

## EU request on analysis of the IUCN process for the assessment of the conservation status of marine species in comparison to the process used by fisheries management bodies

### Advice summary

ICES advises that when the International Union for Conservation of Nature (IUCN) Red List of Threatened Species approach is compared to the stock assessment approach used in fisheries management, it is important to recognise that the two approaches are designed for different purposes. The aim of the IUCN approach is to assess the risk or threat of a taxon going extinct, while advice on fisheries management assesses the status of a stock relative to the productivity of the stock and its capability to produce maximum sustainable yield (MSY).

ICES advises that there are few operational benefits to incorporating IUCN assessments into fisheries management. The IUCN process does not offer as effective an assessment tool for fisheries management as the process used by fisheries management bodies. The IUCN process can be ineffective to alert when a stock is outside safe biological limits and does not assess the exploitation level relative to precautionary and MSY reference points.

IUCN assessments cover species not currently subject to fisheries assessments, and for such species the IUCN assessment may offer valuable information on the need to perform an assessment for fisheries management.

### Request

*The International Union for Conservation of Nature IUCN assessments are increasingly used as source of "scientific" information for the perception of the stock status of marine fish species, including those that are falling under the purview of fisheries management bodies. These assessments are becoming increasingly influential in shaping the public opinion on conservation issues, as well as, in supporting decisions in national and international organisations, in particular multilateral environmental agreements. However, there are also increasingly examples of inconsistencies between the outcome of the IUCN assessments and those of scientific bodies supporting fisheries management organisations, which indicate that there is a need to better understand the pros and cons of the two approaches and most importantly their reliability in the context of decision making processes for the conservation and management of marine fish species. In addition, it is not clear how this process works in terms of methodology, reproducibility, accuracy, coherence and comparability of outputs with fisheries assessments etc.*

ICES was requested to:

1. *Perform a critical analysis of the IUCN assessment process for marine species in comparison the scientific process of relevant fisheries organisations (in particular ICES, scientific committees of RFMOs); including how data/information from different sources used by IUCN are weighted to derive a final perception of decline*
2. *Provide an analysis of the criteria used by IUCN and their suitability for marine fish species*
3. *Provide a comparison between IUCN categories of conservation status and fisheries reference points for defining sustainability at both the species and stock level*
4. *Identify pros and cons of the two processes*
5. *Compare recent IUCN listings for key EU stocks with corresponding information from stock assessments.*
6. *Case studies species should cover a range of taxonomic levels and also include a range of data rich and data limited stocks). Case study species could usefully be agreed between ICES and MARE prior to any workshop.*
7. *Assess suitability and reliability, and advantages or disadvantages of incorporating IUCN assessments for fisheries management and other relevant decision making processes.*

### Elaboration on the advice

#### IUCN Red List categories and criteria and assessment of stock status by relevant fisheries organizations

The IUCN Red List categories and criteria have been developed to improve objectivity and transparency in assessing the extinction risk of a species. IUCN operates with seven categories of "conservation status", from "least concern" to "extinct".

These may be applied to any taxonomic unit at or below species level. In addition, IUCN also has a category for taxa where information is inadequate to make an assessment, as well as one for taxa not yet evaluated.

IUCN assessments cover many more marine fish species than are currently assessed by fisheries management organizations.

IUCN has five criteria to determine which category a taxon belongs in:

- A. Declining population (past, present, and/or projected).
- B. Geographic range size, and fragmentation, decline, or fluctuations.
- C. Small population size and fragmentation, decline, or fluctuations.
- D. Very small population or very restricted distribution.
- E. Quantitative analysis of extinction risks (e.g. population viability analysis).

Criterion A has been almost universally used for marine fishes.

The advice on stock status, provided by science organizations such as ICES and regional fisheries management organizations (RFMOs) is given in the context of agreed fisheries management objectives. A key agreement is the UN Straddling Stock Agreement (UN, 1995). This commits States to adopt measures that ensure long-term sustainability of fish stocks, ensuring that such measures are based on the best scientific evidence available, and that they are designed to maintain stocks at, or restore to levels capable of producing maximum sustainable yield. It is furthermore stated in the agreement that the precautionary approach (PA) should be applied.

The Straddling Stock Agreement operates with two types of precautionary reference points: conservation (or limit) reference points and management (or target) reference points. Limit reference points set boundaries to constrain harvesting within safe biological limits within which the stocks can produce maximum sustainable yield.

The objectives of the EU Common Fisheries Policy (CFP) are in line with the UN Straddling Stock Agreement, and the advice provided by ICES in response to requests from the EU assesses the stock status using the limit reference point  $B_{lim}$ .  $B_{lim}$  is defined as the stock size below which the stock is considered to have reduced reproductive capacity. To account for the uncertainties in the assessment of stock status, ICES has defined a stock status reference point,  $B_{pa}$ , above which the stock is considered to have full reproductive capacity with 95% probability.

When comparing the IUCN Red List approach and the stock assessment approach used in fisheries management it is important to recognise that the two approaches are designed for different purposes. The aim of the IUCN approach is to assess the risk or threat of a taxon becoming extinct, while advice on fisheries management assesses the status of a stock relative to the productivity of the stock and its capability to produce maximum sustainable yield.

**Request 1: Perform a critical analysis of the IUCN assessment process for marine species in comparison to the scientific process of relevant fisheries organizations (in particular ICES and scientific committees of RFMOs), including how data/information from different sources used by IUCN are weighted to derive a final perception of decline**

According to the most recent IUCN Red List guidelines, a taxon shall be assessed against as many of the five criteria as possible and the classification of threat category based on the criteria that gives the highest level of threat. All relevant available information should be used in the assessment, but the final classification of category should be based only on the data used in the criteria giving the highest threat. These guidelines also discuss some specific challenges of assessing commercially exploited fish, such as initial decline in numbers and appropriateness of commercial indices.

Almost all fish taxa assessed by IUCN are based on criterion A (declining population). This means that the assessments primarily use information on relative change in the biomass of mature individuals taken from stock assessments of commercially exploited fish (SSB). For non-commercial or poorly sampled populations, the assessment is conducted using trends in abundance estimates from surveys or trends in reported catches.

The ICES framework for assessing stock status is designed to use all available relevant information and the assessment methods/models applied are selected based on the characteristics and quality of the information and not, as is the case

with the IUCN approach, on the outcome of that assessment. This means that the IUCN process only gives weight to those data incorporated in the assessment that indicate the highest threat.

The interpretation of the precautionary approach by IUCN may result in data-limited methods potentially overriding more knowledge-rich methods. By preferentially using the criterion giving the highest threat assessment, the IUCN approach may discard information of relevance for estimating recent trends and risk to extinction.

Although the IUCN approach can be applied to any taxonomic unit at or below species level, most assessments are undertaken at species level. There is guidance from IUCN on how to merge signals from different populations of the same species, but the focus on the species level may result in local threats not being recognised in the IUCN approach.

“Stock” is typically the unit used in assessments of status by fisheries organizations. This allows for a categorization of the risk to the species at the stock level as well as target management measures to address stocks assessed to be outside safe biological limits.

### **Request 2: Provide an analysis of the criteria used by IUCN and their suitability for marine fish species**

In 2009, ICES assessed the suitability of the IUCN criteria and concluded that for fish with an analytical assessment, criterion E (population viability analysis) was most appropriate for the assessment of extinction risk (ICES, 2009a). This was reiterated by ICES in 2013, when advising on the HELCOM Red Listing of Baltic cod (ICES, 2013). Although both of these advice sheets were based on an older version of the IUCN guidelines, ICES considers them to be still relevant.

Unlike the methods used in fisheries management, IUCN criterion A does not identify a threat to fish species that have a stable stock size but are outside safe biological limits.

Analyses conducted indicate that the IUCN approach rarely overestimates the threat to a species, even in cases where the species shows a decline in stock size whilst still being within safe biological limits.

### **Request 3: Provide a comparison between IUCN categories of conservation status and fisheries reference points for defining sustainability at both the species and stock level**

IUCN and fisheries organization approaches are methods designed to address different objectives. The IUCN Red List classifies extinction risk to a species, while the limit reference points used in fisheries management relate to the productivity of a stock. This results in the IUCN assessments mostly addressing rates of decline in fish populations, while the fisheries assessments address the status relative to biomass target and/or limit reference points.

Simulations suggest that when using IUCN criterion A (the main criterion used in assessing fish species), classing a stock as threatened will occur infrequently when that stock is stable below biomass reference points. A population or stock that has been reduced to a low level, such as below  $B_{pa}$ , is likely to be at higher risk of extinction than one that is well above such a limit reference point. In terms of precautionarity, the fisheries assessment approach accounts better for the risk to a stock of being outside safe biological limits than the IUCN threat categorization.

Simulations that tested extinction risk on stocks being managed with harvest control rules similar to those used by the EU Common Fisheries Policy, prevented stock crash caused by fishing and maintained stocks above critical extinction biomass limits.

Applying the IUCN Red List criteria at species level and not at stock level may result in the extinction risk of a species at regional level not being recognised.

### **Request 4: Identify pros and cons of the two processes**

The identification of pros and cons of the two processes was done in relation to their use in fisheries management.

The pros can be generalized and many are shared by the two approaches. Both frameworks are:

- globally accepted as methods to provide evidence;
- designed to catalyse action (fisheries management approaches are also designed to inform on consequences of action);
- incorporate the precautionary principle, although in different ways and with differing consequences;
- strive to show transparency of methods;
- welcome and expect review and scrutiny.

The pros for the IUCN approach:

- Same approach applied to all species;
- High recognition amongst the general public.

The pros for fisheries management:

- Targeted at delivering the evidence for fisheries management objectives;
- Well-resourced.

The cons shared by both approaches:

- Not well suited to species for which only catch or landings data are available.

The cons for the IUCN approach:

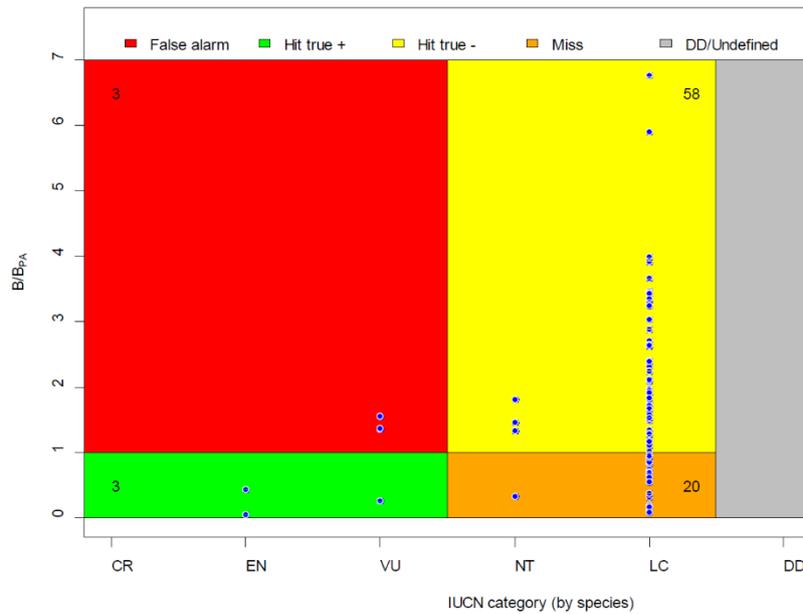
- The process may not alert when populations are outside safe biological limits;
- The process may not use all relevant information and methods – such as management strategy evaluation (MSE) – and may favour data-limited approaches even for data rich-stocks;
- Listing processes do not have a regular timing or resourcing schedule;
- Poorly resourced.

The cons for fisheries management:

- Resource and data hungry;
- Increasingly reliant on complex statistical modelling;
- Is targeted at fisheries management and not species/stock conservation;
- Only relevant for exploited stocks.

#### **Request 5: Compare recent IUCN listings for key EU stocks with corresponding information from stock assessments**

To answer this request ICES compared the species categorized as threatened or not-threatened in the IUCN Red List approach (Figure 1) with stocks assessed to be below and above  $B_{pa}$  in the fisheries approach. The comparison shows that for ICES and the International Commission for the Conservation of Atlantic Tunas (ICCAT) stocks, 73% were similarly assigned. However, almost one in four stocks were below the biomass reference point and assigned to a non-threatened category by the IUCN approach (Figure 1). There is no evidence of bias by IUCN analytical methods towards exaggerating the threat status in Europe.



**Figure 1** Performance of the IUCN Red List in relation to stock status as defined by the estimate of biomass relative to its precautionary reference point ( $B/B_{pa}$ ). Each point is a stock, with the species classified according to the threat criteria of the IUCN Red List. Red List categories are: Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), and Data Deficient (DD). Shading indicates: (1) hits, where the two systems concur, either because the spawning-stock biomass is below the reference point and the threat criteria are met (true positive, in green), or because a stock is above the reference point and the threat criteria are not met (true negative, in yellow); (2) misses, in orange, where a stock is at low biomass but does not meet the threat criteria; and (3) false alarms, in red, where the stock is at high biomass but the threat criteria are met. Numbers in each quadrant refer to the number of stocks.

**Request 6: Case studies species should cover a range of taxonomic levels and also include a range of data-rich and data-limited stocks**

Case studies of simulated populations used to inform this advice were: bluefin tuna (*Thunnus thynnus*, data-rich and assessed by ICCAT), blue shark (*Prionace glauca*, data-limited and assessed by ICCAT), Atlantic cod (*Gadus morhua*, data-rich and assessed by ICES, two populations), and red (blackspot) sea bream (*Pagellus bogaraveo*, data-limited and assessed by ICES). These were chosen in consultation with EU DGMARE. The results of the case studies are available in the report on IUCN assessments and fisheries management approaches (Millar and Dickey-Collas, 2018). These are further described in the basis of the advice (ICES, 2018b).

**Request 7: Assess suitability and reliability, and advantages or disadvantages of incorporating IUCN assessments for fisheries management and other relevant decision making processes**

In terms of providing information for maximizing yield for fisheries and assessing risk to fish stocks in relation to biomass reference points, the IUCN approach does not perform well as it provides no information directly relevant to these objectives. It may not detect that a stock is overfished, if the biomass is very low and stable. When a fish stock is exploited, the IUCN approach may underestimate the risk to a stock of being outside safe biological limits.

ICES has evaluated the value of incorporating IUCN assessments in fisheries management of fish stocks and considers that such incorporation may offer only limited operational added value. The fisheries approach addresses stock status and can identify the level of risk to stocks when information on stock development is available. The analysis shows that a management system based on harvest control rules that have been evaluated to be precautionary, leads to a very low risk of a stock becoming extinct due to fishing.

The IUCN assessment covers species not currently subject to fisheries assessments, and for such species the IUCN assessment may be used to alert on the need for fisheries assessment and management.

If the IUCN approach is incorporated into fisheries management it is important to recognise that the two approaches have been developed for different purposes. The two approaches may therefore lead to different outcomes and their integration may require the adoption of further decision rules.

Norway has formally incorporated IUCN assessments into the fisheries management process through the Marine Resources Act, with the aim of integrating conservation and sustainable use management objectives. The operational benefits to fisheries management of this incorporation are unclear, especially as many new methods are now being applied for data-limited fish stocks. However, it may enhance the credibility of the management system by formally incorporating the conservation objectives of the IUCN approach.

## Basis of the advice

### Methods

#### Literature study and consultations

A literature study and broader consultations with IUCN, the UN Food and Agriculture Organization (FAO), and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) were carried out.

#### Comparison (IUCN and CFP) of the classification of EU stocks

A comparison of the classification of EU stocks (ICES and ICCAT) through the IUCN process and the fisheries management (CFP) approaches was carried out. The choice of stocks for comparison was agreed with EU DGMARE and it was agreed not to cover non-ICCAT stocks in the Mediterranean. ACOM decided that the appropriate biomass reference point for the comparison of classification of EU stocks by IUCN and fisheries management status was  $B_{pa}$ , the precautionary biomass reference point.

Data from ICES stock assessment database for the past five years were downloaded to ensure that all stocks currently assessed by ICES were included. If  $B_{pa}$  reference points were not available,  $MSY$  or management plan reference points were used. If  $F_{MSY}$  reference points were not available, precautionary approach or management plan reference points were used.  $F$  reference points are not available for three Icelandic stocks that use harvest rates rather than  $F_{MSY}$ . These were converted to  $F$  according to  $F = -\ln(1 - HR_{ref\ point})$ . The ICCAT assessments cover 16 stocks. Reference points for these stocks were not always available, but the ratios of  $B/B_{MSY}$  and  $F/F_{MSY}$  were available. As a range of values of  $F/F_{MSY}$  and  $B/B_{MSY}$  are reported in the ICCAT assessment, averages were taken. IUCN assessments do not currently assess Norway lobster (*Nephrops norvegicus*), and as a result, it could not be included in this study. Yellowfin tuna is likewise not assessed in the European Red List.

#### Comparison between IUCN categories of conservation status and fisheries reference points

A comparison between IUCN categories of conservation status and fisheries reference points for defining sustainability at both the species and the stock level was carried out. This was done through simulation studies of four case study species, representing a range of population characteristics and veracities of data provision. The stocks for the case studies were agreed with EU DGMARE: bluefin tuna (*Thunnus thynnus*), blue shark (*Prionace glauca*), Atlantic cod (*Gadus morhua*), and red (blackspot) sea bream (*Pagellus bogaraveo*).

A management strategy evaluation (MSE) was performed for the four stocks. In each case, an operating model (OM) was developed from current information on stock characteristics and conditioned on available information and catch history to represent a simulated "true" population. Populations were assumed to be unexploited in the initial years of the simulation. Each OM was projected forward 100 years, one thousand times, with catches informed by a pseudo-stock assessment and a harvest control rule designed to replicate that frequently used by ICES.

In each year of the projection, the estimated SSB was compared to reference points and the magnitude of population decline over the previous three generations was calculated (calculation of IUCN criterion A). Additionally, extinction risk was also calculated from the 1000 simulations (enabling comparison of population simulations under IUCN criterion E).

For each stock, and for each assessment, two sets of performance matrices were calculated to show:

- if IUCN criterion A thresholds were met; and
- if the assessment estimate was below the biomass reference points ( $B_{pa}$  and  $B_{lim}$ ).

To estimate the magnitude of population size decline needed for the calculation of IUCN criterion A, generation time  $T_{gen}$  was computed for the four stocks. This was achieved by comparing the assessment estimate of SSB in the current year to that at time  $T_{gen+1}$ . Comparison to the biomass reference points was achieved by comparing the assessment values of SSB to the estimated reference points.

An additional set of metrics to evaluate the probability of extinction risk from a quantitative analysis (criterion E) was calculated by considering the distribution of outcomes over simulations for each stock scenario. The frequency with which SSB in the terminal year of the projections fell below 10%, 5%, and 1% of the unfished SSB was calculated.

## Results and conclusions

### Comparison (IUCN and CFP) of the classification of EU stocks

When comparing biomass reference points with their status of IUCN threat, the majority of stocks were similarly assigned (72%). However, this dropped to 55% similarly assigned when comparing fishing mortality reference points to threat status. Both approaches detect changes in biomass to alert concern. However, in this example, the IUCN assessment has a reduced ability to alert to overexploitation ( $F > F_{MSY}$ , as suggested by Punt, 2000) and thus to anticipate an increased risk of the stock remaining outside safe biological limits.

When the IUCN assessment is compared to the fisheries management reference points, the number of misses (23% for biomass and 40% for fishing mortality) suggests that the IUCN approach is less able to alert in cases when the stock is either stable and below safe biological limits, or is being overexploited.

### Comparison between IUCN categories of conservation status and fisheries reference points

The IUCN threat listing was triggered frequently when assessing historical trends in biomass for exploited marine fishes, due to a declining population size at the beginning of exploitation. Populations that began management projection periods at a higher stock level showed greater correspondence between IUCN category listings and stock status relative to reference points than stocks that began at a low level. When the harvest control rule estimated stocks to be above biomass reference points, the IUCN assessment tended to give positive results. Towards the end of the 100-year stock projections, the listing of Vulnerable again became more frequent, as populations were on average at higher levels and were hovering around biomass targets.

Analyses for Baltic cod show that there is a problem summing over multiple populations. The IUCN criterion was not triggered despite one of the two stocks being below biomass reference points.

MSE can be a more comprehensive tool for assessing uncertainty associated with management of social–ecological systems than the traditional population viability analysis (PVA), suggesting MSE is a useful means for assessing fish populations under IUCN criterion E. The analysis shows that the harvest control rules applied here were successful at preventing stock crashes and maintaining stocks above critical biomass limits, even in data-limited cases. Simulated stocks very rarely, or never, fell below the 10% spawning biomass threshold. Using this analysis to assess a stock against criterion E would thus not lead to any of these four stocks being considered threatened, whereas an assessment using criterion A (population decline) would have done so in many cases during the historical period when the stocks were being fished down.

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