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Version 4, 30 June 2016
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5.4.2[*†‡] EU request to provide a framework for the classification of stock status relative to MSY proxies for selected category 3 and category 4 stocks in ICES subareas 5 to 10

Advice summary

ICES provides a framework for stock status classification relative to MSY proxies for stocks in category 3 (stocks for which abundance indices indicate trends) and category 4 (stocks for which only reliable catch data are available). It also classifies selected stocks in ICES subareas 5 to 10 applying this framework – of the twenty-seven stocks considered, stock status could be determined for fourteen (52%), nine of which were classified as having a desirable status and five as having an undesirable status. ICES was unable to determine stock status for the remaining thirteen stocks.

Request

The Commission is preparing long term management plans for western EU waters (ICES subareas 5 to 10). According to Art. 10 of Regulation (EU) No 1380/2013 on the Common Fisheries Policy a multiannual plan shall include quantifiable targets, a time frame to reach the targets and safeguards to ensure that the quantifiable targets are met.

Stocks for which analytical assessments are or can be made available are included in a different request. The present request concerns stocks for which TACs are currently set but on which F_{MSY} cannot be determined on the basis of analytical (age-based or length-based) assessments. The stocks concerned are:

Anglerfish (Lophius budegassa) in Divisions 7b-k and 8a,b,d
Anglerfish (Lophius piscatorius and L. budegassa) in Division 3a and Subareas 4 and 6
Anglerfish (Lophius piscatorius) in Divisions 7b-k and 8a,b,d
Greater silver smelt (Argentina silus) in Divisions 5b and 6a (Faroes grounds, West of Scotland)
Greater silver smelt (Argentina silus) in Subarea 14 and Division 5a (East Greenland, Iceland Grounds)
Greater silver smelt (Argentina silus) in Subareas 1, 2, 4 and Division 3a (Northeast Arctic, North Sea, Skagerrak and Kattegat)
Greater silver smelt (Argentina silus) in Subareas 7–10, 12 and Division 6b (other areas)
Haddock in Division 7a (Irish Sea)
Ling in (Molva molva) Divisions 3a and 4a, and in Subareas 6, 7, 8, 9, 12, and 14 (other areas)
Megrim (Lepidorhombus spp.*) in ICES Division 6b (Rockall)*
Megrim (Lepidorhombus whiffiagonis) in Divisions 7b-k and 8a,b,d[‡]
Nephrops in the FU 20 (Labadie) and FU 21 (Jones and Cockburn)[‡]
Nephrops in Divisions 8a,b (Bay of Biscay, FU 23, 24)[‡]
Nephrops in North Galicia (FU 25)
Nephrops in West Galicia and North Portugal (FU 26–27)

[*] Version 3; Section number corrected.

[†] Version 4; updated to note that megrim (*Lepidorhombus whiffiagonis*) in divisions 7b-k and 8a,b,d is now assessed by ICES as a category 1 stock and MSY reference points and F_{MSY} range were estimated. When this request was made, megrim (*Lepidorhombus whiffiagonis*) in divisions 7b-k and 8a,b,d was classified as a category 3 stock by ICES, and as such MSY proxies were provided. In the spring of 2016, ICES was able to re-classify it as a category 1 stock as a result of the benchmark, IBPMeg (ICES, 2016a). The information for the F_{MSY} range is available in ICES (2016b). Corrections have also been made to the white anglerfish (*Lophius piscatorius*) in Divisions 7b–k and 8a, b, d proxy reference point values.

[‡] Version 5; updated to note changes in the stocks of *Nephrops* in divisions 8.a-b (FU 23, 24) and *Nephrops* in divisions 7.g and 7.h (FUs 20, 21). For these stocks, F_{MSY} proxies were provided in earlier versions of this advice. However, ICES has since then been able to assess these stocks as category 1 stocks using Underwater TV surveys, and to calculate F_{MSY} reference points (in the form of harvest rates) for them (ICES, 2016d; 2016e). The proxy F_{MSY} reference points provided earlier for these stocks have therefore been replaced by the F_{MSY} reference points. Although the stocks are now classified as category 1 stocks, ICES is currently not in the position to provide F_{MSY} ranges for them.

Nephrops in South-West and South Portugal (FU 28–29)
Nephrops in Gulf of Cadiz (FU 30)
Nephrops in the Cantabrian Sea (FU 31)
Plaice in Divisions 7h-k (Southwest of Ireland)
Plaice in Divisions 7f, g (Celtic Sea)
Plaice in Division 7a (Irish Sea)
Plaice in Division 7e[§]
Pollack in Subareas 6 and 7 (Celtic Sea and West of Scotland)
Seabass (Dicentrarchus labrax) in Divisions 8a, b (Bay of Biscay North and Central)
Sole in Divisions 7h-k (Southwest of Ireland)
Tusk (Brosme brosme) in Divisions 3a, 4b, 6a, and 12b, and Subareas 4, 7, 8, and 9 (other areas)
Tusk (Brosme brosme) in Division 6b (Rockall)
Whiting (Merlangius merlangus) in Division 7a (Irish Sea)

For each of these stocks ICES is requested the following:

- *On the basis of available data and expert judgement, to ascertain whether it is possible to define a "desirable" state of the stock assimilate to the state producing MSY, i.e. a state of the stock believed to produce high yields for a long period without a risk of stock depletion.*
- *On similar basis, to explore whether it is possible to determine an "undesirable" state of the stock assimilate to a state where there is a risk of very slow or no recovery towards "desirable" levels.*
- *To assess the current situation of the stock relative to the "desirable" and "undesirable" states.*

Following consultation between ICES and the client, the request was further clarified as follows:

ICES should estimate proxies for F_{MSY} and MSY $B_{trigger}$ based on the data available and expert judgement and classify the stocks in relation to the estimated proxies. The F_{MSY} proxy corresponds to the exploitation rate that will provide maximum longterm yield. The MSY $B_{trigger}$ proxy corresponds to the stock size that triggers a cautious response (i.e., advice on a reduced fishing mortality relative to the F_{MSY} proxy to allow the stock to rebuild). In this context, a stock in a "desirable status" is being exploited at or below the F_{MSY} proxy with a stock size equal to or larger than the MSY $B_{trigger}$ proxy.

In turn, stocks are in an "undesirable state" if they are either exploited above the F_{MSY} proxy or have a stock size smaller than the MSY $B_{trigger}$ proxy.

Elaboration on the advice

Framework

ICES provides a framework for stock status classification relative to maximum sustainable yield (MSY) proxies for stocks in categories 3 and 4; these are stocks without analytical assessments but for which either abundance indices provide trends (category 3) or only catch data and biological information are available (category 4).

A stock is classified on the basis of two MSY proxy indicators: one for exploitation and a second for biomass. Whenever possible, the indicators are designated either green (exploitation is at or below the F_{MSY} proxy, biomass is at or above the MSY $B_{trigger}$ proxy) or red (exploitation is above the F_{MSY} proxy, biomass is below the MSY $B_{trigger}$ proxy). When no determination can be made they are designated unknown. The stock status is derived from the combination of the indicator values such that:

[§] Plaice (*Pleuronectes platessa*) in Division 7e (Western Channel) was classified as a category 3 stock by ICES (IBPWCFlat2; ICES, 2015a) therefore, ICES developed proxy reference points, rather than ranges, for this stock (see ICES, 2016d).

- When both indicators are green, the stock status is classified as desirable;
- When either or both indicators are red, the stock status is classified as undesirable;
- When one indicator is green and the other unknown, the stock status is classified as unknown.

Some methods provide a classification relative to both F_{MSY} and MSY $B_{trigger}$ proxies and can thus be used to classify the status of the stocks as desirable/undesirable. Other methods only provide an indication of exploitation status relative to F_{MSY} proxies.

The methods developed for stocks in categories 3 and 4 allow classification of exploitation and biomass in terms of whether they are above or below MSY proxies. Given the uncertainties in data and knowledge for stocks in these categories, ICES is not currently using these methods to provide quantitative estimates of the distance of F from F_{MSY} or B from MSY $B_{trigger}$. Whereas the classification of stocks is the best available at this time, revisions may occur as more information becomes available for these stocks and the methods and knowledge are further developed. The framework is expected to evolve over time, as the methods are further developed and validated.

After the original advice was published on 5 February 2016, the European Commission indicated a need to have a fuller description of the F_{MSY} and MSY $B_{trigger}$ proxies used under each method and the values of these proxies. Therefore, Table 5.4.2.1 now includes this information. ICES, however, notes that the F_{MSY} and MSY $B_{trigger}$ proxy values will change over time, due to changing conditions and to new data and knowledge that may become available. Stocks in categories 3 and 4 are subject to more uncertainty in data and knowledge than stocks in category 1, which also applies to the values of the F_{MSY} and MSY $B_{trigger}$ proxies calculated for them; moreover, for some of the methods, the values of the proxies are expected to be recalculated each time stock status is evaluated. In developing management plans, managers are encouraged to maintain communication with ICES to ensure that the most appropriate information is used, given that these proxies may change over time. ICES considers that instead of hard-wiring the proxy values in legislation, it would be more appropriate to integrate them in a management framework that facilitates their revision when new knowledge indicates that this is appropriate.[**]

Classification of stocks

ICES examined twenty-seven stocks[††], and arrived at the following classifications of current stock status (full stock names are given in Table 5.4.2.1):

- Nine stocks are classified as having a desirable status: anp-78ab, had-iris, lin-oth, meg-rock, ple-celt, ple-echw, ple-iris, pol-celt, and usk-oth.[†]

- Five stocks are classified as having an undesirable status: nep-25, nep-2627, nep-31, ple-7h-k, and whg-iris.
  For the *Nephrops* stocks in this group, the method used only provided information on fishing mortalities and indicated that they were below F_{MSY} proxies. Auxiliary information (catch per unit effort) indicated very low stock biomass and led to the classification of undesirable stock status.

- Thirteen stocks are classified as unknown:
  - Nine stocks were identified as being exploited below the F_{MSY} proxies but with no information on the biomass status: arg-5b6a, arg-icel, bss-8ab, nep-2829, nep-30, sol-7h-k, and usk-rock.
  - Four stocks have incomplete data and no suitable method is available at this time: anb-78ab, ang-ivvi, arg-1234a, and arg-rest.

[**] Version 2; this paragraph was added to the advice on 04 March 2016.

[††] Version 4; Number revised to exclude the megrim (*Lepidorhombus whiffiagonis*) in divisions 7b-k and 8a,b,d stock (mgw-78). When this request was made, megrim (*Lepidorhombus whiffiagonis*) in divisions 7b-k and 8a,b,d was classified as a category 3 stock by ICES, and as such MSY proxies were provided. In the spring of 2016, ICES was able to re-classify it as a category 1 stock as a result of the benchmark, IBPMeg (ICES, 2016a). The information for the F_{MSY} range is available in ICES (2016b).

Of the 27[†,ǂ] stocks considered, 78%[†] (21[†] stocks) have an F below the F_{MSY} proxy, and 33%[ǂ] (9[ǂ] stocks) have a biomass above the MSY $B_{trigger}$ proxy.

[†] Version 4: value updated due to the exclusion of the megrim (*Lepidorhombus whiffiagonis*) in divisions 7b-k and 8a,b,d stock (mgw-78) of this request.

Basis of the advice

Background

This advice is based on work conducted in two ICES workshops: the first, the Workshop on the Development of Quantitative Assessment Methodologies based on Life History Traits, Exploitation Characteristics and other Relevant Parameters for Data-limited Stocks (WKLIFE V) was held in Lisbon, Portugal in October 2015, where methods to determine proxy reference points were developed (ICES, 2015b); and subsequently, the Workshop to consider MSY proxies for stocks in ICES category 3 and 4 stocks in Western Waters (WKProxy) was held at the ICES Secretariat in November 2015, where stock experts applied the methods developed at WKLIFE V to the stocks in the present request (ICES, 2016c).

The classification was conducted with the most recent data available to WKProxy (ICES, 2016c). In a few cases, 2014 data were not available or could not be used.

A number of methods are available; each uses data in different ways and makes different assumptions: expert knowledge is needed to ascertain that the available data and information on life history parameters are of sufficient quality and that the methods are appropriate for a stock. A brief description of the methods used and the criteria applied to determine the status of the stock is given below. A more detailed description and references for each method is available in the WKLIFE V (ICES, 2015b) and WKProxy reports (ICES, 2016c).

An ICES external review was conducted of both the WKLIFE V and the WKProxy reports.

Methods

ICES used a structured approach to select a method based on available data, appropriateness of a model and its assumptions in order to classify stock status relative to MSY reference point proxies:

- Firstly, if previous ICES advice used a catch/landings and biomass index series this was then investigated by applying a biomass dynamic model (SPiCT – Stochastic Production model in Continuous Time) which provides model diagnostics. If the diagnostics were acceptable, SPiCT was used as the basis for further analyses; if unacceptable, consideration was given to analyses based on length data and life history parameters. The biomass dynamic model gives direct estimates (and time-series history) of the ratio F/F_{MSY} proxy and B/MSY $B_{trigger}$ proxy. The stock is considered in a desirable state if F/F_{MSY} proxy ≤ 1 and B/MSY $B_{trigger}$ proxy ≥ 1 (where MSY $B_{trigger}$ proxy = 0.5 B_{MSY}, a parameter estimated by the model).

- If adequate length sampling data were available together with effort data, the mean length-based mortality estimator (Z) was investigated from a time-series of mean length data. With either a given or a model-estimated value of natural mortality (M), fishing mortality can be compared with reference points obtained from a length-based per-recruit analysis ($F_{0.1}$, $F_{30–40\%}$). If the diagnostics were acceptable, this was used as the basis for further analyses; if unacceptable, consideration was given to analyses based on alternative methods, also based on length data and life history parameters, which make additional equilibrium assumptions, i.e. length-based spawning potential ratio (LB-SPR) or length-based indicators (LBI). The LB-SPR method compares size-based estimates of fishing mortality with size-based yield per recruit reference points: F/M < 1 and SPR typically greater than 35% is considered to be consistent with $F \leq F_{MSY}$ proxy. According to the LBI indicator, a stock is considered to be exploited according to the MSY approach if L_{mean} is greater than L(F = M).

- If adequate length data were not available, then analyses were based solely on catch/landings data and information on resilience (CMSY). Stock status classification was done as for the biomass dynamics method described above (SPiCT).

In exceptional circumstances, an age-based per-recruit F proxy provided an estimate of the recent range of F to be compared with reference points (F_{max}, $F_{0.1}$).

Results

The results are summarized in Table 5.4.2.1, which gives the classification of the stock (desirable/undesirable/unknown).

Additional information

Determination of stock status relative to MSY proxies is now possible based on these methods. However, as already explained, given the uncertainties in data and knowledge for stocks in these categories, ICES is not currently using these methods to provide quantitative estimates of the distance of F from F_{MSY} or B from MSY $B_{trigger}$. ICES catch advice for stocks in categories 3 and 4 will continue to be provided according to the current approach, and the new methods will be used to determine when additional precaution is needed in the advice based on stock status relative to MSY proxies.

The framework was developed in the context of the stocks in ICES subareas 5 to 10 discussed in this request. However, the methods are potentially applicable to all stocks in ICES categories 3 and 4, provided that appropriate data are available, that method assumptions are considered appropriate for the stock, and that results are judged to be reliable.

Data to produce this advice were solicited through an ICES data call to all nations participating in the fisheries concerned. For countries which are also EU members this data call is under the Council Regulations (EC) No. 199/2008 and No. 665/2008. Some of the data requested in the data call were either not delivered in time or were incomplete, mainly from France, Belgium, Iceland, and Spain.

Sources and references

ICES. 2014a. *Nephrops* in Division 8c (North Galicia and Cantabrian Sea, FUs 25 and 31). *In* Report of the ICES Advisory Committee, 2014. ICES Advice 2014, Book 7: 111–125. Section 7.3.14. http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2014/2014/Neph-VIIIc.pdf.

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ICES. 2015a. Report of the Inter-Benchmark Protocol of West of Channel Flatfish (IBPWCFlat), January–March 2015, by correspondence. ICES CM 2015/ACOM:36. 157 pp.

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ICES. 2015c. Whiting (*Merlangius merlangus*) in Division 7a (Irish Sea). *In* Report of the ICES Advisory Committee 2015. ICES Advice, 2015. Book 5. Section 5.3.64. http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2015/2015/whg-iris.pdf.

ICES. 2016a. Inter-Benchmark Protocol Workshop Megrim (*Lepidorhombus whiffiagonis*) in Divisions 7.b–k and 8.a, 8.b, and 8.d (West and Southwest of Ireland, Bay of Biscay) (IBP Megrim 2016), July 2015 – March 2016, By correspondence. ICES CM 2016/ACOM:32. 124 pp.
http://ices.dk/sites/pub/Publication%20Reports/Expert%20Group%20Report/acom/2016/IBPMegrim/01%20IBPMegrim_Report%202016.pdf

ICES. 2016b. EU request to ICES to provide F_{MSY} ranges for selected stocks in ICES subareas 5 to 10. *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 5, Section 5.4.1. ǂ

ICES. 2016c. Report of the Workshop to consider MSY proxies for stocks in ICES category 3 and 4 stocks in Western Waters (WKProxy), 3–6 November 2015, ICES Headquarters, Copenhagen, Denmark. ICES CM 2015/ACOM:61. 159 pp.

ICES. 2016d. Report of the Working Group for the Bay of Biscay and the Iberian waters Ecoregion (WGBIE), 13–19 May 2016, ICES HQ, Copenhagen, Denmark. ICES CM/ACOM:12. 513 pp. ǂǂ

ICES. 2016e. Report of the Working Group for the Celtic Seas Ecoregion (WGCSE), 4–13 May 2016, ICES Headquarters, Copenhagen, Denmark. ICES CM 2016/ACOM:13. 1031 pp. ǂǂ

ICES, 2016f. Norway lobster (*Nephrops norvegicus*) in divisions 8.a–b, FUs 23–24 (Bay of Biscay North and Central). *In* Report of the ICES Advisory Committee 2016. ICES Advice, 2016. Section 7.3.30. ǂǂ

ICES, 2016g. Norway lobster (*Nephrops norvegicus*) in divisions 7.g and 7.h – FUs 20 and 21 (Celtic Sea). *In* Report of the ICES Advisory Committee 2016. ICES Advice, 2016. Section 5.3.47.ǂ ǂ

ǂ Version 4; Reference added.

ǂ ǂ Version 5; Reference added.

Annex

Table 5.4.2.1[♣*†‡] Stock status classification relative to MSY proxies. The classification is provided on the right-most column of the table. For stocks with unknown classification, the third column from the left indicates the MSY proxy methods that were attempted. Stock status is classified as either desirable or undesirable, depending on the current estimates of exploitation and stock biomass relative to proxies for F_{MSY} and MSY $B_{trigger}$. When both indicators are green ✅ (exploitation at or below the F_{MSY} proxy *and* stock biomass at or above the MSY $B_{trigger}$ proxy), the stock status is considered to be desirable. When at least one of the indicators is red ❌ (exploitation above the F_{MSY} proxy *and/or* stock biomass below the MSY $B_{trigger}$ proxy), the stock status is classified as undesirable. If one of the indicators is green and the other is unknown, the stock status is classified as unknown ❓.

Stock code	Stock name	MSY proxy method used or attempted	Exploitation			Stock abundance or biomass			Overall status classification Desirable/ Undesirable/ Unknown
			Proxy for F_{MSY} (or indicator for exploitation rate corresponding to MSY); method used	Value of F_{MSY} proxy (years of data used)***	Stock status relative to F_{MSY} proxy*	Proxy for biomass corresponding to MSY $B_{trigger}$; method used	Value of MSY $B_{trigger}$ proxy (years of data used)***	Stock status relative to MSY $B_{trigger}$ proxy**	
anb-78ab	Black-bellied anglerfish (*Lophius budegassa*) in Divisions 7b–k and 8a, b, d (West and Southwest of Ireland, Bay of Biscay)	Biomass dynamic (SPiCT) and length-based indicator (LBI)	No proxy identified	N.A.	❓	No proxy identified	N.A.	❓	❓
ang-ivvi	Anglerfish (*Lophius piscatorius* and *L. budegassa*) in Subareas 4 and 6 and Division 3a (North Sea, Rockall and West of Scotland, Skagerrak and Kattegat)	Biomass dynamic (SPiCT) and length-based indicator (LBI)	No proxy identified	N.A.	❓	No proxy identified	N.A.	❓	❓
anp-78ab	White anglerfish (*Lophius piscatorius*) in Divisions 7b–k and 8a, b, d (Southern Celtic Seas, Bay of Biscay)	Biomass dynamic (SPiCT)	F_{MSY} (estimated by SPiCT from model parameters^)	0.61[‡] (1986–2014)	✅	0.5 × B_{MSY} (estimated by SPiCT from model parameters^)	19 400[‡] t (1986–2014)	✅	✅

♣ Version 2; this table and its footnotes were updated in the advice on 04 March 2016.
* Version 3; table number corrected
† Version 4; mgw-78 removed from the table as the stock category was changed to category 1 at the IBPMeg (ICES, 2016a) and F_{MSY} ranges are now provided (see ICES, 2016b).
‡ Version 4; Values corrected.

Stock code	Stock name	MSY proxy method used or attempted	Exploitation			Stock abundance or biomass			Overall status classification Desirable/ Undesirable/ Unknown
			Proxy for F_{MSY} (or indicator for exploitation rate corresponding to MSY); method used	Value of F_{MSY} proxy (years of data used)***	Stock status relative to F_{MSY} proxy*	Proxy for biomass corresponding to MSY $B_{trigger}$; method used	Value of MSY $B_{trigger}$ proxy (years of data used)***	Stock status relative to MSY $B_{trigger}$ proxy**	
arg-123a4	Greater silver smelt (*Argentina silus*) in Subareas 1, 2, and 4 and Division 3a (Northeast Arctic, North Sea, Skagerrak and Kattegat)	Biomass dynamic (SPiCT)	No proxy identified	N.A.	?	No proxy identified	N.A.	?	?
arg-5b6a	Greater silver smelt (*Argentina silus*) in Divisions 5b and 6a (Faroes grounds, West of Scotland)	Length-based indicator (LBI)	Expected mean length of catch above L_c when F = M^^	36 cm (2014)	✓	No proxy identified	N.A.	?	?
arg-icel	Greater silver smelt (*Argentina silus*) in Subarea 14 and Division 5a (East Greenland, Iceland grounds)	Harvest rate F_{MSY} proxy from catch and survey data	(Total catch) / (Survey biomass) from a range of years when no detrimental effects observed	0.171 (2002–2007)	✓	No proxy identified	N.A.	?	?
arg-rest	Greater silver smelt (*Argentina silus*) in Subareas 7–10, 12 and Division 6b (other areas)	Biomass dynamic (SPiCT)	No proxy identified	N.A.	?	No proxy identified	N.A.	?	?
bss-8ab	Seabass (*Dicentrarchus labrax*) in Divisions 8a and 8b (Bay of Biscay North and Central)	Length-based spawning potential ratio (LB-SPR)	F/M and SPR estimated using the length-frequencies of the catch	F/M < 1 and SPR > 35% (2013)	✓	No proxy identified	N.A.	?	?
had-iris	Haddock (*Melanogrammus aeglefinus*) in Division 7a (Irish Sea)	Biomass dynamic (SPiCT)	F_{MSY} (estimated by SPiCT from model parameters^)	0.81 (1993–2015)	✓	0.5 × B_{MSY} (estimated by SPiCT from model parameters^)	3 300 t (1993–2015)	✓	✓

Stock code	Stock name	MSY proxy method used or attempted	Exploitation			Stock abundance or biomass			Overall status classification Desirable/ Undesirable/ Unknown
			Proxy for F_{MSY} (or indicator for exploitation rate corresponding to MSY); method used	Value of F_{MSY} proxy (years of data used)***	Stock status relative to F_{MSY} proxy*	Proxy for biomass corresponding to MSY $B_{trigger}$; method used	Value of MSY $B_{trigger}$ proxy (years of data used)***	Stock status relative to MSY $B_{trigger}$ proxy**	
lin-oth	Ling (*Molva molva*) in Subareas 6–9, 12, and 14, and in Divisions 3a and 4a (other areas)	Biomass dynamic (SPiCT)	F_{MSY} (estimated by SPiCT from model parameters^)	0.24 (1988–2014)	✓	0.5 × B_{MSY} (estimated by SPiCT from model parameters^)	48 000 t (1988–2014)	✓	✓
meg-rock	Megrim (*Lepidorhombus* spp.) in Division 6b (Rockall)	Biomass dynamic (SPiCT)	F_{MSY} (estimated by SPiCT from model parameters^)	0.55 (2002–2015)	✓	0.5 × B_{MSY} (estimated by SPiCT from model parameters^)	330 t (2002–2015)	✓	✓
nep-2021[§]	Norway lobster (*Nephrops norvegicus*) in Divisions 7g and 7h, FUs 20 and 21 (Celtic Sea)	MSY approach for category 1 *Nephrops* stocks assessed using Underwater TV surveys	F_{MSY} reference point, equivalent to $F_{0.1}$ for combined sexes.	Harvest rate 6.0%	✓	No MSY $B_{trigger}$ reference point has been defined	N.A.	?	?

[§] Version 5; for nep-2021 an F_{MSY} proxy was provided in earlier versions of this advice. However, ICES has recently been able to assess the stock as a category 1 stock using Underwater TV surveys, and to calculate an F_{MSY} reference point (in the form of a harvest rate) (ICES, 2016e; 2016g). The proxy F_{MSY} reference point provided earlier for this stock has therefore been replaced by the F_{MSY} reference point. Although the stock is now classified as a category 1 stock, ICES is currently not in the position to provide an F_{MSY} range for the stock.

Stock code	Stock name	MSY proxy method used or attempted	Exploitation			Stock abundance or biomass			Overall status classification Desirable/ Undesirable/ Unknown
			Proxy for F_{MSY} (or indicator for exploitation rate corresponding to MSY); method used	Value of F_{MSY} proxy (years of data used)***	Stock status relative to F_{MSY} proxy*	Proxy for biomass corresponding to MSY $B_{trigger}$; method used	Value of MSY $B_{trigger}$ proxy (years of data used)***	Stock status relative to MSY $B_{trigger}$ proxy**	
nep-2324**	Norway lobster (*Nephrops norvegicus*) in Divisions 8a and 8b, FUs 23–24 (Bay of Biscay North and Central)	MSY approach for category 1 *Nephrops* stocks assessed using Underwater TV surveys	F_{MSY} reference point, based on the average realised harvest rates of functional units with an observed history of sustainable exploitation, while also taking into account the low harvest rates applied to the FUs 23–24 stock in the recent past.	Harvest rate 7.7%		No MSY $B_{trigger}$ reference point has been defined	N.A.		
nep-25	Norway lobster (*Nephrops norvegicus*) in Division 8c, FU 25 (Bay of Biscay South, North Galicia)	Mean-length Z for fishing mortality. Biomass status from auxiliary information (lpue) (ICES, 2014a)	$F_{0.1}$, from length-based analysis^^^	0.17 (1986–2014)		No proxy identified but information on lpue indicates very low stock abundance	N.A.		
nep-2627	Norway lobster (*Nephrops norvegicus*) in Division 9a, FUs 26–27 (Atlantic Iberian Waters East, West Galicia and North Portugal)	Mean-length Z for fishing mortality. Biomass status from auxiliary information (lpue) (ICES, 2014b)	$F_{0.1}$, from length-based analysis^^^	0.137 (1988–2014)		No proxy identified but information on lpue indicates very low stock abundance	N.A.		

** Version 5; for nep-2324 an F_{MSY} proxy was provided in earlier versions of this advice. However, ICES has since then been able to assess the stock as a category 1 stock using Underwater TV surveys, and to calculate an F_{MSY} reference point (in the form of a harvest rate) (ICES, 2016d; 2016f). The proxy F_{MSY} reference point provided earlier for this stock has therefore been replaced by the F_{MSY} reference point. Although the stock is now classified as a category 1 stock, ICES is currently not in the position to provide an F_{MSY} range for the stock.

Stock code	Stock name	MSY proxy method used or attempted	Exploitation			Stock abundance or biomass			Overall status classification Desirable/ Undesirable/ Unknown
			Proxy for F_{MSY} (or indicator for exploitation rate corresponding to MSY); method used	Value of F_{MSY} proxy (years of data used)***	Stock status relative to F_{MSY} proxy*	Proxy for biomass corresponding to MSY $B_{trigger}$; method used	Value of MSY $B_{trigger}$ proxy (years of data used)***	Stock status relative to MSY $B_{trigger}$ proxy**	
nep-2829	Norway lobster (*Nephrops norvegicus*) in Division 9a, FUs 28–29 (Atlantic Iberian Waters East, Southwest and South Portugal)	Mean-length Z applied by sex	$F_{0.1}$, from length-based analysis^^^	0.30 males; 0.33 females (1998–2014)	✓	No proxy identified	N.A.	?	?
nep-30	Norway lobster (*Nephrops norvegicus*) in Division 9a, FU 30 (Atlantic Iberian Waters East, Gulf of Cadiz)	Mean-length Z applied by sex	$F_{0.1}$, from length-based analysis^^^	0.36 males; 0.63 females (1994–2014)	✓	No proxy identified	N.A.	?	?
nep-31	Norway lobster (*Nephrops norvegicus*) in Division 8c, FU 31 (Bay of Biscay South, Cantabrian Sea)	Mean-length Z (applied by sex) for fishing mortality. Biomass status from auxiliary information (Ipue) (ICES, 2014a).	$F_{0.1}$, from length-based analysis^^^	0.28 males; 0.47 females (2001–2014)	✓	No proxy identified but information on Ipue indicates very low stock abundance	N.A.	✗	✗
ple-7h-k	Plaice (*Pleuronectes platessa*) in Divisions 7h–k (Celtic Sea South, Southwest of Ireland)	Yield-per-recruit (YPR)	$F_{0.1}$ (ages 4–6), from age-based yield-per-recruit analysis using catch numbers-at-age	0.25 (1993–2014)	✗	No proxy identified	N.A.	?	✗
ple-celt	Plaice (*Pleuronectes platessa)* in Divisions 7f and 7g (Bristol Channel, Celtic Sea)	Biomass dynamic (SPiCT)	F_{MSY} (estimated by SPiCT from model parameters^)	0.27 (1977–2014)	✓	0.5 × B_{MSY} (estimated by SPiCT from model parameters^)	3 800 t (1977–2014)	✓	✓
ple-echw	Plaice (*Pleuronectes platessa*) in Division 7e (Western Channel)	Biomass dynamic (SPiCT)	F_{MSY} (estimated by SPiCT from model parameters^)	0.56 (1980–2014)	✓	0.5 × B_{MSY} (estimated by SPiCT from model parameters^)	1 910 t (1980–2014)	✓	✓

Stock code	Stock name	MSY proxy method used or attempted	Exploitation			Stock abundance or biomass			Overall status classification Desirable/ Undesirable/ Unknown
			Proxy for F_{MSY} (or indicator for exploitation rate corresponding to MSY); method used	Value of F_{MSY} proxy (years of data used)***	Stock status relative to F_{MSY} proxy*	Proxy for biomass corresponding to MSY $B_{trigger}$; method used	Value of MSY $B_{trigger}$ proxy (years of data used)***	Stock status relative to MSY $B_{trigger}$ proxy**	
ple-iris	Plaice (*Pleuronectes platessa*) in Division 7a (Irish Sea)	Biomass dynamic (SPiCT)	F_{MSY} (estimated by SPiCT from model parameters^)	0.50 (1988–2014)	✓	0.5 × B_{MSY} (estimated by SPiCT from model parameters^)	3 700 t (1988–2014)	✓	✓
pol-celt	Pollack (*Pollachius pollachius*) in Subareas 6–7 (Celtic Seas and the English Channel)	Biomass dynamic catch-only mode (CMSY)	F_{MSY} = *r*/2 (estimated from model parameter *r*)	0.134 Subarea 6; 0.27 Subarea 7 (1986–2014)	✓	0.5 × B_{MSY} = 0.25 × *K* (estimated from model parameter *K*)	1 020 t Subarea 6; 11 400 t Subarea 7 (1986–2014)	✓	✓
sol-7h-k	Sole (*Solea solea*) in Divisions 7h–k (Celtic Sea South, Southwest of Ireland)	Yield-per-recruit (YPR)	$F_{0.1}$ (ages 3–6), from age-based yield-per-recruit analysis using catch numbers-at-age	0.17 (1993–2014)	✓	No proxy identified	N.A.	?	?
usk-oth	Tusk (*Brosme brosme*) in Subareas 4 and 7–9 and Divisions 3a, 5b, 6a, and 12b (Northeast Atlantic)	Biomass dynamic (SPiCT)	F_{MSY} (estimated by SPiCT from model parameters^)	0.51 (1989–2014)	✓	0.5 × B_{MSY} (estimated by SPiCT from model parameters^)	8 500 t (1989–2014)	✓	✓
usk-rock	Tusk (*Brosme brosme*) in Division 6b (Rockall)	Length-based indicator (LBI)	Expected mean length of catch above L_c when F = M^^	53 cm (2013)	✓	No proxy identified	N.A.	?	?
whg-iris	Whiting (*Merlangius merlangus*) in Division 7a (Irish Sea)	Length-based indicator (LBI) for fishing mortality. Biomass status from auxiliary information (surveys; ICES, 2015c).	Expected mean length of catch above L_c when F = M^^	22 cm (2014)	✗	No proxy identified but information from surveys indicates very low stock abundance	N.A.	✗	✗

* Stock status relative to the F_{MSY} proxy is classified as follows (depending on method):
  - Methods: Biomass dynamic model (SPiCT); Biomass dynamic model in catch-only mode (CMSY); Mean-length Z; Yield-per-recruit (YPR)
    Green corresponds to: "Estimated F/(F_{MSY} proxy)" ≤ 1.
  - Method: Harvest rate F_{MSY} proxy from catch and survey data
    Green corresponds to: "Observed harvest rate/(F_{MSY} proxy)" ≤ 1.
  - Method: Length-based spawning potential ratio (LB-SPR)
    Green corresponds to: "Estimated F/M" < 1 and "Estimated SPR" > 35%.
  - Method: Length-based indicator (LBI)
    Green corresponds to: "(Observed mean length of catch above L_c) / (Expected mean length of catch above L_c when F=M)" > 1.

** Stock status relative to the MSY $B_{trigger}$ proxy is classified as follows:
  - Green corresponds to: "Estimated stock abundance or biomass / MSY $B_{trigger}$ proxy" ≥ 1.

*** The values provided correspond to the analysis conducted by WKProxy (ICES, 2016c). It is noted that for some of the methods the values of the proxies are expected to be recalculated each time stock status is evaluated.

^ SPiCT is a surplus production model that incorporates stochasticity (i.e. process error) in the stock biomass dynamics model. The calculation of the F_{MSY} and MSY $B_{trigger}$ proxies takes the process error into account, resulting in the formulae:

$F_{MSY} = \frac{r}{2} - \sigma^2 \frac{1-r/2}{(2-r/2)^2}$, MSY $B_{trigger} = 0.5$ $B_{MSY} = 0.25\,K \left\{1 - \sigma^2 \frac{1}{\frac{r}{2}(2-r/2)^2}\right\}$, where r (intrinsic growth rate), K (carrying capacity), and σ (process error of ln(stock biomass)) are model parameters.

^^ For the LBI method, the "Expected mean length of catch above L_c when F = M", where L_c is the length at first catch (length at 50% of mode of catch length frequency distribution), is calculated as (1−a) Lc + a Linf, where a = 1/(1 + 2 M/K) and Linf and K are growth parameters; for the stocks in the table using this method, the default value 1.5 has been assumed for M/K.

^^^ The mean-length Z method estimates F using data on the mean length of the catch above full selection (by sex or combined sexes, depending on availability). Fishing effort data and/or an external M value are also used for some of the stocks. The proxy F_{MSY} ($F_{0.1}$) was calculated assuming knife-edge length selection. For all stocks for which the mean-length Z method was used, this proxy F_{MSY} is lower than $F_{35\%}$ (see "Basis of the advice, Methods" section of this advice document).