAF) and of a risk-based approach to assessment and management (e.g., using precautionary reference points, harvest control rules, and management strategies evaluation); (iv) Development of capacity in governance, science and management; (v) Explicitly addressing socioeconomic dimensions (including profitability and equity); and (vi) Increasing cooperation across data collection, scientific assessment and information exchange to improve reporting. Reporting in these areas may often take the form of narratives which could, however, be turned into quantitative or qualitative regional and global indicators.

Progress in frameworks are examined below only in relation to the fight against IUU-fishing and the application of the Ecosystem Approach of Fisheries (EAF) in relation to IUU.

2.1 The fight against IUU-fishing

IUU-fishing is seen as one of the most serious impediments to sustainable fishing and hence the achievement of Target 6. In the following sections we look at its definition, its assessment, action taken against it, and their outcomes.

2.1.1 Definition of IUU-fishing

There is no simple agreed definition of IUU-fishing. The FAO IPOA-IUU (**FAO, 2001, 2002**) indicates that IUU-fishing is characterized by overlapping violations, at national (EEZ), regional (RFMOs) or international levels (see **FAO, 2015**): (1) Illegal fishing: are fishing activities in conscious contravention with national, RFMO or international legislation concerning access (e.g., pirate fishing) and fishing practices (poaching); (2) Unreported fishing: non-reporting, under-reporting or mis-reporting, of catch, bycatch, discards, fishing location, and other information formally required, eventually including transshipment and transport of fish; (3) Unregulated fishing: activities not covered by the governance system in place, which violate international laws or agreed principles of resources and biodiversity conservation, e.g.: fishing with vessels which (i) are stateless, (ii) belong to non-cooperating Parties to a RFMO, or (iii) are not properly controlled by their flag States. According to **Tsamenyi et al. (2015),** States have the sovereign right to regulate or not activities in their EEZ (presumably subject to LOSC

Article 61.2 requiring the maintenance of stocks at least at their MSY level) and certain unregulated fishing (e.g. in many small-scale or subsistence fisheries) may not violate any applicable international law and hence not require the application of "anti-IUU" measures. A lack of direct jurisdictional regulation of small scale and subsistence fisheries was not explicitly discussed when Target 6 was negotiated. However, as long as such fisheries were prosecuted with the knowledge of the central jurisdiction and "regulated" by community standards and practices (**FAO 2015c**), they should be consistent with the spirit of "legally" as used in Target 6.

2.1.2 Assessment of IUU-fishing

Considering its complex components and their obvious opacity, IUU-fishing cannot be easily reduced to a simple indicator and measured. Nonetheless, illegal and unreported (IU) catches (not unregulated ones) were globally estimated for the period 1980-2003 by regions (**Agnew et al., 2009**). In 2000-2003, they were estimated to represent 11-26 million tonnes per year (13-31% of the reported harvest) with a value of USD 10-23.5 billion. Trends from 1980-1984 to 2000-2003) varied between regions and, overall, show an average decline of IU-catches from 21% to 18% of the reported landings which might not be statistically significant. The worst area appears to be West Africa where total catches were estimated to be 40% higher than reported ones. The worst period seemed to have been the mid-1990s and, as expected, the relative impact was higher on high-value resources and in weak governance areas (**Agnew et al, 2009: 5**). These values are "best educated guesses" and would need to be updated from time to time in a consistent manner to detect trends. The FAO Expert Workshop to Estimate the Magnitude of Illegal, Unreported and Unregulated Fishing Globally (**FAO, 2015**) was organized for this purpose. As a follow-up, international guidelines for IUU-fishing assessments are being drafted through FAO, will be reviewed by an international expert group in May 2018 and presented to COFI in July 2018 (**Camilleri, pers. com**.). Some IUU-fishing assessments have been undertaken in various countries and regions such as NEAFC, Bay of Bengal and South Pacific Island countries (**FAO, 2015**) but no synthesis has been published yet to our knowledge.

2.1.3 Action taken against IUU-fishing

Illegal fishing has been a long-standing concern leading to the development of binding legal instruments and numerous efforts to strengthen Monitoring Control and Surveillance (MCS) well before the adoption of Target 6. The 1993 FAO Compliance Agreement[12], the 1995 UN Fish Stock Agreement (UNFSA)[13], the 1995 FAO Code of Conduct for Responsible Fisheries (CCRF), the 2001 FAO International Plan of Action to Prevent, Deter, and Eliminate Illegal, Unreported, and Unregulated Fishing (IPOA-IUU)[14], the 2002 International MCS Network[15] (2002), and the 2009 Port States Measures Agreement (PSMA) strengthened the arm of flag States and RFMOs, developing their capacity to Curb IUU-fishing but they did not stop it.

The range of measures that it would be useful to report for 2020 is large and may be different when addressing specifically the illegal, unregulated or unreported components of IUU. For examples States and RFMOs were expected to adopt IUU-related plans of action at national (NPOAs-IUU) and regional (RPOAs-IUU) levels to, *inter* alia, (i) enhancing MCS; (ii) reduce overcapacity; (iii) impede the access of IUU catches to markets; (iv) enhance

[12] FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (2003)

[13] Agreement for the Implementation of the provisions of the United Nations Conventions on the Law of the Sea of 10 December 1982 Relating to the Conservation and the Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (1995)

[14] FAO, *International Plan of Action to Prevent, Deter, and Eliminate Illegal, Unreported, and Unregulated Fishing*, adopted at the 24th Session of COFI, Rome, Italy, 02 March 2001.

[15] International Monitoring, Control and Surveillance Network (http://www.imcsnet.org (2002). It now includes 62 States, the European Union and two RFMOs.

port States and flag States controls; and (v) strengthen regional cooperation and effectiveness of RFMOs (**Agnew at al., 2009**; **Bray, 2000**).

The following elements provide some guidance on the elements to be tracked and reported by States and RFMOs to appreciate progress towards Target 6 and some elements of response are found in the responses of FAO Parties to the CCRFQ given below.

a) *National action*

Numerous examples of national action have been reported through various channels.

The 2010 Illegal Fishing Regulation of the European Union, for example, encourages countries willing to export fish in the EU to address their shortcomings in fighting illegal fishing in their waters and by their fleets and asks EU member States to request certificates of the legality of imported seafood products. In addition, by requesting minimum MCS standards in the exporting countries, the EU has encouraged many countries (including Fiji, Panama, Togo, Vanuatu, Belize, Korea and Philippines) to entirely reform their fisheries policies and laws and introduce more sophisticated monitoring (VMS) and sanctioning tools ("yellow cards") to effectively combat IUU-fishing at home. Similar results are expected from action taken by Port-States in the framework of the 2009 PSMA.

b) *International collaboration*

International collaboration against IUU-fishing is essential to achieve significant global results. This collaboration has been intense during the last decade. Several international organizations are working together in various forms, e.g.: (i) the Joint FAO/IMO Ad Hoc Working Group on IUU-fishing (**FAO/IMO, 2016**); (ii) the International Monitoring, Control and Surveillance (IMCS)[16] network which connects enforcement agencies around the world; (iii) The Tuna Compliance Network (TCN**),** supported by the IMCS network, was established in 2017 and promote communication and cooperation between authorities and staff, sharing information on best anti-IUU practices in tuna fisheries[17]. (iv) FISH-i Africa[18] between eight countries in the western Indian Ocean operating in a regional inter-governmental task force to tackle IUU fishing; (v) INTERPOL's Fisheries Crime Working Group[19]; (vi) the United Nations Review Conference on the Fish Stocks Agreement and the Sustainable Fisheries sub-agenda of the General Assembly; (vii) The UNGA process to develop an international legally binding instrument under UNCLOS for the conservation and sustainable use of marine biological diversity in areas beyond national jurisdiction (known as the BBNJ process); (viii) Thailand-Indonesia WG on Labour and IUU.

Numerous private institutions and NGOs have developed intensive information, advisory and advocacy services e.g. (i) Transnational Alliance to Combat Illicit Trade[20]; (ii) Center for Strategic and International studies[21]; (iii) Chatham House Forum on IUU-fishing[22]; (iv) The Pew Charitable Trust[23] in its International Fisheries News; (v) International Sustainable Seas Food (ISSF) trade; (vi) The CBD Sustainable Ocean Initiative (SOI).

[16] imcsnet.org
[17] http://www.fao.org/3/a-i8146e.pdf
[18] https://fish-i-africa.org
[19] https://www.interpol.int/Crime-areas/Environmental-crime/Committee-and-Working-Groups/Fisheries-Crime-Working-Group
[20] https://www.tracit.org/fisheries.html
[21] https://www.csis.org/events/report-launch-illegal-unreported-and-unregulated-fishing-national-security-threat
[22] https://www.chathamhouse.org/search/site/Forum%20on%20illegal%20unreported%20unregulated%20fishing
[23] outreach@pewtrusts.org

2.1.4 Outcomes related to IUU-fishing

a) *Publication of IUU-fishing vessels lists*

Many RFMOs have agreed to cooperate in publishing "positive lists" of vessels know to behave correction in relation to legal fishing (e.g. at http://tuna-org.org/vesselpos.htm) as well as "black list" of vessels known for having been involved in IUU-fishing (e.g. in http://tuna-org.org/vesselneg.htm).

b) *Adoption of IUU-fishing Plans of Action (POAs)*

FAO adopted, in 2001, an international Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing (IPOA-IUU). Implementation at national and regional level may be followed on the FAO dedicated website. National plans of action (NPOA-IUU) have been adopted in 10 States (Antigua & Barbuda, Australia, Belize, Canada, Fiji, Ghana, Korea, Sri Lanka, St Kitts & Nevis, and the USA) and in the European Union. Regional plans of action (RPOAs) have also been adopted before 2010. The Regional Plan of Action (RPOA) to Promote Responsible Fishing Practices including Combating IUU Fishing in the South China Sea, Sulu-Sulawesi Seas (Celebes Sea) and the Arafura-Timor Seas was established in 2007[24]. More recently, in 2014, a Regional WG on IUU-Fishing (RWG-IUU) was established in Trinidad and Tobago under the aegis of the Western Central Atlantic Fishery Commission (WECAFC). No information was found on their actions and performance. The responses of the Regional Fishery Bodies (RFBs) to the CCRFQ in 2015 indicate that several of them contributed to implementation of the IPOA-IUU, mainly through initiatives to strengthen and develop new ways to prevent, deter and eliminate IUU-fishing (71% of RFBs), enhancing information exchange vessels involved in IUU-fishing (63% of RFBs), and at assisting in the implementation of other activities prescribed by the IPOA-IUU (63% of RFBs).

c) *Port States Measures Agreement (PSMA)*

At global level, the focus on IUU-fishing is the implementation of the Port State Measures Agreement (PSMA) and complementary instruments. The PSMA was adopted in 2009, just before the Aichi Targets. It entered into force in 2016 and as at October 2017, there were 51 Parties to the Agreement. The first meeting of the Parties to the PSMA was held in 2017, focussing on exchange of data and information (**FAO, 2017; 2017a**). Recognizing also that the effectiveness of the PSMA related strongly to national capacity to exert the control required, the Agreement has established a fund to assist developing States in their implementation of the Agreement (**FAO, 2017**). In addition, FAO-COFI endorsed, in 2014, a set of Voluntary Guidelines for Flag State Performance intended to help strengthening compliance by flag States with their international duties and obligations regarding the flagging and control of fishing vessels. The FAO Global Record of Fishing Vessels, Refrigerated Transport Vessels and Supply Vessels (Global Record), the Voluntary Guidelines on Catch Documentation Schemes and other I tools developed by RFMOs are complementary instruments facilitating the PSMA implementation. The measures taken by States within the framework of the PSMA can be searched in the FAO database at http://www.fao.org/fishery/psm/search/en.

d) *The FAO Voluntary Guidelines for Flag State Performance*

These guidelines were adopted by COFI in 2014. They are voluntary but based on the LOSC, the CCRF, and the IPOA-IUU. Their objective is to prevent, deter and eliminate IUU-fishing or fishing-related activities through the effective implementation of flag-State responsibilities to ensure long-term conservation of living marine resources and marine ecosystems (**FAO, 2015a**) and in particular to: (i) combat IUU-fishing; (ii) control fishing

[24] With Republic of Indonesia, Australia, Brunei Darussalam, Cambodia, Malaysia, Papua New Guinea, The Philippines, Singapore, Thailand, Timor-Leste and Viet Nam.

vessels flying its flag; (iii) ensure that they do not engage in IUU-fishing; (iv) ensure conservation of living resources; and (v) discharge its duty to cooperate (e.g. in RFMOs).

The performance assessment criteria relate *inter alia* to: (i) translation of international rules in domestic legislation; (ii) adoption of the necessary measures or implementing those taken in a RFMO; (iii) contribution to effective RFMOs functioning; (iv) control of vessels flying the national flag; (v) cooperation in management (effort and catch controls). In addition, the performance is measured by the extent to which the State complies with the international standards regarding: (i) fishery management organisation, institutions, laws and regulations, and implementation; (ii) information registration and formal records; (iii) delivery and recording of authorizations to fish; (iv) monitoring, control and surveillance, and enforcement; (v) cooperation with other flag-states and coastal-States; and (vi) the conduct of the performance assessments which may be self-assessments or independent assessments undertaken by third parties.

e) *Clarification of Flag-States duties*

Flag-States' duties in relation to IUU-fishing –including that of *due diligence*– have been further clarified by the 2015 Advisory Decision that ITLOS delivered on request of the West African Sub-Regional Fishery Commission (**Rajesh Babu, 2015; Schatz, 2016**) regarding the directed responsibility and liability of the Flag State regarding IUU fishing of their vessels beyond due diligence in ensuring lawful behaviour. These developments, as emerging analysis of the jurisprudence established by fishing access agreements (FAAs) have the potential to strengthen international norms on IUU-fishing and sustainable fisheries resources management but many issues remain regarding the liability and responsibility of the flag States regarding IUU-fishing in by vessels flying their flag in other States' EEZs (**Rajesh Babu, 2017; Schatz, 2017**). That responsibility may not be well enough established and a new legally binding agreement might be needed to resolve the issue (**Schatz 2016a).**

f) *National/level measures*

The responses of FAO Parties to the CCRFQ in 2015 (**FAO, 2016**) provide some information about States' action, 79% of which still perceived IUU-fishing as a problem. National Plans of Action (NPOA-IUU) were being drafted by 54% of them while 46% already had such a plan in place. In order of importance, measures taken relate to improvement of: (i) MCS, (ii) legal framework, (iii) bilateral and international cooperation and (iv) port-State controls. In addition, 75% of the respondents are implementing vessel monitoring systems (VMS) and 93% take measures against trade of IUU-fishing products such as enhanced controls and inspections on fisheries (60%) and customs/borders (45%); implementation of the NPOA-IUU and NPOA-Sharks (38%); introduction of tougher sanctions (26%) and implementation of catch traceability practices or controls (25%). Finally, 61% of the respondents declare to formally authorize vessels bearing their flag to fish in the High Sea, monitor and obtain reports on the activities (85%), and report such authorizations to FAO (69%)

g) *Outcomes*

The results "on the ground" of these actions since 2010 should be reflected in indicators of state and trends. Being an illegal activity, IUU is obviously not reported anywhere and hard to measure. Its components of are very difficult to assess with any degree of confidence and available values.

Updating the study of **Agnew et al. (2009)** referred to in **Section 2.1.2** is therefore a major challenge. **May (2017)** extrapolated that estimate to more recent times, using FAO landings data for 2011-2014, and assuming the regional ratios of IUU to legal activities calculated from Agnew et al. data in 2000-2003 were still valid, the author concludes that marine IUU-fishing generated annually a catch of 12-28 million tonnes, or 14-33% of the officially reported landings, and USD 16-36 billion in value (and not "profits" as stated in the original publication). As the total landings reported to FAO changed little between the two periods (100.10^6 t versus 93.10^6 t) and the IUU occurrence was assumed constant, the extrapolation does not show much of a difference after a decade

(**Table 4)**. Moreover, considering the quality and variability in the data available to Agnew et al. both within and between years, the confidence in the extrapolation can only be low[25].

Agnew at al., (2009) indicated that, during the period 1982-2003, IUU-fishing was only well correlated with the governance quality index. In many aspects governance has improved since 2010, on paper, and the information on rebuilding of target species (in **Garcia et al., 2018**, forthcoming) indicates that, in leading nations, it has also improved on the ground. Therefore, IUU-fishing may have decreased in those countries (and RFMOs) that have taken effective measures, but possibly also increased in areas under weak governance and no conclusion is available yet on the overall outcome.

Table 4: Estimates of IUU catch and value in absolute values and in % of reported harvest in 2000-2003 (Agnew at al. (2009) and in 2011-2014 (May, 2017)

	IUU-catch			
	10^6 t.	%	10^9 USD	%
2000-2003	11-26	13-31	12-28	15-35
2011-2014	12-28		16-36	

2.2 The Ecosystem Approach framework

The ecosystem approach (EA) is formally required by the CBD as a condition to sustainable use and better defined in the Malawi Principles (**UNEP/CBD, 1998**) at COP VII (Decision VII/11) as *a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way* (**SCBD, 2004**).

In fisheries, the EA was Implicit in the 1982 LOSC through reference to associated and dependent species and became more explicit in 1995 with the adoption of the UNFSA and FAO CCRF. The EA was formally translated in an Ecosystem Approach (EAF) to Fisheries and Ecosystem-based Fisheries Management (EBFM) in the early 2000s (**FAO, 2001, 2003**; **Brodziak and Link, 2002; Molenaar, 2002; Pikitch et al., 2004; Scandol et al., 2005**). The EAF –which includes the Precautionary Approach– was more clearly elaborated in the FAO EAF guidelines (**FAO, 2003**) and other guidelines and plans of action aiming at reducing biodiversity impact: e.g. on MPAs and fisheries; protection of sharks, seabirds, turtles, and vulnerable marine ecosystems (VMEs). The EAF has been integrated, at least in principles, in most advanced nations' fishery policy and RFMOs' work (if not always in their basic texts) in the decade preceding the Target 6 adoption (**Bianchi and Skjoldai, 2008**), and has since largely penetrated the regional and national legal and policy frameworks **(Skonhoft, 2011**; **Fisher et al., 2015**; **FAO, 2016c**), including the Sustainable Development Goals (SDGs).

In practice, EAF implementation may be gauged by action taken to address: (i) Species interactions in stock assessment and management; (ii) Unwanted bycatch (and discards) and their impact on threatened or protected species; (iii) Fishing gear impact on bottoms habitats and vulnerable ecosystems; (iv) Ghost fishing, reducing gear loss or abandonment; (v) Further integration of the Precautionary Approach to Fisheries (PAF) and adoption of risk-based fishery management approaches; and, although less specific guidance is available, (vi) Impact of –and adaptation to– climate change.

Although Target 6 is decomposed in 4 main elements in this document (**Table 1**) to facilitate the understanding of concepts, indicators and related reporting issues, its drafting reflects implicitly an integrated ecosystem assessment approach, recognizing the dependence of key ecosystem functions on sufficient availability of structural features potentially impacted by fishing and the interconnections between the impacts (See Section

[25] A conclusion checked with D. Agnew, pers. Com. March 2018.

6). The Ecosystem Approach adopted in the CBD (UNEP/CBD, 1998) brought in the requirement to maintain ecosystem structure and function (ESF). Target 6 has built on this foundation specifying the requirement to avoid Significant Adverse Impacts (SAIs) and to ensure impacts do not exceed Safe Ecological Limits (SELs) for ecosystem structure and function. The CBD Strategic Plan for Biodiversity 2011-2020 brought in the concept of ecosystem services and the requirement to maintain them. These elements and their relations are represented in **Figure 3**.

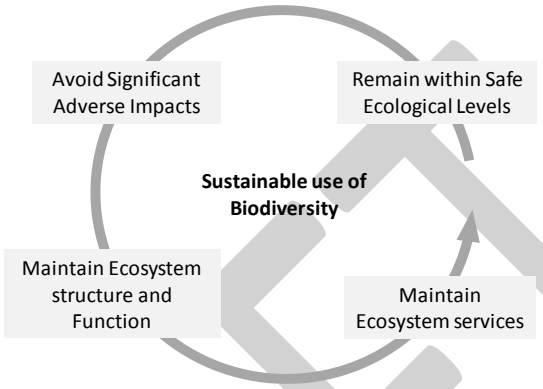

Figure 3. Interconnected ecosystem-related concepts and requirements

A major difficulty for implementation and reporting on progress in that area, however, is that none of the ESF, SAI and SEL concepts have yet led to agreed indicators[26] or standards and, as argued in **Sections 5 and 6**, may not be amenable to fitting into reporting frameworks relying solely on a small number of indicators and rigid performance benchmarks. Consequently, it may not be possible to report this part of Target 6 consistently in quantitative terms, and qualitative reporting in the form of narratives and integrated assessment may not be robustly summed-up in any single format. This is exactly the situation faced generally as fisheries embraces an Ecosystem Approach to Fisheries Management.

The Ecosystem Approach required by the CBD, with its broad (comprehensive) translation in the FAO Ecosystem Approach to Fisheries (EAF), has the potential to generate indicators for all sets of fisheries interacting within ecosystems, feeding not only into Target 6 but also into many other complementary targets (**Figure 4**). Its generalization to all nations, however, represents a major additional investment in research (data collection and assessments) as well as interaction costs with the fishing and coastal communities for participative adaptive governance.

In terms of implementation of an ecosystem approach, the responses to the CCRFQ 2015 (**in FAO, 2016**) indicate that:

- Ecosystem approach to fisheries (EAF). 78% of the 93 respondent parties indicate that they have started implementing it. Of these, 99% have identified ecological and socio-economic objectives of management, 95% have identified the issues that need to be
- Destructive fishing practices. 98% of the 67 respondent parties prohibit explicitly the use of destructive fishing methods and practices
- Ecosystem indicators. 42% of the 33 respondent parties declare to use ecosystem indicators in fisheries management.
- Protection of biodiversity. 86% of the 66 respondent parties address issues related to biodiversity, essential habitats and ecosystems,

[26] This was recognized in the Rome 2016 Expert Meeting report

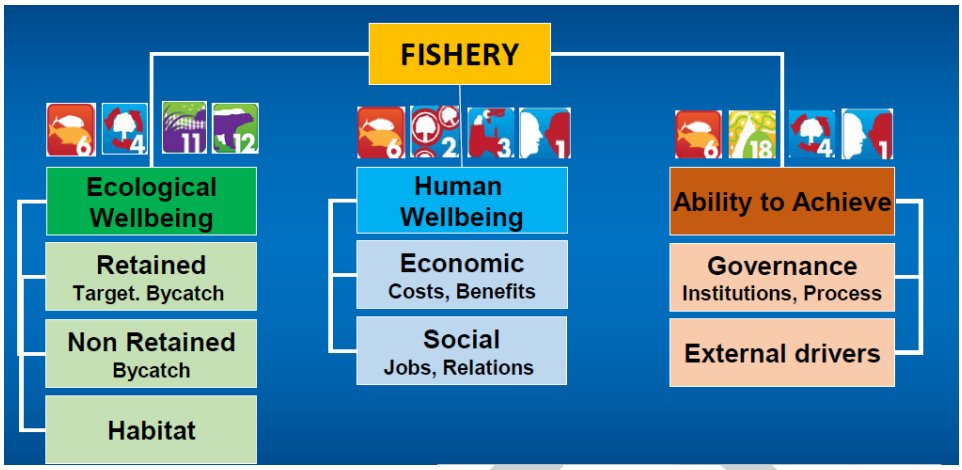

Figure 4. Elements (decision tree) identified in the Ecosystem Approach to Fisheries (EAF) in FAO and connections with Aichi Targets

2.3 Performance of Regional Fishery Bodies (RFBs)

RFBs play an important role in conservation and management of the resources in their jurisdiction and as such are expected contribute to achievement of Target 6. A report from them would be useful, particularly on the High Sea. The information provided on their websites, through their Regional Network (RSN) (**FAO, 2016b**) and the CCRFQ provides useful elements of appreciation of their activities and outcomes.

This section briefly refers to the general role of RFBs as regional frameworks for management. A more detailed review of their contributions to Target 6 will be made in the relevant **Sections 3 to 6** below.

The mixed results of RFMOs regarding the state of stocks as well as the collateral impact of fishing (e.g. on bycatch, discards and impact on the habitat) has been a subject of concern and study (**Cullis-Suzuki and Pauly, 2010; Lutgen, 2010; Rice, 2011; Gilman et al., 2012)** leading to efforts to review more systematically their role, and suggest best practices (**FAO, 1999; Lodge et al., 2007**: **117-128; Ceo et al., 2012; FAO 2012, 2015b, 2016b**). The FAO Guidelines for the Management of Deep-sea Fisheries in the High Seas (**FAO, 2009**) have been widely adopted and translated into action (**Rice, 2010**) but the outcome in terms of stabilization or reduction of the impact biodiversity is yet to be assessed (see **Sections 5 and 6**).

During the last decade, RFBs –particularly RFMOs– have been encouraged to undertake self-performance reviews (PRs) either as self-assessments or independent assessment by third parties. The criteria for these assessments (referred to usually as the Kobe Criteria) are not very different from those that would be used for review of States' performance in relation to implementation of Target 6:

- On conservation and management: (i) the status and trends of target and non-target (associated and dependent) species; (ii) the extent of EAF incorporation; (iii) the scientific basis of the advice; (iv) the extent o which effective measure are taken; (v) the use of the Precautionary Approach; (vi) compliance with the "compatibility principle for straddling stocks); (vii) a clear system of allocation of shares; (viii) attention paid to unregulated and new fisheries; (ix) reduction of harmful impacts (including through bycatch, discards, ghost fishing) on associated and dependent species and biodiversity; (x) the use environmentally safe fishing techniques; (xi) the implementation of effective rebuilding plans for depleted stocks; (xii) effective detection and management of excess capacity.

- On control and enforcement: (i) the degree of compliance with Flag States duties; (ii) the application of Port States Measures (minimum standards) by the RFMO parties including strengthening of MCS through use of VMS; catch documentation and trade tracking schemes; restrictions on transshipment; follow-up on infringements; International cooperation to monitor, detect and report on non-compliance; and market measures. The indicator should account for the extent to which such measures are applied, the measurement of which is not always straightforward.

The principle of undertaking recurrent and publicly available PRs in relation to these indicators is now well established, and reports are made to the governing bodies, and exchanged across the Regional Fishery Bodies Secretariats Network (RSN, fao.org/fishery/rsn/en**; FAO, 2016b**). The PRs are publicly available on the RFB's websites usually, as well as in summary publications (**Ceo et al., 2012; FAO, 2015b**) and at www.tuna-org.org for the performance of Tuna-RFMOs.

To the authors' knowledge, no updated global assessment of RFBs performance is formally available yet. An unpublished comparative analysis (**Fuller et al., 2017**) on biodiversity measures used by RFMOs/As in 2006 – when the UNGA Resolution 61/105 on Sustainable Fisheries and the UNFSA was adopted– and in 2017 indicates significant progress in addressing the provisions of that resolution, and others that have come since. Existing RFMO/As have strengthened and expanded their measures to include more biodiversity-related components, and in regions where no RFMO/As existed, three new bodies have entered into force since 2012. The newcomers benefitted from the experience of the others, existing models, and the existence of the Network, to progress faster and adopt the relevant measures. The analysis also reveals the relative homogeneity of the biodiversity measures taken by these RFMO/As in bottom fisheries (including exploratory fisheries, encounter protocols, VME indicator species, and thresholds) and close alignment with the UNGA resolution 61/105 and the FAO Deep-sea Fisheries Guidelines.

Nonetheless, in general, most RFMOs have updated their basic texts, to account for the adoption of the 1995 UNFSA, the 2009 FAO Guidelines on deep-sea fishing in the high seas and the 2009 Port States Agreement Measures(PSMA). Most have also adopted the Ecosystem Approach and Precautionary Approach a decade or more ago. Detection of IUU has improved as States improved their performance as flag and port States following the Voluntary Guidelines for Flag State Performance (**FAO, 2015a**), and the use of Target Reference Points (TRPs) and Harvest Control Rules (HCRs) is slowly being generalized. The use of Management Strategy Evaluation (MSE) is also spreading in leading RFMOs, but more slowly in others. Identification of threatened species in bycatch and vulnerable habitats is progressing very slowly, limited sometimes by the need to amend basic texts to broaden the RFMO mandate, often constrained by limited budgets and national capacity. Overall, the international standards are up-to-date (even if they could be improved), their political acceptance has been affirmed, formal steps to implement them have effectively started, to a different degree in different RFBs, reflecting operational constrains, certainly, but also insufficient political will or clout. The elaboration and updates of RFMOs' Performance Reviews and their public availability, together with exchange of experience between RFBs through the RSN are elements susceptible to increase performance in the future.

The detailed responses provided in 2015 by RFBs to the FAO CCRFQ version developed for them, are available in **FAO (2016)** and mentioned below in the relevant **Sections 3 to 6** (on Target 6 Elements A to D).

3. Target 6A – Sustainably harvested species

3.1 Rationale

Target 6A envisages that *by 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem-based approaches, so that overfishing is avoided, …* The key concepts that may require indicators have been underlined.

As suggested in **Section 1**, Element 6A is the overarching Element of Target 6 while the following Elements (6B) indicates what is expected when the overarching requirements are violated and species are depleted (6B) and considered threaten with risk of extinction (6C) (**Table 2**). Element 6A indicates that for species to be considered sustainably harvested, their fisheries need to be actively managed by a mandated authority, based on sustainability principles and legal foundations and within an ecosystem context. This Element refers specifically to species targeted for harvesting, that are neither overfished nor depleted or collapsed and need to be maintained as such, remembering, as stressed in **Section 1.1.2**, that in multigear-multispecies fisheries, non-target species incidentally caught (e.g., bycatch species) may often, with time, become *bona fide* target species as demands evolve.

3.2 Key concepts and indicators

The interconnected concepts to understand in order to report properly are underlined in the Element 6A above: (i) sustainable harvest and overfishing; (ii) legal harvest; and (iii) ecosystem-based approach. They are clarified below.

3.2.1 Sustainable harvest and overfishing

Sustainability is defined in CBD (Art. 2) as *the use of components of biodiversity in a way and at a rate that does not lead to long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.* It requires a balance between its ecological, economic, social and governance dimensions. Target 6 refers only to the ecological (biodiversity) dimension (e.g., stocks, species, habitats, ecosystems).

The LOSC uses the term "sustainable" but requires *that the maintenance of the living resources is not endangered by overexploitation (§ 61.2)* and that *measures should maintain or restore populations of harvested species at levels where they can produce the Maximum Sustainable Yield* [referred to as MSY]*, as qualified by relevant environmental and economic factors…taking into account the interdependence of stocks (§ 61.3, emphasis added).* The related UNFSA specified more explicitly that the MSY level of exploitation should be considered as a limit (to remain above) and not as a target (to reach). The ecological and economic factors, respectively, are recognized in the references to referred *environmental* factors and *interdependence of stocks,* on the one hand, *and economic factors* on the other, without specifications.

Overfishing is synonym of overexploiting which, in the LOSC § 61.2, is driving a stock below the level at which it could produce MSY. Overfished stocks may be depleted or collapsed and are dealt with in **Section 4**. Clearly, in Target 6, species are considered *sustainably harvested* when their *overfishing is avoided*, connecting the two antinomic concepts.

The clear implication for reporting on Target 6 is that *sustainably harvested stocks* include fully fished stocks (with $B=B_{MSY}$ and $F=F_{MSY}$ on average) and underfished stocks (with $B>B_{MSY}$ and $F<F_{MSY}$, on average) as described in **Section 1.1.1.** In some countries (e.g., the USA), a distinction is made between (i) a stock that has been reduced below B_{MSY}, considered *overfished* whether the fishing pressure is still excessive or not, and (ii) a stock

subject to excessive fishing pressure, considered under active *overfishing*, whether the biomass is already below B_{MSY} or not yet. Target 6 does not explicitly delineate the boundary between 6A (fished sustainably) and 6B (depleted). However, it did explicitly link "depleted species" with the requirement for a recovery plan and measures. Fisheries management rarely requires the development of recovery plans for stocks with B slightly less than B_{msy}, but definitely when stocks have fallen near or below biologically based limits, below which productivity may start to be impaired (B_{lim}). Between B_{msy} and B_{lim}, conventional fisheries management is expected to reduce fishing pressure and with the productivity of the stock not yet impaired, natural stock dynamics should return the stock to or above B_{msy}. This is typically supported by precautionary buffers (B_{pa} values) intended to ensure exploitation rate is reduced on declining stocks well before the risk of impaired productivity starts to increase. It is assumed that this practice will be maintained in Target 6 reporting. Stocks can be considered "sustainably managed" if biomass is above B_{msy} or an appropriate surrogate or fluctuating around B_{msy} with appropriate precautionary management in place to ensure exploitation rate decreases well before risk of impaired productivity increases.

3.2.2 Legal harvest

To have stocks *legally harvested* implies that fisheries operate under the rule of law, e.g. abiding to regulations contained in a Fisheries Act, effectively enforced by a mandated authority. In theory, all countries have some legal framework regulating commercial fishing activities. In practice, subsistence, small-scale and sometimes recreational fisheries tend to be weakly regulated or unregulated and could fall under IUU-fishing in a "literal" interpretation of the term, if community-scale "regulation" was not effective (cf. **Section 2.1.1**). Ideally, for those fisheries which the States have decided to regulate, the law should: (i) cover all the biodiversity elements (target and non-target species, overfished and threatened species, vulnerable habitats, etc.). Some of these elements might not also covered in environmental conservation legislation; and (ii) aim to reduce non-compliance as much as possible through low-tolerance enforcement, effective and fast judicial processes, and deterrent penalties.

The complexity of reporting on this Target 6 requirement is discussed under IUU-fishing (**Section 2.1.1)**

3.2.3 The Ecosystem Approach

The EAF/EBFM framework have been addressed in **Section 2.2.** For Target species, the implication of the approach is to account for interactions between them, in assessments and management. The practice has been increasing but is far from being the general rule. Related reporting aspects will be discussed **in Sections 5 and 6**.

3.3 Example of outcomes on Target 6A

In this section, we look first at the action taken by FAO Parties and RFBs as reported to COFI in 2016 (half-way through the current decade) based on their responses to the CCRFQ (**FAO, 2016, 2016a**). Percentages refer to the proportion of the 66 to 112 Parties that responded, depending on the questions (**Sections 3.3.1** and **3.3.2**). Examples of available information on outcomes of these actions, aggregated at global level, are given in **Sections 3.3.3 to 3.3.5**

3.3.1 Responses of States to the CCRFQ 2015

- Legislation: 93% of the Parties have legislations which conform fully (54%) or partially (40%) with the CCRF. Of the 7% which are not conforming, 74% are planning to align their legislation with the CCRF. On average, 11% of the FAO Parties have enacted their Fishery legislation after 2010.

- Policies: 94% of the parties have a fishery policy aligned either fully (64%) or partially (34%) with the CCRF. Of the 2% remaining, 80% intend to have their policy aligned with the CCRF.
- Governance: 97% of the respondents provide for stakeholder participation in determining decisions and 98% address the interests and rights of Small-scale fisheries.
- Stock assessment: 83 respondents indicate that (in total) they assess 1627 stocks and that 41 to 50% of key national stocks are covered with reliable assessments.
- Management plans: They are an important step towards implementation of legal obligations and policy decisions. About 82% of the respondents have such plans in place. Over 700 plans have been developed in total in the marine area (and 200 in inland waters) and 90% of these plans are effectively being implemented.
- Control of fishing pressure: 81% of the respondents declare addressing fishing capacity issues and economic conditions of fishing operations. About 52% of the respondents launched a programme to assess fishing capacity, 93% ensure compliance with licensing systems, 90% aim to ensure that the level of fishing is commensurate with the state of fisheries resources, 62% claim to take steps to prevent further capacity build-up, but only 27% implement a NPOA-Capacity.

A summary conclusion on these points is that the very large majority of countries seem to have taken steps in the right direction to enable (maintain) sustainable fisheries, both in the legal, policy and management frameworks. Those who have not done so yet expressed their willingness to proceed. The international instruments and guidance has, therefore percolated down to the national fishery sector level and, through regulations to the fisheries themselves, at least those in which regulations are effectively enforced.

3.3.2 Responses of RFBs to the CCRFQ 2015

- Stock assessment: 20 out of 24 RFBs reported that reliable estimates of the status for a cumulative total of 273 stocks had been obtained within the last three years. 9 RFBs covered over 80% of their key stocks; 6 covered 40-60% of key stocks; and 2 covered less 40% of them.
- Target reference points (TRPs): 15 RFBs (60% of the respondents) have developed TRPs for a total of 109 stocks. 11 of them report having reached TRPs for some stocks and 9 have exceeded them. Measures taken in this case were: Limiting fishing (most commonly); increased research; strengthening MCS; and continuously adjusting fishing capacity (least common). Also catch and effort indicators were by far the most popular alternatives to the use of TRPs (applied by 78% of RFBs not using TRPs).
- Management plans: 24 RFBs indicated that they had management plans with the following measures: (i) in most management plans, measures to control fishing pressure and provide protection to endangered species; (ii) to a lesser extent, to allow depleted stocks to recover, prohibit destructive fishing methods and practices, and address selectivity; (iii) and to the least extent, to address fishing capacity and the interests and rights of small-scale fishers (obviously more complicated to address or less relevant in the high seas). In inland fisheries the focus was on destructive fishing methods, biodiversity of aquatic habitats and ecosystems and the rights of small-scale fishers
- Control and surveillance: 68% of the respondents reported controlling that fishing operations were in line with their management plans
- Vessel Monitoring Systems: 22% of responding RFBs implemented VMS for the entire fleet and 48% for only a portion of the fishing fleet. None reported implementation problems and compliance was high (91% of members in line with standards).

- Other measures taken: assessment of fishing capacity (38%); publication of information material (33%); and capacity building (33%).

As with Parties, above, the conclusion is that the very large majority of RFBs consider that they have taken the expected action (within their different mandates)[27] for the management of their target species. It should be stressed that within RFBs, some organization have a formal management mandate and can make binding decisions (the RFMOs) while others' role is purely advisory and relates capacity-building in terms of data collection, fishery science, stocks assessments, and management.

3.3.3 Trends in fishing pressure

Fishing pressure is a key driver of stocks status more generally than environmental impact (through its footprint) and is a useful indicator for the whole of Target 6 even though it is meaningful only when related to the pressure corresponding to MSY.

The global fleet is composed of a very large range of vessels types, from one-man non-motorized canoe using simple gear, to very large industrial factory ships fishing and processing on board, using very large-scale fishing gear, advanced positioning and detection devices (sonars, sounders, helicopters, planes and satellites). The amount and efficiency of the technology available to these fishing units has very significantly increased with time. In addition, any unit of fishing capacity (e.g., gross tonnage, horsepower, kilowatts, etc.) or effort (e.g., days-at-sea, trawling time, soaking time of gill nets or long lines) may develop a large range of actual fishing mortality depending on species and areas. To make it worse, the fishing mortality generated, on average, by each unit of fishing capacity or effort –the catchability coefficient– tends to change with fish abundance, increasing as abundance decreases. Consequently, calculating global trends in actual fishing pressure since WWII and any change since 2010 is a challenge.

Nonetheless, it is very clear that global nominal fishing power has increased very significantly from 1950 to the mid-1990s (**Garcia and Newton, 1997**). Just before the adoption of Target 6, it was estimated (combining various incomplete data series) that the world fishing capacity was twice the amount that would be sufficient to take the world catch (**World Bank, 2009**), and this capacity continued to increase until around 2010 (**Bell, Watson and Ye, 2016**) (**Figure 5**).

The sharp "jump" in capacity around 1995 shown in **Figure 6**, if real, would represent a massive "instant" investment (for a global capacity increase of over 50% in 2 years) for which there is no supporting evidence. This means that the "jump" may be an artifact that reflects an i change in the information content of the indicators used in the compilation, the methodology applied to construct them, or the national reporting practices**.** The global pattern, including this "anomaly" is imposed by the evolution in Asia which has, by far, the largest fleet capacity and effort (and extends its impact worldwide). Except in Europe, where fishing capacity has been decreasing since the mid-1990s, capacity has been increasing everywhere and the faint hints of decrease in some regions after 2010 (e.g. in North America and Oceania) may not be significant considering the variance observed in the indicators (cf. **Figure 6**) and would need to be confirmed. The evolution of global fishing effort (in watt-days of fishing) shows a similar pattern (**Bell, Watson and Ye, 2016: Fig 2**).

The average fishing efficiency of the global fleet (watt-days[28] of effort spent per tonne of fish officially landed) (**Figure 5**) has also decreased since the late 1960s and was, in 2012, below what it was in 1950, reflecting the global decrease in catch per unit of effort that one should expect as fishing pressure increases up to (and sometimes beyond) the level corresponding to MSY. One interpretation of this trend is that efficiency has, first,

[27] And remembering that many RFBs are not RFMOs and their management competence is mainly advisory.

[28] Multiplying the fishing capacity (measured by KW rating of the main engine) by the number of days fished

increased during the fisheries expansion period as the accessible biomass increased faster through "discovery" of new stocks than it was depleted… until discovery was over.

No matter how approximate these data may be, considering the manipulations needed, they indicate a likely trend.. Extending this analysis to 2020 would provide an element of appreciation of the trend since Target 6 was adopted. Extrapolation of the 2000-2012 trend to 2020 would lead to global concern as countries would have failed to act on a situation of overcapacity well described during the last 3 decades.

The worry is likely justified because reversing the trends of fishing capacity in developing countries to align it to stock productivity, is likely to be high, with significant social, economic and hence political consequences, requiring national and/or international investments in rebuilding for compensations, support to vulnerable communities, creation of alternative livelihoods, etc. (**Garcia et al., 2018**).

3.3.4 Trends in certified fisheries

The number and proportion of world fisheries that are certified by the Marine Stewardship Council (MSC) are indicators of *sustainable harvest*. Close to 300 fisheries have been certified representing about 12% of the world landings in 2017. However, the trends shown in **Figure 6** need to be carefully interpreted. They do not indicate that fisheries are globally improving but that sustainability is an increasingly attractive argument for traders and probably consumers, hence, providing a growing incentive for the fisheries which can afford it, to improve the way they operate and to make it known to consumers through labelling. Many, if not most, of these fisheries have had to improve their practices to obtain the label and must struggle to keep it. According to the MSC, over 1200 improvements have been made in certified fisheries since 2000, including to reduce their impact on habitats and over 20% of the certified fisheries have made at least one improvement into their habitat management measures. Independent assessment has shown that MSC-certified stocks had stable high biomass levels as expected and that biomass levels had increased following certification (**MSC. 2017).**

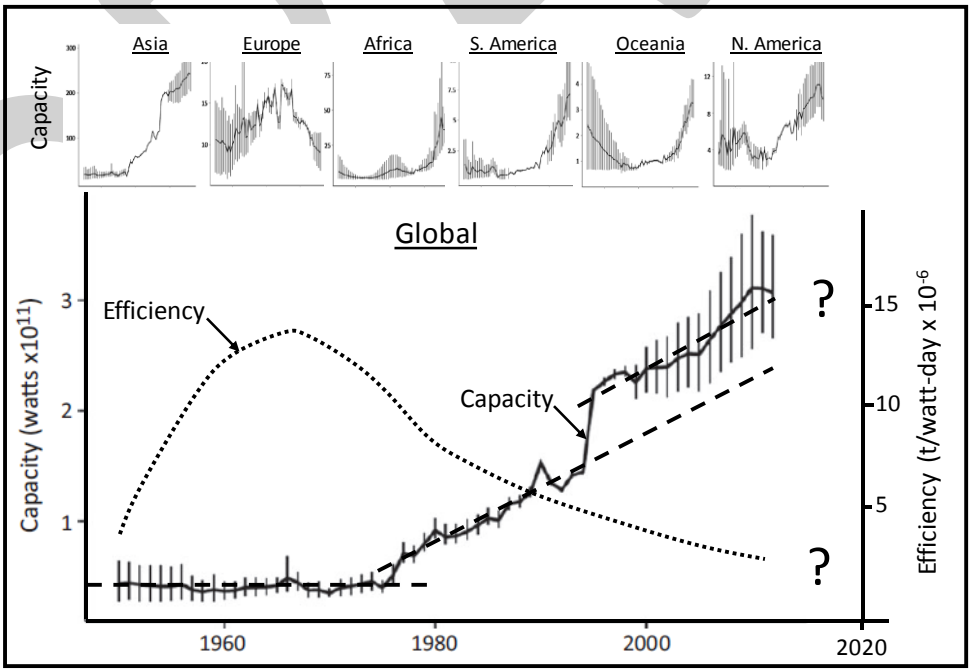

Figure 5. Global fishing capacity from 1950 to 2012. The grey shading materializes the 95% confidence intervals. The capacity scales of the regional inserts are all very different and intended only to illustrates relative trends. The "jump" in capacity before 2000 is odd (see text). Constructed from Bell, Watson and Ye (2016).

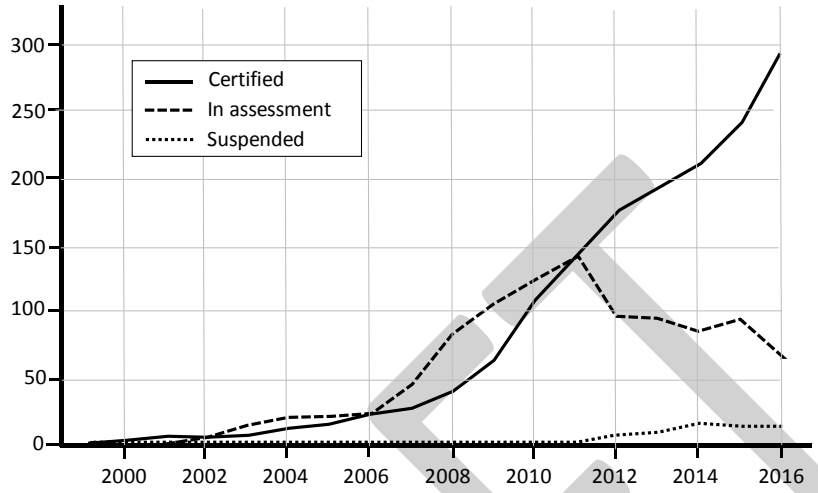

Figure 6: Number of fisheries certified, in assessment, or suspended by the Marine Stewardship Council 2000-2016 (Source: www.msc.org)

The MSC Principle 1 for all certified stocks is that they have a biomass target reference point equivalent to maximum sustainable yield (B_{MSY}) and strive to ensure stocks stay above or fluctuate around this target (due to natural variability). The Principle also requires that each certified stock has an identified biomass level below which the probability of impaired productivity may increase (e.g., B_{lim}), and that the stock is being maintained above that level with very high likelihood, similar to the boundary considered appropriate for the application of 6A. or 6B. While assessments are as much as possible based on quantitative indicators, the MSC has also developed and applies since 2009 a set of precautionary risk-based indicators for the assessment of data-deficient fisheries – the Risk Based Framework (RBF) and 67 fisheries have been certified using the RBF to evaluate fishery impacts on either target or bycatch. Since 2008, with Principle 2, the MSC has been promoting ecosystem-based fishery management with the view to reduce collateral impact of fishing (with special efforts on bycatch and VMEs) and to better account for the role of low-trophic level species in the ecosystem. Certified fisheries area also required to ensure their impacts on marine habitats are sustainable, to have a strategy in place to manage these impacts, and to have sufficient understanding of the relevant habitats to underpin such management (**MSC. 2017**).

3.3.5 Status and trends in sustainably harvested stocks

a) Global assessments

Both conventional assessments (covering of a small part of the world resources) and analyses of catch trends (with much broader coverage) indicate a progressive increase of the number of overfished stocks and a parallel decrease in underfished stocks between 1950 and 2010 (**Grainger and Garcia, 2005; Froese and Kesner-Reyes, 2002; Pauly et al., 2008; Worm et al., 2009; FAO, 2009; Garcia, 2009; Anderson et al., 2012**). The global patterns were confirmed up to 2006 at the regional level for the Mediterranean, with earlier and sharper declines in northern and western countries with more developed fisheries and in higher-value demersal species than in small pelagics (**Garcia, 2011; Vasilakopoulos et al., 2014**). From the 2010s onwards, a series of comprehensive analyses using a combination of catch trends, population parameters and conventional fishery stock assessments approaches yielded comprehensive assessments, improving the assessment coverage, raising

controversies as to the biases available in both methodologies[29] (**Costello, 2012; 2016; Thorson et al., 2012; Anderson et al., 2012; Martell and Froese, 2013; Rosenberg at al., 2014, 2016; Hilborn, 2017; Froese et al., 2018**). While these assessments diverge (sometimes significantly, at stock or regional level), they tend to agree on general trends and indicate that the proportion of overfished stocks has continued to increase after 2010 (**Figure 7**) even if at a slower rate since the 1990s despite successful management and recovery in several leading nations (**Costello et al., 2016; Hilborn, 2017**). The state of global stocks in 2013, as estimated in **FAO (2016)** and **Rosenberg et al. (2018)** using FAO delimitation between stock categories (shown in **Table 2**), differ only slightly (**Table 5; Figure 8**).

Table 5. Percentages of world stocks which are assessed as underfished (U), fully fished (F) and overfished (O) in 2013 according to FAO (2016) and Rosenberg et al. (2018)

	% of stocks by category				
Reference	U	F	O	$<B_{MSY}$	$>B_{MSY}$
FAO (2016)	11	58	31	-	-
Rosenberg et al. (2017)	17	53	30	53	47

Rebuilding depleted stocks and fishing more intensively the underfished ones, it is estimated that 18 million more tonnes of food fish could be produced and perhaps 25 million more tonnes if IUU was eliminated, assuming no IUU catch is already reported and predator-prey interactions are sufficiently accounted for (**Costello et al., 2016**).

[29] Particularly between conventional stock assessment methods and catch-only methods which allow some assessment to be made for poorly informed stocks.

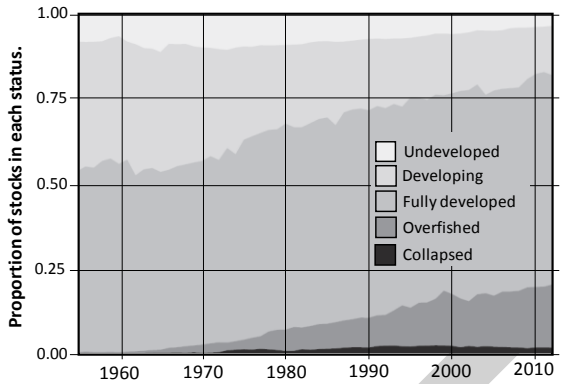

Figure 7: State of assessed stocks 1950-2012. Source: Hilborn (Forthcoming). The stock status categories are defined as Underdeveloped (B/B_{MSY}>1.5); Fully developed (B/B_{MSY} = 1.55 to 1.5); Overfished (B/B_{MSY}<0.5) and Collapsed (B/B_{MSY}<0.2)

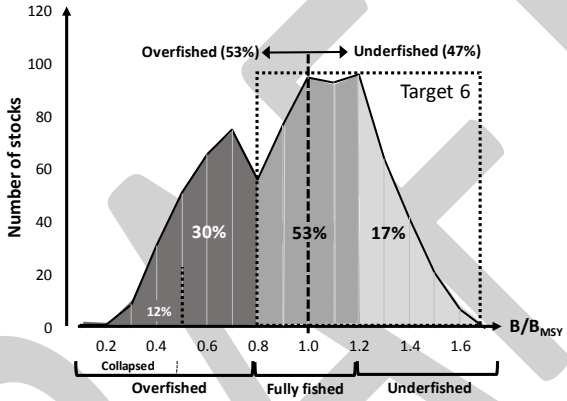

Figure 8. Global distribution of state of stocks in 2013. The 12% of collapsed stocks are included in the 30% of overfished stocks. The stocks in the dotted rectangle are in line with Target 6. Modified from Garcia et al. (2018), based on data from Rosenberg et al. 2018).

The diagnosis on the state of stocks varies somewhat between authors according to data, assessment methods and reference values used to determine the stocks status categories even though the overall situation and trends remains similar. Altogether, the state of the world stocks in the 2013 was distributed around the international MSY standard at which they could produce MSY in a sustainable manner (**Hilborn, 2017; Rosenberg et al, 2018**). However, the spread of values seen around B/B_{MSY} = 1 (e.g. **Figure 8**) reflects in part the variability inherent in the various assessments but also real difference in fishing pressure and management between stocks and regions.

For Target 6 reporting purposes, 69 -70% of the stocks appeared to be fully fished and underfished, i.e. *Sustainably harvested* at the beginning of the current decade (2010-2020). However, Target 6 does not require that all stocks be above B_{MSY} level by 2020 but that management has reduced fishing pressure to allow increases of all stocks below B_{msy} and implemented effective rebuilding plans for stocks that are depleted (below B_{lim}), possibly accounting for the fact that rebuilding may take some time to occur with many longer-lived species (See Section 4). Consequently, it would be necessary to account for both all stocks below B_{msy} but above B_{lim}, and with some form of harvest control ensuring a reduced exploitation rate, and for overfished stocks below Bl_{im}, but under formal rebuilding plan. These are not very numerous yet, and their accounting might not change this global figure (or any equivalent figure) very much, but particularly the former (use of harvest control rules for fluctuating stocks) are being adopted by many jurisdictions. Hence these reviews

could be used as a baseline when measuring performance in relation to 6A, particularly if they can be augmented with national or regional information on harvest management rules for stocks below Bmsy.

A strong concern is that the proportion of overfished stocks at the beginning of the current decade, had been growing slowly but steadily. A note of caution is needed as the number of stocks included in the annual assessments has increased continuously since 1974. The stocks being added are, in many cases, stocks that were unassessed previously for lack of data, and their state tends to be worse than that of assessed stocks (**Costello et al., 2012; Rosenberg et al., 2018**). The continuous increase in the proportion of overfished stocks may be due at least in part to a progressively better accounting of previously unassessed stocks. This sampling bias would not reduce the value of the latest assessments as "best available estimates" but would imply that past levels of overfishing might have been underestimated.

The information on depleted and collapsed stocks is addressed in **Section 4**.

b) *Regional assessments*

Global average statements about state and trends of stocks hide the large disparity between stocks (**Figure 8**) and regions (**Figure 9**) as well as socio-economic groupings[30] (**Hilborn and Costello**, **2018**), and hence the case-specific implications for the actions needed to improve performance. The spread of values around the MSY reference indicates that more food might be extracted from the underfished stocks (with due regard to forage fish) and that significant efforts are needed to bring overfished stocks in line with international legal standards and policy commitments. On **Figure 9**, panels are organized in order of decreasing state of stocks as measured by the median value of their regional frequency distribution of B/B_{MSY} and hence of harvest sustainability (from top left to bottom right). Indian Ocean and Northwest Atlantic stocks appear has the least and most impacted, respectively. Slightly different classifications might emerge from different analyses[31] but the point is that regions differ, and global assessments are not particularly informative for regional, national and single stock management.

[30] **Costello et al. (2012)** have shown that since the mid-1990s well-assessed stocks in advanced countries have stopped declining on average and are slowly recovering, while the opposite is true, for unassessed (and hence probably weakly managed) stocks, largely but not only in developing countries.

[31] For example, stocks have been declining in the Mediterranean over the past several decades through excessive fishing and capture of immature fish (**Vasilakopoulos et al., 2014**). Historically, declines started in the North and are now observed also in the South (**Smith and Garcia, 2014**).

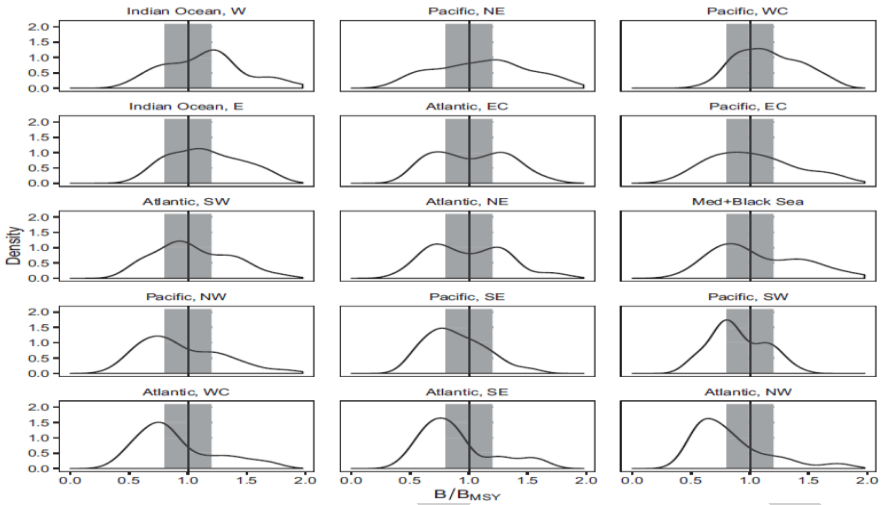

Figure 9. Regional distribution of B/B_{MSY} status in 2013. Black vertical lines indicate B/B_{MSY} = 1. Shaded areas indicate ±20% around this point. The panels are organized in order of decreasing median B/B_{MSY} and hence of harvest sustainability (from top left to bottom right). From Rosenberg et al. (2018). By courtesy of Conservation letters.

Nonetheless regional trends are also important to report, particularly where a large proportion of stocks are shared, as for example in the Northeast Atlantic where stocks seem to have finally started to recover (**Fernandez and Cook, 2013; Smith, 2013**) or in the Mediterranean where they don't (**Vasilakopoulos et al., 2014**). Of particular interest would be a comprehensive assessment of the state of stocks in marine areas beyond national jurisdiction (ABNJ), in particular deep-sea, tuna and tuna-like stocks. The latest comprehensive review of highly migratory, straddling and other high seas stocks was made by **Maguire et al. (2006)** and needs substantial updating.

c) Tuna resources

Regarding tuna resources, which are regularly monitored by tuna RFMOs in charge of the different ocean areas and species, the International Sustainable Seafood Foundation (ISSF) compiles global information that can be split by species and region since 2011[32] and is therefore directly relevant for Target 6. The state of tuna stocks is referred to as (1) Healthy ($B>B_{MSY}$ and $F<F_{MSY}$); (2) Intermediate ($B<B_{MSY}$ but stable or improving and $F>F_{MSY}$ but

[32] Accessible at https://iss-foundation.org/about-tuna/status-of-the-stocks/interactive-stock-status-tool/.

adequately managed) and (3) needing improvement (B<BSMY, decreasing; F>FMSY, not properly managed). The trends during the current decade (2011-2018) is given in **Figure 10.**

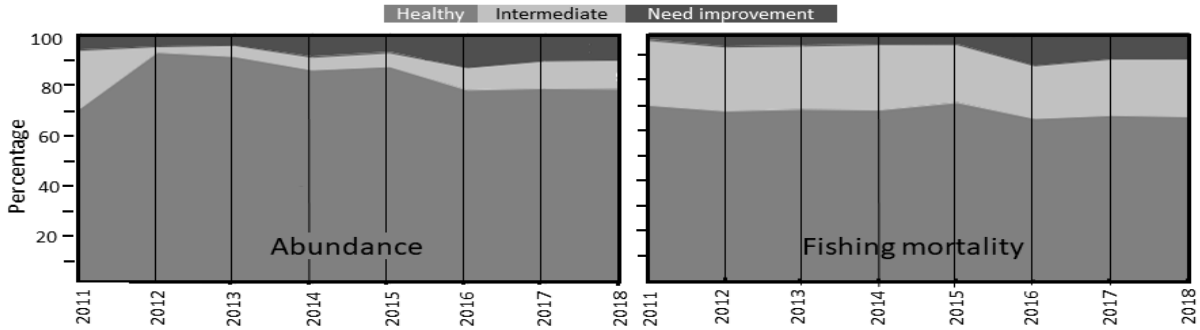

Figure 10. State of world tuna stocks 2011-2018. Source: ISSF website Interactive stock status tool, accessed 12/04/2018 at https://iss-foundation.org/about-tuna/status-of-the-stocks/interactive-stock-status-tool/

The Figure indicate a decrease in healthy tuna stocks, an increase of stocks in intermediate state, and a stable proportion of stocks raising serious management concern. in 2016, 57% of the stocks were considered healthy, 30% at intermediate level (under rebuilding?), and 13% actively overfished ($B<B_{MSY}$, not improving). In terms of fishing pressure, 65% of the stocks are experiencing a low fishing mortality rate ($F<F_{MSY}$), 22% have a high fishing mortality ($F>F_{MSY}$) that is being managed adequately and 13% are experiencing active overfishing ($F>F_{MSY}$), not properly managed (**ISSF, 2018)**. In the international standards identified in **Section 1.1.1** these categories correspond to stocks that are (1) underfished; (2) overfished but rebuilding; and (3) under active and worsening overfishing.

In terms of Target 6, the stocks to be considered *sustainably fished* are the healthy ones and the part of the intermediate ones that are equipped with a *rebuilding plan*, effectively implemented. As this assessment is the timeliest available, it is unlikely to change much in the next 2 years and it would be very urgent to demonstrate that such rebuilding plans are in place.

d) Outlook

Most of the data above refer at best to 2013, near the beginning of the Target 6 current decade. It can be noted that significant delays exist between fishery developments and the assessments of their consequences. The only international institution producing recurrent comprehensive reports on the state of stocks at global level is FAO and the next update in the State of Fisheries and Aquaculture (SOFIA 2018) will cover the data available up to 2015 only and by 2020 the data up to 2017, with delays of about 2-3 years. ICES advises its constituencies every year, but the last syntheses (e.g. the 2018 advice for the Greater North Sea Region)[33] contains data until 2015. The delay has to do with the collection of statistics at national level, the stock assessment process, the transfer of information, control and compilation at global level, and the analysis of this compilation. The implication is that the world community may have to wait for 2023 to find out, in quantitative terms, to what degree Target 6 was reached.

[33] Available at http://www.ices.dk/community/advisory-process/Pages/fisheries-overviews.aspx

The problem might be mitigated, accepting some risk, by projections based on available data and a few assumptions about the future, recognizing that they need to be taken "with a grain of salt" and are not predictions. **Figure 11** indicates the trend in state of stocks according to FAO data from 1974 to 2013 and using FAO categories.

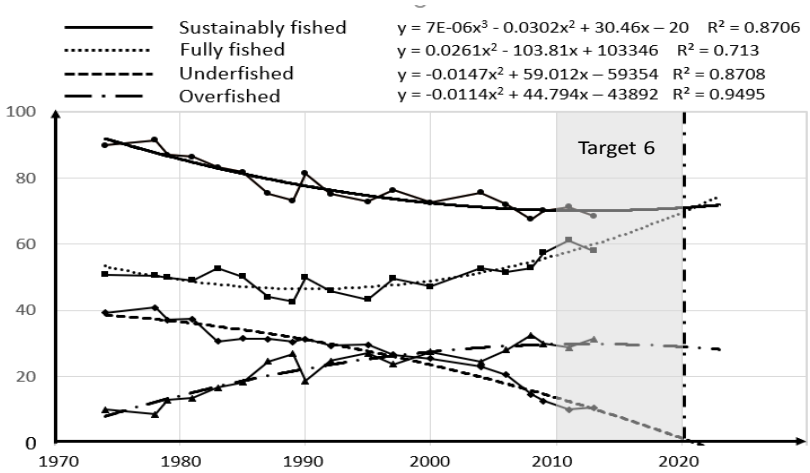

Figure 11. Proportion of sustainably fished stocks (= fully fished + underfished) from 1974 to 2013 and trend extrapolation to 2020. The Target 6 current decade is shaded. Data 1974-2013 by courtesy of FAO.

The trend (order 2 or 3 polynomial) is extrapolated to 2020 as an educated guess for a possible situation at the end of the Target 6 current decade, if the global fishery business evolves as usual. No more underfished stocks exist and fully fished stocks increase to about 70%.

In terms of Target 6, *sustainably harvested* stocks would stabilize at least at 70%, the sum of fully fished and underfished stocks but would also need to include stocks with formal rebuilding plans in place. *Overfished* stocks would remain at about 30%.

Figure 12 presents a set of projections elaborated earlier on by **Costello et al. (2016)** from 2013 onwards according to three different management policies regarding rebuilding: (1) RBFM. A rights-based fisheries management in which economic efficiency (rent extraction) is maximized in all stocks; (2) F_{MSY}. A strategy in which all overfished stocks and those well-managed currently are maintained around their individual MSY level to maximize catch, probably optimizing fishery employments and livelihoods at the same time; and (3) BAU. A business-as-usual strategy in which currently well managed stocks continue to be managed in the same way and poorly managed stocks (in which fishing pressure is not limited) decline significantly following past trends.

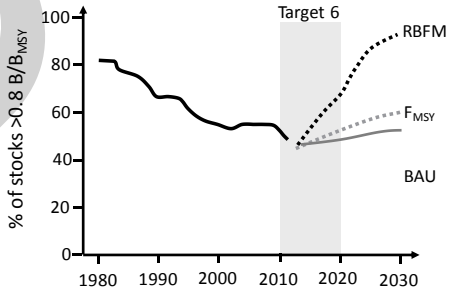

Figure 12: Projected trajectories of the global proportion of sustainably fished stocks ($B>0.8B/B_{MSY}$) in different policy scenarios. RBFM = Economic optimization policy. F_{MSY} = Biological optimization policy. BAU: business-as-usual with presently well-maintained fisheries maintained as such and other fisheries declining under poor or no management.

Modified and redrawn from Costello et al. (2016). The Target 6 decade is indicated to signal that large uncertainties exist still about the likely situation in 2020.

The business-as-usual scenario on **Figure 12** is more pessimistic than our simple extrapolation on **Figure 11**. The update to be presented by FAO to COFI 2018, with data up to 2015 (the center of the Target 6 decade) might help finding which of the trajectories is more likely to be developing in the rest of the current decade. However, a homogenous global evolution is most unlikely and differences in policies and strategies between different socioeconomic systems is to be expected. It is unlikely that States in which fisheries are declining remain inactive, however. If advocacy continues and assistance is provided, some progress can be expected, particularly if governance improves and the private sector gets more involved in management decision-making. This progress will not happen immediately and current political instability, low research capacity and weak governance might not be resolved by 2020, if the past is of any use to predict the future.

4 Target 6B – Depleted target species

4.1 Rationale

Element 6B indicates that … *recovery plans and measures are in place for all depleted species*. Extending Element 6A, it also deals with target stocks but focuses on those stocks that management failed to harvest sustainably. Although Element 6A refers specifically to fish and invertebrate stocks (and aquatic plants), reflecting the focus on targeted stocks, Element 6B applies to all species impacted directly by fishing. Recognizing implicitly that effective recovery takes time, Element 6B requires that *rebuilding plans* be *in place* and not that the species be already fully recovered by 2020. However, elements of appreciation of progress to full recovery (e.g. intermediate milestones) would be useful and the rebuilding strategy may indicate a mandatory maximum allowable time within which the species should be rebuilt (**Garcia et al., 2018**).

Recovery plans are not defined. In fisheries, the term rebuilding plan refers to a management plan elaborated to *rebuild a stock when the measure of its status (e.g. its biomass) is below the (biomass) limit reference point (i.e. it is assessed as overfished)* and which specifies *rebuilding targets, time horizons and control rules* (https://iphc.int/the-commission/glossary-of-terms-and-abbreviations). Rarely have these requirements been generalized to non-target species, however, and we found no widely used standards for rebuilding or recovery plans of depleted non-target species that have not been designated as "threatened" (6C)

The important scope of this Element cannot be over-emphasized. While a core purpose of fishery management is to avoid overfishing (as aimed at in Target 6A), its performance in that respect has been mixed and about 30% of the stocks were overfished in 2013, at the beginning of Target 6 decade (**Figure 8; FAO, 2016d; Costello et al, 2016**). Results tend to appear worse in regions where poorly informed data and catch-only assessment, as well as weak governance dominate (**Froese et al., 2018**). Following the standards and correspondence described in **Sections 1.1.1** and **1.1.2**, the term *depleted* covers both targeted stocks, a that have been seriously overfished in the past ($B<B_{lim}$) and now still experience some fishing pressure through bycatch or active directed fishing; and any non-target species that through excessive mortality (whether largely from fisheries bycatches or not), has had its abundance reduced to a level where productivity may be impaired, and is currently exposed to fishing mortality. Maintaining and restoring resources that have been inadvertently (or intentionally) overfished/depleted and may have collapsed is an obligation under the LOSC, for all resources, target or non-target, and under the CBD for biodiversity in general. This obligation has been usually implicit in normal fishery management plans that formally aim to *avoid overfishing* for target species and has become more and more explicit in States' commitments and actions as fishing pressure and failed resources increased and the need for an Ecosystem Approach has become more widely recognized. .

The specific focus on mandatory rebuilding plans for severely depleted target stocks has started to increase in the 1990s and more rapidly in the 2000s (**Garcia et al., 2018**) although the rebuilding of depleted non-target species (other than highly charismatic megafauna) has received far less attention even less than for vulnerable habitats (**Section 5**) or impacted ecosystems (**Section 6**). When stocks are lightly overfished, stock increases may be undertaken under the "ordinary" management plan, e.g. using a Harvest Control Rule to semi-automatically correct fishing pressure and removals to return to the target management level. These cases are not considered "depleted".

When targeted stocks *are* Depleted, a special management regime, should formally indicate: (i) the minimum biomass level of biomass (e.g. B_{lim}) below which the rebuilding plan is in force; (ii) the level of biomass (and other considerations of structure) at which the rebuilding phase will be formally considered completed and the ordinary management plan resumes ; (iii) the measures being put in place, in addition to, or replacement of, the ordinary management regime.; (iv) the trajectory expected for fishing pressure and resource parameters during the rebuilding process (i.e. the trajectory); and (v) the maximum time allowed for rebuilding (depending on the species concerned) with an acceptable level of probability. Under Target 6B, such measures should supported by legislation and regulations, and ideally become mandatory. Importantly, since 6B explicitly applies to all *species*, 6B also requires that non-target species taken as bycatch be evaluated at appropriate intervals (**see Section 5**) and, if found to be depleted relative to reference levels comparable to B_{lim} for target species, also be covered by such special regimes.

4.2 Key concepts and indicators

4.2.1 Concepts

Following the framework described in **Section 1.1.1** and **1.1.2** and in **Table 2,** we consider here that for targeted species, *depleted species* include stocks with $B < B_{lim}$, or stocks with $B/B_{MSY} < 1$ and either no provisions in a management plan for reducing F or no evidence that such a reduction is occurring), Stocks below B_{msy} require effective measures to increase biomass, either integrated in the "ordinary" management plan, or part of a special rebuilding plan and regime. Stocks with B/B_{MSY} below 0.5 (below B_{lim}) and particularly below 0.2 (collapsed) may require mandatory rebuilding plans. Collapsed stocks are not distinguished from *depleted* species in Target 6 but they may require different, and more drastic measures than less depleted species.

For non-target species, it is rare that values of B_{msy}, B_{lim}, or other fisheries reference points will have been estimated, and not even common that their status is assessed regularly. This was one of the new challenges to fisheries in Target 6: that they were directly accountable for depletion of non-target species, even though that was implicit with the provisions in the LOSC with the inclusion of "associated and dependent species", and in the adoption of the Ecosystem Approach (**Garcia et al. 2003**). Where no efforts are made to monitor and assess status of non-target species taken as bycatch, it will difficult or not possible to report positive outcomes on this aspect of Target 6.

One exception to that generalization is for some groups of megafauna with particularly vulnerable life histories, such as seabirds, marine reptiles, and elasmobranchs. For those groups FAO has led efforts to develop International and National Plans for Action (IPOA and NPOA) for the larger species groups (**FAO 2002**). Because these were developed out of concern for multiple species in those taxa that were considered threatened, the IPOA/NPOAs are dealt with in **Section 5**. However, in cases where effective IPOAs or NPOAs are in place, *depleted* non-target species in these taxa should be covered by appropriate provisions. Because the IPOA guidance is for Plans sufficient to protect and allow recovery of species that are considered *threatened* they should be sufficient for all *depleted* species to which they are applied as well (if they are designed and implemented effectively.

For other non-target species, some rough benchmarks could be of assistance. Simulations have indicated that for a wide range of life histories, reductions of a population below 30% of unexploited biomass (B_0) begin to increase the risk of impaired productivity **(Restrepo et al. 1998)**, although for particularly high productivity species (maturation by age 2, possibility to produce strong recruitments under favourable environmental conditions) this can be as low as 20%. However, this robust but general benchmark of 0.3 B_0 for a "depleted" non-target species still requires that (i) the species composition and amount of bycatch be monitored, (ii) some estimate of unexploited biomass of the species has been developed, and (iii) either bycatch limits to keep fisheries impact from reducing the population to below .3B_0 or that status of the major non-target bycatch species is assessed periodically against this benchmark. 6B also requires that recovery plans are developed and implemented for non-target species if they fall below this benchmark,

4.2.2 Indicators

The indicators could provide evidence of rebuilding efforts such as adoption of specific laws, policies, goals, plans and measures. Such efforts may not always be easily distinguished from general reforms of the fishery system. The countries in which such special efforts are made to deal explicitly with excessive depletion, requiring mandatory rebuilding plans with reinforced conservation measures, are still scarce (e.g. USA, Australia, New Zealand). In the European Union, the mandatory multi-annual plans have similar characteristics when they: (i) provide a detailed and tailor-made roadmap for achieving their objective; (ii) include fishing effort restrictions in addition to total allowable catches (TACs), and specific control rules; (iii) the target of fishing at maximum sustainable yield and a deadline for achieving this target; safeguards for remedial action and review clauses[34]. Evidence of rebuilding efforts and plans is probably less often available for non-target than target depleted species, but when available would have similar content but the form might be either separate recovery plans for the non-target species or extra provisions in the management plans of fisheries that contributed to the depletion.

Evidence of rebuilding outcomes tend to refer to trends in fishing mortality and stock biomass. Evidence of improvements in stock size, age structure, spawning biomass, spatial distribution and migration are still rarely mentioned despite their importance. Similar to the situation with evidence of rebuilding efforts, evidence of rebuilding outcomes are likely to be part of the regular stock-assessment reporting for target species, but would require a special assessment and reporting product for non-target species. Rebuilding programmes usually need a strong socio-economic component to assist communities in facing the added cost of rebuilding, but these aspects are not foreseen explicitly in Target 6, despite the fact that these are not only necessary conditions of success but also, often, explicit expected outcomes.

Global indicators for depleted target species may include:

- The number of States having adopted specific rebuilding laws, policies and plans or are in the process of doing so. This would show progress in interest and intentions;
- The number of stocks identified as currently depleted. Trends in that indicator may reflect a trend in the state of the resource complex but also a trend in the capacity of the local research to detect such stocks in that resource complex;
- The percentage of stocks identified as currently depleted that are covered by a rebuilding plan. Ideally 100% of the stocks identified as depleted should be covered by a plan, or be under pressure to develop one within some time frame (e.g. within two years of their identification as depleted); and

[34] https://ec.europa.eu/fisheries/cfp/fishing_rules/multi_annual_plans

- The number or percentage of depleted stocks that have been recovered. A high percentage may reflect good recovery or poor detection performance.

For depleted non-target species, all these global indicators would also be relevant if available but are often not going to be available. For the groups of vulnerable species covered with IPOAs and NPOA, reporting guidance is presented in 5.3.1. Otherwise, at least reporting the extent to which bycatches are being monitored with sufficient accuracy and precision to detect trends in catch of non-target species, and this information is assessed periodically against depletion benchmarks would indicate progress on this aspect of Target 6. Reporting on cases when recovery plans are developed and implemented for depleted non-target species would be particularly noteworthy when such plans exist.

4.3 Examples of outcomes on Target 6B

Some outcomes on responses to CCRFQ for 6A are also relevant here as they would help maintaining stocks in a *sustainably harvested* category but would also help recovering depleted resources. Indeed, measures to continuously tune fishing effort and removals to the state of stocks, which are central to Target 6A, are also useful in reducing the probability to have depleted or collapsed stocks. The same can be said of efforts to improve MCS systems and combat IUU-fishing **(Section 2.1)** which are relevant even if not repeated below. The fact that some stocks are depleted indicates, however, that the existing measures of the ordinary management plan are not always sufficient, and when they are not the actions required may be to (i) raise the level of control and the quality of enforcement (increasing usually the related costs) on depleted stocks; or /and (ii) introduce new measures, e.g. affecting research (e.g. introduction of Management Strategy Evaluation, MSE), management (e.g. real-time closures to protect recruitment), landings (e.g. checking the scales used to control landed weight) and trade. This is true and more often necessary for depleted non-target species as for target species, in cases when fisheries is contributing to their depletion.

4.3.1 Responses from Parties to the CCRFQ 2015 regarding target species

- Recovery plans. 87% of the respondent Parties have plans to allow depleted stocks to recover.
- Use of Target Reference Points (TRPs). 72% of the respondent Parties make use of stock-specific Target Reference Points (TRPs).
- Response to depletion: When TRPs are exceeded, 95% of the 85 respondents limit fishing effort; 95% increase research effort; 80% strengthen MCS; 68% adjust fishing capacity; and 68% close affected fisheries.

4.3.2 Responses from RFBs to the CCRFQ 2015 regarding target species

- According to the 24 respondents to the CCRFQ section concerning marine capture fisheries, most *management plans include measures… to maintain a level of fishing commensurate with the state of fisheries resources* and, *to a lesser degree … measures to allow depleted stocks to recover…*

The wording seems to indicate that specific rebuilding plans (that specify not only a rebuilding target but also a deadline for rebuilding with a given probability) are not widely used. The questionnaire results indicate that most RFBs use target and limit reference points (TRPs and LRPs) and many use Harvest Control Rules as part of their "ordinary management". Indeed, many RFMOs (e.g. some tuna RFMOs, IHPC) use Management Procedures (MPs) or Harvest Control Rules that specify limit and target reference points in the attempt to avoid overfishing or rebuild overfished stocks. Typically, these are extended, and measures made even more stringent when the targeted species reach levels considered "depleted", consistent with the intent of Target 6B. For example, CCSBT uses a management procedure that fixes a level of rebuilding and a timeframe for it (2011 Bali procedure) for the Southern Bluefin Tuna. Management aims to ensure a 70% probability of rebuilding the stock

to the interim rebuilding target reference point of 20% of the original spawning stock biomass by 2035 (https://www.ccsbt.org/en/content/management-procedure). IATTC uses HCRs the target reference point (TRP) and avoid the limit reference point (LRP) of Yellowfin, bigeye and skipjack tuna but no specific action is designed to rebuild the stock in case of depletion well below the LRP (https://www.iattc.org/ResolutionsActiveENG.htm). ICCAT has been considering adopting HCRs for its main tuna species. A 15-year recovery plan was adopted for the swordfish (*Xyphias gladius*) in the Mediterranean, for 2017-2031 with the goal of achieving B_{MSY} with at least 60% probability. For the western Bluefin tuna (*Thunnus Thynnus*) the rebuilding plan, specifies annual TACs, the MSY target, and the 20-year rebuilding period that may be on advice of the Scientific Committee (**ICCAT., 2017**). WCPFC decided in 2015 to develop or refine harvest strategies and reference points for skipjack, bigeye, yellowfin, South Pacific albacore, Pacific bluefin, including TRPs, corresponding to appropriate levels of risk, a monitoring strategy, harvest control rules, and recurrent evaluation of the strategies. Action seem to be ongoing (https://www.wcpfc.int/doc/supplcmm-2015-04/updated-workplan-harvest-strategies-2016-2019-and-record-outcomes-wcpfc13). NAFO has established recovery plans for Cod (3NO) and American Plaice (3LNO) calling for rebuilding at B_{MSY}, with interim milestones, TRPs, Limit reference points for F, rules for re-opening the direct fishery, and HCRs (NAFO. 2018). None of these RFMOs have recovery plans for any depleted non-target species, nor processes that ensure the status of non-target species are evaluated against relevant reference points, suggesting that the "species" aspect of Target 6B is treated incompletely.

When species straddle the geographical jurisdiction of different RFBs, there may be significant problems of coordination to ensure the application of the compatibility principle of the UNFSA. An example is the management of Bluefin tuna in the Pacific between IATTC and WCPFC.

4.3.3 Status, trends and outlook in overfished target stocks

Some global information was offered already in **Section 3**. **Table 5** and **Figure 8** indicate that in 2013, about 30% of world stocks were overfished including 12% of collapsed stocks, most of the latter likely to be "depleted" according to Target 6. **Figure 10** indicates that 43% of tuna stocks appeared overfished in 2018, and although the proportion of those overfished stocks that are depleted is not indicated separately, overall three-quarters of them of them are under management deemed adequate for recovery (often without defined timeframe).

In terms of outlook, the lack of globally consistent use of Limit Reference Points for stocks means that many of the information sources do not differentiate stocks that are overfished to some extent from stocks that would be considered depleted. Consequently, inferences about outlook for depleted target species must be drawn from the information on overfished stocks. **Figure 11** illustrated the growing trend in the proportion of overfished stocks status from 1974 to 2013 in FAO data (**FAO 2016e**). For all overfished stocks, this figure shows the slowing of that increase since the 1990s and the potential stabilization from 2013 to 2020 in a simple statistical extrapolation (see **Figure 13**). With depleted stocks usually already having been overfished for some years, the stabilization and possibly decrease in proportion of overfished stocks suggests the proportion of depleted stocks has also stabilised and possibly decreased even more. To the extent this is the case, the provisions in these fishery management plans must be sufficient to promote stabilization and commence recovery of the stocks, meeting the expectation of Target 6B.

More detailed projections (**Costello et al., 2016**) indicate a continuous degradation of stocks in the case of a business as usual scenario, in which misbehaving States and fleets continue to do so, or a stocks improvement if fisheries are reformed, to an extent depending on the objectives; higher if aiming at maximum economic rent, and lower if aiming at optimal production and livelihoods.

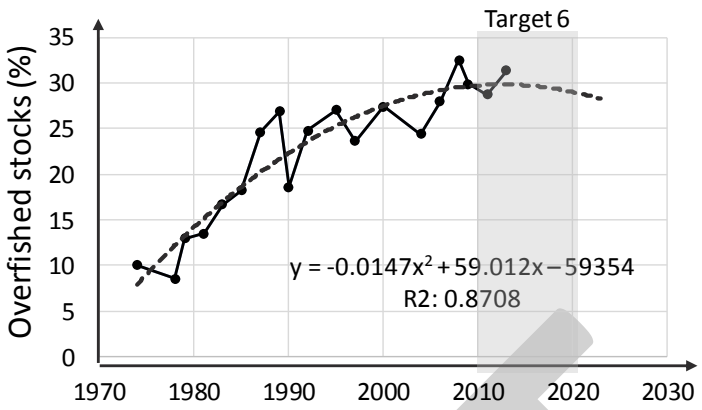

Figure 13. Trends in the proportion overfished stocks (B/B_{MSY} <0.8) from 1974 to 2013. Data from FAO (2016e) with trend extrapolated to 2020.

4.3.4 Status and trends in collapsed stocks (threatened by fishing)

Collapsed stocks are the most likely to be considered depleted stocks in the sense of Target 6B, as in fisheries they are conventionally estimated to have B/B_{MSY} ratio below 0.2 and therefore likely to be below the generic 30% B_0 benchmark for depletion. There is little information on global trends in the proportion of collapsed stocks. Collapses have been part of the natural history of ocean populations, even in the absence of fishing. Modern fisheries have suffered and certainly contributed to many collapses. The frequency of stocks collapses has been estimated at different times in different ways, varying from 9% to 36% depending on authors data, methods, and reference level used to define the category (**Garcia et al, 2018**). The highest values, obtained from catch-only assessments, have been considered overestimated when compared to values obtained for the same stocks with more comprehensive assessments (**Branch et al., 2011; Costello et al., 2012**). More comprehensive assessments combining catch and population data indicated that the proportion of collapsed stocks increased from close to zero in the 1950s (following the interruption of fishing during World War II) to about 5% in the 1960s-1980s and increased rapidly after 1990 to close to 15% in 2007 (**Worm et al., 2009; Branch et al., 2011**). Analysing catch data, **Mullon et al (2005)** describe an increase of collapses from 1950 to the mid-1990s and a decrease afterwards. A similar trend is described by **Hilborn (Forthcoming)** using stock assessment data (**Figure 7**) showing a decrease after 2000. This timing would be consistent with, but not direct evidence of, fisheries management plans adopting adequate measures for stock recovery, as expected for plans consistent with the CCRF and required under Target 6B. However, in the latter analysis, the overall proportion of collapsed stocks is very much lower than in any other analysis, at all times, and should be considered with caution. The data from well-assessed stocks contained in the RAM Legacy Stock Assessment Database (http://ramlegacy.org/) (**Figure 14**) show an increase from the 1960s to the 1990s, to over 8% and a decline after 1995, possibly reflecting the trends in management quality in advanced States and the impact of the CCRF guidance mentioned above. The abrupt and deep decline in the 2010s would indicate a positive trend at the beginning of the current decade but would need to be confirmed with a longer time series. In addition, the proportions are likely to be higher and trends less positive in regions with weaker governance and poorly assessed stocks.

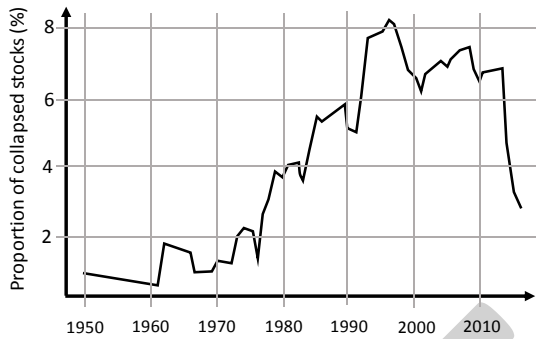

Figure 14. Global proportion of collapsed stocks in the assessed stocks of the RAM Legacy database (data courtesy of R. Hilborn). The decline in the proportion of collapsed stocks starts in the mid-1990s. The very sharp decrease in the 2010s would need to be confirmed with a longer data series.

4.3.5 Status and trends in stocks rebuilding

The proportion of overfished and depleted stocks (**Section 4.3.3**) is related to the increase of fishing pressure but also to some to the proportion of stocks that are (being) effectively rebuilt. Trends in formal rebuilding would also be a useful information in relation to Target 6, both in terms of action and outcomes. Actions are easily seen, e.g. through the existence of a formal rebuilding plan the terms of which can be evaluated. Interim outcomes such as reductions of fleet size and fishing effort are also easily quantifiable. Measuring outcomes of the action may be more problematic for various reasons.

1 Data may be missing if the fishery has been legally closed during the rebuilding process or is commercially extinct;
2 Trends in fishery-dependent abundance data (CPUEs) may be biased by changes in catchability as stocks increase;
3 Increases in biomass indices may be a poor measure of rebuilding of the stock reproduction potential as the age structure, geographical distribution, and migration processes may still be impaired, and
4 The relation between the management action and the observed stock reaction may be complex, with distortions due external drivers (e.g. climate);
5 The stocks in Quadrant II in **Figure 1C** are overfished and even if they are not under active overfishing anymore (and possibly slowly "self-rebuilding") they may not be covered by a formal recovery plan.

We have failed to identify any comprehensive global statistic on rebuilding of depleted target stocks, and only isolated cases of rebuilding for depleted non-target species other than those covered by IPOAs and NPOAs and presented in Section 5. Nonetheless, after some years of debate on whether or not depleted stocks could be rebuilt, it is now established that depleted stocks for which decisive rebuilding measures –particularly those aiming at reducing significantly fishing pressure– had been taken and effectively enforced, rebuilding occurred even though rebuilding time and rate might not have been easily predicted at the onset of the process. It is also clear that the more severe the depletion, the less predictable these two parameters (**Costello et al., 2016**; **Garcia et al., 2018**).

a) Regional assessments

At regional level, rebuilding policies are complicated by jurisdictional issues. We have touched on regional issues under **Section 4.3.2** when referring to RFBs actions and outcomes.

Improvements in European waters started becoming obvious at the beginning of the 2010s, at the beginning of the Target 6 decade following significant reductions in fishing mortality of up to 50% (**Fernandes and Cook, 2013; Cardinale, et al., 2013; Gascuel et al., 2016**). Biomass started to improve in 77% of the stocks assessed

and the majority of the stocks assessed were considered as fished sustainably (i.e. at a right level of fishing pressure even though at low level of biomass). Biomass levels remained low, in part because recruitment decreased during the period concerned for unknown reasons, and because the decrease in fishing mortality might not have been sufficient –or was still too recent– to show a clear rebuilding in terms of recruitment, species composition and trophic biodiversity (**Fernandes and Cook, 2013; Collie et al., 2013; Gascuel et al., 2016**). The recent catch-only assessments are more negative, particularly regarding the southern areas of the EU and the Mediterranean resources (**Froese et al., 2018)** but analyses of more complete informaton sources show marked improvements in the more recent years **(Hilborn; forthcoming)**.

The rebuilding programme of North-Atlantic Salmon, in NASCO is an example of rebuilding failure despite taking very stringent measures at sea and in riverine fisheries. In North America and Europe, most populations are in severe conditions in the South, declining at intermediate latitudes and stable in the North. While the problem could be attributed to the construction of dams, pollution (including acid rain), drying up of freshwater streams, along with overfishing, and recently, changing ocean conditions and intensive aquaculture many declines cannot be fully explained. (**ICES, 2014: table 10.1.8.3**).

Another high-profile example of rebuilding "failure" is that of the Southern Bluefin Tuna (SBT) in the Southern Ocean. The stock is at excessively low level and the present rebuilding strategy is tuned to a 70 percent probability of rebuilding the stock to the interim rebuilding TRP of 0.2 B_0 by 2035.

NAFO developed in 2010 a special Working Group of Fishery Managers and Scientists on Conservation Plans and Rebuilding Strategies with the view to review and update such plans and strategies and consider risk management approaches. The Southern Grand Bank cod (3NO) is still in a state of weak initial rebuilding (still under moratorium since 2014). The American Plaice (3LNO and 3M), under moratorium since 1995 but still taken as bycatch, has slightly improved in recent years. In 2016, the Grand Bank stock was recovering slowly but was still well below its precautionary reference level. The Witch flounder was recovering slowly in 2016 under reduced fishing pressure but not enough to resume direct fishing. However, the redfish stock on the northern Grand Bank (3NL) has recovered strongly from depletion and is now considered to be well above the level that can produce maximum sustainable yield.

b) National assessments

There are still very few analyses (and time series) on States-wide rebuilding efforts and their outcomes. Case studies have become available though, on single fisheries, close to 2010 (**Holland, 2010; Khwaja and Cox, 2010; OECD, 2012)** and more recently (**Garcia and Ye, 2018**) and a few States (e.g. USA[35], Australia[36]) dedicate website sections to their rebuilding efforts. However the annual publication of the state of national stocks (as for example in USA, Australia and New Zealand) is not yet common practice. Some examples follow.

In Australia, 14 out of the 20 stocks identified as overfished were still in need of recovery, and 2 had recovered. Between 2005 and 2010, the proportion of overfished stocks was reduced from 40 percent to 10 percent and the proportion of non-overfished stocks grew from 60 to 84 percent, illustrating the fact that with good management stocks can and do rebuild (**OECD, 2012; Kearney et al., 2013**).

In the USA, in 2006, the Congress passed amendments to the Magnuson-Stevens Fishery Act that required fishery managers to rebuild depleted populations of marine fish to mandatory levels. At that time, 63 stocks required rebuilding, 52 were under formal rebuilding plans and 14 had recovered since the beginning of the rebuilding programme (**Wakeford et al., 2007**). Most recent NOAA data[37] indicate that on the 474 stocks and

[35] http://www.fisheries.noaa.gov/sfa/fisheries_eco/status_of_fisheries/index.html
[36] http://www.afma.gov.au/sustainability-environment/protected-species-management-strategies/
[37] http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/archive/2017/first/q1-2017-final-rebuilt-map.png

stocks complexes monitored by the fishery authority, 91 percent are not subject to active overfishing ($F<F_{MSY}$). 42 stocks (9%) are currently under formal rebuilding plans and 41 stocks have been rebuilt since 2000)[38] (**Figure 15**).

Successful cases of active rebuilding programmes are also described in **Garcia and Ye (2018)** in the Mediterranean Bluefin tuna (**Fromentin and Rouyer, 2018**), in Norwegian herring and cod **(Gullestad et al., 2018)**, Japanese mackerel (**Makino, 2018**), West Australian snappers and scallop (**Fletcher et al., 2018**), South Africal deep-sea hake and sardine fisheries (**Augustyn et al., 2018**). The same set of analyses also illustrate the difficulties met by rebuilding programmes in: (i) complex multispecies multigear fisheries in Southeastern Australia (**Smith et al., 2018**) and Western Australia (**Fletcher et al., 2018**); in presence of strong environmental drivers of pelagic assemblages (**Makino, 2018**); under weak or corrupted systems of governance of small-scale fisheries (**Augustyn et al**. **2018**); and under a combination of overfishing and climatic pressure, high socio-economic stakes and conflicting research advice (**Rice, 2018**)

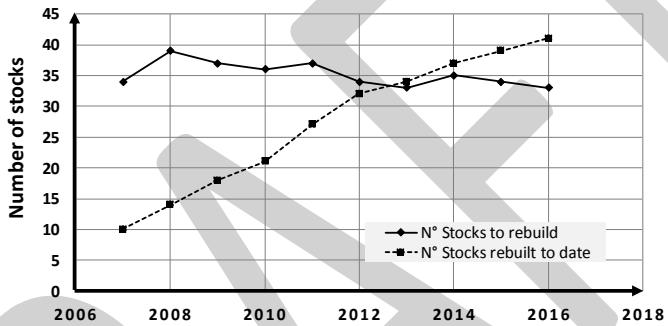

Figure 15. Numbers of stocks in need of rebuilding and total number of stocks rebuilt in the USA (2007-2016)

c) Multispecies considerations

Target 6 does not refer to multispecies fisheries challenges. It is practically impossible to fish all target species of an ecosystem at their individual MSY level, because of their numerous interactions resulting in a multispecies MSY (mMSY). Their *sustainable harvest* implies fishing some at MSY and others above or below that level and hence modification of the structure of the assemblage (in terms of relative abundances and demographic structures of its components). As long as no species were harvested to levels resulting in their biomasses falling below their respective B_{lim} values, such multispecies harvest strategies would be consistent with Target 6, although not necessarily with a narrow interpretation of the LOSC standard to maintain all stocks about their individual B_{msy} levels. Harvesting a species assemblage while maintaining a structure (species composition and relative abundances) and system productivity close to the unexploited state is theoretically possible through Balanced Harvest, distributing fishing pressure across species and sizes proportionally to their production rate. However, the concept is still being discussed and has not been applied formally (**Garcia et al., 2010, 2012; Kolding et al., 2016**).

Rebuilding species assemblages that have been significantly disturbed by fishing is a complex endeavour on which there is still very limited information. The example below (**Figure 16)** from **Pedersen et al. (2017)** illustrates the decline and rebuilding of a species community in the overfished Atlantic Canadian shelf.

[38] http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/trends_analysis.html).

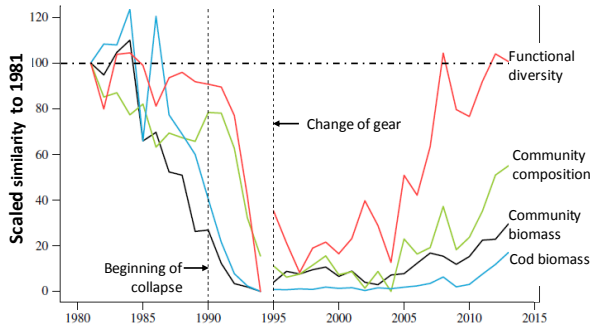

Figure 16: Relative change of different community metrics over time scaled between 0 and 100, the reference value in 1981. 1990 is considered the start of the cod collapse, and an important change of gear occurred in 1995. Redrawn from Pedersen et al., 2017. © Creative Commons

It illustrates the fact that rebuilding is possible as well as the hysteresis and delays than can be expected in rebuilding complex species assemblages and the uncertainties about re-establishing biomass and species dominance patterns.

d) *Depleted non-target species*

Our review found all well documented cases of efforts to rebuild depleted non-target species focused on species considered threatened or near-threatened by the competent authority. These will be presented in section 5.4.2. Examples of at least partial and on-going recovery of threatened species suggests that it should be feasible to recover non-target species that are depleted but not yet threatened. However, the general lack of attention this review has found to monitoring non-target bycatches and periodically checking the status of non-target species that experience substantial bycatches (relative to their productivities) against biologically-based reference points underscores that this aspect of Target 6B still receives little attention in fisheries. Addressing the issue would demand a substantial increase in resources for bycatch quantification and assessment of status of non-target species in exploited ecosystems, and it can be argued that these may not be the most effective uses of additional resources for fisheries management. On the other hand, paying little attention to non-target species exposed to relatively high bycatch rates until some of these species are assessed as threatened, and then bear the burden of draconian management measures usually necessary to protect and recover threatened species can be a costly alternative. Initiatives like the Plans of Action (**Section 5.3.2.i)** for groups of species vulnerable to bycatch mortality may be a practical compromise.

5. Target 6C - Threatened species and vulnerable ecosystems

5.1 Rationale

In Element 6C, threatened species and vulnerable ecosystems have been combined in a requirement that sustainable … *fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems.*

This element can be associated with the LOSC provision that, in taking conservation and management measures, States should *take into consideration the effect on species associated with or dependent upon harvested species [i.e. target species] with the view to maintaining or restoring populations of such species* <u>*above the level at which their reproduction may become seriously threatened*</u> *(§ 62.4).* The association gives a clue for the concept of *significant adverse impact* which, in the case of populations, is the impact that seriously threatens their reproduction. This level is similar to the levels used in fishery management as reference values for minimum or

safe biological levels (B_{lim}, B_{pa})[39] in Harvest Control Rules (HCRs) and for rebuilding strategies. In the general case, this standard is fully covered by **Sections 3** and **4** of this report, in that target species and bycatches are to be kept at levels where population productivity is not impaired.

However, Element 6C adds two additional aspects to Target 6: (i) a standard for impacts on habitats that may be especially vulnerable to the impacts of fishing (*vulnerable ecosystems*). and (ii) a separate and very stringent standard for the impact of fisheries on stocks and species that for any reason have already been reduced to a level where their productivity may already be impaired (*threatened species*). More specifically:

- Vulnerable ecosystems are ecosystems in which some fishing types or intensity may cause particularly large or otherwise disruptive alterations that may have widespread ecological consequences and/or from which recovery may be particularly difficult. The use of the expression *vulnerable ecosystems* intentionally uses the concept of *vulnerable marine ecosystems* (VMEs) earlier used in the 2007 UNGA Resolution 61/105 and the International Guidelines for the Management of Deep-sea Fisheries in the High Seas (**FAO, 2008a**). In the UNGA resolution, the scope of VMEs was limited to High Sea deep-sea fisheries using gear in contact with the bottom. Element 6C does not carry those explicit restrictions and, as part of an Aichi Biodiversity Target, it covers the full range of marine ecosystems considered as *vulnerable* at other depths, under other jurisdictions, and possibly vulnerable to other pressures than just bottom-contacting fishing gears, consistent with **FAO et al. (2016)**.
- Threatened species are species threatened with a risk of extinction for any reason. The drivers of the poor status may be fishing, through excessive targeted depletion, possibly augmented by international trade demands[40] (**McClenachan et al., 2012; Davies and Baum, 2012; Purcell et al., 2014**) or possibly through other natural or human-induced factors, but depleted to a level where any pressure, including fishing as target or bycatch, may further jeopardize survival or recovery of the species. The use of the term *threatened* was intentional, to link this element to processes that assess the state of species against risk of extinction, either from intrinsic biological vulnerability (e.g. in the IUCN Red List; **IUCN, 2016**) or from international trade (CITES Appendices). At the level of State's jurisdictions, many countries have legislation or other binding legal arrangements to identify species at a relatively high risk of extinction and usually also to offer them a higher level of protection than the norm for biodiversity not designated as *threatened* (e.g. the EU Species and Habitats Directive[41] ; the US Endangered Species Act[42], the Canadian Species at Risk Act [43] and the Australian Endangered Populations and Biodiversity Act[44] .

For *threatened species* and *vulnerable ecosystems*, the standard to be met is *no significant adverse impacts (SAIs)*, which was chosen to closely align Target 6C with the guidance in UNGA Resolution 61/105 and the International Guidelines for the Management of Deep-sea Fisheries in the High Seas (**FAO, 2008a**).

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[39] B_{pa} is used here to refer to any of the triggers in harvest control rules that manage the risk of biomass falling below a biologically defined limit reference Point (B_{lim}). The exact name given to such Reference Points differ among jurisdictions, and for this report, the interpretation in **ICES (2002, 2003)** is used for such reference points.

[40] Eventually calling for an intervention of CITES

[41] http://ec.europa.eu/environment/nature/info/pubs/docs/brochures/nat2000/en.pdf

[42] https://www.fws.gov/endangered/laws-policies/

[43] http://laws-lois.justice.gc.ca/eng/acts/s-15.3/

[44] http://www.environment.gov.au/biodiversity/threatened/species

5.2 Key concepts

5.2.1 Vulnerable ecosystems

The term *vulnerable (marine) ecosystems* was not established in CBD language. However, it had recently gained prominence in fisheries management though its use in paragraphs 80-87 of UNGA Resolution 61/105 in 2007, although it had appeared much earlier in UNGA Resolution 53/240, which "*Reaffirms the efforts of States to develop and facilitate the use of diverse approaches and tools for conserving and managing vulnerable marine ecosystems*" (§ 54). These paragraphs do not have a definition or criteria for what types of marine ecosystems were "vulnerable", but the language of the resolution 61/105 clearly focused on vulnerability specifically to impacts from mobile, bottom-contacting fishing gears. The need for a definition and criteria was quickly filled by the FAO International Guidelines for the Management of Deep-Sea Fisheries In the High Seas (**FAO, 2008a**), based on a set of Expert Consultations (**FAO 2006; 2008b, c**).

The FAO Guidelines do not contain a definition of *vulnerable marine ecosystems* (VMEs) but notes (§ 42) that a marine ecosystem should be classified as "vulnerable" based on the following characteristics/criteria:

i. Uniqueness or rarity of species and habitats;
ii. Functional significance of the habitat for the survival, productivity and reproduction of stocks;
iii. Fragility and susceptibility to anthropogenic degradation;
iv. Life-history traits of component species that make recovery difficult; and
v. Structural complexity e.g. in biogenic structures supporting essential ecosystem processes.

The Guidelines and criteria they included were available at the time the Targets were being negotiated, although the CBD was focused on Ecologically and Biologically Significant Areas (EBSAs) as their preferred phrase for habitats in need of more risk-averse management (Cop Decision IX/20). However, the CBD EBSA language was intentionally not used for a target on fisheries, because COP Decision IX/20 explicitly stressed that there should be no direct link between identifying as area as meeting EBSA criteria and any specific management actions to provide the desired risk averse protection. In the same COP where the Aichi Targets were adopted, Decision X/29 reaffirmed the need to avoid linking EBSAs to specific management actions but also explicitly acknowledged the FAO VME criteria as "*relevant compatible and complementary nationally and inter-governmentally agreed scientific criteria*" to the EBSA criteria in Decision IX/20. The Decision calls for States and IGOs working on EBSAs to "*share[s] information and harmonize[s] with similar initiatives, … such as FAO's work on vulnerable marine ecosystems (VMEs) (§ 39)* and specifically "*Encourages Parties and other Governments to fully and effectively implement paragraphs 113 through 130 of the UNGA resolution 64/72 on responsible fisheries in the marine ecosystem, … calling on States and/or regional fisheries management organizations (RFMOs), consistent with the Food and Agriculture Organization of the United Nations International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (§ 54*).

Although VMEs and EBSAs are different instruments developed for different purposes and geographical and ecological scopes, the similarity of their identification criteria and of their long-term goal (to maintain essential ecosystems) suggest that both could be reported by States as a contribution to implementation of the *vulnerable ecosystems* aspects on Target 6C. The intent of the CBD Decisions would be maintained, because Target 6 highlights only the desired *outcome* – no significant adverse impacts on these areas – and not the measures that should deliver it. However, the language makes clear the outcome desired from all fisheries is similar to the outcome already agreed to by the UNGA as *necessary* for high seas fisheries, but unlike UNGA 61/105, without specifying any specific fisheries, gears, or specific management measures.

5.2.2 Threatened Species

The term *Threatened species* was the aspect of Element 6C best-established in the CBD discussions at the time the Target was negotiated but has not proven simple to implement in fisheries. Within the CBD operations there has been widespread acceptance of the IUCN Criteria for "red-listing" species (**IUCN, 2016**). Element 4 of Target 6 was intended to deal in general with non-target species on which fisheries have a collateral impact and to set for them a general standard of impact comparable to that set for target species (i.e. a standard comparable to B_{lim}; see **Section 4**). The biomass of species or populations designated as *threatened* ought to be well below any biologically-based Limit Reference Point (B_{lim}) used in fisheries, because such fisheries limits are supposed to be set at levels of biomass below which productivity may be impaired but well above the level below which the risk of extinction is unacceptable (**Powles et al., 2000**). How far below a fisheries Limit Reference Point is appropriate for considering a population as "threatened" has been debated for some decades (Mace et al. 2014).

For several reasons this logical relationship between healthy marine stocks and species, depleted marine stocks and species in need of rebuilding, and marine species threatened with extinction has proven challenging to delineate, particularly when fishing has either played a role in the population decline or when catch (intended or not) is deterring population increase. Some of the challenge arises from the multiple criteria recommended by the IUCN for assessing risk of extinction, where the robustness of the decline criterion used to assess extinction risk in general has been questioned when applied to fished marine fish populations (**Mahon et al., 2000, Mace et al., 2014**). Although this debate has been resolved operationally with a formal agreement between FAO and CITES for how marine fish are assessed and listed in CITES Annexes[45] (**Friedman et al., 2018a**), the substantive differences of view have not been fully resolved, and CITIES is still expected to place an activist role on protection of threatened species from fishing impacts (**Vincent et al., 2014**).

Notwithstanding any differences in points of view regarding application of the *threatened species* criteria, fisheries can take bycatches of species with highly vulnerable life histories or that are severely depleted, such that levels of mortality from a given amount of fishing effort that are sustainable for healthy target species may be excessive for these other species. These concerns may apply widely but have centred on groups of species that are intrinsically particularly vulnerable (**Musick 1999**) such as sharks and other elasmobranchs (**Worm et al., 2013; Croll et al., 2016; Dulvy et al., 2017, Stein et al., 2018**), seabirds (**Anderson et al., 2011; Zydelis et al., 2013; Gilman et al., 2016**) and sea turtles (**Lewison and Crowder, 2007; Wallace et al., 2013**). Efforts at simply applying a higher degree of risk aversion (greater precaution) in managing bycatch of such vulnerable species encounters increased difficulties from the asymmetric consequences of the necessary actions. The more stringent control rules applied to fisheries on healthy species, such as greatly reducing fishing opportunities or enforcing very restrictive bycatch quotas to decrease the likelihood of a bycatch event that may already have a low probability of occurrence but a nonetheless very serious impact on the threatened species if it occurs, may have severe economic consequences for the fishery (of the "choke species" issue)[46] (**Rice and Legacè, 2007; Auge et al., 2012**).

For Target 6 reporting on *threatened species*, no specific source of listings was specified. Since reporting is done at the national level, it is expected that each State will use whatever standards are applied at the national level for listing threatened species, consistent with national legislation of designating species at risk (**DeMaster et al., 2004**; **Dorey and Walker, 2018)**. Such choices may be contested inside and outside the State in question by interest groups who consider such listing criteria as too permissive or too constraining, and the listing and revision processes as too slow or strongly influenced by special interests (**Mooers et al., 2007; Mace et al.,**

[45] https://www.cites.org/sites/default/files/eng/disc/sec/FAO-CITES-e.pdf

[46] "Choke species" is a term used in mixed fisheries, when one species (typically with a lower quota or higher market value than other species in the mixed catches) has its quota fully taken, and the fishery much close even though substantial quota is left from other species in the mix.

2014). However, all CBD Marine and Coastal Decisions fully acknowledge national sovereignty over their jurisdictional waters, so it is most consistent with CBD process to us whatever official processes States have for designation species as "threatened" in Target 6 reporting.

Applying internationally agreed criteria may help if this Target is applied in areas beyond national jurisdiction, for example the FAO-CITES MOU; **Friedman, 2018a**). For RFMOs and high seas fisheries that might be reviewed or report during the evaluation of the Aichi targets, the listings of marine species in CITES Appendices might be an appropriate starting place for evaluations.

5.2.3 Significant adverse impacts (SAIs)

The standard of *no significant adverse impacts (SAIs)* also was taken directly from UNGA 61/105 and, in Target 6C, is applied both to *vulnerable ecosystems and* to *threatened species* with implications looked at below.

a) SAIs on vulnerable ecosystems

Referring to vulnerable ecosystems, the UNGA Resolution, again, did not contain a definition or standards for what adverse impacts were "significant", nor even technically for which impacts of fishing gears would be "adverse". This void, too was filled by the FAO Guidelines for the Management of Deep-sea Fisheries in the High Seas, which states "*Significant Adverse Impacts (SAIs) are those that compromise ecosystem integrity (i.e. ecosystem structure or function) in a manner that: (i) impairs the ability of affected populations to replace themselves; (ii) degrades the long-term natural productivity of habitats; or (iii) causes, on more than a temporary basis, significant loss of species richness, habitat or community types. Impacts should be evaluated individually, in combination and cumulatively (§ 17)*". Points (i) and (iii) of this understanding suggest a connection between SAIs and threatened species (see next section).

These Guidelines also indicate that –when determining the scale and significance of an impact– the following factors should be considered: *(i) the intensity or severity of the impact at the specific site being affected; (ii) the spatial extent of the impact relative to the availability of the type of habitat being affected; (iii) the sensitivity/vulnerability of the ecosystem to the impact; (iv) the ability of an ecosystem to recover from harm, and the rate of such recovery; (v) the extent to which ecosystem functions may be altered by the impact; and (vi) the timing and duration of the impact relative to the period in which a species needs the habitat during one or more life-history stages "(§ 18).*

The acknowledgement and general endorsement of the FAO Guidelines in CBD Decision X/29 applied to these standards for what constitutes *significant adverse impacts*. Although the CBD has not tested the robustness of these standards for delivering the intended outcomes of Target 6 for threatened species and vulnerable marine ecosystems, it has neither proposed any alternative standards nor explicitly questioned their appropriateness. Moreover, there have been two UNGA reviews of progress on their effectiveness for protecting vulnerable marine ecosystems (findings summarized below), illustrating a level of rigour in evaluating the effectiveness of the interpretation of the standard that exceeds the rigour of testing many of the reporting standards for Aichi Targets, at least when applied to vulnerable marine ecosystems.

b) SAIs on threatened species

The application of *significant* adverse impact as a standard for *threatened species* would allow some *not significantly* adverse impact from fisheries on such species, so the Target does not offer *full* protection. However, it is possible to transpose directly to threat*ened species* the understanding about SAIs and vulnerable ecosystems contained in the FAO Guidelines that the CBD has explicitly recognized. Is direct application of consistent standards for impacts that would mean "significant adverse impacts" on threatened population would impacts that (i) impair the ability of affected populations to replace themselves; (ii) degrades their long-term natural productivity; or (iii) causes, on more than a temporary basis, significant loss of intra-specific

diversity. Impacts should be evaluated at both species and multispecies levels, accounting for interactions and cumulative effects. When determining the scale and significance of an impact, the following factors should be considered: (i) the intensity or severity of the impact on the threatened species; (ii) the relative extent of the fishing impact (on the population age and genetic structures); (iii) the intrinsic sensitivity/vulnerability of the population to the impact; (iv) the ability of the population to recover from harm, and the potential rate of such recovery; and (v) the extent to which populations functions (productivity and reproduction) may be altered by the impact.

When dealing with target species, these criteria have some similarities to those used in stock assessment to define situations of overfishing, depletion and collapse. However, precautionary reference points are used in Harvest Control Rules and Management Strategy Evaluation (MSE) to define upper boundaries on such stock conditions (overfished, depleted collapsed), and to calibrate rebuilding strategies.

Because *threatened species* are, by definition, in much poorer status than most species in an ecosystem and have already been identified as in need of rapid and secure rebuilding to a status where the threat of extinction is no longer imminent or likely (i.e. to an status considered consistent with IUCN Category of "Special Concern" or higher) the appropriate benchmark for a *significant adverse impact* must allow even less impact than the Limit Reference Points (e.g. F_{lim} or B_{lim}) used in fisheries harvest control rules for rebuilding (see **Sections 3** and **4**). Even in fisheries rebuilding plans, a clear distinction in the urgency and the level of action to be taken is made between "overfished" or "depleted" stocks ($B_{MSY}>B>0.5B_{MSY}$) and "collapsed stocks ($B<0.2B_{MSY}$). For a population that is considered *threatened* the adverse impact of fishing that is not "significant" must therefore be lower than the impact allowed for a collapsed stock.

At the extreme, setting F=0 as the tolerance for fishing mortality on threatened species would consist of instating a moratorium for target species and a zero bycatch for non-target species. Such measures would certainly meet the intent of 6C and have been shown to be effective but expensive means to rebuild collapsed resource but could exceed the agreed conceptual standard. Target 6 does not require "no impact on threatened species" but rather no <u>significant adverse</u> impact, strongly suggesting that adverse impacts could be accepted as long as they were not "significant". Judging what non-zero level of fishing impact is consistent with 6C requires information about the particular species and fishery. For some highly endangered species, a standard of zero impact (moratorium or zero bycatch) may actually be necessary for species survival (e.g. **Phillips et al., 2016; Thiebot et al., 2016**). For other species, however, appropriate science-based standards are still debated (**Dulvy et al., 2008; Phillips et al., 2015; Cooke et al., 2016; Williams et al., 2016; Garcia et al., 2018**).

A possible option for guiding the determination of a species/fishery specific level of impact as the standard for "significant" is to focus on the recovery plans and/or measures adopted by States or RFMOs for *threatened target species* within their jurisdictions (**Taylor et al., 1993; NMFS, 2010**). Typically, fisheries recovery plans specify explicit targets for recovery of population numbers (or appropriate surrogate) and timetables for the achievement (**Foin et al., 1998; Clark et al., 2002**) based on comprehensive science input and consultation (**Clark et al., 2002; Lundquist, 2002**). Impacts of fisheries large enough to reduce the planned likelihood of achieving these targets of stock status and time to recovery (assuming all other components of the recovery plan were operating within their respective parameters), would be *de facto* impeding recovery of the *threatened species*, an hence considered *significant* and *adverse*. Such an approach would be consistent with that taken by a number of jurisdictions that require assessments of "allowable harm" as part of developing recovery plans[47]. Such an approach would allow *significant adverse impacts* to have a consistent interpretation across all threatened species in a jurisdiction, taking into account both existing science knowledge and public consultation processes,

[47] http://www.gazette.gc.ca/rp-pr/p2/2013/2013-03-27/html/sor-dors34-eng.html

and linking the standard directly to the *recovery* of the threatened species, rather than to a status quo that would maintain it in a threatened state.

5.3 Indicators and alternative reporting approaches

5.3.1 Vulnerable ecosystems

Given the definition of *significant adverse impact*, and particularly the set of considerations necessary in its evaluation, simple numerical indicators based on widely available data sets are both impractical and inappropriate. However, alternatives (such as narratives and more integrated assessments) are both feasible and informative, even for data-moderate cases. In relation to *vulnerable ecosystems,* such progress reporting could be: (i) the steps taken for their formal identification; and (ii) the measures taken for their conservation.

a) *Identification of potential fishery impacts on vulnerable ecosystems*

For the VME aspects of Element 6C, the FAO criteria for identifying areas that are *vulnerable marine ecosystems* were developed only for deep sea areas beyond national jurisdiction (even though nothing impedes sovereign States to identify VMEs in their EEZ) and only relative to mobile, bottom-contacting gears. This is a serious limitation on their generality. However, synchronous with the development of VME criteria and implementation processes in RFMOS, the CBD and other conservation biology interests were developing criteria for describing Ecologically and Biologically Significant Areas (EBSAs) and processes for their implementation. EBSA criteria were intended to be globally applicable in areas within and beyond national jurisdiction, possibly under different jurisdictional authorities, and from the surface to the bottom of the oceans. In addition, from the outset, the CBD took care not to link the EBSA description process to any specific pressure (natural or anthropogenic) on biodiversity or to any specific regulatory action. The intent was to identify areas where management should be more risk-averse than in the adjacent "background" areas (COP decision X/29), but the actions by which the greater risk aversion would be achieved was left at the discretion of the management authority. This gave EBSA criteria the global applicability that VME descriptions lack.

There have been several comparisons of the VME criteria of FAO and the EBSA criteria from the CBD, including both by the FAO (**FAO, 2010**) and the CBD (**CBD, 2009**) and research reports (**Ardron et al., 2014; Rice et al., 2014**). These authors conclude that the two sets of criteria –which are very similar– would be expected to perform very similarly with the same information and identify the same areas as in need of more risk-averse management, although **Rice et al. (2014)** note that no formal test of similarity of their outcomes in terms of identification of bottom vulnerable ecosystems has been performed.

The existing criteria for identifying EBSAs or VMEs give States the criteria and guidance for identifying areas that are *vulnerable ecosystems*. This identification of relevant areas, applying the VME, EBSA or comparable national criteria (e.g. **DFO, 2006**) is the first element of reporting on implementation of the *vulnerable ecosystem* part of Target 6. Both the FAO Guidelines and CBD Decisions then highlight that a risk assessment of some sort should be done[48], to evaluate the fishing activities, if any, that could cause *significant adverse impacts* to the areas unless those fishing activities are appropriately managed or excluded from the area of the VME or the EBSA.

b) *Measures taken*

The next step is in evaluating the degree to which the appropriate fishery measures are being taken, including closures in areas where gear impacts cannot possibly be managed (FAO, 2008a). As a consequence, this aspect of Target 6 could be considered fully achieved if: (i) all the waters under a given jurisdiction have been assessed

[48] for EBSAs, ideally as part of the EBSA description process (CBD Decision X/29), and for VMES, as part of the RFMO fishery scientific committee actions (FAO Guidelines)

in terms of significance and vulnerability, using EBSA, VME or comparable criterion-based evaluations; (ii) at least qualitative risk assessments have been conducted; and (iii) appropriate fisheries management measures have been implemented. If this agenda is only partially implemented, achievements will be proportionally less but States may report on transitional or interim results and possibly specify the intended scope and calendar and outcomes of their further implementation.

5.3.2 Threatened Species

a) Identification of Impacts on Threatened Species

Reporting on the direct impact of fisheries on *Threatened Species* requires obtaining reliable information of the amount of mortality imposed on such species and evaluating that information relative to the level of mortality consistent with its survival and recovery. There are also indirect ways that fisheries can impact threatened species, primarily through depleting essential prey. Measuring and reporting on these indirect effects requires looking at fisheries within an ecosystem-based framework, with reliable ecosystem models (**Section 2.2**).

The direct effects themselves pose many challenges for assessing and reporting. Clear guidance in both measuring and reducing bycatches in fisheries have been available since Target 6 was adopted (**FAO, 2011**), and many papers have reviewed the effectiveness of bycatch monitoring for quantifying take or harm to rare species (see **Section 5.4.2**). Some of these challenges are present in all efforts to quantify bycatch amount and species composition as described in **Section 4**, but special attention must be devoted to threatened species. Guidance on assessing impacts from fishing on potentially threatened species has been developed most thoroughly for species that have particularly vulnerable life histories or are rare. Across sharks, seabirds, other fish and marine mammals, the messages are generally the same. Indirect methods of quantifying the take of rare species are likely to be inaccurate and often biased low (**Brothers et al., 2010; Phillips et al., 2015**). Direct methods are often expensive to implement, hence are usually preferred and sometimes the only feasible option (**Gilman et al., 2017; Pilcher et al., 2017**). Technologies are in development to improve monitoring but are not yet well tested and widely available (**Bartholomew et al., 2018**). Fairly accurate direct estimates of magnitude of take may be made if there is adequate investment in monitoring; otherwise much more uncertain estimates can be obtained indirectly, with a greater risk of underestimating than over-estimating bycatch rates for rare species.

This element of Target 6C also requires that estimates of bycatch levels for threatened species must be compared to benchmark levels to assess the significance of impact on the species. Again, there has been substantial research on estimates of appropriate reference points for very uncommon or threatened species (**Forrest and Walthers, 2009; Clarke and Hoyle, 2014; Courtney et al., 2016; Jaiteh et al., 2017**). In addition, many of the methods developed for estimating reference points for data-poor fisheries can be explored for threatened species, since many of the features of the data needed in both cases are similar (**Carruthers et al., 2014; Newman et al., 2015**) although the uncertainties in the bycatch information can have substantial impacts on these estimates (**Tsai et al., 2011; Wetzel & Punt., 2011; Moore et al., 2013; Wiedenmann et al., 2013**). Again, reference points are obtainable for many kinds of threatened species, and they can be developed with little more than general life history information. However, the weaker the species-specific information available to identify the level at which the impact becomes significant and adverse, the more uncertain and therefore the more restrictive the reference points are likely to be (assuming the application of precaution in setting the benchmarks).

b) Measures taken

With the many challenges in obtaining the necessary information to directly assess if impacts of a fishery on threatened species are sustainable, there has been substantial interest in at least measuring the effectiveness of measures to avoid or mitigate bycatches. Spatial closures are a potential tool for protecting threatened species from fisheries. The topic has been explored in depth in the February 2018 CBD Workshop on Target 11

reporting[49] and not revisited here. However, for mobile protected species, that workshop report noted the residual risk to the species from fisheries outside the closed area. This risk is sometimes multiplied by the relocation of fishing effort from the closed area to areas remaining open where the threatened species also occurs (**Rice et al. 2018**). Many non-spatial tools have also been developed to mitigate or avoid bycatch mortality, with a particular focus on threatened or vulnerable species. Many of these methods for gear modification can be highly effective or ineffective, depending on details of how they are deployed and how the fishing gear is retrieved (**Rice et al., 2012**). The use of financial instruments as incentives is also being intensively studied and tested (**Squires and Garcia, 2016; Squires et al., 2018; Milner-Gulland et al., 2018**), and their presence can also be included in reporting on this aspect of Element T6

These issues are primarily considered relative to Element 6B of Target 6 (**Section 3**), but there are particularly detailed studies of their effectiveness for sharks (**Favaro and Côté, 2013; Gilman et al., 2016**), seabirds (**NMFS, 2005; Gilman et al., 2005, 2014; Yokota et al., 2011; Clarke et al., 2014, Melvin et al. 2014**) and turtles (**Luchetti et al., 2016; Gilman & Huang 2017**). Multiple performance reviews of these mitigation measures highlight the variable effectiveness of all bycatch mitigation measures for reducing fishery impacts on threatened species depending on the particular circumstances of the fishery, the degree of involvement of the fishers in measure design, and the ability to evaluate the actual implementation of the measures. As a generalization with many exceptions, gear modifications that can be implemented for full fisheries are more effective than spatial measures or temporary or set-by-set gear modifications (**Wakefield et al., 2017; Senko et al. 2014**). In well managed industrial fisheries, economic incentives result in much more effective economic efficiency in protecting megafauna (**Squires et al., 2018**).

The diversity of measures available for mitigating the impacts of fisheries on threatened species represent opportunities as well as challenges. There are many opportunities to use combinations of gear modifications, spatial and temporal measures, economic incentives, and even multispecies measures to manage these impacts. The potential of these opportunities and the need to act on them was recognized early in the adoption of the Ecosystem Approach to Fisheries (**Section 2.2**). Of particular relevance to minimizing the impact of fisheries on threatened species have been efforts in FAO to develop International Plans of Action (IPOAs) for both sharks[50] and seabirds[51]. The generic frameworks for the IPOAs lay out the principles and general approach for each particularly vulnerable species group, with Guidance on how the general framework can be adapted to individual fisheries at national (NPOAs) or regional (RPOAs) levels.

5.4 Examples of outcomes on Target 6C

5.4.1 Examples of outcomes on vulnerable ecosystems

Information on implementation of the proposed approaches is not speculative. Rather, because of the importance of its resolution 61/105, the UNGA has requested regular reviews of progress and effectiveness of efforts to achieve the commitments it contains. An expert workshop held in 2011, at the beginning of the decade of Target 6, concluded that there were substantial differences among RFMOs with regard to progress made on implementing the provisions of the resolution. CCAMLR appeared as making the most progress but most of the RFMOs in the Atlantic were taking partial actions with more in-planning stages. However, few RFMOs were collecting all the types of environmental data needed for full implementation of the FAO Guidelines and corresponding intent of Resolutions 61/105 and the similar following 64/72. Likewise, where VME

[49] https://www.cbd.int/doc/c/36f1/d6e8/90a68e516b0c5e8aa3f5a0eb/sbstta-22-06-en.pdf
[50] The FAO International Plan of Action for the Conservation and Management of Sharks and includes all species of sharks, skates, rays, and chimaeras (Class Chondrichthyes). http://www.fao.org/ipoa-sharks/background/about-ipoa-sharks/en/
[51] http://www.fao.org/fishery/ipoa-seabirds/about/en

identification was incomplete, management measures to protect VMES either were not in place, or only move-on rules of questionable effectiveness were being used (**Weaver, 2011**). These general findings were in accord with the UNGA conclusions. However, it was noteworthy that where VMES were identified and measures implemented, no shortcomings with the outcomes were identified, although weak data for their evaluation was a concern.

A second UNGA review just five years later found the situation substantially improved. The letter about the review sent by the workshop moderator to the UNGA President[52] indicated that: (i) the application of the VME framework has been acknowledged as also covering the long-term sustainability of deep-sea fish stocks, and important aspect of 6C from a biodiversity conservation perspective; (ii) "*considerable progress … had been made at the global, regional and national levels since the adoption of resolution 61/105. However, it was noted that implementation remained uneven and that further efforts to strengthen it were needed*" (§ 5); and (iii) although there are "*still gaps in the coverage of regional fisheries management organizations and arrangements for bottom fisheries, bottom fishing was not taking place in most areas lacking those organizations and arrangements competent to regulate such activities* (§ 11)); (iv) the shortcomings are in the information available to support implementation of the Resolutions and Guidelines, and the UNGA review "*noted that a comprehensive evaluation of the scale of impacts on benthic ecosystems was not feasible owing to the relative lack of data" (§ 8*) , that "*more needed to be known about the status and characteristics of many deep-sea fish stock* (§ 9), and with "*regard to the assessments of cumulative impacts, seabed mapping, threshold-level determination, encounter protocols, footprint determination and an understanding of the nature of vulnerable marine ecosystems*" (§ 10).

Importantly, at the national level, the review found clear evidence of progress in implementing many types of measures to deliver the objectives of the UNGA resolutions – and correspondingly of Element 6C, including "… *the imposition of gear restrictions, the establishment of protected areas and ecologically and biologically significant areas, capacity-control measures, data-collection measures, the management of shark fisheries, awareness-raising programmes, the application of the precautionary and ecosystem approaches and monitoring, control and surveillance mechanisms, including logbook reporting*" (§ 25). Similar measures were being expanded at the regional level (§ 29). Despite the incomplete implementation of all the provisions in the resolutions and guidelines, whether due to limitations in data or in capacity, all workshop participants "*commended the good progress made in implementing the relevant General Assembly resolutions at the regional and national levels*" (§ 35) and many participants "*expressed the view that the full implementation of the resolutions would be sufficient to protect vulnerable marine ecosystems and the long-term sustainability of fisheries resources*" (§ 37).

The conclusions of these reviews are both encouraging in terms of the progress made to date in describing VMES in areas beyond national jurisdiction and closing them to bottom trawling, and informative about the areas where more work is needed for identification of VMES and expanding the protection measures to apply additional tools for reducing risk and broadening the range of fishing gears considered. The greater consideration of EBSAs in fishing plans at national and subnational scales that is also occurring in some jurisdictions (**Kenchington et al. 2014; Dunston et al. 2016**) also offers scope for greater progress on the vulnerable ecosystems aspects of Target 6.

More recent information on actions taken has been obtained in the responses obtained from RFMOs/AS to the CCRFQ 2015 (**FAO, 2016**):

[52] Letter dated 9 September 2016 from the moderator of the workshop to discuss the implementation of paragraphs 113, 117 and 119 to 124 of resolution 64/72 and paragraphs 121, 126, 129, 130 and 132 to 134 of resolution 66/68 on sustainable fisheries, addressing the impacts of bottom fishing on vulnerable marine ecosystems and the long-term sustainability of deep-sea fish stocks addressed to the President of the General Assembly

- All RFMOs/As appear to have taken actions to assess the presence of VMEs and protect them from SAIs.
- Almost all the efforts of RFMOs/As have focused on identifying areas with "significant concentrations" of corals and sponges, and in a few cases seamounts. Very little work has been done with other VME criteria.
- In almost all cases RFMOs/As have noted that the absence of clear standards for how to interpret "significant concentrations" has impeded progress on identification of VMEs based on presence of corals and sponges.
- Incomplete information on distribution, abundance and species composition of corals and sponges specifically, but more generally of all the ecosystem features that may meet the VME criteria, also impedes progress of RFMOs/As to implement the FAO Guidelines. However, in all cases the RFMOs/As have been able to assemble enough information to make at least partial progress on identification of areas where corals and sponges are present.
- Management measures used to protect VMEs have been almost exclusively closures of areas considered to have significant concentrations of corals and sponges (and in a few cases, seamounts). There is some exploratory work with other mitigation measures, but such work is in early stages.
- There are numerous gaps remaining in the implementation of the International Guidelines, many arising from either the focus on corals and sponges at the expense of attention to other VME criteria and from the lack of operational guidance on how to interpret "significant concentrations".
- There are also numerous opportunities for activities to increase progress. Most of these involve collaborative efforts among RFMOs/As, and usually with FAO playing a major role in facilitating the collaborations. Development of a global database on known VMEs (and the criteria they meet), and sponsoring Expert meetings for provision of "best practice" guidance would be roles that should return particularly high benefits.

The examples of outcomes reflect strong support for the adequacy of this general framework for delivering the vulnerable ecosystem aspects of Element 6C, and evidence that substantial progress can be made even with very incomplete information on marine ecosystems. Although the conclusions presented here are from discussions among science and policy experts at the UNGA workshop, substantial evidence supporting these conclusions was consolidated and communicated to the workshop in **FAO (2016)**. The details in that document can provide more case and situation-specific information needed by individual States to undertake the type of evaluation of progress outlined above, updating the assessment for the 2020 timeline.

5.4.2 Examples of outcomes on threatened species

Progress on threatened species can be appreciated, inter alia, looking at the implementation records of the FAO IPOAs-sharks and IPOA-seabirds for which there are some information.

A comprehensive review of the implementation of the FAO IPOA-Sharks, undertaken in 2012, in 26 top shark-fishing nations and 10 RFMOs (representing about 84% of the global shark catches from 2000 to 2009) showed that more than two third (18) of the top shark-fishing countries had a NPOA-Sharks in place and that five more were in the process of developing one. The main problems hindering successful implementation are linked to problems with fisheries management in general, such as institutional weaknesses, lack of trained personnel, and deficits in fisheries research and in "management, control and surveillance" (MCS to fisheries professionals).

In addition, there existed at that time a number of Regional Plans of Action for the conservation and management of sharks (RPOA-Sharks) by; the European Union (2009); UNEP/IUCN in the Mediterranean Sea (2003); CPPS in the South East Pacific (2010); Central American Integration System (SICA) (2012); OSPESCA

(2011); FFA, SPREP and WCPFC (2009) and the CSRP and International Foundation for the Banc d' Arguin in West Africa (http://www.fao.org/ipoa-sharks/national-and-regional-plans-of-action/en/). The IPOA-seabirds was adopted in 1999. National Plans of Action for reducing incidental catch of seabirds in longline fisheries were adopted in the USA (2001, 2003); Australia (2003); South Africa and New-Zealand (2004); Brazil (2004, 2006); Uruguay (2006, 2015); Canada (2007); Japan (2009); Argentine (2010).

Most of the progress on development of IPOAs and NPOAs was "on paper" and had been made before the adoption of Target 6. However, the increasing collaboration of FAO and CBD on all the Aichi Targets, and particularly the workshops of both IGOS that addressed aspects of Target 6C has helped to advance their shared interest in more sustainable fisheries and better conservation of marine biodiversity. These shared interests were reflected in a number of questions added to the CCRFQ that FAO sends to all its Parties and RFBs, monitoring progress on implementation of the Code of Conduct for Responsible Fishing. Several questions were intentionally framed to simultaneously provide information relevant to reviewing progress on Target 6. The responses of both individual States and RFBs underscore the increasing attention to these biodiversity concerns.

The responses of the FAO members to the CCRFQ 2015 indicate:

- Protection of endangered species. 91% of the 65 respondents have measures providing such protection addressed by management plans in relation to these objectives, and 74% have established mechanisms for monitoring and evaluation of performance.
- Precautionary approach. 89% of the 65 respondent parties use the precautionary approaches to ensure conservative safety margins in decision making.
- Bycatch management. 94% of 67 respondent parties address selectivity in their regulations. 63% of the 92 respondent parties recognized having the problem. 58% monitored bycatch and discards. Of these, 74% find their bycatch and discards unsustainable, 92% put in place corrective measures which aim, *inter alia*, aiming at protecting juveniles (in 97% of the cases) and reducing ghost fishing (67% of the cases).
- Protection of sharks. 49 of the 90 respondent parties recognized having sharks as target or bycatch species, 39 have conducted shark assessments, 36 concluded that a NPOA-sharks was needed, and 27 have now such a plan in place. However, the recent assessment of national capacity in Asia, Africa and Latin America (FAO, 2018) revealed that very few countries (particularly in Africa) meet all the minimum conditions to implement the CITES requirements to export Appendix II species of sharks and rays. Several countries already have a management framework in place that could support the regulation of shark fisheries and provide the basis for meeting the CITES requirements. However, implementation is hampered by the limited information available to support the making of non-detriment findings (NDFs), which is compounded by limitations in the ability to identify the listed species in the catch and trade, and the weak enforcement capacity in fisheries.
- Protection of seabirds. 77 of the 89 respondent parties recognized having longline fishing in their area, 36 of them assessed such fisheries for the need of a NPOA-seabirds, 23 recognized the need for such a plan and 15 have now it in place.

In addition, the review of responses from RFMOs/As to the CCRFQ 2015 (in **FAO, 2016**) indicates that:

- Bycatch and discards. 96% of the RFBs have taken or strengthened measures to limit bycatch and discards.
- IPOA-Sharks. Assessments of shark stocks status were the most common activity (58% of RFBs) followed by publishing documents and guidance (50% of RFBs).

- IPOA-Seabirds. The most common activity was assessing the incidental catch of seabirds in longline fisheries (50% of RFBs) and the publication of related documents (42% of RFBs).

The uptake indicates that, before the adoption of Target 6, many fishing nations already took seriously the aspects related to fishing impacts on remarkable ecosystem components (particularly megafauna). However, the real impact on the ground, in terms of bycatch amounts and on abundance of the species concerned would be better reflection of the efficiency of the IPOA/NPOA initiatives, and the responses of Parties to this Element of Target 6.

Unfortunately, measuring the degree to which *significant adverse impacts* of fisheries on *threatened species* has been avoided is not a simple matter. None of the generic indicators suggested by the AHTEG for Target 6 could be expected to provide information on that matter. To have reliable reporting on this aspect of Target 6, would require, as a minimum, to have three practices in place:

- Some form of bycatch monitoring, of known accuracy and precision, that would reliably detect and report mortalities of rare or threatened species;
- Some method for estimating the maximum allowable bycatch and indirect mortality that can be imposed by the fishery on the threatened species, taking into account the recovery goals in population status and, time-to-recover, the other sources of mortality on those species, and the desired probability of achieving the goals.
- A process for periodic evaluation of the bycatch estimates relative to the bounds on fishery impacts on the species, with feedbacks on management actions if the fishery impacts are not within those bounds.

Only if the three practices were in place would it be possible to directly report in performance of a fishery relative to Target 6C. These are demanding standards even for data-rich fisheries with significant science capacity. Consequently, at least relative progress could be reported in terms of the extent to which: (i) bycatch of threatened species is actually being monitored accurately in fisheries; (ii) the extent to which biologically-based allowable harm or bycatch limits for threatened species are established and used in evaluation of fisheries performance; and (iii) when progress on (i) and (ii) are not available, the degree to which bycatch mitigation measures are used (gear modifications, spatial and temporal limits on fishing opportunities, economic incentives). The latter may be the weakest option when conducted and reported in an *ad hoc* manner, but it could be an informative option if the reporting is on the extent of development and implementation of comprehensive IPOAs for fisheries of concern. Presenting the information in the context of implementing the FAO Guidelines on Bycatch Management and Discard Reduction (2011) would also give some consistency to even narrative rather than quantitative reporting.

5.4.3 Common conclusions

Most of the examples of progress listed above can all be viewed as "progress on paper" with agreements being made to do things, without necessarily changing fishing practices on the water. The "acid proof" of improvements would be given by direct assessment of trends in the status of stocks of *threatened species* and *vulnerable ecosystems*. However, because of the nature of these biodiversity components, often characterized by very long recovery times from disturbances (**Musick, 1999; Mahon et al., 2000; Van Allen et al., 2012**) it may take decades for threatened species and even longer for vulnerable ecosystems to accumulate the evidence that they have recovered to acceptable baselines. There are at least encouraging signs of reduced pressure on vulnerable seafloor ecosystems and expanded identification of those systems (according to the UNGA review of 2016). However, trends in exploitation of sharks and threatened marine fish, and bycatches of seabirds suggest progress on reducing fisheries pressure on *threatened species* needs to accelerate. (**Clarke et al., 2014; Torres-Irineo et al., 2014; McDevitt-Irwin et al., 2015; Baretto et al., 2016; Phillips et al., 2016; Stein et al., 2018**).

These examples of progress on actual conservation and protection of *threatened species and vulnerable ecosystems* may reflect a more general pattern of better collaboration between fisheries management and conservation biology interests (**Garcia et al., 2014**), where these special features provide set of priorities common to both perspectives. Conservation-focused initiatives have begun to provide greater recognition of, and substantive support for 'sustainable use' of commercially-exploited fish species through closer cooperation with FAO, fishers and fishery management agencies. For example, FAO, RFBs, CITES and IUCN (especially through its species specialist groups) now work more collaboratively to promote and support capacity-building in fisheries management to support CITES provisions (regarding legality and sustainability of fish trade). According to **Friedman et al. (2018**), this cooperation includes: (i) decision support and shared program planning or management of species listed on CITES Appendices, such as the development of National Plans of Action (NPOAs) for CITES listed species that can guide fisheries management (e.g. **Sadovy et al., 2007; Gillett, 2010;**) as well as for sharks and rays (**Fischer et al., 2012, Friedman et al. 2018b**); and (ii) assessment of responses to threatened species listing under CITES, such as a jointly funded web-based portal that documents management responses in relation to fisheries for cartilaginous fish (Chondrichthyes), and a database of measures put in place to conserve and manage sharks and rays, and a questionnaire framework to assess expert opinion on the delivery and impact of CITES provisions.

At the most basic reporting level, trends in fishing effort alone, in the relevant fisheries, would provide information on the potential pressure exerted on *threatened species* and *vulnerable marine ecosystems*. Less fishing overall would reduce the opportunities for fisheries to encounter them. However, unless planned otherwise, it is likely that the remaining amount of effort would be disproportionately concentrated in area of maximum abundance of the target species. Consequently, the degree to which the reduced effort actually reduces impact on the threatened bycatch species and vulnerable ecosystems depends on its new spatial distribution of effort relative to the distribution of these components. If the distributions were similar (i.e. areas of high abundance of the stocks targeted by the fishery and of the vulnerable ecosystem or threatened species largely overlap) the reductions in pressure on the vulnerable ecosystems and threatened species might be much less than the total reduction in effort on the target species. Clearly, if effort reduction is a major tool for reducing impact of fisheries on vulnerable ecosystems or threatened species, spatial allocation of the reductions taking the distribution of the vulnerable ecosystems and threatened species into account would usually be more effective than just reducing overall effort but allowing fisheries to fish where and when they choose within the effort limits. In addition, as High sea VMEs are normally closed to trawling as soon as discovered a recognition of already exploited (and impacted) areas and a freezing (or reduction) of that footprint would be a measure stabilizing (or reducing) the impact.

6. Target 6D – Safe ecological limits

6.1 Rationale

Target 6 ends with the commitment that …*the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.*

This Element (6D) refers to stocks, <u>all</u> species (implicitly target, non-target) and ecosystems in general (not only vulnerable ones) and can function to integrate all the preceding Elements. By drawing them together, it implicitly acknowledges the interactions among the parts and allows consideration of the both the aggregate

and cumulative impacts of fishing on ecosystems[53] and extends the conservation commitments to multispecies communities, food chains, all habitats (including non-vulnerable ones) and, ultimately, the ecosystem structure and functions. Considerations of this element, therefore, necessarily overlap with those in the preceding ones.

However, the concept of *safe ecological limits* (SEL) also referred to in Aichi Targets 4 and 5 has never been precisely defined (and agreed) in operational terms, e.g. with clear units for their quantification (**Donohue et al., 2016**). Links with the concepts of ecosystem health and integrity may be assumed but these are also controversial and not better operationally described. These concepts often assume ecosystem stability although it is becoming widely accepted that ecosystems are variable, may alternate among different locally stable states, and may show directional trends over time (**Frank et al., 2007; Shackell et al., 2012**). Against this ecological background, the SEL concept, when used in a policy objective such as Target 6, implies a normative goal reflecting mainly "resistance to perturbation" and relates to the concepts of persistence, resilience, variability and multiple locally stable equilibria (**Donohue et al., 2016**) which are not easily defined in measurable terms. It may also relate to conservation of ecosystem services.

Thus, the actual implementation of this aspect of Target 6 requires much more framework development and interpretation, before guidance on reporting can be developed.

6.2 Key concepts

The notion of the variability of ecosystems was well recognized in 2010, when the target was adopted (**Ives et al., 2007; Cardoso et al., 2010**), so the roots of the commitment to maintain not just stocks and species but full ecosystems within *safe ecological limits* requires detailed consideration. The expression has not been used by the science advisory bodies of Western Europe, Canada, or the US (pers. comm., ICES, CSAS, CIE), three of the fisheries jurisdictions with formal and structured science advisory processes for fisheries management, nor by any RFMOs (pers. comm. FAO). Rather, the term has its roots in the concept of Planetary Boundaries that was gaining currency at the time of COP X. The summary paper by **Rockström et al. (2009)** was providing a basis for arguing that across all the pressures that humans put on ecosystems, the aggregate and cumulative impacts need to all remain with a "safe operating space". This space had boundaries on many environmental dimensions, including air and water quality (**Gerten et al., 2013; Sala et al., 2013**), land degradation (**de Vries et al., 2013**) and biodiversity (**Mace et al., 2014**). Initially proposed as a global scale concept, it was recognized from the outset that to be operational, downscaling to more jurisdictional scales would be necessary. Proposals for applying the concepts and approaches at regional (**Dearing et al., 2014; Nykvist et al. 2013**), national (**Dao et al., 2013; Fang et al., 2015; Häyhä et al., 2016; Fauré et al., 2016**) and local (**Kahiluoto et al., 2015**) have been explored.

Importantly, in addition the planetary boundaries framework also acknowledges legitimate dimensions of "safe operating space" for humanity, including social and economic opportunities and social justice (**Rockström et al., 2009, Raworth, 2012; Steffan and Stafford Smith, 2013**), as well as for nature. This has placed the framework in the center of much of the conceptual debate about how to harmonize the Sustainable Development Goals in ways that serve both humanity and nature (**Griggs et al., 2013; Hajer et al., 2015**).

[53] By aggregate impact, we refer to the ways that a single fishing action can alter multiple parts of an ecosystem, such that interactions among populations or between populations and habitats may make impacts of fishing different ten expected from the individual initial impacts; by cumulative impacts, we mean both the accumulated impacts of multiple fisheries in the same area and the accumulated impacts of a fishery prosecuted over longer time periods. Both are addressed in the general Ecosystem approach to Fisheries (**Garcia et al. 2003**)

Thus, the concept of "*safe ecological limits*" is clearly about how to use the ecosystem in ways that are sustainable, but do not push it beyond its boundaries and tolerances. This focus on defining boundaries of ecosystem tolerances as a precondition for the discussing how to share human pressures within those boundaries has taken many forms in the discussion of sustainable development since the framework emerged (**Sandin et al., 2015; Depledge 2009; Mace et al., 2013**) The discussion has quickly centered on the location of "critical transitions" or the "adaptation frontier" (**Bruckner et al. 2003; Preston et al., 2013**) as the defining property of these property-specific safe boundaries, as reflected in approaches like the "hockey stick" relationship between many ecosystem structural properties and functional properties (**Rockström and Karlberg, 2010**). Although the concept has elicited strong criticism as well as support (e.g. **Montoya et al. 2018**) it appears to be the original source of the phrase in the Target, and the role of critical transitions or tipping points is not the major basis for the professional criticisms.

Although the concept of planetary boundaries is now a central, if disputed (**Montoya et al., 2018**), concept in many discussions of sustainability of human development initiatives terrestrially, the comparatively slow uptake of the concept in marine policy, planning and development has been noted recently (**Steffan et al., 2015; Nash et al., 2017**). However, this convergence of research within the planetary boundary framework on tipping points and regime limits and shifts (**Hughes et al., 2013; Baum and Handoh, 2014**) provides a direct link to work within more established and less disputed frameworks for evaluating human impacts on marine systems. In particular, as explored in depth in **Section 3** of this working paper, the identification of limits for stock status and fishery parameters such as spawning biomass (state) and fishing mortality (pressure) are the foundation for contemporary single species fisheries management, used both in designing harvest strategies and setting annual sustainable fisheries quotas, and assessing the status of exploited stocks to insure removals have been within "*safe limits*" for individual stocks.

Although that well-established fisheries management and conservation framework was developed for use in single-stock management, it has several features that facilitate its extrapolation to other uses in fisheries. One feature is that the placement of the limit along the stock spawning biomass axis is determined largely by a function that spawning biomass serves for the stock – provision of recruits to the stock in future. Although the stock-recruit relationship is weakly determined overall for most stocks, with substantial variation in recruitment at any given spawning biomass, many methods have been used to identify the spawning biomass below which probability of poor recruitment begins to increase markedly (**ICES 2001, 2002**). The function (recruitment) served by the state (spawning biomass) has an inflection point below which the specific state variable is a dominant factor in further degradation of the function, and above which many other factors can strongly influence the function. This pattern with a critical inflection point defining a limit for a state variable relative to a function it supports, has been developed as a general formulation of the relationships between environmental states and the related functions (**Rice, 2009**). So, on a feature by feature basis for the ecosystem, the "critical transition" or "adaptive frontier" aspect of the "*safe limits*" is compatible with the common framework already in place for single species fisheries management. Moreover, the methods used in fisheries, including details like the "hockey stick" relationship (**Barrowman and Myers, 2000**) and more general non-parametric methods (**Cadigan, 2013**) for locating the inflection point or safe limit (**ICES, 2001; 2002)**, are well known and do not require knowing the full functional relationship between the ecosystem state property and the functions it serves.

A second feature of the fisheries framework for reference points is that methods are well established for including uncertainty in both the status assessment and harvest advisory roles of the framework (**Cadrin and Dickey-Collas, 2015**). There are many possible ways it can be done, depending on the nature of the uncertainty (**ICES, 2012**) but the diversity of methods is a positive feature of the framework, allowing a wide range of causes of uncertainty to be accommodated and both data-rich and data-poor stocks to be assessed and managed within the same conceptual framework (**Canales et al., 2017, Fulton et al., 2016.**).

By including both biologically-based limits and uncertainty, the stock assessment framework can provide information about the degree of precaution needed to manage the risk of falling below the safe limit. This is the third feature that nests the established single-species reference-point based framework within the broad planetary boundaries framework. Ecological risk assessments (ERA) are becoming established as a part of fitting fisheries into the broader ecosystem, with well-developed methods for both assessing risk relative to ecosystem structure and function (**Hobday et al., 2011**) and for individual ecosystem features such as seabird bycatches (**Small et al.,2013**). These risk assessment and management approaches complement well the general risk-based approaches used in the broader planetary boundaries framework (**Rockström et al., 2009; Mace et al., 2015; Dearing et al., 2014**).

This review of the Planetary Boundaries and fisheries Precautionary Approach to single species assessment and management provides two points about how "*safe ecological limits*" could be interpreted in its application in Target 6, in a way consistent with the intent of this aspect of Target 6, when it was adopted. First, *safe ecological limits* might be interpreted as identifying *limits* for ecosystem perturbations, just as it is being interpreted in fields like climate change (**Preston et al., 2013**), pollution (**Diamond et al., 2015, Sandin et al., 2015**.; **Griggs et al., 2013**), and agriculture (**Campbell et al., 2017**)). Second, these limits are to accommodate human uses and societal values to as large an extent as possible, because of the human dependencies on activities that require impacts on natural systems (e.g. **Robert et al., 2013; Heestermann, 2017**) and the values used to judge those impacts (e.g. **Mee et al., 2008; Gilbert et al., 2015**).

Within the concepts and framework comprising the Planetary Boundaries, the basis for interpreting and applying "*safe ecological limits*" for fisheries can be developed. The steps are not easy, but they are at least clear. The notions of "safety" and "risk" will need to be operationally defined, and the definitions will have to be flexible enough to accommodate societal goals and preferences that are likely to differ culturally and economically. Once defined, the characteristics of appropriate indicators would have to be delineated, as would the properties of the "safe limits" on such indicators. Finally, assessment approaches that could operate in a range of data-poor as well as data-rich situations and inform about the risk of not being "within safe ecological limits" would also need to be described.

6.3 Indicators and alternative reporting approaches

Given this background for the derivation of the term "within safe ecological limits", what are the implications for measurement of progress towards the aspect of Target 6? Four considerations emerge from **Section 6.2:**

- Being within "*safe ecological limits*" is concerned with avoiding <u>limits</u> where structural or functional properties critical to an ecosystem are degraded to a state where ecosystem processes cannot be supported, and further degradation is likely. It is *not about* being at or near some targets defined on a range of socio-ecological factors and trade-offs.
- The key properties that should not be driven below their safe limits are well-identified <u>functional properties</u> of ecosystems.
- The <u>structural properties</u> of ecosystems (and species and stocks) are far more readily quantified than ecosystem <u>functions</u>, so the relationships between the level of key ecosystem functions and structural properties that produce or strongly influence them are usually the basis for defining operational limits
- The "*safe limits*" that should be avoided with high probability are inflection points in the structure – function relationship. Below the inflection point the likelihood that the function is being adequately supported in the ecosystem begins to decrease rapidly with further decrease in the structural property (**Figure 19, Panel 1**). Above the inflection point the function may increase further with increases in the structural property, but other factors are likely to have increasing influence on the function (as for

example oceanographic conditions increase their influence on recruitment to a fish stock, as long as spawning biomass is sufficiently large to allow good recruitment under "normal" environmental conditions).

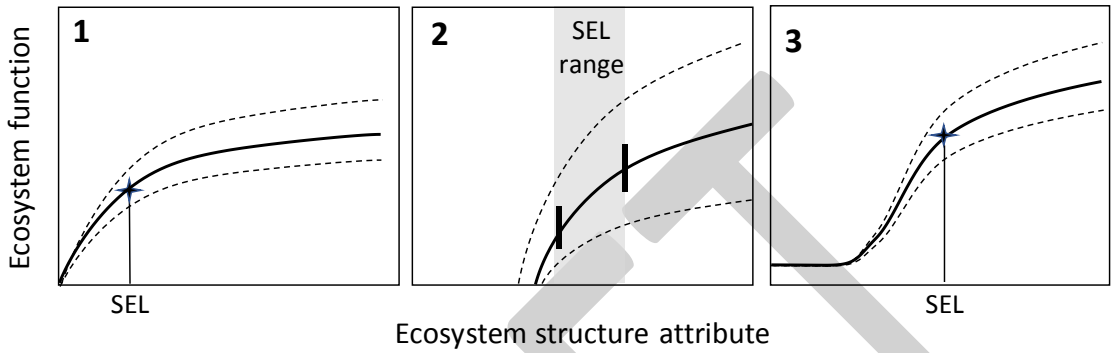

Figure 17. schematic diagram illustrating the relation between an ecosystem function to protect and a functionally - related ecosystem structure indicator. The SEL – designated by a cross (+) in the figure - corresponds to the point of inflection of a relationship, the exact shape of which may not be (completely) known. Panel 1 – A typical structure function relationship, with greatest adverse impact on the function at low availability of the structural attribute. Panel 2 – a less sensitive relationship, where at best an interval for the SEL boundary (a) can be identified. Panel 3 a case where at low levels of the structural attribute the function can be partially supported by other ecosystem features.

These considerations help in evaluating the properties of indicators needed to measure achievement of this aspect of Target 6. Following from these considerations, several practical approaches to identifying indicators emerge:

- If indicators of ecosystem functions are available, they can be used directly to measure the state of the ecosystem being impacted by fishing. However, it is necessary to know how much of the function is needed to maintain the ecosystem processes in order to set a limit on the level of the function that must be avoided with high likelihood.
- If functional indicators are not directly available, or critical levels of the function to maintain ecosystem processes are not known, then indicators of ecosystem structure can be used. However, the structural features should be ones known to be (or plausibly) linked to key ecosystem functions.
- Such structural features do not have to be the only features of the ecosystem linked to the functions of concern, as long as there is sufficient information to identify a region of the structural indicator below which the function is highly likely to decline, even if other factors influencing the function are in their typical range[54]. If the function supported by the structural property is highly likely to continue to decline as long as the structural property is not improved (or the function is otherwise actively enhanced) then the *safe ecological limit* can be the limit on the structural feature, since if that structural limit is not avoided, the dependent function will be on a degradation pathway that will eventually also reach a level of *serious or irreversible harm*. (vertical lines on **Figure 19**)

[54] In the language of the precaution approach, this is the regional of the structural property where the likelihood of *serious or irreversible harm* begins to increase markedly

- Importantly, though, the shape of the full functional relationship between the structure and function does not have to be quantified, so issues like degree of density dependence or saturation at excessive levels of the structural feature (asymptotes in **Figure 19)** are of secondary importance to identifying the lower inflection point in the structure – function relationship (localized at crosses [+] in **Figure 19**).

Because important ecosystem functions such as productivity (**Brown et al., 2002; Peck et al., 2018**) resilience (**Ieno et al., 2006; Saint-Béat et al., 2015**), and energy flows (**Pinniger et al., 2005, Blanchard et al., 2011**) are the consequence of many contributing species and populations, aggregate indicators of ecosystem state (**Loomis et al. 2014**) may sometimes be more tractable for identifying the location of the inflection points representing the safe ecological limits. However, aggregate indicators may make it more difficult to isolate the exact causes of the decline in the function, and to direct management interventions most effectively. Unfortunately, the alternative of using a large suite of indicators including every individual population or habitat feature (in the water column or on the seafloor) in an ecosystem related to the function of concern poses other challenges. The alternative of using suites of indicators to collectively evaluate ecosystem status, (whether relative to targets or limits) is both data demanding and requires some additional assessment-like process to interpret their collective information and choose the approach management interventions (**Rice, 2003; Link, 2005**), a topic returned to in **Section 6.4.**

This conclusion about the need for indicators that track at least moderately integrated ecosystem structural properties that are linked to important ecosystem functions reinforces a conclusion from the 2016 Expert Workshop on CBD Target 6. That workshop concluded that, because the indicators discussed by the AHTEG were chosen within constraints of accessibility and global coverage of data needed, the resultant indicators "*focused largely on fishing pressure, with a notable absence of indicators of fishing impacts at the ecosystem scale*". To address the "*safe ecological limits* of … *ecosystems*" that workshop called for additional indicators of fishing *impacts* on ecosystem properties, structure and functions. Such indicators would allow use of national assessments and reports on ecosystem status, even if the same data were not available globally. Types of indicators specific to ecosystem impacts that were suggested included:

- <u>Size-based indicators</u> such as the Large Fish Indicator (Proportion of large fish in the species community) used in the EU (**Graham et al., 2005, Greenstreet and Rogers, 2006; Modica et al., 2014**);
- <u>Food-web indicators</u>: e.g. trophic level in the community, biomass of functional groups (**Bourdaud et al., 2016; Reed et al., 2016**);
- <u>Species-based indicators</u>: e.g. abundance or biomass of sensitive species or keystone species (for example, habitat building species, nodal species in wasp-waist food-webs, herbivore species in coral reefs) (**Foch et al., 2014; Coll et al., 2016**),
- Trophic level of the community is a fishing impact indicator; trophic level of the catch is a fishing pressure indicator. (**Gascuel et al., 2005; Branch et al., 2010**)

In addition, direct indicators of habitat structure and integrity (**Rice et al., 2012; Lederhouse and Link, 2016**) have also been used to evaluate ecosystem impacts of fishing.

All these indicators, and others, have been used to measure at least qualitatively and usually quantitatively how fishing has impacted ecosystem structure – size, food web linkages, species composition, or trophic structure. However, this does not mean that they have been used to quantify (in absolute or relative terms) the ecosystem functions affected by fishing, such as energy flow, productivity, and stability or resilience. In addition, many of these applications have been to determine whether targets, such as those specified in the EU Marine Strategy Framework Directive (e.g. **Rice at al., 2012; Greenstreet and Rogers, 2006**) or the US Magnusson –Stevens Act (**Lederhouse and Link, 2016**) have been achieved. This is quite a different role in decision-making than determining the likelihood that limits have been avoided.

The Planetary Boundaries Framework for interpreting "*safe ecological limits*" highlights that setting targets is a complex interaction of social, economic and ecological considerations, including factors such as justice and equity for which universal empirically determined targets are unlikely to be possible (**Diaz et al., 2018**). On the other hand, the inflection points in the structure – function relationship do give a consistent basis for determining the general position of a limit on any appropriate indicator (**Rice, 2009**). These inflection points may not be easy to locate, but for applications to single stocks and species the diverse methods have been developed (**Section 6.2**) and results have been shown to be robust in tests (**Piet and Rice, 2004**).

The infrequency with which limits rather than targets have been set for marine ecosystem indicators is not the only challenge with making this aspect of target 6 operational. Even when used either to assess progress towards a target or simply to just track the trajectory of the impacted ecosystem, interpretation of the indicator values is not straightforward relative to broad ecosystem status. Challenges include that:

- Details of formulations of the analyses streams or models that produce the community indicator values can either make the model hypersensitive or overly buffered to ecosystem changes (**Pinnigar et al., 2005, Robinson et al., 2011, Rombouts et al., 2013**);
- Even when trends are found in the indicator, attributing the trend to specific causes is difficult and not possible without excellent data (**Jennings et al. 2008; Seebacher et al., 2012; Sugihara et al., 2012; Gislason et al., 2017**);
- Specific changes to ecosystem structure may have widespread impacts on ecosystem functions, so single structure-function relationships may appear to be capturing the ecosystem impact of a structural change, but not detect other functional impacts that may be more serious (**Myers et al., 2007; Baum and Worm, 2009; Cianelli et al. 2013**), or a key function may be being driven simultaneously by multiple changes in ecosystem structure (**Mueter et al., 2006; Fonseca et al., 2015**).

Together, these factors paint a pessimistic picture of the ability to actually apply the standard of *within safe ecological limits* for at least the ecosystem impacts of fishing using solely an indicator approach, even with suites of indicators. However, if efforts are taken to go beyond narrow indicator-based approaches more promising pathways are available.

6.4 Integrated Approaches

Although the evaluation of ecosystem impacts relative to "*Safe Ecological Limits*" differs from the task of evaluating ecosystems relative to achievement of targets (such as multispecies MSY), key lessons have been learned from the efforts to assess ecosystem status relative to policy targets. In both the US and EU, such assessments gained priority since the Millennium Ecosystem Assessment, and a variety of approaches were explored.

One thought was to develop systematic guidance for selection of the most effective indicators for each evaluation. Such guidance could be provided readily enough (e.g. **Rice and Rochet, 2005; Greenstreet and Rogers, 2006**) but, when the outcomes were tested, "effectiveness" was found to be judged differently by different potential users of the ecosystem indicators (**Rochet and Rice, 2005**). In addition, when suites of indicators of the single property of benthic community status were tested, no single indicator was found to be sensitive to pressures and impacts across the range of nutrient enrichment pressures and flow regimes planned to be assessed. Rather, different indicators would be informative in different flow regimes and at different stages of past levels of perturbation **(Keeley el al., 2012**). Efforts to conduct such largely indicator-based assessments of Good Environmental Status (GES) made substantial progress (e.g. **Shepherd et al. 2014, 2015**), frameworks for interpreting the results were proposed (e.g. **Cardoso et al., 2010; Mee et al., 2008; Tett et al., 2013**), and useful results were identified (**Potts et al., 2015; Coll et al., 2016**). Nevertheless, the actual evaluation

of GES remained debated from the policy perspective (**Gilbert et al., 2015**), and without scientific consensus on many aspects of their content and how to conduct them (**Borja et al., 2013, 2014**).

These circumstances led to re-evaluating indicator-based approaches to assessing ecosystem status relative to properties like the GES called for in the EU Marine Strategy Framework Directive. A particularly thorough evaluation concluded that to assess whether just the pelagic component of an exploited ecosystem was in GES, three conditions would have to be met: *"(i) all species present under current environmental conditions should be able to find the pelagic habitats essential to close their life cycles; (ii) biogeochemical regulation is maintained at normal levels; (iii) critical physical dynamics and movements of biota and water masses at multiple scales are not obstructed*" (**Dickey–Collas et al., 2017**). Each of those three conditions would require multiple indicators for the life cycle of *all* species, the components of bio-geochemical regulation, and "*physical dynamics and movements of biota and water masses at multiple scales* ". The study also noted that "*reference points for acceptable levels of each condition and how these may change over time*" would require consultations and agreement among knowledge experts, stakeholders, and governance jurisdictions".

These conclusions are no longer calling for indicator-based assessments, but stress that some variant of "integrated ecosystem assessments" (IEAs), will be required to evaluate ecosystem status relative to specified targets. This same conclusion will apply to assessing ecosystem status relative to "*safe ecological limits*". Even if the dependence of limits on ecosystem structure, function and their dynamic interactions (**Section 6.2**) may make identifying the appropriate limits somewhat more objectively-based rather than socially-negotiated, they also make an integrated approach to setting the limits even more necessary. Whether standardized indicators are used alone or are augmented with a diverse and likely variable body of information from multiple knowledge systems, the integrated outcome across all the available information is necessary to draw qualitative or quantitative inferences regarding the likelihood that the ecosystem is within "*safe ecological limits*".

Integrated Ecosystem Assessments are not new. Guidance was already available in the 1990s (**Toth and Hizsnyik, 1998**), and assessments have been done in some waters on regular intervals for recent decades in **HELCOM (2010)**, **OSPAR (2010)**, UNEP Transboundary Diagnostic Assessments (TDAs), and for placing fisheries within its larger ecosystem context (**Garcia et al., 2003**). As the limitations of solely indicator-based evaluations of ecosystem status relative to targets, and in some TDAs became more apparent, attention to IEAs as central to such evaluations has grown. A call for more ecosystem-based approaches to fisheries management in waters under US jurisdiction led to key guidance documents nearly a decade ago (**Levin et al., 2009, 2013**). The assessments arising from these initiatives underwent critical scrutiny (**Link and Browman, 2014**), with calls for even more expanded and inclusive assessments (**Dickey-Collas, 2014; Walter and Mollman 2014**). In the case of integrated assessments relative to the GES for EU waters, detailed guidance has been developed for conducting them (**Walmsley et al., 2017**) and interpreting their results (**EC, 2017**). The emergent priorities throughout these integrated approaches is that they need to:

- Include as wide a collection of sound information and knowledge (and experts) on the ecosystem as feasible,
- Take into account the objectives and reference points (when they exist) of the jurisdictions that will use the IEAs to inform planning and decision-making, and
- Use flexible approaches and formats to allow the two previous priorities to be well served across a wide range of marine ecosystems, jurisdictions and cultures, and quantities and quality of information.

6.5 A possible way forward

If such an integrated assessment approach is taken to evaluate the impact of fisheries on stocks, species and ecosystems, what features would appropriate assessments have?

As a start, it would be reasonable to assume that if all impacts addressed under Elements 6A, 6B and 6C (individual target stocks, other species, and vulnerable marine ecosystems) meet with agreed international standards and related national ones[55], the ecosystems supporting them are highly likely to be within *safe ecological limits*. Even if they do not meet the international and national standards for Targets, where single species limit reference points have been (or could be) determined using established methods (e.g. **ICES 2002, 2003**) that take account of factors like species interactions (e.g. B_{esc} for forage species[56]), as long as the respective stocks, populations or species have a low likelihood of being below their Limit Reference Points, then *safe ecological limits* are likely to be met. for the individual populations. This does not guarantee that the habitat structure and all community interactions are also within safe limits, but if they were seriously degraded then the evidence should show in the status of at least some populations. On the other hand., if some of these individual populations have an unacceptable probability of being below their Limit Reference Points, it is necessary to consider the cumulative impacts of all pressures on these highly-impacted populations at the ecosystem level. In addition, the role of non-fishery drivers on their status (such as climate and pollution) should be considered. Partitioning out the effects of drivers like climate and fishing is not straightforward (**Boldt et al., 2012; Shackell et al., 2012**) and already identifies the need for integrated assessment approaches (**Sugihara et al., 2012**).

It is when confronting the task of evaluating the status of ecosystems (VMEs or ecosystems in general) against *safe ecological limits* that the integrated approaches become essential. Based on **Sections 6.2** and **6.3** the operational objective would be to maintain ecosystem structure and function[57] above the state where serious or irreversible harm is likely, with "serious harm" being defined as ecosystem functions falling to levels where the relationships among species, or the rates of a key process, cannot support the biological community. These breakdowns can take countless forms, such as depletion of a key Lower Trophic level population (**Sydeman et al., 2017**), depletion of a top predator (**Baum and Worm, 2009**) or damage to habitat structure important for community members (**Rice et al., 2012**). Again, however, the very large number of kinds of structural features of habitats or ecosystem, and the ways the functions to which those features contribute may be at risk of serious or irreversible harm, call for comprehensive ecosystem assessment approaches. On a feature-by-feature basis, the inflection point associated with the structure – function relationship may serve as a limit reference point (LRP) for the structural feature itself, relative to its *safe biological limits*, but such relationships have rarely been examined in relation to SELs for the ecosystem as a whole (**Rice, 2012**). In addition, developing case-specific limit reference points takes time and expertise, even when the data and appropriate framework are both available (**ICES, 2002, 2003**). Consequently, this cannot be done quickly and readily by most states. As a fallback the outcome of well conducted integrated ecosystem assessments can be expected to identify:

- Functional properties of the ecosystem that are at least outside typical bounds of variation and may be having serious adverse impacts on other functions or relationships in the ecosystem;

[55] E.g. all target stocks are around MSY, all non-target and other species are above the level at which reproduction is threatened and do not suffer any significant adverse impact, and all vulnerable ecosystems are protected),

[56] See http://www.ices.dk/community/Documents/Advice/Acronyms_and_terminology.pdf. B_{esc} refers to the escapement biomass required.

[57] As required in the 1998 CBD Ecosystem Approach, the Malawi Principles (Decision V/6) and the 2004 Addis Ababa Principles for Sustainable Use (Decision VII/12)

- Structural properties of the ecosystem that are being perturbed to the extent that functions dependent on the structures are being altered;
- The roles of major drivers in the changes observed in the structural and functional properties above.

Conclusion on properties and drivers may be reached by many combinations of indicators, quantitative and qualitative information, and expert knowledge. Several outcomes are possible, all informative for Target 6 reporting:

- The ecosystem looks fine: If the assessment concludes that the ecosystem is in a state consistent with the Targets set for it, then as explained in **Section 6.4**, it is safe to also conclude the impacts of specific pressures, including fisheries, have all been within *safe ecological limits*.
- The ecosystem is under growing pressure: If the assessment notes pressures from fisheries are escalating, its impacts may not yet be outside *safe ecological limits* but may be moving in that direction and require monitoring and regular examination.
- The ecosystem has been impacted: If the integrated assessment concludes some functions are being affected in ways that could have serious adverse consequences, then the assessment's evaluation of the main drivers in the ecosystem should shed as much light as possible on the extent to which the impact of fisheries on ecosystem structural components is contributing to those trends of the functions. On a case by case basis, such assessment may provide direction for focused follow-up studies to identify the specific fisheries and ecosystem features involved in the trend, so that appropriate management measures can be implemented to mitigate the impact. But in terms of Target 6 reporting, the integrated assessment will provide the necessary information that some impacts of fishing are at risk of being outside *safe ecological limits*, how many, and how seriously. Even if this is a relative measure of outside "*safe ecological limits*", it is a relative context that can be re-evaluated over time with regard whether the number of structure and functional properties that are being adversely affected and the level of risk of serious or irreversible harm are being reduced.

Even in cases where there is adequate information and expertise to evaluate specific individual ecosystem structure – function relationships relative to their inflection points and assess the state of the structural features relative to those inflection points, there would have to be a number of such individual evaluations to state generically if the impacts of fishing on the habitat and ecosystem are all within *safe ecological limits*. The integration step would still be necessary to combine he individual results into the message needed for reporting. Again, as well, periodic repetition of these integrated assessments would allow tracking of the trajectory of the aggregate likelihood that the fishery impacts are outside safe limits.

7. Discussion and conclusions

This paper does not draw any firm conclusions regarding the potential achievements of fisheries in relation to Target 6 by 2020. It offers a perspective on a possible reporting framework, elaborated by the 2016 Expert Workshop, decomposing Target 6 in its key elements that differ in the criteria and indicators to be used to measure or qualitatively gauge achievements.

An indicator framework?

Ideally, e.g. to contribute to the measure of progress towards global sustainability, and to relate to SDGs, the indicators of fisheries sustainability should address its ecological, economic, and social dimensions –the so-called "triple bottom line". Although the Convention on Biological Diversity is focused on the biodiversity aspects of that triple bottom line, the commitment to both its conservation and its sustainable use makes all

three dimensions relevant to the CBD goals. Although Target 6 does not have Elements directly addressing economic or social outcomes of fishing, patterns and levels of fishing that deliver all the Elements of Target 6 must be sustainable on the social and economic dimensions as well for fishers and governments to support keeping fisheries in those conditions. This makes the "use" part of the "sustainable use" goal of the CBD an intrinsic part of Target 6.

The problem of assessment and representation of sustainability in fisheries using indicators was raised two decades ago in the wake of UNCED (cf. **Garcia, 1997)** and with the publication of the FAO Guidelines on the issue (**Garcia et al., 1999**). Although reporting on implementation of adopted international instruments has become common practice across the UN (e.g. with the FAO CCRFQ), no international "tri-dimensional" sustainability dashboard has been established for fisheries, even when the ecological outcomes are not as comprehensively laid out. This perhaps indicates the low potential cost/benefit value of such an instrument.

Without aiming specifically at such a dashboard, the 2016 Expert Workshop outlined an ambitious framework for comprehensive reporting on sustainable fisheries along the key elements of Target 6. The commitment of fishing nations, against the LOSC, the UNFSA, the CCRF, EAF, etc. covered already most of what is required in Target 6, particularly with regard to Target stocks and "associated and dependent species". The incremental expectations of Target 6 were greater focus on threatened species and ecosystem status, and the 2020 deadline for aligning, in the medium-term, laws, policies and plans with the long-term goal of sustainable harvesting and conservation. Progress on these previous fisheries commitments has been consistent but slow (SOFIA Reports and Annual UNGA Sustainable Fisheries resolutions), and the 2020 deadline implied a rate of change and a related implementation capacity (in institutions, knowledge, human resources and budgets) and change that were not explicitly assessed.

Some available statements on key indicators of state, and some trends, have been given as an illustration of the types of information that might become available by 2020 and more information than envisaged here may be forthcoming if States report comprehensively on their actions and on the results obtained. The coverage in time and space of the information available on each Element (6A-6D) is very uneven. The available information tells us already that actions and responses are very case specific and that a large range of responses needs to be expected depending on species, State, jurisdictional areas, political and socio-economic conditions. Global generalizations, if possible, might not be very meaningful in terms of what to do after 2020 to enable further progress.

Global assessments?

Some analysis of the global "response landscape" might be found useful anyway for international agencies and as a support for international dialogue between fisheries and conservation stakeholders. **Friedman et al. (2018b)** provide an example of statistical analysis of response to questionnaires concerning the impact of CITES listings on conservation of sharks and rays. While much narrower than Target 6 in scope, the methodology might be useful. Something to be mindful of perhaps would be the impact of the questionnaire itself and the process of familiarization with the questions on the answers coherence and quality. A simpler approach might be used to map the response landscape and perhaps appreciate future changes if further Target dates (e.g. in 2030, etc.) are set for the future. The present FAO CCRFQ does not land itself easily to collect quantitative responses. However, a possibility would be to use binary "metrics" (Yes/No; 0/1) and a system of grading the proportion of responses (e.g. 0-25%; 26-50% and >50%) associating them with a color code (traffic light approach) to generate a representation that would reflect the degree of progress made on countries responses, the areas lacking implementation, etc. (e.g. **Table 6**).

A comprehensive system of indicators (over 60, with 5 grades each) was developed by **Anderson et al (2015)** for 64 case-studies (fisheries) covering the period 2010-2013 and the three dimensions of sustainability: ecological, economic, and social (community). While with 70 metrics the system is probably too complicated for

use at global level (as only well-documented fisheries might be reported on), the outcome of the analysis may already prefigure what we might expect out of an analysis of Target 6 implementation, namely:

1. A high range of performance should be expected between fisheries, from very good to very bad and the overall score is sensitive to weighting used between the three dimensions;
2. The rankings of fisheries performance based respectively on ecological, economic, or community criteria performance are poorly correlated

Table 6. Example of traffic light representation of achievements in terms of action claimed by FAO Parties to have been taken in the 2015 CCRFQ (FAO 2016). Shading density indicates relative levels of completion, based on the percentage of respondents giving a positive response. sustainability: High (dark; >75%); Intermediate (medium); Low (light)

Target 6 Elements		Actions			outcomes
		Laws	Policies	Plans	
6A	Sustainably harvested	>75%			$B>_{BMSY}$
	Legally harvested				Compliance
	Overfishing is avoided				$B>B_{MSY}$
6B	Recovery plans in place	50-75%		<50%	
6C	Threatened species				
	Bycatch				
	Vulnerable ecosystems				
	Other species				
6D	Safe ecological limits				
	Eco. Structure/function				

Some challenges

The barriers that may slow down progress towards Target 6 can be related to the various dimensions of sustainability: (1) Environmental: e.g. Ignorance or instability of the ecosystem carrying capacity, species interactions at the ecosystem scale, and vulnerability to degradation; and the insufficient (too little too late) protection of vulnerable species and habitats; (2) Technological: e.g. excessive capacity leading to unsustainable use of goods and services; non-existent or unaffordable alternative technology; continual technological innovation even in many small scale fisheries, making it difficult to control effort; insufficient focus of innovation on practices to protect or enhance the ecosystem productivity; (3) Economic: e.g. primacy of short-term economic gains; inadequate incentives for and insufficient investment in conservation, or excessive costs of solutions (cost of compensation, transition and alternative livelihoods, see below); perverse subsidies; (4) Social: e.g. poverty; low capacity to act; marginalization; cultural barriers; violations of traditional rights; and (5) Governance: e.g. inadequate legal and institutional frameworks; unclear objectives; uncertain tenure and use rights; participation deficit; poor planning; lack of performance assessment; inadequate resolution of conflicts within fisheries and with other sectors. Information plays a central role overall and many of the barriers relate to ignorance or uncertainty; inadequate data; lack of agreed indicators; poor communication; lack of transparency; insufficient science and disregard of informal knowledge (**Grafton et al., 2008; 2010**), as does a lack of capacity in many places to implement measures likely to resolve problems (see below).

The responses to the FAO CCRFQ 2015 indicated that constraints to implementation of the CCRF –and hence of Target 6– include, by order of importance (and % of respondents): (i) Budget limitations (69%), insufficient human resources, partly related to the first (39%), inadequate data (32%); Institutional weaknesses (28%) and incomplete legal or policy frameworks (23%). In this respect, FAO has launched a global programme of capacity-building in developing nations, aiming to: (i) strengthen national policy and legislative frameworks, MCS enforcement institutions and systems; (ii) enhance States' capacity and performance in relation to the FAO Voluntary Guidelines, to perform inspections in port and to more effectively take action against persons and entities engaged in IUU-fishing and to implement market access measures, such as catch documentation and traceability schemes. Up to 40 countries are expected to benefit from the Programme over the next 5 years within a budget of USD 15-20 million (**Camilleri, pers. Com**). This capacity building alone should contribute substantially to the intent of Target 6. In addition, data gaps are identified to be mainly on stock status (52%), ecosystem (37%), IUU and MCS (36%), catch (35%), and effort (29%).

Like the other Aichi Targets, Target 6 drafting focuses on the desired biodiversity outcomes and not the costs of achieving them, and thus does not explicitly deal with trade-off. Remaining in the bio-ecological domain, its commitments are nonetheless rather coherent. All the elements identified overlap and sustain each other. The problem is that behind these elements are at stake other social and economic objectives of sustainable use which are in tension. The usual tensions are about: (i) Short and long-term costs and benefits of the conservation measures required; (ii) The distribution of such conservations cost and benefits (and resulting equity issues); and (iii) The trade-offs between improved ecosystem, economy and provision of livelihoods. For example, in all countries where strong bio-economic reforms of the capture fishery sector have been implemented, employment in the sector have paid the high price (with a reduction of about 90% in Norway for example). **Teh & Sumaila (2013)** estimated that 260 ± 6 million people are involved in global marine fisheries, encompassing full-time and part-time jobs in the direct and indirect sectors, with 22 ± 0.45 million of those being small-scale fisheries, equivalent to 203 ± 34 million full-time equivalent jobs. Suppressing 80% of that workforce to substantially improve financial and ecological performance is a challenge that not many politicians would like to face. Even if the necessary reductions in participation would be proportionately less in small-scale fisheries, the livelihood dependencies on small-scale fisheries (FAO 2015c) would make even more modest reductions very challenging socially and politically.

The delays between fishery developments and analysis of status and trends indicate clearly that by 2020, the final conclusions on performance during the current decade (2010-2020) will not be fully available before 2023-2025, particularly for the quantitative assessments. Forward projections of historical trends, and their coherence or divergence with time and between sources may help fill some time-gaps. Being purely statistical, or based on simulation models, their conclusions need to be considered very carefully, using multiple sources of information and "forecasting" means. In addition to the extent that Target 6 was intended to change fisheries practices for the better (from a biodiversity perspective) such projections will have to include hypotheses of how new measures will perform, making them particularly vulnerable to confirmatory (or exculpable) bias. A good example of use of projection methods is provided in **Section 3.3.5**.

The national reports from CBD Parties and the responses of the FAO Parties, RFMOs and NGOs to the enhanced CCRF implementation questionnaire, are likely to be the most comprehensive and up-to-date information available by 2020. The responses will report on actions taken, mainly, and reflect the intentions of the Parties and their adherence to international instruments, pending confirmation by quantitative outcomes. The relation between actions and outcomes is usually not very good (as shown inter alia by **Anderson et al., 2015**). In addition, the balance needed between the three dimensions (e.g. the Pareto equilibrium and frontier) is case-specific, e.g. very different in a small-scale abalone fishery in Chile, a large-scale snow crab fishery in the North Pacific, or a tuna fishery in Solomon Islands.

Finally, measuring the "influence" of Target 6 on the evolution of the fishery sector at global (if this was in the objectives of the Target) would be a major challenge because of the impossibility to separate the impacts of actions taken towards improving fisheries sustainability by scores of institutions at all levels. The outcomes of these efforts are a result of complex interactions within the fishery social-ecological system and between it and its environmental and socio-economic environment. Chances to demonstrate a cause-effect relation between actions and outcome are better at local fishery or sector level but disentangling the conundrum of the climatic and socio-economic drivers operating at higher scales remains a challenge. Efforts to address fisheries impacts of target species, bycatches, threatened species and the vulnerable ecosystems aspects of Target 6 all were underway well before 2010, when the Aichi Targets were adopted, although a review requested by CBD and FAO in 2011 (**Rice et al., 2011**) concluded that substantial additional efforts would be needed by States, RFBS and the fishing industry, to achieve the intent of Target 6. Hence it is not possible to attribute with any certainty the progress achieved during the current decade (2010-2020) specifically to the actions taken in fulfilment of Target 6 commitments. Nevertheless, the intent of all the Aichi Targets is to improve the status of biodiversity and reduce the adverse impacts of human activities on Nature, so progress on all aspects of mainstreaming biodiversity into fisheries practices (as illustrated in **Friedman et al 2018a**) also contribute to progress towards Target 6.

In terms of trends, between the last quantitative data available (2013) and 2020, the analysis of **Costello et al (2012)** shows, as expected, that the future is tightly dependent on the policy choices (and particularly on the alternative of pursuing purely economic performance (in terms of rent extraction) or maintaining a sustainable level of employment. While the first is likely to be followed id developed nations, the second is more likely to be the choice of developing nations. However, as stated by **Anderson at al. (2015)** there are probably notable exceptions to this "rule".

Blanchard et al. (2018) emphasize how regional and national futures, and thus progress towards meeting global goals (SDGs and hence also Target 6), will depend on developments in: (i) aquaculture and farming; (ii) differences in countries' and sectors' adaptive capacity: (iii) climate change on land and sea, and (iv) changing patterns of wealth, demand and trade. This situation has existed for decades even though drivers have evolved and, despite some progress, has not changed fast enough to face modern globalization challenges. Such situation is very unlikely to change before 2020 and a difference between national and regional reports, in quality and comprehensiveness, must be expected. Paradoxically, it is in the countries were fisheries are more in need of improvement that information on sustainability will be less available and reliable.

Outlook

Friedman et al. (2018) argue that development and on-going delivery of biodiversity mainstreaming through a co-evolution of policy and programmes between the fishery and environment conservation governance streams will continue to progress because of several enabling factors including:

- Growing awareness of (i) Increasing human pressures on biodiversity; (ii) Human-biodiversity interactions in marine social-ecological systems; (iii) The risk of reduction or loss of the ecosystem services needed for economic development, food security and livelihoods; (iv) The fact that conservation without or against People is likely to fail; and (v) the convergence of economic and ecological interest in the longer term;
- The existence of a corpus of international legally binding agreements (e.g. UNCLOS, UNFSA, CBD), policy commitments (e.g. UNCED, WSSD, UNCSD, SDGs), and high-level guidance (CCRF, EAF, Plans of Action) that create the needed enabling environment;

- Growing political support and experience on participatory adaptive management in converging streams of governance for improved mainstreaming of biodiversity in fisheries and improved balance of environmental, social and economic goals;
- Growing consumer demand for certified sustainable fisheries, with lower collateral impact on biodiversity.

Regarding joint progress in conservation and management of marine habitats, there are a number of examples that illustrate large scale processes of biodiversity mainstreaming on ecosystem scales. For example, the United Nations Development Program (UNDP) and the Global Environment Fund (GEF) have provided opportunities for inter-institution and cross-sectoral interactions across 'large marine ecosystems' in Latin America and the Caribbean (**Troya, 2017**).

The growing collaboration between RFMOs and RSOs (promoted by UNEP-CBD and FAO and the SOI program[58]) has also the potential to improve governance towards a more integrated approach to habitats conservation. For example, the North-East Atlantic Fisheries Commission (NEAFC) has adopted recommendations to protect and conserve jointly identified vulnerable marine habitats (**NEAFC and OSPAR, 2015**). This arrangement sees both organisations work within their mandates to mainstream biodiversity and aligns closely with other global initiatives that offer sustainable fisheries management and biodiversity conservation in the areas beyond national jurisdiction (**Friedman et al., 2018**).

However, these factors do not apply equally well everywhere. While the developed world and some advance developing nations are progressing rapidly, most developing nations and Small Island Developing States (SIDS) are struggling to develop implementation capacity and to obtain an equitable share of their resources use.

Significant tensions remain, e.g. in: (i) the short-term trade-off in objectives regarding conservation, economic returns and food security and livelihood; (ii) the different perception of risk of conservation and sectoral institutions and stakeholders, that translates into disparities in preferred actions and outcomes (**Mace and Hudson, 1999**; **Rice and Legacè, 2007**; **Gehring and Rufing, 2008**). The coherence between Aichi Targets and SDGs should facilitate the consideration and, hopefully equitable solutions, at global as well as regional and national levels, enabling collaboration and/or triggering constructive confrontation.

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ANNEX 1: Actions and indicators referred to in the 2016 Expert Meeting

Table 1: Actions and indicators of relevance for *Target species* and *Depleted species.* <u>Policies and Laws</u> aim at sustainable use. <u>Outcomes</u> are as specified in Aichi Target 6.

		1: Policies and laws are in place	2: Management measures in use	3: State	4: Outcome
A: All Target species	Actions	1. International agreements translated into national legislation. 2. National fisheries policy implemented 3. EBFM/EAF in policy documents	1. Capacity management plan. 2. EBFM/EAFM measures. 3. Proper incentives in place. Reliable data on fishing operations and catches with regular stock assessment 4. Controls on fishing capacity & catches	1. Stock status evaluated against relevant benchmarks. 2. Harvested sustainably, within safe (stock) limits	Overfishing avoided
	Indicators	1. Number and coverage of stocks with adaptive management systems / plans 2. Number and coverage of MCS systems in place (including IUU assessment	1. Number and coverage of stocks with effort or catch limits 2. Number and coverage of stocks with capacity to adjust effort or catch levels in relation to status	1. Coverage of stocks sustainably harvested based on assessments of B and F or surrogates; 2. Coverage of stocks within safe limits	1. Coverage of stocks with unknown status 2. Coverage of stocks under overfishing 3. Coverage of stocks that are overfished or depleted
B: Depleted Target species	Actions	Policy goals, legislation and incentives in place for bycatch/discards	1. Recovery plans and measures in place for depleted species, Closures. Mandatory discards reporting or bans. 2. Species status monitored. Discard levels assessed 3. Recovery plans and measures in place, Closures. Mandatory discards reporting or bans. 4. Species status monitored. Discard levels assessed 5. Recovery plans and measures in place, Closures. Mandatory discards reporting or bans. 6. Species status monitored. Discard levels assessed	1. Depleted species are rebuilding towards safe biological limits. 2. Bycatch/discard species within SBL	Trajectory to recovery is secure
	Indicators	Presence of regulations requiring recovery of depleted species	Depleted species designated and with recovery plans developing or adopted	Number and coverage of depleted stocks with rebuilding plan in place	1. Number and coverage of depleted species with $F<F_{Lim}$ 2. Number and coverage of depleted species with increasing biomass

Table 2. Actions and indicators of relevance for *Threatened species* and *Other species.* Policies and Laws aim at sustainable use. Outcomes are as specified in Aichi Target 6. *Threatened species* are species on which fisheries have a significant adverse impact. *Other species* are species not otherwise covered in A, B or C. The state of these species is described strictly in relation to fisheries impact. The impact of other factors is ignored.

		1: Policies and laws are in place	2: Management measures in use	3: State	4: Outcome
C: Threatened Species	Actions	1. Policies make adequate provisions to minimize impacts of fisheries on threatened species. 2. Legal provisions in place.	Protection measures in place. Species status regularly monitored.	Direct and indirect impacts of fishing kept low. Populations are increasing. Conservation status is improved.	No significant[59] adverse impacts of fisheries on *threatened species*
	Indicators[60,61]	1. Policies make adequate provisions to minimize impacts of fisheries on *threatened species*. 2. *Threatened species*	1. % of fisheries for which impacts on threatened species have been assessed 2. % of fisheries that require measures to minimize impacts on *threatened species* that have such measures. 2.b. Coverage of *threatened species* impacted by fisheries for which there are bycatch limits 3. Coverage of fisheries with regular monitoring and reporting of impacts on *threatened species*	Coverage (or range of coverage) of *threatened species* for which mortality rate due to fisheries is decreasing	Coverage of *threatened species* experiencing significant adverse impacts from fisheries
D: Other species[62]	Actions	1. Policies to ensure that fisheries are managed and harvested using ecosystem-based approaches 2. Policies to secure that mortalities and significant indirect adverse impacts on *other species* are accounted for	1. Requirements for reporting on *other species* are in place, including catches and discards 2. Management measures in place to ensure that impact of fisheries on *other species* is within safe ecological limits	Mortalities and significant indirect adverse impacts on other species reduced where they exceed sustainable levels	The impacts of fisheries on *other species* are within Safe Ecological Limits (SEL)
	Indicators	1. Policies to ensure that fisheries are managed and harvested using ecosystem-based approaches in place 2. Policies to secure that mortalities and significant indirect adverse impacts on other species are accounted for are in place	1. Coverage of fisheries with mandatory bycatch reporting (species not covered in A, B or C) 2. Coverage of fisheries with mandatory discards reporting (species not covered in A, B or C) 3. Coverage of fisheries with management measures to reduce bycatch and discards	Trends in population of other species not covered in A, B or C	Coverage of other species within Safe Ecological Limits (SEL)

[59] Further elaboration on the term may be required. The language in the FAO deep-sea guidelines may be used as a model.
[60] Trade related policies and measures not included here as they are more directly addressed in Aichi Targets 3 or 4.
[61] Indirect impacts of fisheries on threatened species (e.g. on habitats) are not included here as they may be dealt with by Group 3 – Ecosystems.
[62] *"Other species"* includes all species that are directly or indirectly impacted by one or more fisheries apart from those that have been identified as *target species* (A and B) or *threatened species* (C). See text for further explanation

Table 3. Actions and indicators of relevance for *Ecosystems,* including *vulnerable marine ecosystems.* <u>Policies and Laws</u> aim at sustainable use. <u>Outcomes</u> are as specified in Aichi Target 6. Indicators refer to fisheries impacts on ecosystems, not to state of the ecosystems in general, which may result from other impacts.

		1: Policies and laws are in place	2: Management measures in use	3: State	4: Outcomes
E: Ecosystem properties	Actions	1. Inventory of potential impacts developed 2. Vulnerable ecosystems identified 3. Policies to manage the impacts in an EBFM/EAF perspective adopted. 4. Legal mandate to adopt, implement, and enforce measures preventing significant adverse impacts exists	1. Measures to monitor ecosystem impacts of fishing and the progress towards the goals below 2. Measures to avoid, minimize, or mitigate significant adverse impacts on structure and function, such as spatial and temporal management, gear management, mesh sizes and minimum landing sizes, aggregate catch limits, to: • Maintain extent, quality and integrity of habitats • Reduce significant adverse impacts of fishing with bottom-touching fishing gears • Reduce bycatch of unmarketable fish and invertebrates. • Reduce discarding. • Reduce incidental mortality on birds, turtles, and mammals and other vulnerable bycatch species • Keep aggregate catches of functional groups from depleting the aggregate units to levels where their function in the ecosystem may be compromised • Measures to minimize loss of gears (littering) and ghost fishing	1. Governance mechanisms in place (ex: management plans, MSP, CBM) 2. Assessment of potential significant adverse impacts. 3. Assessment of ecosystem state (structure, function, important components) 4. Assessment of fishing pressure. 5. Assessment of effectiveness of species management and governance measures	1. Ecosystem impacts reduced to a level within Safe Ecological Limits. 2. Potential for recovery of ecosystem structure and function is enhanced and maintained

ANNEX 2: List of Target 6 indicators in Decision XIII/28

Indicator	Metrics	Available (X). Under development (Y)	Easy to communicate	Can be disaggregated into, or is aggregated from, national data	National data aggregated in global indicators	Used in GBO3/GBO4	SDG indicator	Source
Trends in certified sustainable fisheries	Number of MSC-certified stock	X	X	X		X		MSC
Trends in proportion of depleted, target and bycatch species with recovery plans	N° of countries with regulations requiring recovery of depleted species	X	X		X			FAO
	Proportion of depleted stocks with rebuilding plans in place	Y			X			FAO
Trends in population and extinction risk in target and bycatch species	Red List Index (Harvested aquatic species)	Y						IUCN & Partners
	Number of countries with policies that make adequate provisions to minimize impacts of fisheries on threatened species	X	X		X			FAO
	Proportion of countries with regular monitoring and reporting on impacts of threatened species	Y						FAO
	Proportion of threatened species for which mortality rates from fisheries is decreasing	y						WWF/ZSL
	Number of countries with policies to secure that mortalities are accounted for and kept within SBLs	X	X		X			FAO
	Trends in populations of non-target species affected by fisheries	y						FAO
	Red List index (impact of fisheries)	X	X	X		X		IUCN & partners
	Living Planet Index (trends in target and bycatch species							
Trends in fishing practices	Global effort in bottom trawling	X	X			X		UBC & IOF
	Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing (indicator for SDG target 14.6)						X	
	Amount (spatial extent, gear type, intensity) of fishing effort within vulnerable habitats	X			X			FAO
	Number of countries with ecosystem impact monitoring and/or assessment programmes	Y						FAO
	Number of countries with legislation allowing for actions for the protection of vulnerable habitats (including VMEs), and addressing threats to ecosystem structure and function	X			X			FAO
	Coverage of fisheries with management measures to effectively manage bycatch and reduce discards	X			X			FAO
	Number and coverage of stocks with adaptive management systems / plans	X			X			FAO
Trends in proportion of fish stocks outside SBLs	Proportion of fish stocks within biologically sustainable levels (indicator for SDG target 14.4)	X	X	X	X	X	X	FAO
Trends in CPUE	Estimated fisheries catch and fishing effort	X		X				UBC & IOF
Small-scale fisheries	Progress by countries in the degree of application of a legal/regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries (indicator for SDG target 14.b)						X	FAO

ANNEX 3. SDGs of relevance to fisheries

SDG Target 14.4: *By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated [IUU] fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics.* Indicator: *14.4.1- Proportion of fish stocks within biologically sustainable levels* (related to Aichi Target 6A).

SDG Target 14.6: *By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation.* Indicator 14.6.1: *Progress by countries in the degree of implementation of international instruments aiming to combat illegal, unreported and unregulated fishing* (related to Aichi Target 6A).

SDG Target 14.7: *By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism.* Indicator 14.7.1: Sustainable fisheries as a proportion of GDP in small island developing States, least developed countries and all countries (no echo in Target 6).

SDG Target 14b: *Provide access of small-scale artisanal fishers to marine resources and markets*. Indicator 14.b.1: *Progress by countries in the degree of application of a legal/ regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries* (indirectly related to A through the legal aspect, but Target 6 has no requirement regarding allocation or equity).

SDG Target 14c: *Ensure the full implementation of international law … for the conservation and sustainable use of oceans and their resources by their parties*. Indicator 14.c.1*: Number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments that implement international law, as reflected in the United Nations Convention on the Law of the Sea, for the conservation and sustainable use of the oceans and their resources* (related to Aichi Target 6A)

Reference

United Nations. 2017. Work of the Statistical Commission pertaining to the 2030 Agenda for Sustainable Development. Resolution 71/313 adopted by the UN General Assembly on 6 July 2017. Document A/RES/71/313: 25 p. Available at https://undocs.org/A/RES/71/313