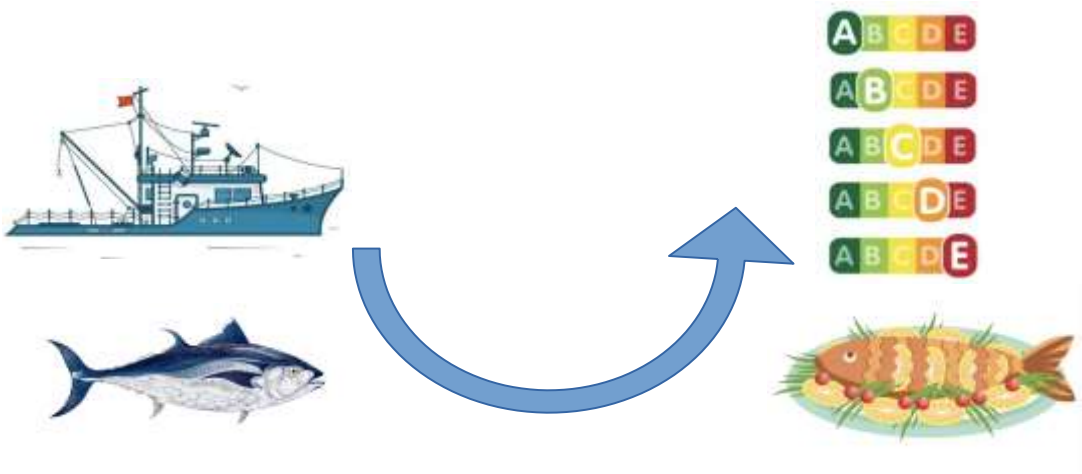
REPORT TO THE COMMISSION

Ad Hoc Report 2350

Operationalising the indicator on stock status developed under EWG 22-12



October 2023

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EXECUTIVE SUMMARY

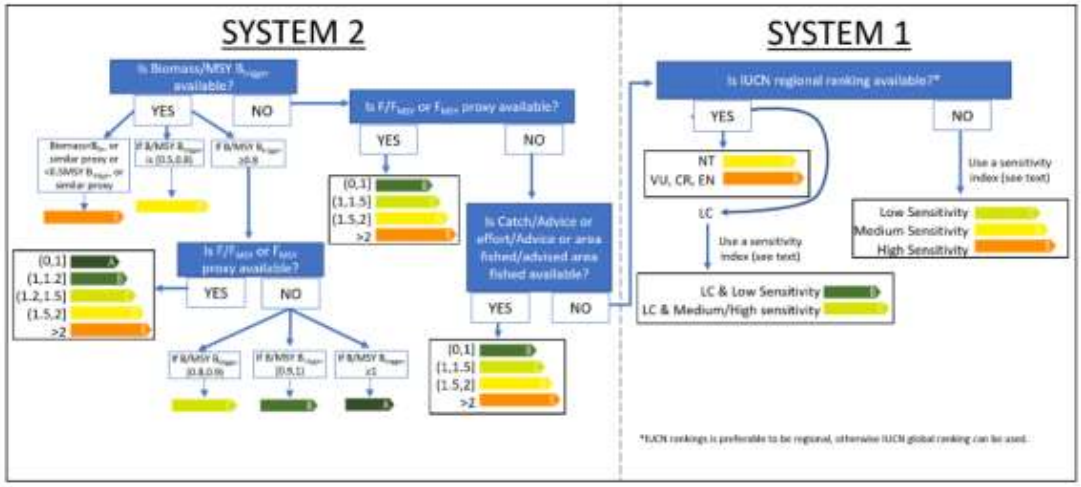
EWG 22-12 STECF working group defined a decision tree to incorporate sustainability aspect in the marketing standards. This decision tree aims to provide a score for each fishery products. It's based on quantitative and qualitative information. Quantitative information from stock assessment, if available, will be prioritized and will be used in the system 2 part of the decision tree. If quantitative information is not available, system 1 will be used. Using first IUCN regional assessment, secondly IUCN global assessment and thirdly a sensitive species list (regionally if available, globally otherwise).

To operationalize this decision tree, data sources were defined and data gathering method proposed regarding each data source in this report.

An R package has been developed, as a pilot tool:

- to concretely create and populate the database that could support the decision tree.
- to use this database for operationalizing the decision tree.
- to propose a user interface for the grading process.

The use of a scripting software to develop this pilot tool aims to propose a handover from fisheries experts and consortium team that will be engaged to develop the final tool.



KEY FINDINGS

This report describes a prototype of a tool operationalizing the stock status indicator for global seafood, based on a support database that can be updated regularly.

The database includes online data from the IUCN Red List, ICES Stock assessment, Stock SMART NOAA database and Balance Capacity STECF working group database.

For stocks without this type of data, data on Catch, Catch Advice, Effort and Effort advice by stock was available from pdf reports on individual stocks. The collection of this data was time consuming, and here as an example, a subset of data concerning 20 stocks was included to operationalize this part of the decision tree proposed. The process to collect the data from ICES has been described in this document but a more automatic approach should be discussed with stock assessment providers.

For species and areas where nor stock assessment, nor catch and effort advice is available, stock status indicators were derived from IUCN species indicators. Where these were not available, the last information used is the regional sensitive species list.

To operationalize the calculation, a prototype database was set up and the calculation algorithm was initiated and tested.

The prototype is based on a shiny application available here: https://halieut.agrocampus-ouest.fr/discardless_app/fishing_pressure2023/

GLOSSARY

CMO	Common Markets Organisation
COMEXT	EUROSTAT's reference database for detailed statistics on international trade in goods
DCF	Data Collection Framework
EFCA	European Fisheries Control Agency
EU	European Union
EUMOFA	European Market Observatory for Fisheries and Aquaculture products
EUROSTAT	Statistical Office of the European Union
ETPs	Endangered, Threatened and/or Protected species
FAO	Food and Agriculture Organisation of the United Nations
FISHSTAT	Fisheries and Aquaculture statistics (From FAO)
FAPs	Fishery and Aquaculture Products
FIC	Food Information to Consumers
GFCM	General Fisheries Commission for the Mediterranean
IATTC	International Commission for the Conservation of Atlantic Tunas
ICCAT	Inter-American Tropical Tuna Commission
ICES	International Council for the Exploration of the Sea
IOTC	Indian Ocean Tuna Commission
MSC	Marine Stewardship Council
NAFO	Northwest Atlantic Fisheries Organisation
NOAA	National Oceanic and Atmospheric Administration
RFMO	Regional Fisheries Management Organisation
STECF	Scientific, Technical and Economic Committee for Fisheries
WCPFC	Western and Central Pacific Fisheries Commission

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1 INTRODUCTION

Food Sustainability Labelling refers to the practice of labelling food products to inform consumers about their environmental and ethical attributes. Sustainability labels help consumers make more informed choices by providing information on various aspects of a product's production and sourcing, such as its impact on the environment and social considerations.

In this context, the European Commission is developing indicators, which are measurable parameters or criteria used to assess the sustainability of fisheries. To this aim, a grading method was outlined by STECF (STECF 20-05[1], STECF-22-12[2]). This method is used to assign a grade or rating to a fisheries product based on its sustainability performance. The grades mentioned (e.g., A to E) indicate different levels of fisheries sustainability, with A being the most sustainable and E being the least.

The development of such grading methods and indicators is a significant step in promoting sustainable fishing practices and helping consumers make informed choices about the seafood they purchase. It encourages fisheries to operate in a way that minimizes negative impacts on the environment and ensures the long-term viability of fish populations.

When defining the fisheries sustainability aspects, they may include the health of the targeted fish stock, the impact of fishing practices on the marine ecosystem, the management or the regulation compliance. However, the main sustainability aspect is the state of the targeted stock/species. This report focuses on the health and abundance of the fish populations that are being targeted by fisheries. It assesses whether the fish stock is being harvested at a sustainable level, considering factors like population size, stock sensitivity and the impact of fishing.

Terms of References

Operationalizing the indicator on stock status developed under EWG 22-12

Background information provided by the Commission

The topic of sustainability indicators has been subject to two expert working groups (EWG) under the STECF. In May 2021, the STECF released a report (STECF 20-05[3]) proposing methods of measuring and communicating along the supply chain some sustainability aspects of fisheries and aquaculture products (FAPs), based on scientifically sound, simple and verifiable criteria and indicators. The STECF suggested developing a scoring system step by step, starting with a System 1 based on simple indicators for data-limited fishery and aquaculture products, while products benefiting from additional data may allow for a more reliable assessment of sustainability criteria under a System 2.

A follow-up EWG met in September 2022 to finalise grading methods for what the Commission considered priority indicators. This concerned (i) the state of the targeted stock / species and (ii) the impact of the fishing activity on the seabed. The EWG, at the Commission's request, also initiated a preliminary process that could lead to a third indicator on the impact on sensitive species. The STECF subsequently published a report (STECF-22-12[4]) that was based on the EWG's work.

[1] Report EWG 20-05
[2] Report EWG 22-12
[3] Report EWG 20-05
[4] Report EWG 22-12

The report includes an operational grading process for the indicator on the targeted stock. That process is based on a decision tree (p. 34 of the report) that aims at maximising the robustness of the grading through a hierarchical (system 2 / system 1) approach reflecting the availability of data on a given stock or species.

Hence, the STECF agreed on a detailed and comprehensive method that allows determining robust gradings on the state of a stock or species for all wild-caught fishery products marketed in the EU. This conceptual method now needs to be operationalised in concrete terms.

With the help of a contractor, DG MARE is planning the development of a publicly accessible database and IT tool that calculates product gradings based on the two input parameters (i) targeted species and (ii) fishing area. For that purpose, this ad-hoc team should support the contractor's work by achieving the objectives below:

Objectives

- Identify the relevant publicly accessible data sources that should be used to set up the database. These include stock assessment data (biomass and fishing mortality), catch / effort advice, IUCN classifications and sensitivity indices.
- From the various data sources, extract the data that should populate the sustainability indicator database. If possible, implement a first version of the decision tree.
- Document the above findings for the contractor setting up the database, incl. instructions for calculating averages of assessment data as required in the approach described in the EWG report.

Tasks:

1. Develop a prioritised approach by establishing a ranking of the most important commercial species on the EU market (domestic and imported) linked with possible fishing areas. The task could build on EUMOFA data[5] and the commercial designation database[6].
2. Based on the task 1 priority ranking, establish a list of data sources for quantitative stock assessments on biomass and fishing mortality. In the case of ICES, that means MSY $B_{trigger}$ and F_{MSY} data, while other RFMOs might use similar indicators for the same purpose. Table 2 of the EWG report provides an indicative list of these RFMOs.
3. Based on the priority ranking, extract the necessary stock assessment data from the various data sources identified in task 2 to populate the sustainability indicator database. Assessment data should be averaged over 6 years to capture at least the two most recent assessments.
4. Where no quantitative stock assessments are available, identify data sources for existing catch or effort advice and extract the necessary advice data to populate the database.
5. Where neither quantitative stock assessments nor advice are available, identify data sources for regional / global IUCN classifications and extract the data for all relevant species for the sustainability database.

[5] EUMOFA - European Market Observatory for Fisheries and Aquaculture
[6] https://fish-commercial-names.ec.europa.eu/fish-names/home_en

6. Based on the priority ranking, identify sources of sensitivity indices in those cases where IUCN classifications are not available. Extract the necessary data for the sustainability database.
7. If possible, implement a first version of the decision tree mentioned in the STECF report.
8. Document the findings above in a comprehensive and clear report that can be used for future updates of the sustainability grading database. This should also include methods for calculating averages where necessary.
9. Compile all extracted data in a user-friendly Excel database.

Deliverables

The work carried out will be the presented in a final methodological report in English. A database in Excel format will be delivered based on the tasks above. Potentially, a first version of the decision tree would also be included.

2 MATERIAL AND METHODS

Database structure

To feed the grading process, several data sources are used as shown in Figure 1 Decision tree diagram, which was defined in STECF EWG22-12.

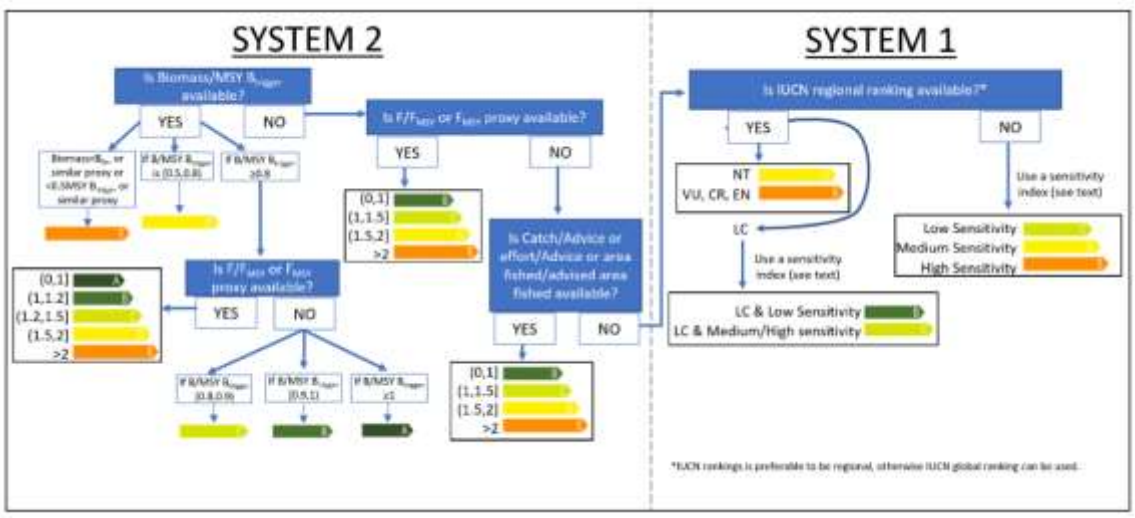


Figure 1. Decision tree to evaluate sustainability level according to fishing pressure. See text for the description of System 2 (steps 1 and 2) and System 1 (step3). The specific limits between the score B/C/D should be further analysed (see text on step 2).

Once all the data are processed, we can use the flow described in following schema (Figure 2. Decision tree with pathway.Figure 2). In this updated schema we identify different roads that will be use regarding data availability.

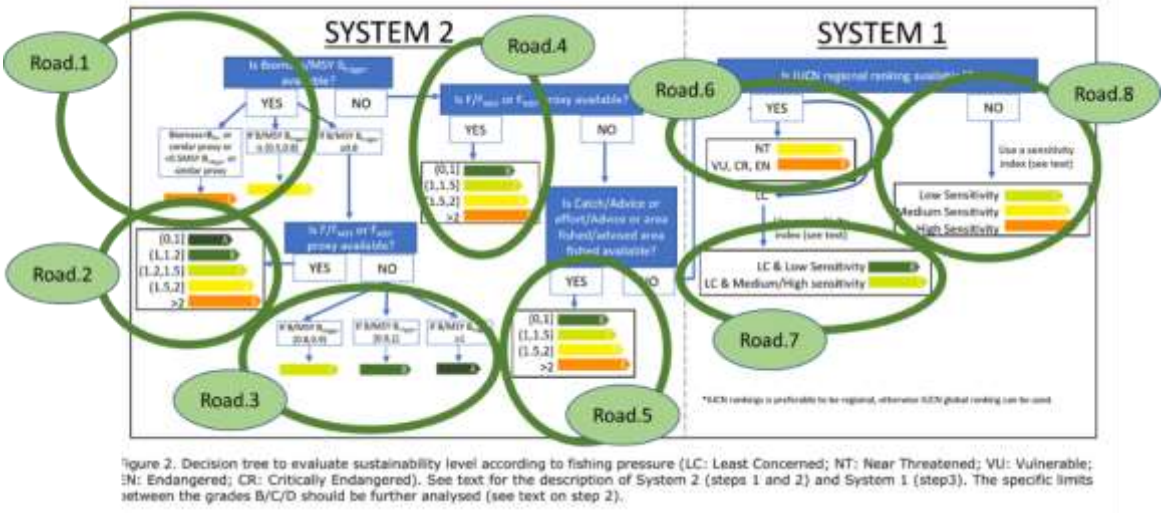


Figure 2. Decision tree with pathway.

For System 2, data are provided by the advisory bodies (Annex 1). The necessary information to feed the System 2 grading comes from stock assessment models where biological reference points are defined and different values are compiled or from stock advised catches or efforts compared to realised catch or effort. This information is not available for all stocks for two main reasons, lack of data or issues in fitting stock assessment models to data.

The necessary information is:

- F: fishing mortality yearly estimated by the models.
- F_{MSY}: fishing mortality consistent with achieving Maximum Sustainable Yield (MSY).
- SSB: spawning stock biomass (total weight of all sexually mature fish in the stock) yearly estimated by the models.
- B_{pa}: precautionary reference point for spawning stock biomass (SSB).
- MSY $B_{trigger}$: a biomass reference point that it *is* an action points; when SSB is below this level managers are expected to take measures to reduce fishing mortality.
- Alternatively, time series of advised and realised catch or effort can be used.

To compile all the data coming from different stock assessment models and working groups, several types of data are defined:

- Fishdata table: Time series of different data (F, SSB, landings, discards) by each stock, year and working group (Table 1).
- Fishdata_ext table: Time series of Catches/ Effort advice and values. This is an extension of the fishdata table to process system 2 (no B/MsyBtrigger and no F/Fmsy; Table 2).
- Limits table: Reference points or limits (F_{MSY}, MSY $B_{trigger}$, B_{lim}, B_{pa}) defined for each stock, year and working group are stored in this table (Table 3).

Table 1. Fishdata table example.

evaluationyear	workinggroup	fishstock	year	recruitment	tbiomass	ssb	landings	yieldssb	mssef	sop	discards
2003	NAFMC	Bluefish - Atlantic Coast	1982	NA	NA	NA	4.671960e+04	NA	1.790000e-01	NA	NA
2003	NAFMC	Bluefish - Atlantic Coast	1983	NA	NA	NA	4.892300e+04	NA	3.120000e-01	NA	NA
2003	NAFMC	Bluefish - Atlantic Coast	1984	NA	NA	NA	3.774980e+04	NA	1.770000e-01	NA	NA
2003	NAFMC	Bluefish - Atlantic Coast	1985	NA	NA	NA	3.078190e+04	NA	2.830000e-01	NA	NA
2003	NAFMC	Bluefish - Atlantic Coast	1986	NA	NA	NA	3.193600e+04	NA	4.190000e-01	NA	NA
2003	NAFMC	Bluefish - Atlantic Coast	1987	NA	NA	NA	4.451700e+04	NA	4.560000e-01	NA	NA
2003	NAFMC	Bluefish - Atlantic Coast	1988	NA	NA	NA	3.332700e+04	NA	4.040000e-01	NA	NA
2003	NAFMC	Bluefish - Atlantic Coast	1989	NA	NA	NA	2.455500e+04	NA	3.430000e-01	NA	NA
2003	NAFMC	Bluefish - Atlantic Coast	1990	NA	NA	NA	2.198900e+04	NA	3.200000e-01	NA	NA

Table 2. Fishdata.ext table example.

evaluationyear	workinggroup	fishstock	year	catches_advice	catches
2023	ICES	sel.27.22-31	2022	0	36
2023	ICES	ple.27.24-31	2016	2156	1380
2023	ICES	ple.27.24-31	2017	2587	1058
2023	ICES	ple.27.24-31	2018	3104	2355
2023	ICES	ple.27.24-31	2019	3725	2359
2023	ICES	ple.27.24-31	2020	2826	1247
2023	ICES	ple.27.24-31	2021	3297	1317
2023	ICES	ple.27.24-31	2022	3956	NA
2023	ICES	sel.27.32	2011	13000	9410
2023	ICES	sel.27.32	2012	12000	13810
2023	ICES	sel.27.32	2013	NA	12610
2023	ICES	sel.27.32	2014	9000	12000
2023	ICES	sel.27.32	2015	11800	10370
2023	ICES	sel.27.32	2016	11800	9670
2023	ICES	sel.27.32	2017	11800	9750

Table 3. Limits table example.

evaluationyear	workinggroup	fishstock	flim	fpa	blim	bpa	fmsy	msybtrigger	FishingPressure	FishingPressureDescription
2018	ICES	spr.27.4	NaN	NaN	9.000000e+04	1.420000e+05	NaN	NaN	1.19983333	F
2018	ICES	her.27.irls	0.4500000	0.2700000	5.400000e+04	3.400000e+04	0.280000	5.40000e+04	0.28637133	F
2018	ICES	her.27.6a7bc	0.3000000	0.1800000	2.500000e+05	4.100000e+05	0.160000	4.10000e+05	0.09478633	F
2018	ICES	her.27.20-24	0.4500000	0.3500000	1.200000e+05	1.500000e+05	0.310000	1.50000e+05	0.32883333	F
2018	ICES	her.27.nirs	0.3970000	0.2860000	8.500000e+03	1.183100e+04	0.266000	1.18310e+04	0.17112347	F
2018	ICES	her.27.3a47d	0.3400000	0.3000000	8.000000e+05	9.000000e+05	0.260000	1.40000e+06	0.19528667	F
2018	ICES	tur.27.22-32	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NA
2018	ICES	her.27.28	0.8800000	0.6300000	4.080000e+04	5.710000e+04	0.320000	6.00000e+04	0.30888333	F
2018	ICES	cod.27.21	NaN	NaN	NaN	NaN	NaN	NaN	0.56308638	Fishing pressure: Relative
2018	ICES	spr.27.22-32	0.3900000	0.3200000	4.100000e+05	5.700000e+05	0.260000	5.70000e+05	0.34390000	F
2018	ICES	her.27.25-2932	0.5200000	0.4100000	4.300000e+05	6.000000e+05	0.220000	6.00000e+05	0.19690491	F
2018	ICES	ple.27.24-32	NaN	NaN	NaN	NaN	NaN	NaN	0.72577855	Fishing pressure: Relative
2018	ICES	gfb.27.nea	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NA

The limits table and fishdata table describe stock status and the reference points defined for each stock. In both tables there is a column named “fishstock”. This column “fishstock” contains a unique code for the stock.

To link the data from “fishstock” column from Limits table and Fishdata table with species scientific name (taxonomic one) and the distribution area, a table Stockdef table is defined.

- Stockdef table: this table defines for each stock code (“fishstock” column) the scientific name and list of distribution area concerned (Table 4).

Table 4. Stockdef table example.

fishstock	species_code	scientific_name	sub_division_fao
Acadian redfish - Gulf of Maine / Georges Bank	REN	SEBASTES FASCIATUS	GEORGES BANK / GULF OF MAINE
agn.27.nea	AGN	SQUATINA SQUATINA	27.10.A.2 / 27.12.A.3 / 27.1.B / 27.3.D.31 / 27.8.E.1 / 27.8.E.2 / 27.3.D.32 / 27.9.A / 27.2.A.1 / 27.4.A / 27.4.B / 27.12.A.4 / 27.2.A.2 / 27.4.C / 27.5.A.1 / 27.2.B.1 / 27.5.A.2 / 27.5.B.1.A / 27.10.B / 27.12.B / 27.2.B.2 / 27.5.B.1.B / 27.5.B.2 / 27.3.A / 27.6.A / 27.6.B.1 / 27.12.C / 27.3.B.23 / 27.6.B.2 / 27.7.A / 27.3.C.22 / 27.7.B / 27.7.C.1 / 27.10.A.1 / 27.12.A.1 / 27.14.A / 27.3.D.24 / 27.7.C.2 /

Once all the databases are fed with stock information coming from the different data sources, they are linked to each other to create a model of data that will provide the requested output for system 2. The relationship among tables is described in Figure 3.

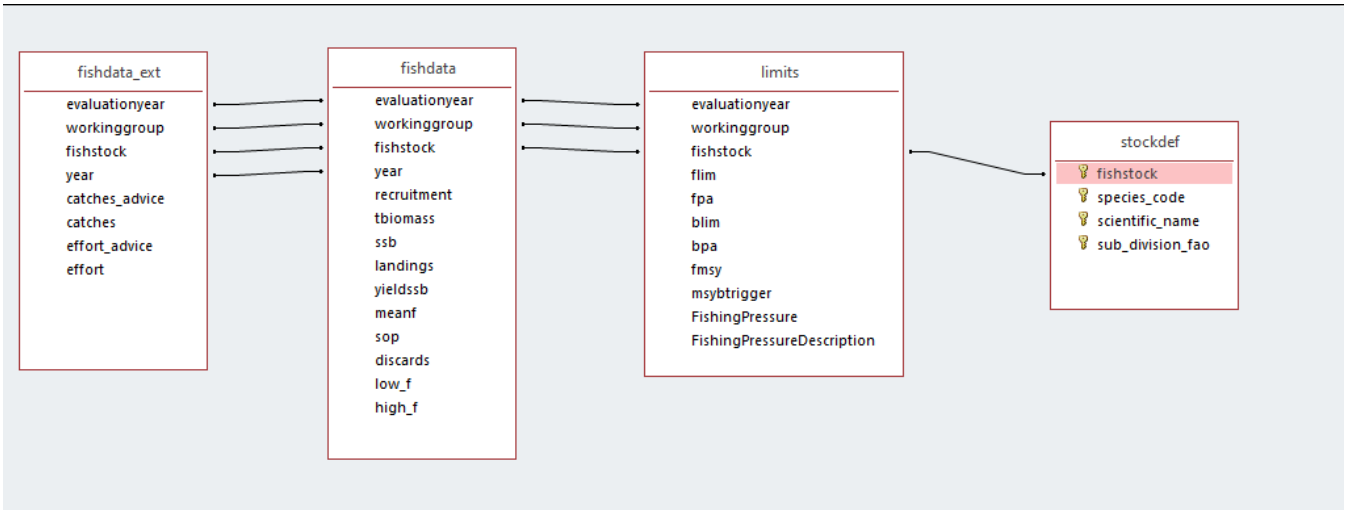


Figure 3. General model of data used to gather all needed information for system 2.

For system 1, two additional tables are completed:

- IUCN data for species status for large area (Table 5).
- Sensitive data for the sensibility to fishing mortality of each species (Table 6).

Table 5. IUCN data through Red List web services.

scientific_name <chr>	yrcompiled <int>	freshwater <chr>	category <chr>	region <chr>
BODIANUS BIMACULATUS	2009	false	LC	europe
CRYPTICHTHYS JOJETTAE	2014	false	LC	europe
DENTEX ANGOLENSIS	2014	false	NT	europe
ENNEAPTERYGIUS PAUCIFASCIATUS	2014	false	LC	europe
NEOCLINUS BLANCHARDI	2014	false	LC	europe
PRAEALTICUS OORTII	2014	false	LC	europe
RAJELLA NIGERRIMA	2019	false	LC	europe
FESTUCALEX PROLIXUS	2016	false	DD	europe
CHAETODON UNIMACULATUS	2010	false	LC	europe
BOOPS LINEATUS	2014	false	DD	europe

Table 6. Sensitive species qualification.

scientific_name <chr>	area.req <chr>	source_code <chr>	Sensitivity_indicator <dbl>	Indicator_source <chr>
ACANTHISTIUS BRASILIANUS	Global	C	49.00	Cheung_et_al_2007
ACANTHOCYBIUM SOLANDRI	Global	C	50.00	Cheung_et_al_2007
ACANTHOPAGRUS LATUS	Global	C	47.00	Cheung_et_al_2007
ACANTHOPAGRUS SCHLEGELI	Global	C	47.00	Cheung_et_al_2007
ALBULA VULPES	Global	C	53.00	Cheung_et_al_2007
ALECTIS ALEXANDRINUS	Global	C	60.00	Cheung_et_al_2007
ALEPOCEPHALUS BAIRDII	Global	C	71.00	Cheung_et_al_2007
ALOPIAS SUPERCILIOSUS	Global	C	79.00	Cheung_et_al_2007
ALOPIAS VULPINUS	Global	C	79.00	Cheung_et_al_2007
ALOSA AESTIVALIS	Global	C	49.00	Cheung_et_al_2007

Following the same procedures, in System 1 databases are fed with information coming from the different data sources, and they are linked with a relationship among tables described in Figure 4.

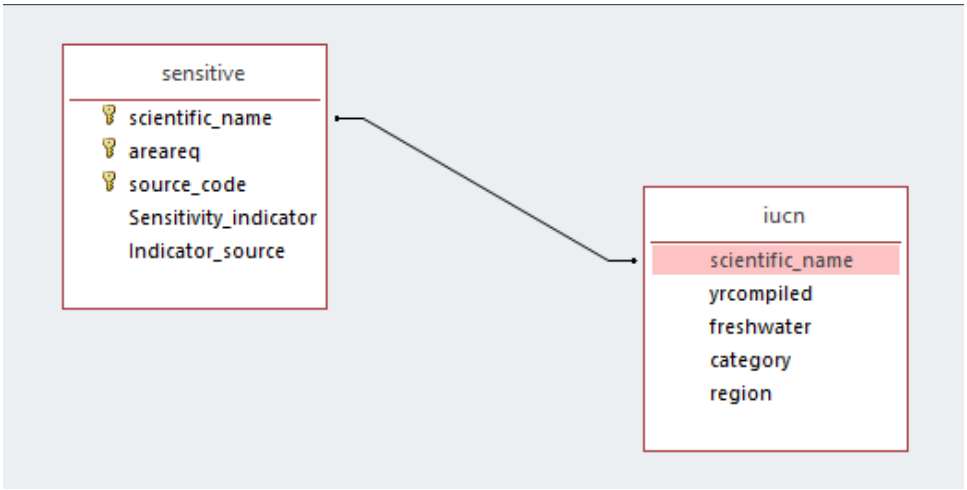


Figure 4. Data model for IUCN and sensitive species information.

Establishing a ranking of the most important commercial species on the EU market (domestic and imported) linked with possible fishing areas.

The most important commercial species on the EU market and the areas they were derived from were identified based on data from EUMOFA. Data for species caught in EU waters were expected to be available through ICES, GFCM, STECF and ICCAT assessments. However, for species caught outside EU waters, other data sources must be investigated. To identify these, the species quantities imported from non-EU waters by country of origin was examined. The top ten import species are listed in Table 7. Catches of these species from Norway, Iceland, UK, Greenland and Faroe Islands were assumed to be assessed by ICES. This means that most of catches of Atlantic cod, Atlantic herring, Atlantic mackerel and saithe are expected to be covered by data attained from ICES. As skipjack tuna and yellowfin tuna are assessed by tuna RFMOs (ICCAT in Atlantic Ocean, IOTC in Indian Ocean and WCPFC/IATTC in Pacific Ocean), common sardine (Morocco) by CECAF and are exploited also by EU fleets, data are available from STECF balance database. Catches and stocks of Alaska pollock in US waters are assessed by NOAA and available from NOAA database. Finally, there was no information available to the reporting team for the remaining two species of Cape hakes, which are assessed at national level by South Africa and Namibia. The issue of having insufficient information to assign fish to stock is expected to occur regularly, for example the main countries of origin of skipjack tuna would not define accurately the stock and which stock status has to be used. For the tool, it is recommended that species for which area is insufficient to identify stock, the grading of the stock achieving the lowest rank is used. This ensures that there is no incentive to remove stock information to achieve a better grading. Often, the information on catch area was not at the same level where the fish could be identified to stock. This was particularly true of NOAA assessed species, where FAO area codes were not included in stock definition.

Table 7. Top ten species imported in terms of weight and the country from which they were imported.

Species	**Scientific name**	**Main countries of origin**
Skipjack tuna	*Katsuwonus pelamis*	Ecuador (30%), China (12%), Papua New Guinea and Philippines (9% each), Mauritius (6%), etc.
Alaska pollock	*Theragra chalcogramma*	China (46%), USA (37%), Russia (16%)
Atlantic cod	*Gadus morhua*	Norway (40%), Iceland (23%), Russia (16%)
Yellowfin tuna	*Thunnus albacares*	Seychelles (14%), Philippines (11%), Ecuador (9%)
Atlantic herring	*Clupea harengus*	Norway (72%), UK (11%), Iceland and Faroe Islands (6%)
Cape hakes	*Merluccius capensis, Merluccius paradoxus*	Namibia (61%), South Africa (39%)
Common sardine	*Sardina pilchardus*	Morocco (94%)
Atlantic mackerel	*Scomber scombrus*	UK (32%), Norway (27%), Iceland (18%), Faroe Islands 13%), Greenland (10%)
Saithe	*Pollachius virens*	Norway (46%), Iceland (24%), Faroe Islands (12%)

Data sources

To feed the tables presented in the section above, information was collected from three different sources (ICES, NOAA and balance capacity STECF working group) and using different means regarding data

and service availability. We are mainly focusing on the first two sources because of the robustness of ICES and NOAA stock assessment process and dissemination of results are summarized below:

International Council for the Exploration of the Sea (ICES): ICES plays a pivotal role in providing scientific advice on fisheries and environmental issues in the North Atlantic and adjacent seas. ICES' primary function is to offer impartial, science-based advice to member states and international bodies regarding the status of fish stocks, ecosystem dynamics, and the potential impacts of fishing activities. ICES experts conduct regular stock assessments to estimate the size of fish populations in most of the cases on yearly basis and during June of each year. ICES mainly focus on Northeast Atlantic shared stocks. These assessments help determine sustainable catch limits and other management measures. ICES stock assessment output datasets are available through web services easily usable through a R packages - Icessag – (https://github.com/ices-tools-prod/icesSAG). Functions were developed to collect data for all available years and to format them in the common format. Contact for more information is info@ices.dk. Disclaimer for the use of ICES information is here: https://www.ices.dk/pages/disclaimer.aspx.

National Oceanic and Atmospheric Administration (NOAA): NOAA in the United States plays a critical role in the stock assessment of fishery resources. NOAA's duties in this domain are multifaceted and essential for the sustainable management of the country's marine and aquatic ecosystems. NOAA employs sophisticated stock assessment models and scientific methodologies to estimate the health and status of fish stocks. NOAA's stock assessment process is dynamic and continually updated as new data becomes available, usually every November of each year for all the stocks. This adaptive approach allows for timely adjustments to management strategies based on the latest scientific information. NOAA data are available through web services easily usable through an R packages – stocksmart (https://apps-st.fisheries.noaa.gov/stocksmart/). This package aims to provide resource managers information they need for a sustainably management. Function was developed to collect data for all available years and to format them in the common format. Contact for more information is Stock.SMART@noaa.gov.

Those 2 scientific bodies provide online services to access stock assessment output in a comprehensive manner, through documented R packages.

We will use the STECF working group data gathering process to get a broader number of stocks status.

To complete the data with assessment from other sources than ICES and NOAA, we use the database populate by the STECF balance capacity working group. For this working group, a group of scientists consult RFMOs (See Annexe 1) websites to collect needed data (limits, fishdata and stock definition) not obtained through ICES or NOAA tools. Data is thus available in the same structure we have previously defined (see Table 2 and 4) through a database connection or by request to STECF for an Excel or csv file (Figure 5). The balance working group is generally organized by STECF in October

under DG MARE umbrella. Contact person is Hendrik Doerner (hendrik.doerner@ec.europa.eu).The work done during this working group is quite similar to the RAM legacy database.[7]

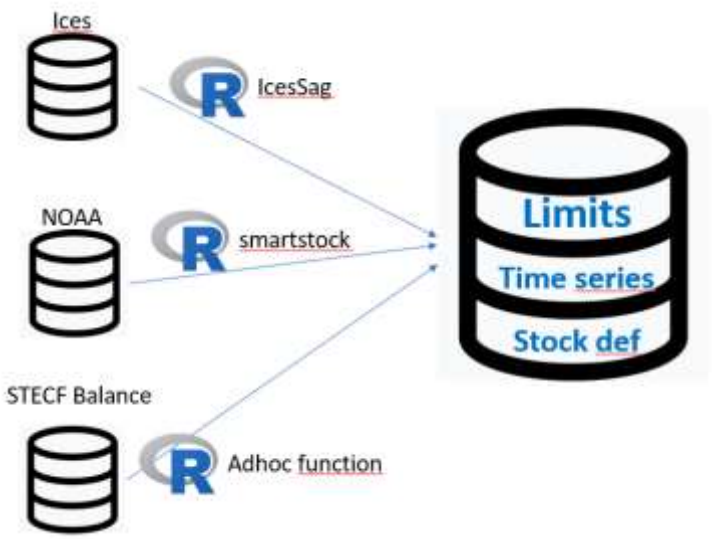


Figure 5. General Data gathering schema for system 2.

Concerning those three sources of information, database was updated the 23rd of September 2023 for the report.

Extraction of data from stock assessments

Availability and accessibility of stock assessment data is very heterogeneous. Some scientific bodies as ICES or NOAA are providing a standardized information through web services (with a very short time between the assessment and the publications of the advice) but most of them are still providing data in Excel sheets or working group reports in pdf (Tuna RFMOs, CECAF, GFCM, etc.).

A first step of data extraction can be made through NOAA and ICES harmonized dissemination. A second one, more ad hoc, will dig up information through website and pdf and will gather information on a common database (in a format close to ICES one). Here we can mutualize effort already made within STECF Working groups (e.g. Balance capacity).

In parallel, for the future, we can promote an open data process direction for other RMFOs.

For the first set of more accessible data (ICES and NOAA) R packages are developed to easily access webservices (Stock SMART and icesSAG packages).

[7] The RAM Legacy Stock Assessment Database is a compilation of stock assessment results for commercially exploited marine populations from around the world. The recently updated database offers many graphical and analytic tools to explore the data, as well as new data sets including assessments from N.W. Africa, assessments from the Mediterranean Sea, assessments from Chile, data sets on Pacific salmon. The database is seeking collaborators to cover parts of the world that are missing here. The purpose of this database is to allow scientist to obtain a global overview of stock assessment worldwide. As the RAM Legacy Database is not derived in a formal quality assured organisation but more of a collaborative approach, the data are not used here.

We here mention this database as it covers similar aspect that we try to integrate in what we call “system 2”.

ICES webservices are promoted here (https://stock-assessment-graphs.ices.dk/webservices.aspx) and the associated R package is described here (https://github.com/ices-tools-prod/icesSAG).

For NOAA, webservices are described here (https://apps-st.fisheries.noaa.gov/stocksmart?app=additional-resources) and the R package is available here (https://noaa-edab.github.io/stocksmart/).

The data from the STECF balance opportunity working group were included using the R Fisheries Product Sustainable Indicator / FPSI package (https://github.com/polehalieutique/FPSI). This R package covers technical aspect to collect data and to process them (calculation method). For quantitative data collection specific function are addressed to each data sources we used (ICES, NOAA and STECF).

Functions to get references points data (limits table) are:

- limits.ices(Stock_Name = NULL,Assessment_Year = NULL,update = FALSE,from = 2018,to = NULL). This function, with parameter update=FALSE will load internation limit.ices.dta dataframe provided by the R package. With parameter update to TRUE, the function will get all limits data from ICES online service and will get last available data. User can define or not stock to be updated. Without stock (Stock_name parameter not provided; all stocks available will be download)
- limits.noaa(Stock_Name = NULL, Assessment_Year = NULL, update = FALSE). This function will use stocksmart R package to download last available data from NOAA.
- limits.other(Stock_Name = NULL,Assessment_Year = NULL,update = FALSE,user = NULL,password = NULL,server = NULL,db = NULL)? For a specific stock or all available one, this function, if update is set to TRUE will download all information for balance capacity database available on a specific server, accessible through authentication (login/password). Hidden parameter (server, login and password could be requested from Jerome Guitton

Similar function for time series (F, SSB, landings…) to populate fishdata table (fishdata.ices, fishdata.noaa and fishdata.other) were used to load or update fishdata needed information.

The stockdef.other function will load or download stock definition defined by STECF balance working group (update=TRUE,user=NULL,password=NULL,server=NULL,db=NULL).

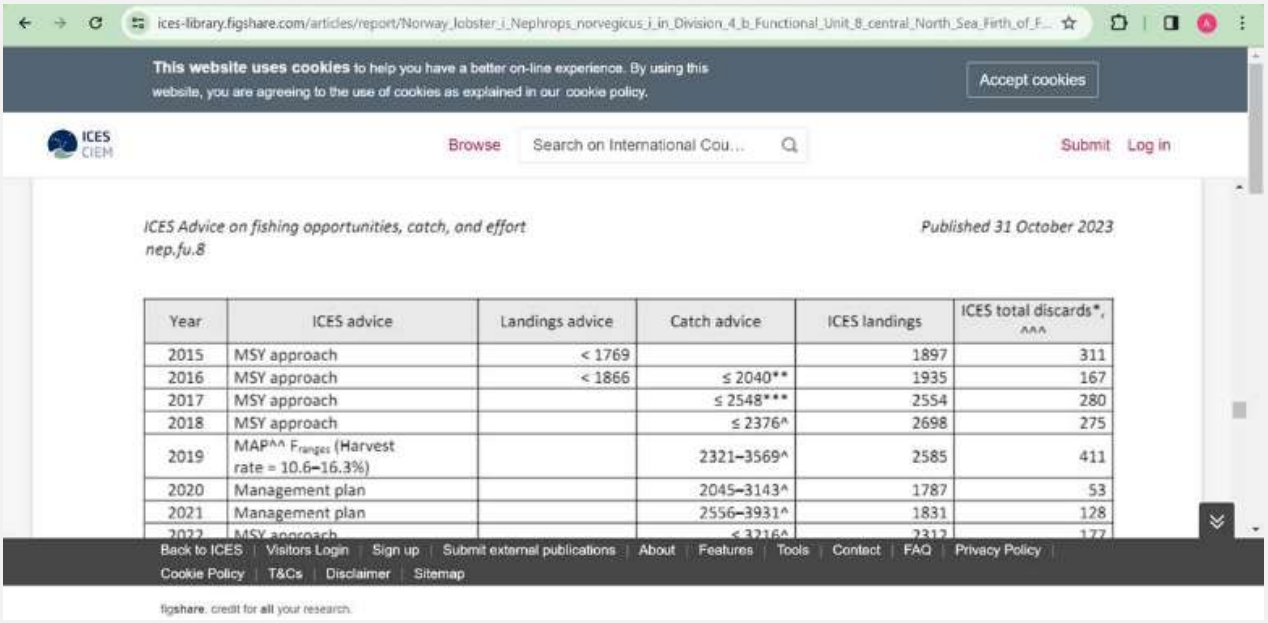
The exception is for fishdata_ext (catches advice, catches) as this is not used by STECF balance working group and not automatically downloadable.

Data sources for existing catch or effort advice and extraction of data

Unfortunately, data on catch or effort advice is not readily reported in quantitative databases. They are however often available in text files and reports. To demonstrate the use of these data, ICES advice reports from the Azores, Baltic Sea, Bay of Biscay and Celtic Sea regions were examined and information on stock, year, catch advice and catch taken entered into the database. As this process is time-consuming, it was not completed for all areas and RFMOs but it is presented here as a proof of concept. This process is replicable for other ICES stocks on the basis of the instructions in the box below. However, the collection of this information from other bodies is replicable only by fisheries experts. This issue could be resolved if RFMOs or scientific bodies are requested to include this information in a proper manner as other quantitative outputs.

Specific ad hoc process used to collect catch and catch advice data from ICES :

1. Go to https://www.ices.dk/advice/Pages/Latest-Advice.aspx
2. Click on the ecoregion of interest
3. Click on a stock
4. In the pdf, take the stock ID from the top left corner (nep.fu.8 in the example below), species, area and advice year from the advice title on page 1. Find the section 'History of the advice, catch, and management' and the columns year, Catch advice and EITHER sum landings and discards to get catches OR use catches if given in the table.
5. Copy the numbers into a file of the format given in the report.
6. Go to the next stock.



Data sources for regional/global IUCN classifications, species sensitivity and extraction of data

IUCN data is available through a webservice easily usable through a R package (rredlist - https://github.com/ropensci/rredlist) and can also be downloaded from https://www.iucnredlist.org/search . Regional assessments were used when they were available and global assessments in other cases.

Within the R FPSI package the function system.1.iucnws(sci_name = NULL, area = NULL,iucn.dta = NULL,sensitive.dta = NULL,area.dta = NULL, iucn_to_stock_area = NULL,token = NULL) will get category from online redlist service using regional assessment if available. This function needs a token as requested by IUCN to use their service (a token is a kind of password freely provided to access webservices).

An alternative function system.1 will use R package internally available IUCN data. Regarding issues on IUCN redlist webservices (update 28/11/2023) this system1 function using local file is recommended.

Where the assessment was either not available or the assessment was Data Deficient (DD), the sensitivity of the species was assessed using assessments based on life history traits. For species in the Mediterranean (FAO 37), vulnerabilities of Osio et al (2015[8]) were used. For species in the Northeast Atlantic (FAO 27), the precautionary fishing mortality of Rindorf et al. (2020[9]) was used. In other areas and for non-listed species, the vulnerabilities of Cheung et al. (2007[10]) were used.

The list of species sensitivity is available within the package (sensitive.dta dataframe) as there is no real process and need to update it. The data are available for download at https://doi.org/10.11583/DTU.21063193.

In accordance with the original suggestion from STECF, species sensitivity was defined as (Table 8):

Table 8. Species sensitivity.

	Low sensitivity	**Medium sensitivity**	**High sensitivity**
Cheung et al. (2007) vulnerability	≤40	>40 and ≤70	>70
Rindorf et al. (2020) precautionary F	>3	>0.41 and ≤3	≤0.41
Osio et al. (2015) vulnerability	≤1.6	>1.6 and ≤2	>2

Other needed information

For the stock definition, STECF balance capacity working group common database were used (STECF 22-15)[11]. These databases are updated annually, and are available in the STECF website. The file name used for the stock definition is Annex I A - Biological indicator stock reference list[12].

For area definition FAO fishing area codes are used. The FAO Major Fishing Areas are geographical division used to classify and manage marine and freshwater fisheries resources around the world. There

[8] Osio, G. C., Orio, A., & Millar, C. P. (2015). Assessing the vulnerability of Mediterranean demersal stocks and predicting exploitation status of un-assessed stocks. *Fisheries Research*, *171*, 110-121.

[9] Rindorf, A., Gislason, H., Burns, F., Ellis, J. R., & Reid, D. (2020). Are fish sensitive to trawling recovering in the Northeast Atlantic?. *Journal of Applied Ecology*, *57*(10), 1936-1947.

[10] Cheung, W. W., Watson, R., Morato, T., Pitcher, T. J., & Pauly, D. (2007). Intrinsic vulnerability in the global fish catch. *Marine Ecology Progress Series*, *333*, 1-12.

[11] https://stecf.jrc.ec.europa.eu/documents/43805/41486733/STECF+22-15+-+Balance+capacity.pdf/81f9b561-6c1a-4833-bba6-3e1f55e7d68f

[12] https://stecf.jrc.ec.europa.eu/reports/balance/-/asset_publisher/3rBi/document/id/47730558?inheritRedirect=false&redirect=https%3A%2F%2Fstecf.jrc.ec.europa.eu%2Freports%2Fbalance%3Fp_p_id%3D101_INSTANCE_3rBi%26p_p_lifecycle%3D0%26p_p_state%3Dnormal%26p_p_mode%3Dview%26p_p_col_id%3Dcolumn-2%26p_p_col_pos%3D1%26p_p_col_count%3D2

are 19 major marine fishing areas defined[13]. Each fishing area is defined with 2 digits code (for example Major fishing area 27, Northeast Atlantic). Each area can be divided into Subareas (27.1) and each subarea can be divided into several Divisions (27.1.a).

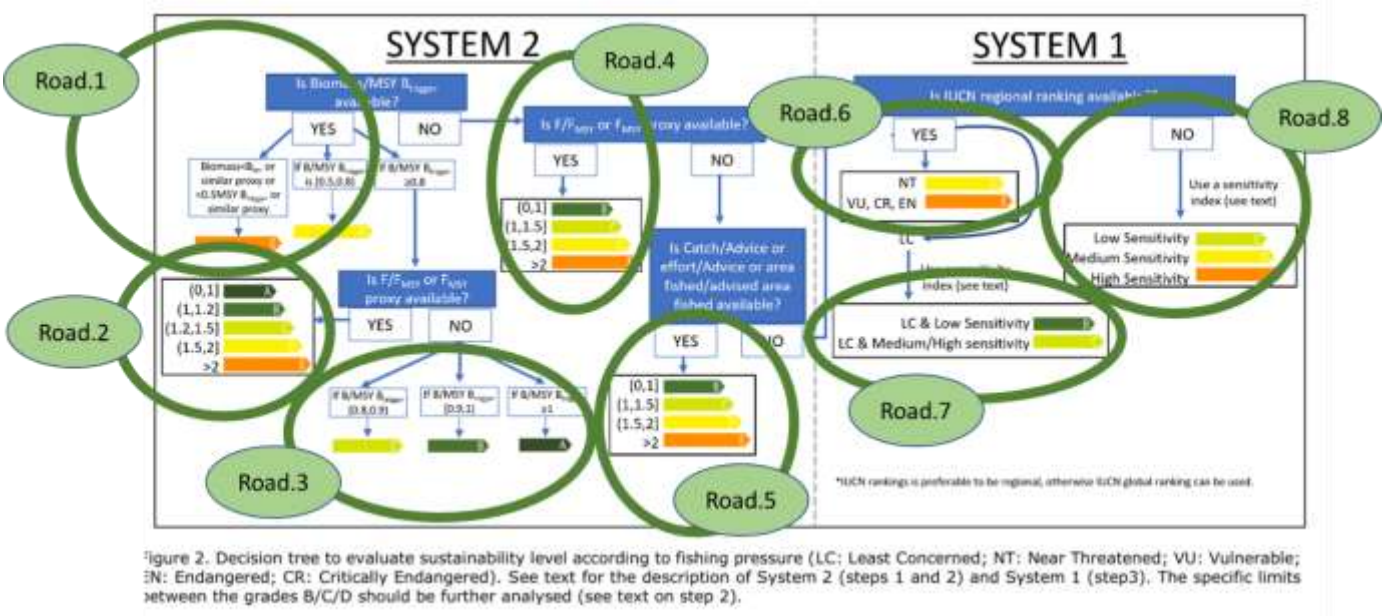
The main advisory bodies as ICES or NAFO follow the FAO fishing area codes when defining the stocks. However, NOAA divides the U.S. into regions, such as the Northeast, Southeast, Northwest, and Alaska regions to manage and conserve marine ecosystems and fisheries. These area names do not have a clear link with FAO areas.

This is an issue because in some cases, for example a stock defined in NOAA as an Atlantic stock, when converting it to FAO codes it could be FAO 27 Northeast Atlantic, FAO 21 Northwest Atlantic, etc.

[13] https://www.fao.org/fishery/en/area/search

METHOD: CALCULATION PROCESS

Once all the data are processed, we can use the flow described in following schema (Figure 6).



igure 2. Decision tree to evaluate sustainability level according to fishing pressure (LC: Least Concerned; NT: Near Threatened; VU: Vulnerable; EN: Endangered; CR: Critically Endangered). See text for the description of System 2 (steps 1 and 2) and System 1 (step3). The specific limits between the grades B/C/D should be further analysed (see text on step 2).

Figure 6. Reminder Decision tree with pathway.

The process is hierarchical. First, for a specified taxonomic name and area a system 2 measure is investigated. If there is nothing available, to the grade is calculated using system 1.

A list of R script function developed through the R Github package FPSI (https://github.com/polehalieutique/FPSI) operationalized the Decision Tree. This package is provided as an annex of this report. The report will only focus on main concept that are technically described in the FPSI functions.

System 2 calculation

The system 2 is based on quantitative values:

- B/ MSY $B_{trigger}$ or proxy
- F/ F_{MSY} or proxy
- Catches advice/Catches or Effort advice /Effort

System 2 function (calculation for system2):

- Collects all available data from stock assessments made since 2018. The last available assessment is used. (inputs)
- Within the last assessment, function will average Fishing mortality (or proxy) and SSB on last 6 available yearly values. (calculation)
- Provide following table used as input of the grading function (output, Figure 7).

fishstock	species_code	scientific_name	sub_division_fao	FishingPressureDescription	mean.f_fmsy	mean.b_bmsy	mean.catch.advice
pil.27.8c9a	PIL	SARDINA PILCHARDUS	27.8.C / 27.9.A	F	0.9152174	1.2403431	NaN
pil.27.8abd	PIL	SARDINA PILCHARDUS	27.8.B / 27.8.D.1 / 27.8.D / 27.8.A / 27.8.D.2	F	1.3280353	0.9680718	NaN
pil.27.7	PIL	SARDINA PILCHARDUS	27.7.J.1 / 27.7.K.2 / 27.7.A / 27.7.H / 27.7.C.2 / 27.7....	F	NaN	NaN	NaN

Figure 7. Output of system 2 function.

System 1 calculation

The system 1 calculation process is done by system1.iucnws function (using on line webservices and internal sensitive species list) or system1 function (that use internal iucn data and internal sensitive species). As previously said regional assessment is only available through web services.

First, the system1.iucnws (or system1) function identifies the regional distribution area. Areas beginning with 27 refers to Northeast Atlantic area IUCN assessment and areas beginning with 37 refers to Mediterranean and Black Sea regional IUCN assessment. If area requested is not 27 or 37 or SA, the IUCN assessment level will be Global.

Secondly, information on sensitivity of the species is providing using the sensitive species list and the categorization (see Table 8).

Output of system1 function will provide either IUCN or sensitivity categorization for the requested species/area (Figure 8).

id_no	scientific_name	yrcompiled	freshwater	category	area.req	source_code	Sensitivity_indicator	Indicator_source	fishstock
186106	ACANTHOLABRUS PALLONI	2009	false	LC	27	R	6.33	Rindorf_et_al_2020	ACANTHOLABRUS PALLONI+27

Figure 8. Output of system1 function.

Remarks: system1.iucnws function use IUCN reddlist service. That means that for each system1 used, a request is submitted to this online webservices. An offline version of the data is available within the packages (system1 function).

Transversal calculation

For one request (species name + area) the system may provide more than one stock (for large area by example) and for each stock a system 2 or system 1 could be used.

That means that we may obtain a list of stock related to one species in one area and for some a system 2 quantitative approach and for some a system 1 qualitative approach.

System.1.2 function will sequentially use system2 and, if for some stock system2 cannot be successful (not enough data to process), system1.iucnws functions. System1.2 function will provide a common table merging system2 and system1.iucnws outputs.

Grading

The grading process itself is provided by the score.transcript function. Input of this function is the system.1.2 function output (Figure 9).

For each line regarding the system 1 or 2 used, the function operationalized the decision tree, from data (F_fmsy, B_bmsy, IUCN category, sensitive value) to the letter (A to F).

```
Case_when(category=='NT' ~'D',
          category %in% c('VU','CR','EN') ~'E',
          category=='LC' & source_code=='R' & Sensitivity_indicator>3 ~'B',
          category=='LC' & source_code=='R' & Sensitivity_indicator<=3 ~'C',
          category=='LC' & source_code=='O' & Sensitivity_indicator<=1.6 ~'B',
          category=='LC' & source_code=='O' & Sensitivity_indicator>1.6 ~'C',
          category=='LC' & source_code=='C'  & Sensitivity_indicator<=40 ~'B',
          category=='LC' & source_code=='C'  & Sensitivity_indicator>40 ~'C',
          (is.na(category) | category %in% c('DD')) & source_code=='R' & Sensitivity_indicator>3   ~'C',
          (is.na(category) | category %in% c('DD')) & source_code=='R' & (Sensitivity_indicator>0.41 & Sensitivity_indicator<=3) ~'D',
          (is.na(category) | category %in% c('DD')) & source_code=='R' & Sensitivity_indicator<=0.41 ~'E',
          (is.na(category) | category %in% c('DD')) & source_code=='C' & Sensitivity_indicator <=40   ~'C',
          (is.na(category) | category %in% c('DD')) & source_code=='C' & (Sensitivity_indicator >40 &  Sensitivity_indicator<70)  ~'D',
          (is.na(category) | category %in% c('DD')) & source_code=='C' & (Sensitivity_indicator >=70 ) ~'E',
          (is.na(category) | category %in% c('DD')) & source_code=='O' & Sensitivity_indicator <=1.6 ~'C',
          (is.na(category) | category %in% c('DD')) & source_code=='O' & (Sensitivity_indicator >1.6 &  Sensitivity_indicator<=2)  ~'D',
          (is.na(category) | category %in% c('DD')) & source_code=='O' & (Sensitivity_indicator >2 ) ~'E'
```

Figure 9. Simple grading process using multiple condition for system 1.

3 RESULTS – PILOT TOOLS

A pilot tool using the FPSI R package has been developed to process available database and to operationalize the decision tree.

During the ad hoc contract users were able to test the tool, to check and correct miscalculation and to get explanation on the grading process.

The pilot tool was developed using Rshiny application to be easily transferable (Figure 10).

The Main menu of the Pilot tool is composed of four components:

- the main arrival component with explanation on the purpose of the tool
- the grading component itself
- the comment, feedback, and "Missing information"
- the download data panel

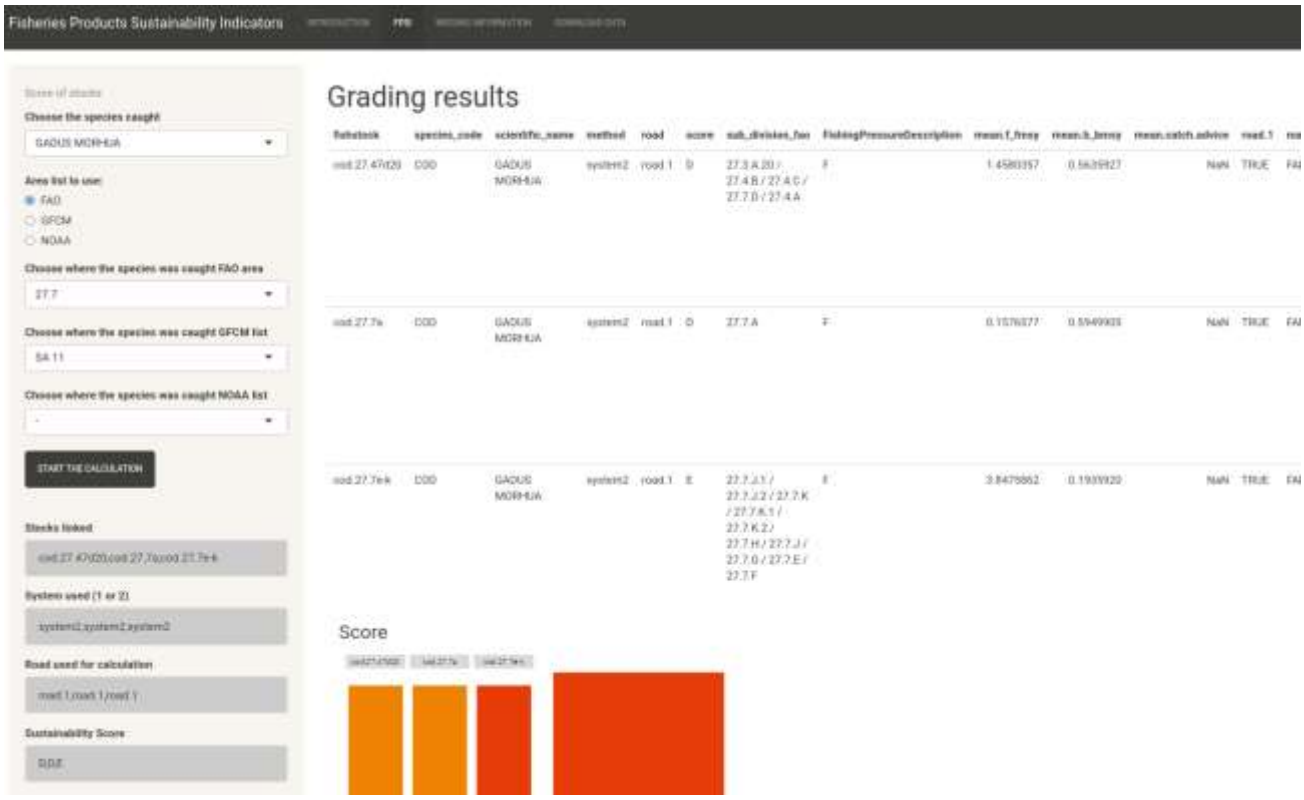


Figure 10. Grading request interface.

For the grading interface, user can define the taxonomic name of the species and the area of catches.

The area information can be defined using three different referential (ICES/FAO, GFCM or NOAA).

On the pilot tool, values and road choice for the calculation are also provided.

4 RECOMMENDATIONS

The development of a grading system requires considerable effort for building up databases that contains all available information in a standardized format.

The main issues to implement the tool, are the difficulty to combine several data sources due to the difference in the data availability or data disaggregation in the compiled variables.

Therefore, to improve the tool, several issues which could be improved are listed. Most of these issues are related to data availability.

Suggestion to ICES:

Datasets are organized around specific thematic data portals in International Council for the Exploration of the Sea (ICES). A set of webservices are set up by ICES to access to the databases and using R several stock assessment outputs are available.

There is database from ICES that compiles a list of assessed stocks, where the "Stock Size Description" (if SSB, A_index_B_index_, etc…) and "Fishing Pressure Description" (F, F/Fmsy, harvest rate, …) used in each stock are defined. However, output information from the stock assessment like ICES Catch Advice provided by the group is not available using these tools. During the contract period, ICES Catch Advice for all stocks was downloaded one by one from the pdf files published by ICES Latest advice section. This was a time-consuming task.

So, we suggest to ICES to develop a tool to extract to the timeseries from ICES Advice in relation to Catch Advice and realised catch in an automatic manner using R or any other database format. Further, species sensitivities or vulnerabilities should be provided for non-assessed species which contribute in numbers to landed weight.

A second issue for ICES is the link between old and new stock definition. During benchmark periods of different stocks, due to new stock information or research, changes in stock spatial distribution may occur, like an increase or decrease in the stock spatial distribution (for instance, spr.27.3a is now included in spr.27.3a4). In these cases, the old stock is no more relevant for advice and it should be mentioned in some way for data users. Actually an expert knowledge is needed to do that and to delete no more relevant stock definition. In this case, we suggest to ICES to deliver an additional information through webservices, that could be something like a "no more relevant" flag and additional information with the new stock name, if exist, that would replace the old one. We also suggest to specifically address this question to the STECF balance capacity WG for other stocks.

Suggestion to NOAA:

The National Oceanic and Atmospheric Administration (NOAA) is a U.S. federal agency that provides a wide range of data related to the Earth's oceans and atmosphere.

In the case of NOAA data accessibility and availability, the main issue is the difference in the area definition. NOAA Fisheries Regions divides the U.S. into regions, such as the Northeast, Southeast, Northwest, and Alaska regions, to manage and conserve marine ecosystems and fisheries. Those area names do not match or there is not a clear link with FAO areas. To tackle this issue, a proposal was made in the pilot tool to keep several spatial references in the area interface (FAO, GFCM and NOAA reference) and to provide the option to choose from three of them, where the species was caught. For users, requesting area using precise spatial reference instead of a common reference that not really match with the precise one, it is more coherent to keep the spatial area options. For example FAO areas are not matching with GSA, one GSA could cover more than one FAO subarea, and one FAO subarea could cover more than one GSA.

Suggestion to GFCM:

General Fisheries Commission for the Mediterranean (GFCM) does not provide a publicly available data extraction service like other organizations. When visiting the official GFCM website, even if the online availability of data has been improved, and in section “Stock Assessment Results” (STAR system) data can be visualized from Excel sheets, no option for data extraction is available.

Therefore, GFCM data are still not available through an R script or webservices. This made the data extraction very time-consuming. In addition, effort advice and effort information were also missing.

We suggest GFCM to develop a tool or an R script to extract to the information from different databases that are compiling fisheries information.

We also suggest GFCM to add Catches and Effort advice and realised catch and effort is made available in an accessible dissemination tool.

Suggestions to DG Mare:

Coastal stocks (mussels, scallops) are mostly assessed at the national level and no peer review occurs for this process. National assessments are thus out of the scope of the database even if the methods used in the assessments are in line with ICES standards. DG MARRE should enforce a process to review national scientific advice in line with international advice if the products are to be graded.

5 ANNEXE I: LIST OF RFMOS AND OTHER OFFICIAL BODIES THAT SUPPLY STOCK ASSESSMENT

Advisory bodies reporting data for quantitative stock assessments on biomass, fishing mortality and extraction of datasets needed for system 2, are collected from advisory bodies as A Regional Fisheries Management Organization (RFMOs) or national institutions. RFMO is an international body established to promote the sustainable management and conservation of fishery resources in a specific region of the world's oceans.

For the purpose of the current database, we directly collect the data only from NOAA and ICES and we indirectly collect data from other bodies available through the STECF balance opportunity WG.

These organizations play a crucial role in addressing the challenges of overfishing, by bringing together coastal states and sometimes distant water fishing nations (as EU fishing vessels) to cooperatively manage shared fish stocks. There are several RFMOs operating in different regions, each with its own mandate and governing structure.

The RFMOs are instrumental in promoting responsible fishing practices, setting catch limits, and protection of marine ecosystems in their designated areas. Collaboration and compliance among member nations are essential for the success of these organizations in achieving their conservation and management objectives. Implementing conservation measures to prevent the depletion of fish stocks. They also work to combat illegal, unreported, and unregulated (IUU) fishing activities in their respective regions. While each RFMO operates independently, they share a common goal of ensuring the long-term sustainability of fisheries. Below are reported the main duties of RFMOs and international advisory bodies, the stock assessment timeframes of each of them (if clearly defined). It is important to stress that the following list is not comprehensive as stock assessment analyses are often carried out in local frameworks and outputs are not always transparently disseminated.

RFMOs managing highly-migratory species, mainly tuna

International Commission for the Conservation of Atlantic Tunas (ICCAT): ICCAT manages tuna and tuna-like species in the Atlantic Ocean. This organization is critical for the conservation of highly migratory and economically valuable species like bluefin tuna. The stock status is provided in different timeframes, every 3 or 4 years depending on the stocks. The stock status is validated by the ICCAT commission meeting, which usually meets in November each year. However, the status of the stock can be retrieved from the stock assessment meeting reports (https://www.iccat.int/en/meetings.html) even before the commission meeting.

Indian Ocean Tuna Commission (IOTC): IOTC is responsible for the conservation and management of tuna and tuna-like species in the Indian Ocean. It also addresses issues related to sharks and other bycatch species. The stock status is provided in different timeframes, every 3 or 4 years depending on the stocks. The status of the stock can be retrieved from status summary available from the website (https://iotc.org/science/status-summary-species-tuna-and-tuna-species-under-iotc-mandate-well-other-species-impacted-iotc). IOTC does not provide a repository with stock assessment outputs.

Western and Central Pacific Fisheries Commission (WCPFC): WCPFC manages fisheries in the western and central Pacific Ocean, overseeing species such as bigeye tuna, yellowfin tuna, and skipjack tuna. This region is a vital source of tuna for global markets. In WCPFC website (https://www.wcpfc.int/current-stock-status-and-advice) the current stock status and

management advice for stocks of interest to the area, for which assessments have been conducted, are presented. Each attached file has a similar layout, providing the latest information on stock status and management advice, research recommendations, useful references and links to previous stock assessment documents. Fishery indicators are updated on year basis for all the stocks, but a full stock assessment is conducted every 2 or 3 years depending on the stock.

Inter-American Tropical Tuna Commission (IATTC): IATTC is the regional fisheries management organization (RFMO) responsible for the conservation and management of tuna and tuna -like species, associated species and their ecosystems, throughout the Eastern Pacific Ocean, from Canada, in the north, to Chile, in the South. Its mandate and competence are therefore much broader that the reference in its name to tropical tunas – inherited from a distant past – would seem to indicate. IATTC generally aims to provide assessments and stock status reports on a regular basis every 2 or 3 years. The exact schedule may vary depending on the species and resources in question, but IATTC strives to provide these assessments periodically to ensure the sustainable management of highly migratory species. For the most up-to-date and specific information on the timeframe for stock status updates, it is advisable to consult the official IATTC website and publications (https://www.iattc.org/en-US/publication/commission/Stock-Assessment-Report). The organization regularly reviews and adjusts its procedures and timelines to respond to changing fishery conditions and emerging scientific information. IATTC does not provide a repository with stock assessment outputs.

Commission for the Conservation of Southern Bluefin Tuna (CCSBT): CCSBT is an international organization responsible for the conservation and management of southern bluefin tuna, a valuable and highly migratory species found in the Southern Ocean. CCSBT has specific duties related to fisheries management, and it provides stock status updates on a regular basis. The specific schedule for these updates may vary depending on the species and the availability of data, but CCSBT strives to provide these assessments periodically to ensure the sustainable management of southern bluefin tuna (https://www.ccsbt.org/en/content/latest-stock-assessment).

RFMOs managing fish stocks by geographical area

Northwest Atlantic Fisheries Organization (NAFO): NAFO is responsible for managing fisheries in the northwest Atlantic Ocean. It oversees the conservation and management of various species, including cod, shrimp, and redfish. The stock status is provided in different timeframes, which depends on the species/area and can be yearly (as for the stocks on the Flemish Cap) or every two/three years (as the stocks on the Grand Bank). The stock status is usually provided in June and the info are available from the website (https://www.nafo.int/Science/Science-Advice/Stock-advice) in form of stock assessment report and does not provide a repository with stock assessment outputs.

North East Atlantic Fisheries Commission (NEAFC): NEAFC manages fisheries in the North East Atlantic, focusing on species like mackerel, herring, and blue whiting. It also addresses ecosystem and bycatch concerns. NEAFC implements the requirements for the reporting and monitoring of fishing activities within the NEAFC regulatory area and enforces specific measures following the scientific advices provided under a MoU with ICES.

South East Atlantic Fisheries Organization (SEAFO): SEAFO is focused on managing fisheries in the southeast Atlantic, including species like deep-sea crabs, hake, and other demersal

resources. Scientists from Contracting Parties contribute to the assessment of marine resources in the SEAFO Convention Area and provide their scientific advice to the Commission through the Scientific Committee. Information related to the main SEAFO marine living resources (*Beryx splendens*, *Chaceon erytheiae*, *Hoplostethus atlanticus*, *Dissostichus eleginoidesm Pseudopentaceros richardsoni*) are updated annually, and include catch and effort information as well as additional information relevant to the stocks e.g. spatial and temporal distributions of fishing, length-frequency distributions, life history parameters and other population information, and incidental mortality (sea birds, mammals and turtles) and by-catch of fish and invertebrates (http://www.seafo.org/Science/Species-Summary). SEAFO does not provide a repository with stock assessment outputs.

Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR): CCAMLR is responsible for the conservation and management of marine living resources in the Southern Ocean, including Antarctic krill and various species of toothfish. The fisheries in the Convention Area currently target Patagonian toothfish (*Dissostichus eleginoides*), Antarctic toothfish (*Dissostichus mawsoni*), mackerel icefish (*Champsocephalus gunnari*) and Antarctic krill (*Euphausia superba*). These fisheries are managed using the ecosystem-based and precautionary approach, and management objectives which balance 'conservation' and 'rational use' of living resources and maintain existing ecological relationships. The fisheries operate in a regulatory framework which recognises five types of fisheries that reflect the stage of development and the level of information available to make management decisions. Catch limits in each fishery are agreed using decision rules that ensure the long-term sustainability of the fishery. These limits and the other operational aspects defined in the conservation measures determine when, where and how fisheries are conducted in order to manage the potential impacts on the ecosystem. These regulations are usually specific to a fishing season, and currently apply to toothfish, icefish and krill fisheries. Other fisheries have operated at various times in the past and are no longer active. The status of the stock can be retrieved from status summary available from the website (https://fisheryreports.ccamlr.org/). CCAMLR does not provide a repository with stock assessment outputs.

North Atlantic Salmon Conservation Organization (NASCO): NASCO is an intergovernmental organization focused on the conservation and management of Atlantic salmon in the North Atlantic. NASCO has several key duties related to fisheries management and conservation, and it provides stock status updates on a regular basis. The specific timeframe for these updates may vary depending on the region and the individual salmon populations, but NASCO aims to deliver assessments periodically. For the most current and specific information on the timeframe for stock status updates, it is advisable to consult the official NASCO website and publications (https://nasco.int/events/). Similarly to NEAFC, the scientific advices are provided under a MoU with ICES.

North Pacific Anadromous Fish Commission (NPAFC): NPAFC is an international organization responsible for the conservation and management of anadromous fish species in the North Pacific Ocean. NPAFC has several key duties related to fisheries management, and it provides stock status updates on a regular basis. The specific timeframe for these updates may vary depending on the species and the region, but NPAFC aims to deliver assessments periodically. For the most current and specific information on the timeframe for stock status updates, it is advisable to consult the official NPAFC website (https://www.npafc.org/status-of-stocks/).

South Pacific Regional Fisheries Management Organization (SPRFMO): SPRFMO is responsible for the conservation and management of high-seas fishery resources in the South

Pacific Ocean. SPRFMO has several key duties related to fisheries management, and it provides stock status updates on a regular basis. The specific timeframe for these updates may vary depending on the species and the region, but SPRFMO aims to deliver assessments periodically. SPRFMO Scientific Committee has established three fishery-defined Working Groups: the Jack Mackerel Working Group, the Squid Working Group, and the Deepwater Working Group. These groups meet during the annual Scientific Committee meeting and in inter-sessional virtual meetings and SC Workshops. For the most current and specific information on the timeframe for stock status updates, it is advisable to consult the official SPREFMO website and publications (https://www.sprfmo.int/science/).

General Fisheries Commission for the Mediterranean (GFCM): GFCM is a regional fisheries management organization responsible for the sustainable management and conservation of fishery resources in the Mediterranean and the Black Sea. The GFCM has several key duties and generally aims to provide assessments and stock status reports on an annual basis. However, the specific schedules and timelines for stock assessments may vary depending on the species and the availability of data. The stock assessments are usually carried out at the end of each year in the framework of working groups on demersal and small pelagics stocks. However, in the last years also benchmark sessions are carried out during the intersessional periods. The assessment outputs are accessible after the SAC meeting usually carried out in June of each year. GFCM regularly reviews and adjusts its procedures to respond to changing fishery conditions and scientific advancements. The most up-to-date and detailed information on stock status updates and assessment schedules is available in the official GFCM website (https://www.fao.org/gfcm/data/star/es/).

Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (CCBSP): CCBSP has four main objectives: to establish an international regime for conservation, management, and optimum utilization of pollock resources in the Convention Area; to restore and maintain the pollock resources in the Bering Sea at levels which will permit their maximum sustainable yield; to cooperate in the gathering and examining of factual information concerning pollock and other living marine resources in the Bering Sea and to provide, if the Parties agree, a forum in which to consider the establishment of necessary conservation and management measures for living marine resources other than pollock in the Convention Area as may be required in the future. For the most current and specific information on the timeframe for stock status updates, it is advisable to consult the official SSCSP website and publications (https://www.fisheries.noaa.gov/region/alaska#science). Similarly to other RFMOs, the scientific advices are provided in the framework of NOAA.

North Pacific Fisheries Commission (NPFC): NPFC is an inter-governmental organization established by the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean. The objective of the Convention is to ensure the long-term conservation and sustainable use of the fisheries resources in the Convention Area while protecting the marine ecosystems of the North Pacific Ocean in which these resources occur. Species Summaries for NPFC target species (Blackspotted and Rougheye Rockfishes, Blue Mackerel, Japanese Flying Squid, Japanese Sardine, Neon Flying Squid, North Pacific Armorhead, Sablefish, Splendid Alfonsino) are adopted in December every year (https://www.npfc.int/species-summaries).

Southern Indian Ocean Fisheries Agreement (SIOFA): SIOFA objectives are to ensure the long-term conservation and sustainable use of the fishery resources in the Southern Indian Ocean through cooperation among the Contracting Parties, and to promote the sustainable development

of fisheries in the Area, taking into account the needs of developing States bordering the Area that are Contracting Parties to this Agreement, and in particular the least developed among them and small-island developing States. This Agreement covers fishery resources including fish, molluscs, crustaceans and other sedentary species within the area, but excluding highly migratory species (Annex I of UNCLOS) and sedentary species subject to the fishery jurisdiction of coastal states (Article 77(4) of UNCLOS). For the most up-to-date and specific information on the timeframe for stock status updates, it is advisable to consult the official SIOFA website (https://siofa.org/meetings/SERAWG. SIOFA does not provide a repository with stock assessment outputs.

Joint Norwegian-Russian Fisheries Commission (JNRFC): JNRFC provides efficient joint management of the most important fish stocks of both Norway and Russia, in the Barents Sea and the Norwegian Sea. Historically this commission does not analyse data to carry out stock assessments, which were usually performed by ICES. However, due to the Ukrainian/Russian conflict and the following lack of participation of Russian scientists in ICES working groups, this commission provided updated stock status of many shared stocks (https://www.jointfish.com/eng.html). JNRFC does not provide a repository with stock assessment outputs.

Regional fisheries bodies (RFB)

Western Central Atlantic Fisheries Commission (WECAFC): WECAFC is a regional fisheries management organization that focuses on the sustainable management and conservation of fishery resources in the western central Atlantic Ocean. While WECAFC's duties are primarily focused on facilitating cooperation and information exchange among member countries, it may not conduct stock assessments itself. Instead, WECAFC primarily functions as a forum for collaboration, research, and policy coordination among its member states.

Fisheries Committee for the Eastern Central Atlantic (CECAF): CECAF is a regional fisheries management organization responsible for the sustainable management and conservation of fishery resources in the eastern central Atlantic Ocean. CECAF has several key duties related to fisheries management, and it promotes scientific research and cooperation among its member countries. However, CECAF may not conduct stock assessments itself. Instead, it primarily serves as a forum for collaboration, research, and information exchange among its member states.

Regional Commission for Fisheries (RECOFI): RECOFI was established under the Food and Agriculture Organization (FAO), is responsible for the promotion of sustainable fisheries management and development in the Red Sea, Gulf of Aden, and the Arabian Sea. RECOFI's duties and specific stock assessment timeframes may vary depending on the regional context and the species under consideration. Regarding the specific timeframes for stock assessments, it is important to note that RECOFI itself may not conduct stock assessments directly. Instead, individual member countries and relevant scientific institutions are typically responsible for conducting stock assessments for specific species in the region.

Other bodies providing stock assessment outputs by geographical area/nation

International Pacific Halibut Commission (IPHC): IPCH is an international organization established by a Convention between Canada and the United States of America, to develop the stocks of Pacific halibut in the Convention waters to those levels which will permit the optimum yield from the fishery and to maintain the stocks at those levels. The stock status of the target stock is provided regularly every year in December. For the most current and specific information on the timeframe for stock status updates of Pacific halibut, it is advisable to consult the official IPHC website and publications (https://www.iphc.int/venues/details/99th-session-of-the-iphc-annual-meeting-am099).

Out of these international organisation, national bodies are assessing very coastal stock of stocks outside the scope of international bodies. We do not list all of them but a framework to collect all valuable (and to assess the quality of them is here a key point) stock assessment still need to be defined.