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COMMITTEE ON FISHERIES

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OPPORTUNITIES AND CHALLENGES IN THE HARMONIZATION OF CRITERIA USED TO DEFINE THE STATUS OF COMMERCIALLY-EXPLOITED AQUATIC RESOURCES ACROSS INTERNATIONAL BODIES AND MULTILATERAL ENVIRONMENTAL AGREEMENTS

Executive Summary

This session background document informs Members on proposals by the International Union for Conservation of Nature's (IUCN) for the Red List Index be accepted as a complementary indicator to FAO's fish stocks indicator (SDG 14.4.1) to report on delivery of SDG 14.4.

The IUCN's Red List Index based on Red List assessments offers an assessment of extinction risk of aquatic species. In this document, we report on FAO's understanding of the potential congruence, complementarity and challenges in harmonizing FAO's fish stock status assessments with IUCN's Red List Index assessments.

Information in this session background document was generated as a result of work aligned to the FAO-IUCN interagency working group (FAO-IUCN SDG 14.4 Ad Hoc Technical Working Group) that was established to respond to COFI and COFI Sub Committee Decisions on this issue.

I. BACKGROUND AND SCOPE

1. FAO is a global repository of technical knowledge and expertise on fisheries and aquaculture, and has the technical capacity and mandate to address global fisheries and aquaculture issues. Its goals in fisheries are to support the eradication of hunger, food insecurity and malnutrition, the elimination of poverty, and sustainable management and utilization of natural resources.

2. The International Union for Conservation of Nature (IUCN), composed of government and civil society organizations, has a role to influence, encourage and assist conservation of the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

3. Both FAO and IUCN have well-established advisory frameworks that inform international, regional and national authorities' on issues related to sustainable fisheries management and biodiversity conservation. The information they provide documents the status and risks to marine life (fish stocks and other marine life impacted by fisheries), informs normative adaptive management responses to declines in fish stock abundance below limit reference points, or extra-ordinary management responses in relation to elevated risk of extinction of aquatic species.

4. Multilateral environmental agreements such as CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) receive advice from both FAO and IUCN assessments when CITES Parties are considering whether to establish binding trade regulations under the Conventions' provisions. CITES' controls only come into force once a fish species has been placed on a CITES Appendix.

5. The UN 2030 Agenda for Sustainable Development provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. Within the Sustainable Development Goals (SDGs), targets and indicators have been set to help countries measure progress in maintaining or recovering productive and sustainable marine and terrestrial aquatic systems (SDG 14).

6. In assessing progress of the fisheries target, SDG 14.4., countries need to …*restore fish stocks*…. In this case, progress against SDG 14.4. is measured through the use of FAO's indicator SDG 14.4.1.; '*proportion of fish stocks within biologically sustainable levels*'. The United Nations Statistical Commission's Inter-agency and Expert Group on SDG Indicators (IAEG-SDGs) made FAO the custodian for preparation and delivery of this indicator that charts countries progress in delivery of SDG 14.4..

7. In assessing progress of the SDG biodiversity target, SDG 15.5., countries need to… *protect and prevent the extinction of threatened species.* The IAEG-SDGs has designated IUCN's Red List Index indicator SDG 15.5.1. as the official indicator for charting countries progress in delivery of SDG 15.5..

8. Both FAO's indicator SDG 14.4.1. and IUCN's indicator SDG 15.5.1. are measures designated by the IAEG-SDGs as Tier 1 Indicators, meaning they are measures that are conceptually clear, have internationally established methodology and standards, and where

work on delivery of the indicator is generally relevant and on-going.

9. The breadth of uptake of fishery and biodiversity conservation assessment frameworks can be desirable, however, simultaneous adoption of differing approaches for management and conservation of fishes (often across different government ministries) is recognized to result in an array of overlapping and sometimes conflicting policy and practice.

10. The need for conceptual clarity in assessment frameworks for measuring progress against the fisheries target (SDG 14.4.) has been open to debate. In this arena, IUCN has twice proposed to the IAEG-SDGs that their Red List Index, that assesses shifts in extinction risk of groups of species, be accepted as a complementary indicator to FAO's fish stocks indicator (SDG 14.4.1) for reporting on the restoration of fish stocks (SDG 14.4.). To date Members of the IAEG-SDGs have twice declined this request.

11. FAO and IUCN continue to work together under a 2018 MOU that has a section describing areas of collaboration. It states that the organizations will, 2a) Support the integration of metrics, concepts, terminology and practices across diverse constituencies and clients; 2b) Develop and jointly support knowledge management platforms, communities of practice and decision support tools that are inclusive and support participatory approaches; and 2c) Convene advisory panels in support of the implementation of key policies and strategies.

12. At the request of COFI[1], the FAO Secretariat formed an interagency working group (FAO-IUCN SDG 14.4 Ad Hoc Technical Working Group) in an attempt to build mutual understanding of the complementarity between the FAO 'fish stock status' and IUCN 'extinction risk' indicators, and to assess opportunities for better harmonisation of their various processes in relation to SDG and related international reporting processes. This interagency working group is recognised in the FAO-IUCN 2018 MOU.

13. This FAO-IUCN interagency working group (FAO-IUCN SDG 14.4 Ad Hoc Technical Working Group) met on numerous occasions between 2016 and 2019 to share information on the various assessment approaches for assessing the status of marine fish (stocks and species). The International Council for the Exploration of the Sea (ICES), CITES Secretariat and academia were also invited to provide input to these discussions. A description of the resulting comparison of the various assessment processes in relation to SDG and related international reporting processes is given below.

II. GLOBAL FISH ASSESSMENT PROCESSES UNDER FAO AND IUCN

14. FAO is tasked with making food production sustainable, while making an appreciable contribution to food security, poverty alleviation and human well-being. Despite FAO's fisheries work initially focusing on the subset of biodiversity that is commercially exploited, the adoption of the Malawi Principles in 1998 and the Reykjavik Conference in 2001

[1] Decisions from the COFI process (and links http://www.fao.org/about/meetings/cofi/en/, http://www.fao.org/about/meetings/cofi-sub-committee-on-fish-trade/en/). See decisions: COFI 32: para 138; COFI FT 16: para 24 + 61; COFI 33 para 103; COFI FT 17 para 55.

increased FAO's Members focus to the full extent of species and habitats impacted directly or indirectly by the practice of fishing. This broader outlook for fisheries, as required by the 1982 United Nations Convention on the Law of the Sea (UNCLOS), is described within the FAO Ecosystems Approach to Fisheries (EAF). FAO collaborates closely with RFBs established inside and outside of the FAO Constitution, national fisheries authorities, private fisheries organizations, academic groups, businesses and civil society with an interest in fisheries and aquaculture.

15. IUCN comprises national and state authorities (carrying 50% of the weight of the IUCN's governance), and non-government conservation organizations, indigenous peoples' organisations, academic groups, businesses and civil society with an interest in biodiversity conservation (carrying the other 50%). IUCN mobilizes expert Commissions, of which the Species Survival Commission is the most important in completing extinction risk assessments. More than 140 Specialist Groups, Red List Authorities and Task Forces are active in preparation, direction and oversight of IUCN's Red List extinction risk assessments.

16. In order to compare the FAO and IUCN frameworks, a description each's process is presented side by side in Table 1.

Table. 1. FAO and IUCN assessment activity and reporting, side by side.

FAO	IUCN
Criteria and Assessment Process	
FAO's measures for global and regional assessment of fish stocks have changed from the 1970s and 80s when they were mainly based on surveys, capture production data and catch rates. By the 1990s and 2000s quantitative assessments have more regularly informed the assessment[2], while from 2010 onwards, semi-quantitative assessments, e.g. formal quantitative, model-based assessments together with qualitative opinion-based assessments have been used[3]. FAO's global assessment of fish stock status proceeds either by, i) adopting existing assessment results at the regional or country level with adjustments to FAO's criteria (including assessments completed by FAO's Article VI and article XIV regional fishery bodies and that of Member countries fishery authorities), ii) using a range of data-sources and measures to carry out assessments using qualitative and / or quantitative methods for stocks where traditional stock assessment information is absent, or iii) combining information from these various sources[5].	The IUCN Red List of Threatened Species (hereafter Red List), measures and documents extinction risk of species[4]. Repeating IUCN Red List assessments for whole clades of species yields a Red List Index, a mechanism to track and report trends in the projected overall extinction risk of large sets of species[5]. The IUCN measures for determining the extinction risk of species have evolved from use of subjective expert opinion in the 1960's to more quantitative assessments used today. Red List assessment measures were refined in the 1980s and in 1994 the first Red List Criteria (version 2.3) and Categories were adopted as a system for quantifying extinction risk measures for species. Again in 1997, IUCN reviewed the Red List Criteria and categories primarily to incorporate population decline parameters under fisheries management, which resulted in a further revised version of the IUCN Criteria being adopted in 2000. The IUCN Criteria for classifying extinction risk are supported by documented standards[6].

[2] http://www.fao.org/3/W3244E/W3244E00.htm
[3] http://www.fao.org/3/i2389e/i2389e.pdf.
[4] DOI: 10.1111/j.1523-1739.2008.01044.x; ISBN: 978-2-8317-1063-1; IUCN http://www.iucnredlist.org/documents/RedListGuidelines.pdf; ISBN: 978-2-8317-1435-6.
[5] DOI: 10.1111/j.1523-1739.2006.00410.x, DOI:10.1371/journal.pone.0000140
[6] https://nc.iucnredlist.org/redlist/resources/files/1530703338-RL_Standards_Consistency.pdf.

Criteria and Assessment Process (continued)	
For those stocks without a formal, quantitative assessment, FAO uses a wide range of quantitative and qualitative information to inform stock status classifications. The types and sources of information used include catch and fishing effort trends, size/age composition, spawning potential, and/or abundance indices. FAO also involves local experts as much as necessarily to acquire local information and their opinions and/or to validate certain data sources. In 2019/20 FAO organized the first call for countries to report on their SDG indicator 14.4.1 according to a methodology[7] based on a country's reference list of stocks (described in the FAO SDG14 portal).	The individual measures that comprise an IUCN Red List assessment include, for example taxonomy, geographic range, biology, ecology, population parameters, population trends, threats and conservation action in place. Assessments depend primarily on the stock assessment and its underlying data for assignment of a Red List Criterion when they are available. Red List assessments also allow use of observation, as well as, in specific cases, estimation, inference, projection and suspicion. Information used in Red List assessments need to be reasonably supported and clearly specified and Red List guidelines offer advice to assist assessments[8]. Most of completed marine species Red List assessments were completed using the most recent IUCN criteria, with conversion of the few remaining pre-2001 assessments underway (<1% of the marine fish species assessments).
Coverage by Fish Stocks and Species	
Since the 1970s, FAO has provided a regular description of the global status of commercially exploited fish stocks relative to the conventional fishery reference point MSY[9], an assessment that covers an estimated 70-80% of the global fish catch by weight. This assessment monitors stocks with globally significant capture production (note 23% of world fishing catch by weight is sourced from 10 fish species), but also a number of stocks producing smaller catches	Around 50% of marine fishes (n = 9,651) have now been assessed in IUCN Red List assessments. Marine Red List Index assessments are available only for reef building corals (Order Scleractinia). Other marine Red List Index assessments are not completed, but those in development include tunas and billfishes (Family Scombridae), sharks, rays and chimaeras (Class Chondrichthyes), and groupers (Family Epinephelinae).
Coverage by Area	
Coverage is global. In terms of geographic coverage, major fish stocks are well assessed across Europe (except for the Mediterranean), North America and Western South America. With the exception of Japan, Morocco and South Africa, coverage of fish stocks in Asia and Africa have insufficient information to be well addressed[10].	Coverage is global. IUCN plans to reach 160,000 Red List species assessments as a Barometer of Life[11] (all species) with in excess of 9,651 marine fish species including at least 72 assessments of species known to have fisheries stock assessments[12]. Regional conservation initiatives supported by a variety of national and international institutions have commissioned Red List assessments[13].

[7] https://unstats.un.org/sdgs/metadata/files/Metadata-14-04-01.pdf
[8] http://cmsdocs.s3.amazonaws.com/RedListGuidelines.pdf.
[9] http://www.fao.org/3/a-v9878e.pdf; http://www.fao.org/3/i2389e/i2389e.pdf; https://doi.org/10.1016/j.marpol.2011.10.024; http://www.fao.org/3/I9540EN/i9540en.pdf.
[10] http://www.fao.org/3/i2389e/i2389e.pdf, DOI: 10.1111/j.1467-2979.2011.00435.x
[11] https://science.sciencemag.org/content/328/5975/177.full.
[12] ISBN: 978-2-8317-1435-6, https://www.iucnredlist.org/resources/redlistguidelines.
[13] DOI: 10.3354/meps09545, https://portals.iucn.org/library/node/46290, DOI 10.1002/aqc.2744; https://portals.iucn.org/library/node/46711; https://onlinelibrary.wiley.com/doi/abs/10.1002/aqc.2959; ISBN: 978-92-79-45412-7; https://www.nature.com/articles/s41559-017-0170.

Output Categories	
The FAO global assessment defines the status of fish stocks within one of three status categories: i) Overfished (having abundance lower than 80% of the level that can produce MSY); ii) Maximally sustainably fished (an abundance between 80% and 120% of the level associated with MSY); and iii) Underfished (with a population abundance above 120% of the level corresponding to MSY[14]. The 'underfished' and 'maximally sustainably fished' components combined, specifies the proportion of fish stocks within biologically sustainable levels defined by SDG 14.4.1 indicator of the status of global fish stocks.	The IUCN Red List assessment measures results in marine species being defined in one of eight extinction risk categories: i) Data Deficient; ii) Least Concern; iii) Near Threatened; iv) Vulnerable; v) Endangered; vi) Critically Endangered, vii) Extinct in the Wild; and viii) Extinct. The Vulnerable, Endangered and Critically Endangered categories are collectively termed "threatened" under Red List criteria. The majority of marine fishes assessed and listed as threatened under Red List Criteria, have been listed due to population size reduction measures (~58% Criterion A), while 22% were assigned using Criterion B (Geographic range) and 20% using Criterion D (Population size estimated to number fewer than 50 mature individuals). IUCN Red List categories are fully described in the second edition of the IUCN Red List Categories and Criteria: Version 3.1[15].
Timing of Reporting	
FAO assessment of global fishery datasets are completed every two years[16], and its review of the state of world marine fishery resources is completed approximately every 5 years[17]. FAO's fishery statistics are available through on-line databases with data exploration and extraction functions (http://www.fao.org/fishery/statistics/en). FAO, plus some RFBs and agencies with fisheries interests also disseminate stocks inventories and status data through the 'Fisheries and Resources Monitoring System' (FIRMS) (http://firms.fao.org/firms/en), which now also integrate the Global Record of Stocks and Fisheries (GRSF)[18], the 'FAO Yearbook of Fishery and Aquaculture Statistics'[19]. Additionally the 'Aquatic Sciences and Fisheries Information System' (ASFIS) lists exploited species for fisheries and aquaculture[20].	Red List Assessments are meant to be repeated every 5 to 10 years in order provide a temporal indication of success or failure of conservation action. As Red List assessments of commercially exploited marine species did not start in earnest until 2006, most exploited marine species were assessed less than 10 years ago. However, many assessments of marine fish species are past the 10 years date (35% of species), whereas some others are assessed more frequently. If the 10 year period elapses without re-assessment, assessments are flagged as in need of reassessment, but the most recent assessment is maintained on the Red List as valid. The IUCN Red List is published and freely available on the web[21] with each assessment or reassessment allocated a Digital Object Identifier.
Peer Review of Reporting	
A formal peer review process is in place for the FAO's *State of the World Fisheries and Aquaculture* report, as per FAO policy guidelines for flagship publications[22].	Red List assessments are peer reviewed by IUCN experts that did not take part in the assessment process.

[14] http://www.fao.org/3/i2389e/i2389e.pdf; http://www.fao.org/3/I9540EN/i9540en.pdf.
[15] https://www.iucnredlist.org/resources/categories-and-criteria.
[16] http://www.fao.org/3/I9540EN/i9540en.pdf.
[17] http://www.fao.org/3/i2389e/i2389e.pdf.
[18] https://i-marine.d4science.org/web/grsf/data-catalogue
[19] http://www.fao.org/3/cb1213t/cb1213t.pdf
[20] http://www.fao.org/3/ca5495t/CA5495T.pdf.
[21] www.iucnredlist.org.
[22] http://www.fao.org/3/a-i7429e.pdf.

III. CONGRUENCE, COMPLEMENTARITIES AND CHALLENGES ACROSS FAO AND IUCN APPROACHES

Recognising overlaps in the remit of FAO fisheries and IUCN biodiversity conservation assessments as illustrated in the comparison of these processes and their resulting reports above, the following section summarises congruencies, complementarities and challenges that arise.

Congruence

17. **Convergence around Sustainable Harvest**: The UN Committee on Fisheries (COFI) adoption of an ecosystems approach to fisheries in the early 2000's, formerly expanded the fishery sector's outlook beyond target resource species, to include a wider range of lifeforms directly or indirectly impacted by fishing[23]. Meanwhile IUCN's adoption of sustainable use policies at a similar time[24] emphasizes a more inclusive approach by officially recognizing the long term value of 'sustainable' and 'beneficial' use of biodiversity that provides economic incentives for better custodianship of species or habitats.

18. **Common Data Sources and Results**: The data that inform both the assessments of exploited fish stock status and extinction risk of marine fish species mostly originate from a common source, the fishery sector (See Appendix 1.). Additionally, fishery independent data, such as habitat status are also used as a proxy for population decline by IUCN, particularly in cases where population trend data are unavailable or missing across a species distributional range.

19. **Widespread Use of Knowledge Products**: FAO and IUCN knowledge products are widely used by national and international audiences with their advice considered credible and legitimate.

Complementarities

20. **Focus on Fisheries Species compared to Biodiversity**: FAO and IUCN assessments both cover marine fish, but FAO assessments are predominantly based on targeted stocks and bycatch, while IUCN assessments cover a wider range of fish, including those that are not the focus of fisheries (see Appendix 1.).

21. **Assessment Outputs have Differing but Overlapping Uses**: FAO's fish stock assessments are used to inform policy and operational management of fish stocks by informing managers of fishery performance against target and limit reference points. IUCN Red List assessments highlight extinction risk that are intended to inform conservation action, while Red List Indices reveal shifts in extinction risk for clades of species (a group of taxa descendant of a common ancestor).

Both FAO and IUCN highlight species approaching or exceeding reference points where sustainability is or could be compromised, and both inform global and more local decision making in order to maintain long term productivity of fish stock(s)/species. Whereas determination of extinction risk is not a standard process in management of commercially exploited fish stocks outside of the collaborations with the biodiversity conservation, fisheries managers generally seek to adjust management measures for *any* stock or population experiencing overfishing (if the trend in fish stock biomass is consistently below MSY).

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[23] https://academic.oup.com/icesjms/article/62/3/311/658728; DOI 10.1079/9781845934149.0000; https://www.iucn.org/sites/dev/files/content/documents/2018._friedman_et_al._mainstreaming_biodiversity_concerns_in_fisheries_0.pdf.

[24] IUCN Resolution 2.29 in its World Conservation Congress in Amman in 2000 (https://portals.iucn.org/library/sites/library/files/resrecfiles/WCC_2000_RES_29_EN.pdf).

22. **Use of Precautionary Approaches**: By theoretical necessity, the choices of thresholds that delimit status assessments or categories of extinction risk are somewhat subjective, as they divide a continuum of possible results into different and definitive categories. On occasion, the result of an assessment spans thresholds between categories. Explicit guidelines on risk tolerance are needed in dealing with uncertainty amongst data sources, and to guide reporting when an assessment arrives at an inconclusive result (e.g. spans status or extinction risk categories). Both FAO[25], Red List and related assessments[26] adopt precautionary approaches in their assessment frameworks.

Challenges (mis-alignments or conflicts)

23. **Differences of Community of Practice**: Separation between each sector's participants (public and professional) can lead to disconnected rather than collaborative decision-making. For the most part, national fishery and biodiversity conservation authorities are not amalgamated across country or regionally based governance frameworks, resulting in a general lack of awareness and acceptance that fisheries also has a conservation-related mandate, and conversely, that the biodiversity conservation sector has an active focus on sustainable use.

24. **Differences in Units of Assessment**: Fisheries units of assessment are defined as a combination of species and stocks, since these usually corresponds to the units defined for management. This allows for one stock of a particular species to be differentiated from another stock of the same species that might have different status profiles. Conversely, IUCN Red List extinction risk assessments are conducted at a level of species. This is based on the premise that loss of an entire species cannot be recovered (note that some Red List assessments are undertaken at national and regional scales[27]).

25. **Timing of Assessments**: There is often a mismatch in the timing and therefore a perception of disparity in advice from fisheries and Red List assessments. Because of the fisheries sector's interest in optimizing annual catches in the long term, data acquisition, assessment and publication of stock assessments are done or updated either every year or within a cycle of 2-5 years, whereas Red List assessments are typically not completed as regularly (valid for a maximum of 10 years). The recognized delays that are a common challenge for both sectors, due to limited access of both capacity and resources, can result in assessment reports that are out of step with one another[28].

26. **Use of Rate versus Absolute Number in Assessment of declines**: The most frequently used criterion for Red List assessments of marine fish, Criterion A, assesses population decline as the main path to extinction; a rate based approach *independent of total population abundance* is used to estimate change. The Red List Criterion A measures declines over ten years or three generations (whichever is longer) and thus by taking into account the generation length of the species operates on

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[25] http://www.fao.org/3/V8045E/V8045E00.htm; 1995 Straddling Fish Stocks Agreement-Article 6 (http://www.un.org/ga/search/view_doc.asp?symbol=A/CONF.164/37&Lang=E).
[26] https://digitalrepository.unm.edu/nrj/vol39/iss2/2/; ISBN: 2-8317-0810-9; https://www.cites.org/sites/default/files/eng/com/ac/25/E25-10.pdf; http://www.iucnredlist.org/documents/RedListGuidelines.pdf; and CITES Conf. 9.24-Annex 4 (https://cites.org/sites/default/files/document/E-Res-09-24-R17.pdf).
[27] https://doi.org/10.1016/j.marpolbul.2015.11.033; https://www.nature.com/articles/s41559-017-0170; https://www.iucn.org/sites/dev/files/import/downloads/overview_of_the_conservation_status_of_the_marine_fishes_of_the_mediterranean_sea_rep.pdf; https://www.nature.com/articles/35002183; https://stri-apps.si.edu/docs/publications/pdfs/Linardich_et_al_2018_Caribbean_shorefishes_Red-List-Aquatic-Conservation.pdf.
[28] The IUCN Atlantic Bluefin Tuna assessment published in 1996 and more recently in 2011 is now out of step with fisheries understanding of stock status.

times scales relative to the ability of population to replace itself. Under Criterion A of the Red List a globally distributed marine fish species, which is not shown to be exhibiting range contractions and which numbers in the millions of individuals can yield an assessment of the species as threatened with extinction[29]. FAO and fishery sector assessments characterize change in abundance relative to an unexploited, baseline/reference biomass and in relation to target abundances such as would ensure long-term productivity of the fish stock (MSY).

For a small number of cases, the fishery sector argues that the risk of extinction articulated by Red List assessments differs to that derived from fisheries metrics of status[30]. The differing approaches adopted by FAO and IUCN present two particular challenges. The first divergence between the two assessment is in the early history of exploitation, when abundant stocks are under high fishing pressure aimed at maximizing the productivity of the stock (i.e. fishing down the population to achieve MSY; Fig 1, point 1 at the start of panel B), where FAO's assessment will show a healthy stock where fishing is encouraged to boost production, and in contrast, IUCN's assessment might consider the stock at risk. Although assessments at this point in the trajectory of a declining stock can set up differing assessment outcomes between fishery and Red List assessments, this situation is less a common occurrence now as most accessible commercial fish stocks have already been exploited for some time. However, the United Nations Convention on the Law of the Sea (UNCLOS, 1982) notes: "…State(s) must set an allowable catch, based on scientific information, which is designed to maintain or restore species to levels supporting a maximum sustainable yield (MSY)." Therefore for some short lived fish stocks that periodically experience periods of high productivity (e.g. Peruvian anchoveta, *Engraulis ringens*), situations where fish are at great abundance and experience short 'fishing down' periods where large percentages of the population is removed are still common.

The second challenge occurs when a stock is overfished but remains stable at low total abundance (Fig. 1, point 3 start of panel D). For this challenge, Red List assessments may categorize depleted but very slowly declining or long stable species as of 'Least Concern' (not threatened), even when they are well below fishery limit thresholds and still of high concern under fisheries management approaches. Real world examples are seen in Appendix 2., Fig. 2ab.[31], and include the common ling, *Molva molva* that remains Least Concern on the European Red List.

27. **Awareness and Communication**: General awareness of both fishery and biodiversity conservation assessment approaches could be improved. For example, advice on how to interpret FAO fisheries status assessments is regularly not followed, resulting in 'overfished' and 'maximally sustainably fished' assessment categories being represented together as overfished when this is an incorrect representation. In the case of the Red List, use of available advice on application of Criterion A[32] could be better communicated. This mirrors the situation for understanding and use of the footnote of Annex 5 that is part of the CITES listing criteria[33].

The FAO-IUCN interagency working group recognized that information on the broad scope and range of fisheries assessments (Cochrane 2002) and Red List processes continues to be an ongoing task. An example of an IUCN function not well known by fisheries is the existence of the IUCN Standards and Petitions Sub-Committee that has been explicitly set up to answer inquiries about

[29] https://www.iucnredlist.org/species/39370/117721799 for Silky shark, *Carcharhinus falciformis*; also see discussion on Hawksbill turtle *Eretmochelys imbricate* in https://core.ac.uk/display/47195739.
[30] https://academic.oup.com/icesjms/article/64/4/718/639981.
[31] http://dx.doi.org/10.1098/rspb.2013.2935; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3413007/; https://www.nature.com/articles/s41559-017-0170; https://www.ices.dk/sites/pub/Publication%20Reports/Advice/2018/Special_requests/eu.2018.26.pdf.
[32] http://www.iucnredlist.org/documents/RedListGuidelines.pdf especially sections 5.4 - 5.6.
[33] https://cites.org/eng/res/09/09-24R16.php see *Application of decline for commercially exploited aquatic species.*

assessments (e.g. petitions to the IUCN on up-listing and down-listing of Red List decisions[34]).

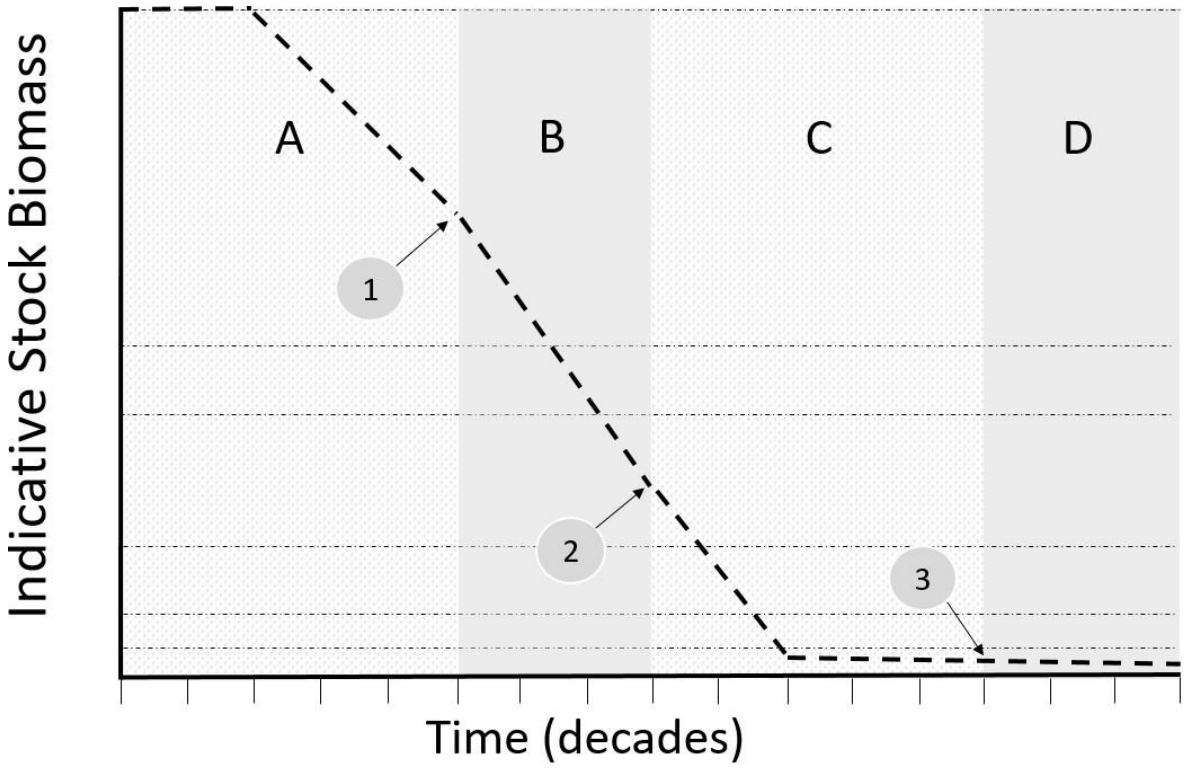

Fig 1. Conceptual graph for fish population where the species had a generation length of five years, showing alignment (and misalignment) between assessments of fish status and extinction risk. Hypothetical description of a fish population's biomass response to fishing (dotted line), with vertical Panels (A-D) and Points (1-3) showing congruence, complementarity and differences between fishery and environment (IUCN Red List and CITES) focused assessments. In Panel A there is congruence across assessments (a 'hit') as fisheries assesses stocks as not-overfished (B>BMSY) and IUCN Red List thresholds for the threatened categories, and CITES criteria are not met. Arriving at Panel B (Point 1) a 'miss' might occur as fisheries continue to assess stocks as not-overfished (at B>BMSY), while for the IUCN Red List criteria the decline of 30% within the ascribed rules results in an assessment as threatened. In Panel B differential assessment outcomes continue until stock declines reach Point 2 and enter Panel C, where the stock biomass falls below the fisheries threshold (B<BMSY). In Panel C another 'hit', as both fisheries and Red Listing yield complimentary assessments, where the outcome is concern for the status of stocks (categorization as both over-fished and threatened). In Panel C, the CITES criteria might also be met if the fish stock biomass falls to below 5-20% of baseline (depending on inherent productivity of the species). On reaching Point 3 and Panel D another 'miss' could occur, as fisheries continues to consider the fish stock overfished (potentially depleted or collapsed), while Red List assessments may in time revert to Least Concern when the ascribed rules relating to the inherent productivity of the species are taken into account.

[34] https://www.iucnredlist.org/resources/rules-of-procedure see Annex 5.

IV. KEY FINDINGS AND POLICY RELEVENT RECOMMENDATIONS ON USE OF VARIOUS ASSESSMENT /

28. Data and advice on the stock status and extinction risk of fishes continues to be an urgent information need for a wide range of user and management groups. It is important both fishery and biodiversity conservation sectors recognize the relationships between fisheries and marine biodiversity, as overfishing can erode ecosystem function, and sustainable management of fisheries and aquaculture using an ecosystems approach can positively *contribute* to biodiversity conservation.

29. Both today and in the historical record, IUCN characterizes 'biological resource use' (overexploitation) as the principal threat to marine organisms (followed by habitat loss and, to a lesser extent, pollution and climate change). This ranking of threats originates largely from Red List assessments. It needs to be considered that the partitioning of pressures in Red List assessments is often less straight forward for aquatic environments than on land. Data measuring the differential impacts of pressures is often not accessible and the partitioning of threats is reliant largely on expert opinion (without quantitative or experimental data to evaluate the differential impacts of the full range of threats).[35]

30. Fisheries in marine systems differ markedly from food production on land. Land-based food production has dominated terrestrial environments due to millennia of land modifications, use of chemical controls and additives that are used to limit unwanted pests or boost productivity. In contrast, broad scale exploitation of marine fish is relatively recent[36], is conducted without supplement across largely unchanged natural and habitable space that is 600 times larger than the terrestrial biosphere. These differences, beyond the different life histories and habits of marine and terrestrial species, have significant implications for the risk profile of fisheries to marine species.

31. Despite marine systems having a very low proportion of fishes listed as threatened on the Red List (IUCN Red List assessments document extinction risk of teleost fishes to be the lowest of all species groups[37]), there is no room for complacency as FAO's global fish stock assessment shows that capture production has slowed and stabilized, and the proportion of fish stocks sustainably exploited is declining below 70% — from 90% in the 1970's (see Appendix 1.).

32. Red List assessments record 660 species as having become extinct in the past two decades (2000-2019), with none of these losses being teleost fish that spent their life in the sea. In fact, up until 2020, no fully marine fish has been recorded as going extinct due to fishing in the last few hundred years[38]. Yet in 2020, the IUCN Red List published an assessment that the Smooth Handfish was 'Extinct'[39] — the first modern-day marine fish extinction. This extinction of a benthic Australian fish species, known only from *a single specimen* collected about 200 years ago (holotype from 1802) is attributed to the category, 'Biological resource use' (fishing and harvesting aquatic resources) — the first fully marine teleost every to be designated as extinct due to fishing. Experts who completed this Red List assessment have advised FAO that the threat codes for 'Habitat change' and 'Pollution'

[35] Vié, J.-C., Hilton-Taylor, C. and Stuart, S.N. (eds.) (2009). Wildlife in a Changing World – An Analysis of the 2008 IUCN Red List of Threatened Species. Gland, Switzerland: IUCN. 180 pp.. Threats in Red List documentation are partly a reflection of the scientific understanding of the time, so recently recognized impacts such as climate change are likely underrepresented.
[36] https://www.sciencedirect.com/science/article/pii/S0308597X18300605.
[37] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3413007/pdf/srep00561.pdf; https://ipbes.net/global-assessment
[38] https://onlinelibrary.wiley.com/doi/abs/10.1046/j.1467-2979.2003.00105.x; https://science.sciencemag.org/content/347/6219/1255641.full.
[39] https://www.iucnredlist.org/species/123423283/123424374.

have been requested to be added alongside 'Biological resource use', as they believe that this would more accurately reflect their assessment. There has been no change in the published Red List assessment for the Smooth Handfish at the time of writing his background paper (October 2020).

33. For marine fishes, IUCN Red List assessments reveal a higher extinction risk for cartilaginous sharks and rays (elasmobranchii) that have life history characteristics and fishery interactions that result in their having an extinction risk profile similar to that of terrestrial mammals. In addition, fresh and brackish water fishes are a highly threatened group, as they face the synergistic pressures from habitat modification, fragmentation, and destruction, invasive species, overfishing, environmental pollution, agricultural and forestry practices, and climate change.

34. Historically, fisheries governance has responded to concerns over the long-term productivity of fisheries by pivoting away from a focus on fishery development to a greater focus on management and conservation[40]. In cases where fish stocks are depleted or collapsed FAO Members, within the ecosystem approach to fisheries framework, have the responsibility to rebuild stocks under international instruments (UNCLOS, UN Fish Stocks Agreement and SDGs) and have established International Plans of Action (with related National Plans of Action) and fish stock recovery plans supporting fishery rebuilding plans[41].

35. Variation in the alignment of FAO and IUCN assessments has been the subject of discussion for some time. FAO staff in the FAO-IUCN interagency working group confirmed that there was both coherence[42] and inconsistencies[43] in the process and outcomes of the assessment approaches (see Fig. 1. and Appendix 2., Fig. 2ab).

36. Recognizing the need to ensure FAO and IUCN assessment frameworks and reports can inform both the management of marine fisheries and effective prioritisation of threatened species conservation, three areas of opportunity for continued work on coherence become apparent:

> **Strengthening of cross-sectoral dialogue and cooperation**: To work towards more coherence, joint objectives could be defined in cross-sectoral agreements (e.g. FAO-IUCN MOU 2018; FAO-CITES 2006 MOU), and implementation could be practically facilitated through the use of cross-sectoral working groups (e.g. like the FAO-IUCN Working Group on SDG 14.4.).
>
> **Continued evolution of assessment approaches**: Increase the clarity of assessment advice, delivered at spatial scales aligned with recognised management and reporting responsibilities. Further evolution of international reporting requirements are already foreseen under new post-2020 Convention on Biological Diversity reporting requirements, with a need to extend

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[40] https://www.sciencedirect.com/science/article/pii/S0308597X17305444?via%3Dihub.
[41] http://www.fao.org/fishery/code/ipoa/en; http://www.fao.org/3/ca0161en/CA0161EN.pdf; http://www.fao.org/3/ca0342en/CA0342EN.pdf.
[42] https://onlinelibrary.wiley.com/doi/book/10.1002/9781118392607; https://www.sciencedirect.com/science/article/pii/S0308597X17305444?via%3Dihub.
[43] https://conbio.onlinelibrary.wiley.com/doi/10.1111/j.1523-1739.1991.tb00119.x; Isaac, N., and Mace, G. M. 1998. The IUCN Criteria Review: report of the scoping workshop. IUCN Species Survival Commission, Gland, Switzerland. 34 pp.; https://www.researchgate.net/publication/226985313_Vulnerability_and_body_size_Tetrapods_versus_fish; https://www.researchgate.net/publication/227704618_The_Consistency_of_Extinction_Risk_Classification_Protocols; https://www.int-res.com/abstracts/esr/v6/n2/p155-159/; https://core.ac.uk/display/47195739; https://conbio.onlinelibrary.wiley.com/doi/pdf/10.1111/j.1523-1739.2008.01044.x; https://www.sciencedirect.com/science/article/abs/pii/S0006320710000546; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3413007/.

descriptions of fish populations to descriptions of whole ecosystems[44].

Clearer communication of advice: Assessments should note i) the full range of information both considered and used in assessments, with 'quality' indicators and clarifying notes on why information was considered valid or discounted; ii) how precautionary principles were applied, and iii) how all parts of any mandated criteria were addressed. Better cross-sectoral collaboration on documentation of assessments is especially important for promoting orderly discussion when FAO and IUCN assessments appear contradictory, to limit loss of trust of managers and the public (including unnecessary damage to markets of fish and fish commodities).

37. Currently FAO's and IUCN's parallel and sometimes overlapping decision frameworks for considering fisheries and biodiversity conservation exist, and are influential in public debate. As the same countries have signed international agreements to cooperatively achieve conservation goals, managers require clear and un-biased advice to guide their decision making rather than parallel and often confusing processes and messaging.

38. There is a biological and ethical imperative to reverse overfishing and risk of extinction , noting that long-term resilience of species and ecosystems is a prerequisite for sustainable development of a world where the population is projected to reach over 9 billion by 2050.

39. In the respective assessments of FAO and IUCN, many similarities in the design of components and in their implementation (in strategic vision, data sources, delivery of information, and management acceptance) were noted. The differences (in purpose, depth vs breadth, and risk tolerance), where complementarities are challenged by differences in approach (communities of practice, units of measurement, timing of assessments, consideration of rates vs absolute numbers, and communication) can and have resulted in delivery of incompatible or contradictory advice.

40. FAO and IUCN need to continue to foster trust and understanding between information providers and decision makers and increase the durability of management decisions. This is strengthened by the legitimacy and social robustness of inter-sectoral relationships that need to be strengthened so as to jointly promote the overlapping aims of fisheries and conservation sectors.

41. The initial aim of the FAO-IUCN Working Group on SDG 14.4 was to publish a joint report of FAO-IUCN interagency working group discussions in a reputable scientific journal. Unfortunately differences between the authorship team on the scope, content and conclusions of the draft paper that was prepared, made joint publication of this report not possible.[45]

42. Considering both the synergies and differences outlined in this document (and para 36 above), the formalising of cross-sectoral dialogue; continuation of evolution of assessment frameworks; and cooperation on jointly communicating advice by both FAO and IUCN could be seen as potential positive steps to strengthening the effectiveness of this collaboration — for the purposes of securing the ultimate aim of both fisheries and conservation sectors; *healthy and productive aquatic systems*.

[44] see 'safe ecological limits' as part of Convention on Biological Diversity Aichi Target 6 and Aichi Target 11 - for Other Effective Area Based Management criteria and guidance.

[45] There was contradictory advice by the authorship team on whether the Red List Index was a suitable complementary indicator for SDG 14.4.

Appendix 1. General, Fisheries and FAO and IUCN data, side by side.

Category	Estimate	Percent of Aquatic Fish Species	Reference and comments
General			
Aquatic Fish Species	~35,519	100%	Catalogue of fishes, version of June 2020. FishBase lists 33,932 species. World Wide Web electronic publication. www.fishbase.org, version (06/2018).
Marine and Freshwater Fish Species	~18,179 Marine ~17,907 Freshwater	Current estimates	Data from Catalogue of fishes, June 2020 version. Marine and freshwater advice from Nicolas Bailly (pers. comm. 2020). <100 brackish water species not included.
Exploited (or otherwise impacted by fishing) Marine and Freshwater Fish Species	~8,817	~26%	From ASFIS List of Species for Fishery Statistics Purposes, and International Standard Statistical Classification of Aquatic Animals and Plants codes (ASCCAAP) that recognize 6,606 marine and 2,422 freshwater species items (as per ASFIS definition that includes12,751 species items, including "sp.", "spp." or other levels).
FAO and Fisheries			
Exploited Fish *Stocks* Assessed through Formal Stock Assessments	295 – 560 stocks (146 spp.)	>1%	Ram Legacy database. Note: Global capture production from fish stocks is highly variable, with just ten species contributing almost 30% of global catches by weight. In 2015, 77.4 percent of stocks of these species were fished was within target range (less than or equal to MSY).
Exploited Fish *Stocks* in FAO SOFIA Assessment of Stock Status	441 (stock here refers to taxon by FAO Area)	>1%	See http://www.fao.org/3/a-y5852e.pdf. Also see figure 14 and data in Table 3. of FAO, 2018 - 1591 stocks. These stock numbers can alter very slightly with each iteration, depending on the availability of data.
Inventory of fish stocks disseminated through the Fisheries and Resources Monitoring System (FIRMS)	1480 stocks inventoried (Marine)	= 0.5 % (209 marine fish species)	See http://firms.fao.org/firms/en. Inventory of stocks submitted by 21 Regional Fishery Bodies, and published with stock status reports for 65o stocks. Search status for the 248 species (209 Fish, 39 other taxa), at http://firms.fao.org/firms/summaries/en
Global Record of Stocks and Fisheries (GRSF), a new component database of FIRMS	More than 1400 Stocks published with unique identifiers (Marine)	> 1.5% (534 marine fish species ASFIS codes, including genus or family levels)	See GRSF catalogue https://i-marine.d4science.org/web/grsf/data-catalogue. GRSF disseminates under the FIRMS governance umbrella stocks inventories and stock status data collated from FIRMS, Ram Legacy and FishSource global databases, and publishes them with Unique Global Identifiers. – 1400 stocks currently published. Once resolved all unique identifiers, the total number of stocks is likely to amount to between 2000 and 2400 stocks.
Exploited Fish *Stocks* Assessed through 'Other' Assessment Processes	Not all documented – see examples in reference and comments	Unknown	https://marine.rutgers.edu/~ojensen/Documents/Branch_etal_2011_ConBio.pdf - 1938 stocks (855 taxa reported at the species, genus or family level); https://science.sciencemag.org/content/338/6106/517.full - 1793 stocks (552 spp, 17 genera, 3 families); and https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/conl.12363 - 785 stocks; ICES Area full stock assessment - 107 stocks and >150 stocks completed through 'other' assessments using data limited methods - 94 stocks using secondary information

			(abundance in surveys, life characteristics, production models to enhance knowledge base, and a further 66 stocks by catch or bycatch only.
IUCN Red List and CITES			
Marine and Fresh Water Fish Species on Red List	~16,803	~49%	Numbers of species by major groups of organisms (1996–2018) from IUCN Red List summary statistics. Note, i) the Red List is dynamic with assessment efforts initially focused on those species that are likely to be threatened, with on-going additions through time, and ii) some species are assessed as Data Deficient, making threatened status difficult to assess.
Red List assessments of Marine Fish Species	~8,698	>25	Freshwater 5,685 species assessed (Dr William Darwall pers comm.)

Appendix 2. Fish stock examples for Atlantic Bluefin tuna and Mediterranean swordfish that present real world examples of situations described in Figure 1.

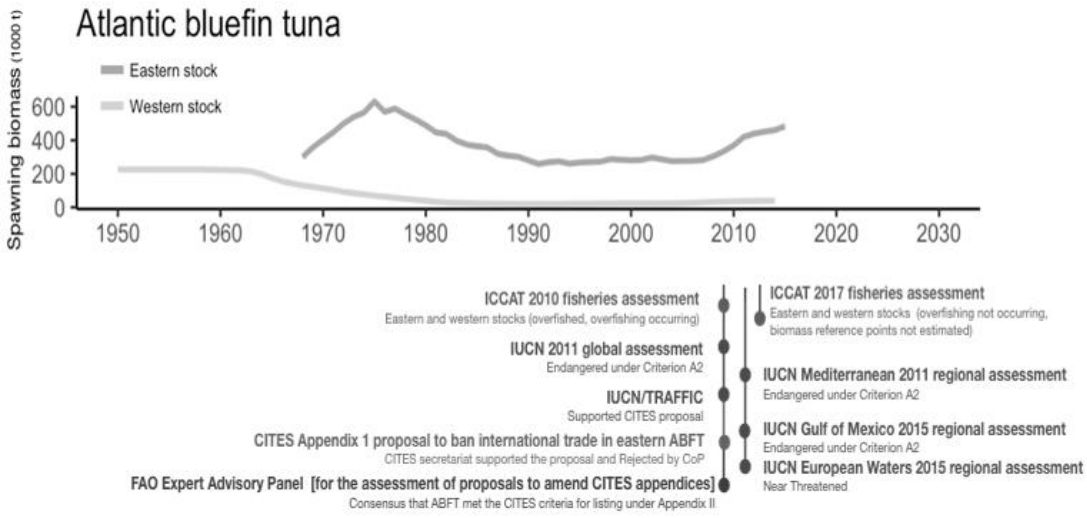

Fig. 2a. Atlantic bluefin tuna (*Thunnus thynnus*) biomass indicator (spawning stock). This figure offers a real world example of a 'hits' and 'misses'. A 'hit' occurring in 2010-2011 when fisheries assessed both stocks overfished (ICCAT fisheries assessment) and the IUCN Red List[46] assessed them as Endangered. A CITES Appendix II listing proposal was lodged in 2009, for which both FAO and IUCN agreed that CITES criteria had been met, however CITES Parties voted not to list the species under the convention in 2010. A 'miss' is set up due to differential temporal and spatial regularity of assessments made across sectors; Fishery assessments completed biennially since the 1970s, with assessments in 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010 mostly reporting stocks as overfished with overfishing continuing, however stock assessment from 2014, 2016 showing stocks as not overfished, with no overfishing occurring. This now sets up a mismatch with the 2010 global Red List assessment of *Thunnus thynnus*. Regional assessments offer more complementarity; the IUCN Red List European 2015 assessment[47] resulted in a not threatened assessment (Near Threatened), however the IUCN Red List Mediterranean 2011 assessment[48], which remains valid, assesses the stock as Endangered. The improvement in the European status assessment from Endangered to Near Threatened reflects the apparent recovery in spawning biomass for the eastern stock as reflected by the 2012 and 2014 and 2017 ICCAT fishery assessments. The IUCN Red List Gulf of Mexico 2015 assessment[49] retained a threatened categorisation (Endangered), which reflects the slow recovery in the spawning stock biomass for the western stock as reflected by the 2012 and 2014 and 2017 ICCAT fishery assessments.

[46] http://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T21860A9331546.en.
[47] Collette, B.B., Fernandes, P. & Heessen, H. (2015) *Thunnus thynnus* (errata version published in 2016). The IUCN Red List of Threatened Species 2015: e.T21860A97778482.
[48] Di Natale, A., Collette, B., Pollard, D., Juan Jorda, M., Miyabe, N., Kada, O., Nelson, R., Chang, S., Fox, W. & Uozumi, Y. (2011) *Thunnus thynnus*. The IUCN Red List of Threatened Species 2011: e.T21860A9330380.
[49] Collette, B.B., Wells, D. & Abad-Uribarren, A. (2015) *Thunnus thynnus*. The IUCN Red List of Threatened Species 2015: e.T21860A76599358.

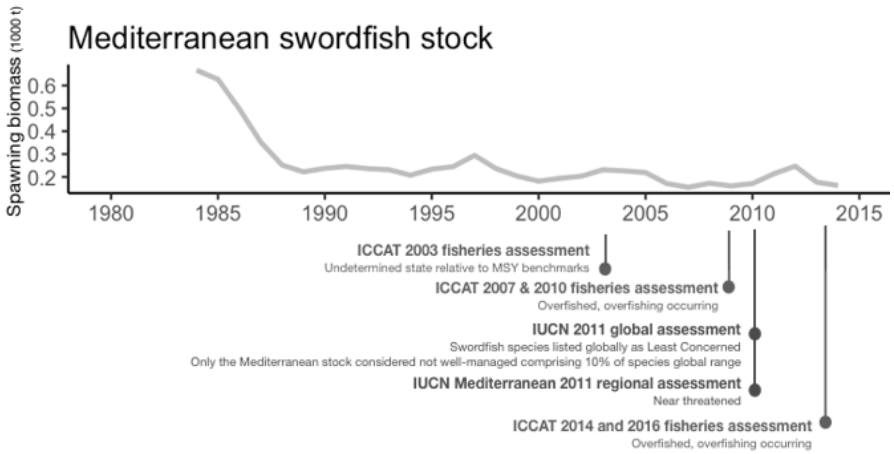

Fig. 2b. Mediterranean swordfish (single stock of a global population) biomass indicator (spawning stock). This figure offers a real world example of a 'miss' between fisheries status and a regional IUCN Red List assessment, as seen in Point 3 Panel D of Fig. 2a and of differing temporal and spatial approaches taken across sectors. The 'miss' occurs as the Mediterranean stock is assessed as overfished and experiencing overfishing by fisheries (ICCAT) while the IUCN Red List regional Mediterranean assessment[50] resulted in a non-threatened status ("Near Threatened"). ICCAT assessments in 2007, 2010, 2014, 2016 all stated that the Mediterranean stock was overfished and suffering overfishing, with a minimum landing size, bans on certain gears and a recovery plan put in place. The IUCN Red List 2011 Global assessment[51] resulted in a non-threatened status for the global swordfish population ("Least Concern"), but flagged that the Mediterranean stock was not being well-managed, yet it represented 10% of the species global coverage.

[50] Di Natale, A., Bizsel, C., Masuti, E. & Oral, M. (2011) Xiphias gladius. The IUCN Red List of Threatened Species 2011: e.T23148A9420041.

[51] Collette, B., Acero, A., Amorim, A.F., Bizsel, K., Boustany, A., Canales Ramirez, C., Cardenas, G., Carpenter, K.E., de Oliveira Leite Jr., N., Di Natale, A., Die, D., Fox, W., Fredou, F.L., Graves, J., Guzman-Mora, A., Viera Hazin, F.H., Hinton, M., Juan Jorda, M., Minte Vera, C., Miyabe, N., Montano Cruz, R., Masuti, E., Nelson, R., Oxenford, H., Restrepo, V., Salas, E., Schaefer, K., Schratwieser, J., Serra, R., Sun, C., Teixeira Lessa, R.P., Pires Ferreira Travassos, P.E., Uozumi, Y. & Yanez, E. (2011) Xiphias gladius (errata version published in 2016). The IUCN Red List of Threatened Species 2011: e.T23148A88828055. http://dx.doi.org/10.2305/IUCN.UK.2011-2.RLTS.T23148A9422329.en.