Scientific, Technical and Economic Committee for Fisheries (STECF)
-
Monitoring the performance of the Common Fisheries Policy (STECF-Adhoc-18-01)

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Abstract

Commission Decision of 25 February 2016 setting up a Scientific, Technical and Economic Committee for Fisheries, C(2016) 1084, OJ C 74, 26.2.2016, p. 4–10. The Commission may consult the group on any matter relating to marine and fisheries biology, fishing gear technology, fisheries economics, fisheries governance, ecosystem effects of fisheries, aquaculture or similar disciplines. This report deals with monitoring the performance of the Common Fisheries Policy.

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Monitoring the performance of the Common Fisheries Policy (STECF-Adhoc-18-01)**

Article 50 of the Common Fisheries Policy (CFP; Regulation (EU) No 1380/2013 of the European Parliament and of the Council of 11 December 2013) stipulates: "The Commission shall report annually to the European Parliament and to the Council on the progress on achieving maximum sustainable yield and on the situation of fish stocks, as early as possible following the adoption of the yearly Council Regulation fixing the fishing opportunities available in Union waters and, in certain non-Union waters, to Union vessels."

Request to the STECF

The STECF is requested to report on progress in achieving MSY objectives in line with the Common Fisheries Policy.

STECF observations

STECF notes that to address the above Terms of Reference a JRC Expert Group (EG) was convened to compile available assessment outputs and conduct the extensive analysis. The EG output was presented in a comprehensive report accompanied by several detailed annexes providing: 1) CFP monitoring protocols as agreed by STECF (STECF, 2017); 2a) R code for computing NE Atlantic indicators; 2b) R code for computing Mediterranean indicators and 3) ICES data quality issues corrected prior to the analysis. The report and Annexes are available at https://stecf.jrc.ec.europa.eu/plen18_01

STECF notes that the report is clear and well laid out, transparently describing the analysis undertaken, cataloguing changes made in approach since the previous report (2017) and including URL links to the various reports and stock advice sheets underpinning the analysis. STECF commends the effort employed in updating nomenclature following various changes to the ICES database and the careful attention paid to ensuring the correct figures were used.

The most significant changes in the 2018 approach were:

i)   A revision of the Mediterranean sampling frame used for the analysis
ii)   Where data were unavailable for the most recent year, the data from the previous year was rolled forward
iii) $MSY_{Btrigger}$ was used as a proxy for lower bound of B_{MSY}

Details of these changes and other points to note can be found in section 2 of the EG report.

The EG report then sets out results of the analysis for the ICES area of the NE Atlantic and Mediterranean & Black Sea separately in Sections 3 and 4 (respectively). Based on these results STECF provides an overview of what is currently known regarding the achievement of the MSY objectives, drawing together the results from the different sea areas to provide a comparative picture. The overview focuses on a limited number of 'core' indicators earlier agreed by STECF (2017). The EG report contains results for a number of 'experimental' indicators which STECF notes are still at the development stage. It is expected that these will be further developed as part of another STECF EWG (EWG 18-15) to be held later in 2018 (see conclusions). In this report, "ICES Area" refers to all stocks in the FAO Area 27 in the Northeast Atlantic assessed by ICES, while the denomination "NE Atlantic stocks" refers more specifically to the stocks distributed widely, including outside EU Waters

Trends towards the MSY objectives in the ICES area and Mediterranean& Black Seas

The overview below describes the trends observed in the ICES area and the Mediterranean for the periods 2003 to 2016 and 2003 to 2015 respectively and applies to the stocks included in the reference list of stocks for these areas. The stocks are primarily those with a full analytical assessment (ICES Category 1).

Stock status in the ICES area

The indicators provided by the JRC EG show that stocks status has significantly improved (Figure 1) but also that many stocks are still overexploited in the ICES area, and that the rate of progress has slowed in the last few years. In the ICES area, among the 65 to 71 stocks which are fully assessed, the proportion of overexploited stocks (i.e. $F>F_{MSY}$, blue line) decreased from more than 70% to close to 40%, over the last ten years and seems to have stabilised in the last three years. The proportion of stocks outside the safe biological limits ($F>Fpa$ or $B<B_{pa}$, orange line), computed for the 46 stocks for which both reference points are available, follows the same decreasing trend, from 65% in 2003 to around 30% in 2016.
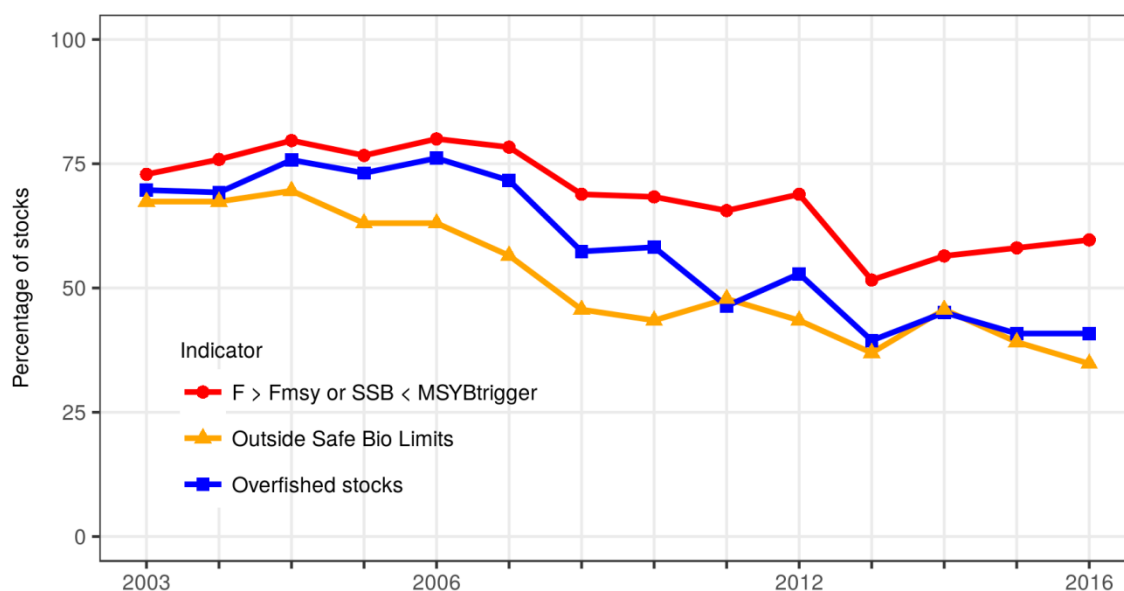
Figure 1. Trends in stocks status, 2003-2016. Three indicators are presented: Blue line: the proportion of overexploited stocks ($F>F_{MSY}$) within the sampling frame (65 to 71 stocks fully assessed in the ICES area, depending on year); Orange line: the proportion of stocks outside safe biological limits ($F>F_{pa}$ or $B< B_{pa}$) (46 stocks); Red line: $F>F_{MSY}$ or SSB $<MSY_{Btrigger}$

It is important to note, however, that some stocks now managed according to F_{MSY} may still be outside safe biological limits, or conversely some stocks inside safe biological limits may still be overfished.

The red line illustrates changes in the proportion of stocks where $F>F_{MSY}$ or SSB $<MSY_{Btrigger}$. Here the improvement in status has been slower with the indicator remaining above 75% of stocks until 2007 before declining. The decline then appears to have stopped in 2013 and began to slowly increase again to about 60% of stocks in 2016 where $F>F_{MSY}$ or SSB $<MSY_{Btrigger}$.

STECF notes that the number or proportion of stocks above/below B_{MSY} is still unknown, because an estimate of B_{MSY} is only provided by ICES for very few stocks.

STECF observes that the recent slope of the indicators suggests that progress until 2016 has been too slow to allow all stocks to be maintained or restored to at least the precautionary B_{pa}, and managed according to F_{MSY} by 2020.

Stock Status in the Mediterranean & Black Sea

In the Mediterranean & Black Sea, the variable number of stocks contributing information in the early part of the time series renders the calculation of a robust indicator difficult and potentially misleading. STECF suggests the possibility of investigating this in the future for a shorter time period (e.g. from 2008 to 2015 when the stock numbers appear to be more stable). For the present STECF has utilised the summary Table 5.1 in the EG report to compute the F status for 2015 (last year in Mediterranean stock assessments). Out of 47 stocks, only around 13% (6 stocks) are not overfished, the majority are overfished.

Trends in the fishing pressure (Ratio of F/F$_{MSY}$)

As agreed by STECF (2017) the Expert Group computed the trends in fishing pressure using a robust statistical model (Generalised Linear Mixed Effects Model, GLMM) accounting for the variability of trends across stocks and including the computation of a confidence interval around the median. A large confidence interval means that different stocks have different trends. Because this is a model-based indicator, and because the number of stocks is slightly different from last year, small differences in the resulting outcomes compared to last year's report should not be over interpreted.

This indicator can be used for regional comparison between the ICES area and Mediterranean & Black Seas. In the ICES area, the model-based indicator of the fishing pressure (F/F$_{MSY}$) shows an overall downward trend over the period 2003-2015 (Figure 2). In the early 2000s, the median fishing mortality was more than 1.5 times larger than F$_{MSY}$, but this has reduced and has now stabilised around 1.0. Reaching F$_{MSY}$ for *most* stocks in the analysis would require the upper bound of the confidence interval in figure 3.1 in the EWG report to be around 1. STECF also notes that this indicator of fishing pressure has not decreased since 2011.

The same model-based indicator was computed by the EG for an additional set of 9 stocks located in the NE Atlantic, but outside EU waters. This indicator seems to confirm the positive overall trend observed in EU waters, with the median value of the F/F$_{MSY}$ indicator closely tracking that produced for EU waters. STECF notes that the indicator for NE Atlantic stocks outside EU waters is based on comparatively few stocks and thus should be considered with care.
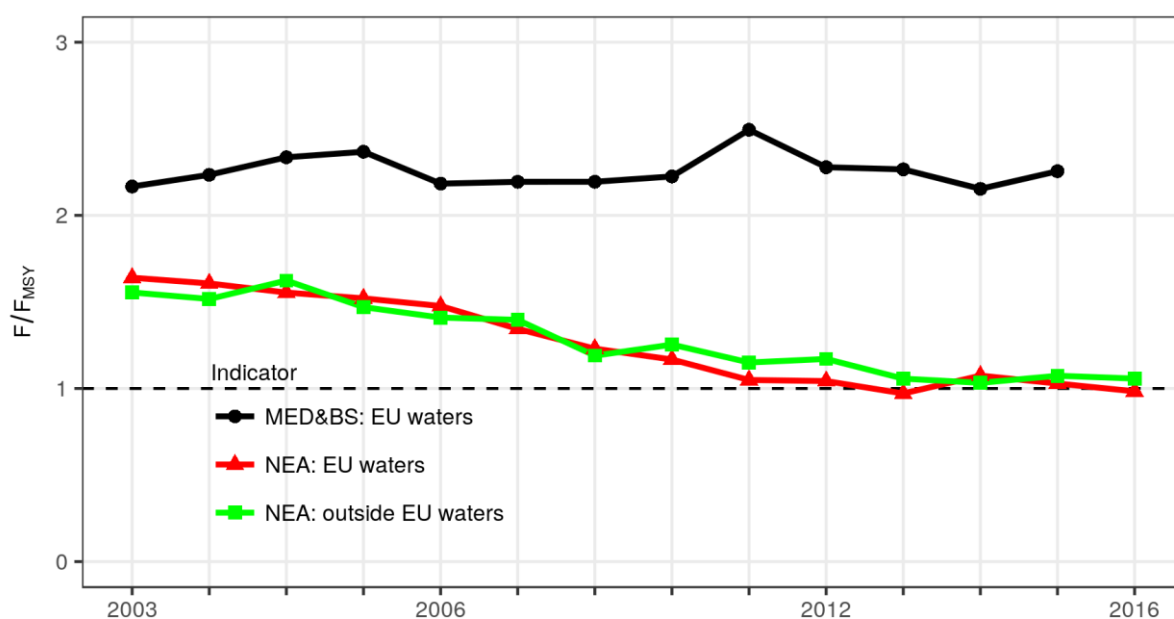
Figure 2. Trends in the fishing pressure. Three model based indicators F/F$_{MSY}$ are presented (all referring to the median value of the model): one for 48 EU stocks with appropriate information in the ICES area (red line); one for an additional set of 9 stocks also located in the NE Atlantic but

outside EU waters (green line), and one for the 47 assessed stocks from the Mediterranean and Black Sea region (black line).

In contrast, the indicator computed for stocks from the Mediterranean Sea and Black Sea has remained at a very high level during the whole 2003-2015 period, with no decreasing trend. The value of F/F_{MSY} varies around 2.3 indicating that the stocks are being exploited on average at rates well above the F_{MSY} CFP objective.

Trends in Biomass

The model-based indicator of the trend in biomass shows improvement in the ICES area, but not in the Mediterranean and Black Sea (Figure 3). In the ICES area the biomass has been generally increasing since 2006, and was in 2016 on average around 39% higher than in 2003. This represents a slight change from the reporting in 2016 reflecting the fact that the modelled trend incorporates new information. In the Mediterranean & Black Sea the uncertainty associated with this indicator (see Figure 4.4 in the EWG report) makes it difficult to conclude anything about trend and the situation is essentially unchanged since the start of the series in 2003.

An improving trend is also observed for data poor stocks (Figure 3.23 in the EWG report), according to the indicator computed by the EG for 61 ICES Category 3 stocks. However, in view of the fact that this indicator is still regarded as experimental, care in interpretation is required.
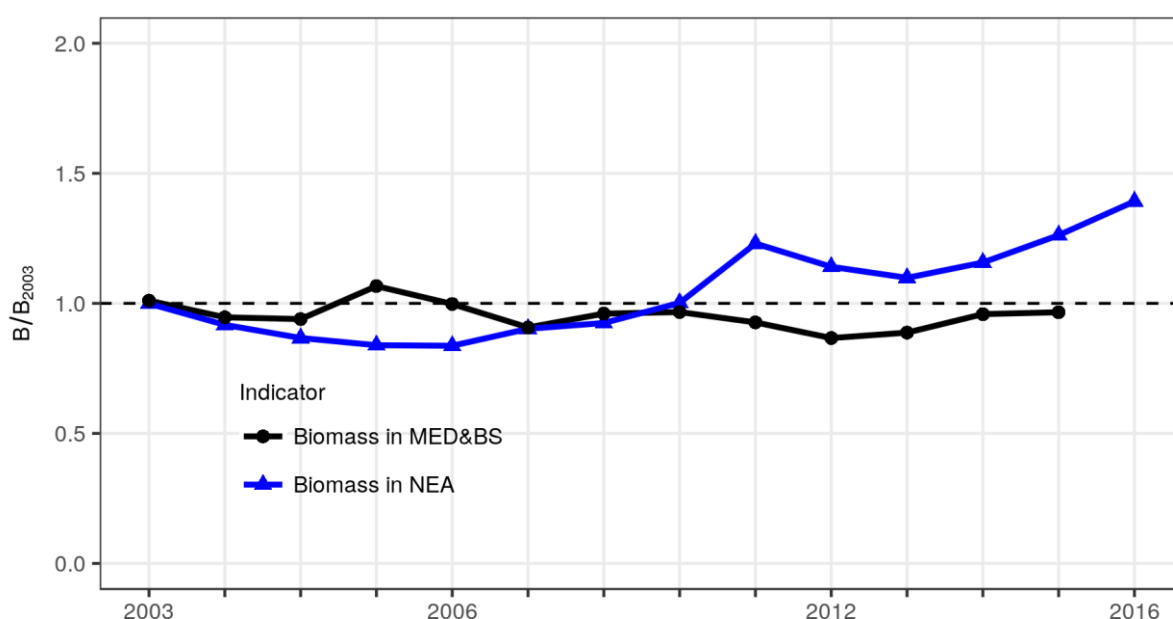
Figure 3. Trends in the indicators of stock biomass (median values of the model-based estimates relative to 2003). Two indicators are presented: one for the ICES area (54 stocks considered, blue line); one for the Mediterranean region (47 stocks, black line). The EG noticed that a large uncertainty is associated to these estimates, coming from the fact that the biomass estimates are quite variable from one year to the next.

Trends per Ecoregion

For the ICES area, the EG provides some information and figures broken down by Ecoregion. The main trends are summarised here.

The fishing pressure has decreased and the status of stocks has improved in all ICES Ecoregions. In 2016, the proportion of overexploited stocks ranged between to 29 - 50% across the different Ecoregions, while the modelled estimate of the F/F_{MSY} ratio for 2016 was between 0.89 and 1.18.

Some variations between Ecoregions in modelled trends can be seen. According to the latest indicator trends presented in the EG report, the fishing pressure decreased consistently over the whole period and the stock status improved most markedly in the Celtic Sea. Here the fishing mortality was at a very high level at the beginning of the time series ($F/F_{MSY}>1.9$) and decreased significantly to below 1.0. In the remaining areas, marked declines are also evident in the first part of the time series but the rate of decline of the indicator falls around 2010 and the indicator tends to level out. In the Bay of Biscay and Iberian Ecoregion, and stocks present throughout the wider Northeast Atlantic the indicator has fluctuated in the most recent years.

Coverage of the scientific advice

Coverage of biological stocks by the CFP monitoring

As stated previously (STECF PLEN 16-03), the analyses of the progress in achieving MSY objectives in the ICES area should consider all stocks with advice provided by ICES, on the condition of being distributed in EU waters, at least partially. Based on the ICES database accessed for the analysis, ICES provides a scientific advice for 257 biological stocks included in EU waters (at least in part). Of these, 159 stocks are data-poor, without an estimate of MSY reference points (ICES category 3 and above). Details of the numbers of ICES assessments by Category and by area are shown in Table 1.

Table 1. Numbers of stocks assessed by ICES for different stock categories in different areas. Note that not all of these stocks are managed by TACs and so the numbers are higher than those used in the CFP monitoring analysis.

	ICES Stock Category						
	1	2	3	4	5	6	Total
Arctic Ocean	10	1	11	0	3	10	35
Azores	0	0	3	0	0	2	5
Baltic Sea	8	0	9	1	0	0	18
BoBiscay & Iberia	11	1	20	1	9	4	46
Celtic Seas	30	0	19	1	13	11	74
Faroes	3	0	1	0	0	0	4
Greater North Sea	19	0	14	5	7	3	48
Greenland Sea	5	0	3	0	0	1	9
Iceland Sea	1	0	0	0	1	0	2
Northeast Atlantic	8	1	7	0	0	0	16
Total	95	3	87	8	33	31	257

The present CFP monitoring analysis is focused on stocks with a TAC and for which estimates of fishing mortality, biomass and biological reference points are available. As detailed in the EGs technical reports, not all indicators can be calculated for all stocks in all years, and the EG was able to compute indicators for 46 to 71 stocks of category 1 depending on indicators and years. These stocks represent the vast majority of catches but a large number of biological stocks present in EU waters are still not included in the CFP monitoring.

STECF notes however that the EG computed some additional indicators of trends in abundance index for 61 data poor stocks of category 3. These indicators are still considered experimental by

the EG and are not presented in the current STECF overview. Once this indicator becomes part of the 'core' list, the total number of stocks included in the CFP analysis will be up to 50% of the stocks assessed by ICES (ie 71 Category 1-2 plus 61 Category 3). STECF notes also that MSY reference points are expected to be computed by ICES for an increasing number of data-poor stocks over the coming years, which will increase the coverage of the CFP monitoring.

In the Mediterranean region, the EG selected 230 stocks (Species/GSA) in the sampling frame (Mannini et.al 2017), of which 47 have been covered by a stock assessment in recent years. In the Mediterranean region, stocks status and trends can be monitored only for a minority of stocks.

Coverage of TAC regulation by scientific advice

According to the EG report, STECF notes that 156 TACs (combination of species and fishing management zones) were in place in 2016 in the EU waters of the NE Atlantic.

STECF underlines that in many cases, the boundaries of the TAC management areas are not aligned with the biological limits of stocks used in ICES assessments. The EG therefore computed an indicator of advice coverage, where a TAC is considered to be "covered" by a stock assessment when at least one of its divisions matched the spatial distribution of a stock for which reference points have been estimated from an ICES full assessment. Based on this indicator, 56% among the 156 TACs are covered, at least partially, by stock assessments that provide estimates of F_{MSY} (or a proxy) and 43% by stock assessments that have B_{pa} (or a proxy).

Additionally, STECF notes that, using this index, some TACs can be considered as "covered" even if they relate to several assessments contributing to a single TAC (e.g. *Nephrops* functional units in the North Sea) or to a scientific advice covering a different (but partially common) area (e.g. whiting in the Bay of Biscay). Thus, such an approach overestimates the spatial coverage of advice (i.e. the proportion of TACs based on a single and aligned assessment). This means that a large number of TACs are still imperfectly covered by scientific advice based on F_{MSY} or B_{pa} reference values.

General principles for future analysis

Based on the latest process of analysis and overview, STECF advises that the CFP monitoring process should continue with the following principles:

- The three indicators of stock status are useful and should be regularly computed in the coming years (expressed in stock numbers in the detailed report and in proportion in the synthesis)
- As soon as a representative number of B_{MSY} estimates become available from ICES assessments, the proportion (and number) of stocks below or above this reference point should become part of the 'core' indicator set, together with an indicator of trends in the B/B_{MSY} ratio.
- Regarding trends in fishing mortality and biomass, all indicators should be computed in a consistent way. STECF considers that the model-based indicators should continue to be used as the standard method for every time series (including indicators per Ecoregion and indicators for NE Atlantic stocks outside EU waters). These model-based indicators are preferable to arithmetic mean estimates, which although easy to communicate, are generally sensitive to outliers.
- To maintain ease of visual comparison, indicators of biomass trends should continue to be rescaled to the value of the starting year.

- As far as possible, according to data availability, the same indicators should be computed in the ICES area and in the Mediterranean region.

Ongoing development

STECF notes that the EG Report again includes sections providing preliminary outputs from a number of experimental indicators. STECF considers that these require further development to fully understand their performance and stability before adoption as 'core' indicators. STECF draws attention to an STECF EWG planned for later in the year (STECF 18-15) which is dedicated to the development of CFP monitoring and suggests that further progress on the experimental indicators relating to fish stocks could be made. During this meeting STECF encourages exploration of indicators for other aggregations such as stock categories (eg pelagic fish versus demersal fish)

STECF conclusions

STECF acknowledges that monitoring the performance of the CFP requires significant effort in order to provide a comprehensive picture. The process presents a number of methodological challenges due to the annual variability in the number and categories of stocks assessed (especially in the Mediterranean) and due to the large variations in trends across stocks. As a result, the choice of indicators and their interpretation is being discussed, expanded and adjusted over time, as duly documented in the suite of STECF plenary reports and in the JRC EG technical reports. In particular, STECF notes that the CFP monitoring has improved this year thanks to the implementation of a revised protocol and ongoing improvements in the coverage of fish stock assessments and estimates of reference points. STECF is aware that minor differences in the indicators can occur compared to previous years. However STECF always use the latest assessment and best science available at the time of the report

Regarding the progress made in the achievement of F_{MSY} in line with the CFP, STECF notes that the latest results are generally in line with those reported in the 2017 CFP monitoring and confirm a reduction in the overall exploitation rate for the ICES area. On average the stock biomass is increasing and stock status is improving. Nevertheless, based on the set of assessed stocks included in the analyses, STECF notes that many stocks remain overfished and/or outside safe biological limits, and that progress achieved until 2016 seems too slow to ensure that all stocks will be rebuilt and managed according to F_{MSY} by 2020.

STECF also concludes that stocks from the Mediterranean Sea and Black sea remain in a very poor situation, with no change apparent in terms of fishing pressure or stock biomass.

STECF concludes that further progress has been made on the development of additional indicators relating to fish stocks which would benefit from some additional testing before being adopted as core indicators. STECF also recognises the need to broaden the scope of the CFP monitoring to cover additional aspects not so far dealt with. In particular, there is a need to develop the CFP monitoring process to cover wider ecosystem and socio-economic aspects in the analysis. STECF notes that the scheduled STECF EWG on CFP monitoring later in the year (STECF 18-15) will provide an opportunity to progress these requirements.

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[1] - Information on STECF members' affiliations is displayed for information only. In any case, Members of the STECF shall act independently. In the context of the STECF work, the committee members do not represent the institutions/bodies they are affiliated to in their daily jobs. STECF members also declare at each meeting of the STECF and of its Expert Working Groups any specific interest which might be considered prejudicial to their independence in relation to specific items on the agenda. These declarations are displayed on the public meeting's website if experts

explicitly authorized the JRC to do so in accordance with EU legislation on the protection of personnel data. For more information: http://stecf.jrc.ec.europa.eu/adm-declarations

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REPORT TO THE STECF

Report of the ad hoc Expert Group on monitoring the performance of the Common Fisheries Policy

Ispra, Italy, March-April 2018

This report does not necessarily reflect the view of the STECF and the European Commission and in no way anticipates the Commission's future policy in this area

1   INTRODUCTION

Article 50 of the EU Common Fisheries Policy (REGULATION (EU) No 1380/2013) states:

"The Commission shall report annually to the European Parliament and to the Council on the progress on achieving maximum sustainable yield and on the situation of fish stocks, as early as possible following the adoption of the yearly Council Regulation fixing the fishing opportunities available in Union waters and, in certain non-Union waters, to Union vessels."

To fulfil its obligations to report to the European Parliament and the Council, each year, the European Commission requests the Scientific, Technical and Economic Committee for Fisheries (STECF) to compute a series of performance indicators and advise on the progress towards the provisions of Article 50.

In an attempt to make the process of computing each of the indicators consistent and transparent and to take account of issues identified and documented in previous CFP monitoring reports, a revised protocol was adopted by the STECF in 2017 (Annex I).

An ad hoc Expert Group comprising Experts from the European Commission's Joint Research Centre (JRC) was convened during March and April 2018 to compute the performance indicator values according to the agreed protocol (Annex I) and to report to the STECF plenary meeting scheduled for 09-13 April 2018.

1.1   Terms of Reference to the ad hoc Expert group

The Expert group is requested to report on progress in achieving MSY objectives in line with CFP.

2　DATA AND METHODS

2.1　Data sources

The data sources used referred to the coastal waters of the EU in FAO areas 27 (Northeast Atlantic and adjacent Seas) and 37 (Mediterranean and Black Seas). The Mediterranean included GSAs 1, 5, 6, 7, 8, 9, 10, 11, 15, 16, 17, 18, 19, 25 and 29. The NE Atlantic included the ICES subareas "III", "IV" (excluding Norwegian waters of division IVa), "VI", "VII", "VIII", "IX" and "X".

2.1.1　Stock assessment information

For the Mediterranean region (FAO area 37), the information were extracted from the STECF Mediterranean Expert Working Group repositories (https://stecf.jrc.ec.europa.eu/reports/medbs) and from the GFCM stock assessment forms (http://www.fao.org/gfcm/data/safs/en).

For the NE Atlantic (FAO area 27), the information was downloaded from the ICES website (http://standardgraphs.ices.dk) on the 19th March 2018, comprising the most recent published assessments, carried out up to and including 2017. A thorough process of data quality checks and corrections was performed to ensure the information downloaded was in agreement with the summary sheets published online (Annex III).

Table 6.1 shows the URLs for the report or advice summary sheet for each stock.

2.1.2　Management units information

For the NE Atlantic, management units are defined by TACs, annual fishing opportunities for a species or group of species in a Fishing Management Zone (FMZ). The information regarding TACs in 2016 was downloaded from the FIDES (http://fides3.fish.cec.eu.int/) reporting system. Subsequently, such information was cleaned and processed, to identify the FMZ of relevance to this work, as well as the ICES rectangles they span to (Gibin, 2017).

2.2　Methods

The methods applied and the definition of the sampling frames followed the protocol (Jardim et.al, 2015) agreed by STECF (2016) and updated following the discussion in STECF (2017a). The updated protocol is presented in Annex I and the R code used to carry out the analysis in Annex II.

2.3　Points to note

- Stocks assessed with biomass dynamics models do not provide a value for F_{PA}, although they may provide a B_{PA} proxy (0.5 B_{MSY}). Consequently, such stocks cannot be used to compute the indicators relating to safe biological limits (SBL).
- The Generalized Linear Mixed Model (GLMM) uses a shortened time series, starting in 2003, instead of the full time-series of available data. This has the advantage of balancing the dataset by removing those years with only a low number of assessment estimates, but it has the disadvantage of excluding data that could improve model fit.
- For all stocks managed with a $B_{escapement}$ strategy, except Bay of Biscay anchovy (ane.27.8) and Norway pout in the North Sea, Skagerrak and Kattegat (nop-27.3a.4), $MSYB_{escapement}$ was set by ICES at B_{PA} instead of B_{MSY}.
- Norway pout in the North Sea, Skagerrak and Kattegat (nop.27.3a4) uses a probabilistic method to set the catches: $C_{y+1}=C|(P[SSB<B_{lim}]=0.05)$. For this stock, the lower (0.025%) boundary of the SSB confidence interval was compared to B_{lim}.

- Bay of Biscay anchovy (ane.27.8) uses a HCR with Biomass triggers. ICES does not report reference points other than B_{lim}. The HCR's upper biomass trigger was used as $MSYB_{escapement}$.
- ICES is in the process of shifting $MSY_{Btrigger}$ settings to levels which increase the probability of keeping F at F_{MSY}, making it a good proxy for B_{MSY}. Nevertheless, there are still 40 out of 69 stocks relevant for this exercise, with $MSY_{Btrigger}$ set at B_{PA}.
- The GLMM fit within the bootstrap procedure does not converge for all resamples, up to 20% of the fits fail, with the exception of the trend in SSB or biomass index for stocks of data category 1-3 (relative to 2003) which had 223 over 500 resamples failing. Failed resamples were excluded when computating model-based indicators.
- The 2017 ICES update of eco regions' definition removed the category 'widely distributed' stocks. For compatibility with previous versions of this report, the stocks previously included in the category 'widely distributed' were kept, and renamed 'Northeast Atlantic'.

2.4 Differences from the 2017 CFP monitoring report (STECF 17-04)

2.4.1 Northeast Atlantic

- Stocks with less than five years of data were not included in the analysis.
- The CFP requirements indicator was updated, replacing B_{PA} by $MSYB_{trigger}$, making it more in line with the CFP regulation and renamed to avoid misleading the readers, to 'Stocks with F above/below F_{msy} or SSB below/above $MSYB_{trigger}$'.
- Stocks without stock assessment estimates for 2015 and/or 2016 were assigned values equivalent to 2014 and/or 2015 estimates respectively.
- The Northern shrimp stock (pra.27.1-2) was removed from the computation of the indicator F/F_{MSY} outside the EU coastal waters, because the indicator values were heavily influenced by the outlier behaviour of this stock (STECF, 2017a).

2.4.2 Mediterranean and Black Sea

- A new reference list of stocks was adopted in accordance with the revised protocol adopted by STECF (2017a). The previous reference list (Mannini et al., 2017) was complemented with stock assessment results for selected additional species established by the STECF (2017a).
- Stocks with less than five years of data were not included in the analysis.
- Stocks without stock assessment estimates for 2015 and/or 2016 were assigned values equivalent to 2014 and/or 2015 estimates respectively.

Because of the changes in data and protocol, the annual indicator values and associate time-series trends for the Mediterranean and Black seas presented in the current report, cannot be directly compared to those presented in previous CFP monitoring reports.

3 NORTHEAST ATLANTIC AND ADJACENT SEAS (FAO REGION 27)

3.1 Number of stock assessments to compute CFP performance indicators

The number of stock assessments with estimates of F/F_{MSY} for the years 2003-2016 for FAO Region 27 are given in Figure 3.1 and by ecoregion in Table 3.1.

The time-series of data available for each year and stock (data categories 1 and 2) is shown in Figure 3.2. For stocks without estimates in 2016 the estimates of F and SSB were assumed to be the same as 2015. Consequently, the number of stocks included to compute the indicator values for 2016 was 71.

The stocks, including data category 3, used to compute each indicator are shown in Table 3.2.
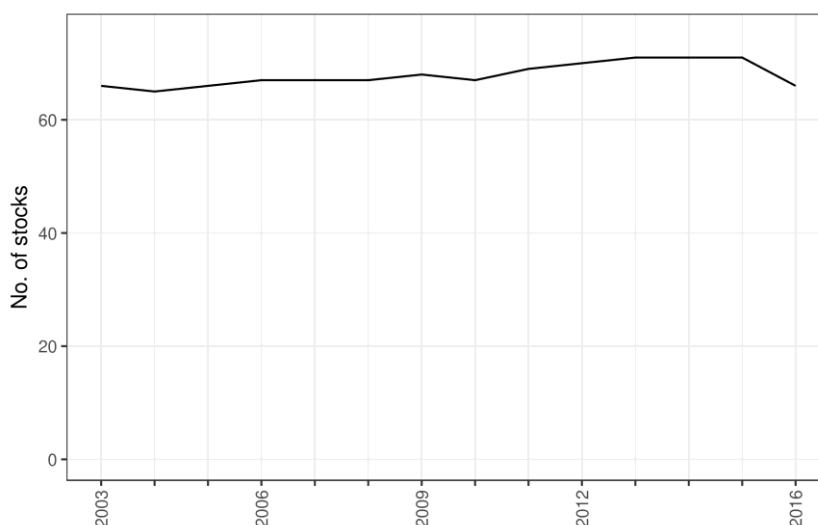
Figure 3.1 Number of stocks in the ICES area for which estimates of F/F_{MSY} are available by year.

Table 3.1 Number of stocks in the ICES area for which estimates of F/F_{MSY} are available by ecoregion and year

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ALL	66	65	66	67	67	67	68	67	69	70	71	71	71	66
Baltic Sea	8	8	8	8	8	8	8	8	8	8	8	8	8	8
BoBiscay & Iberia	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Celtic Seas	21	20	21	22	22	22	23	22	23	24	25	25	25	23
Greater North Sea	21	21	21	21	21	21	21	21	22	22	22	22	22	22
Northeast Atlantic	7	7	7	7	7	7	7	7	7	7	7	7	7	4
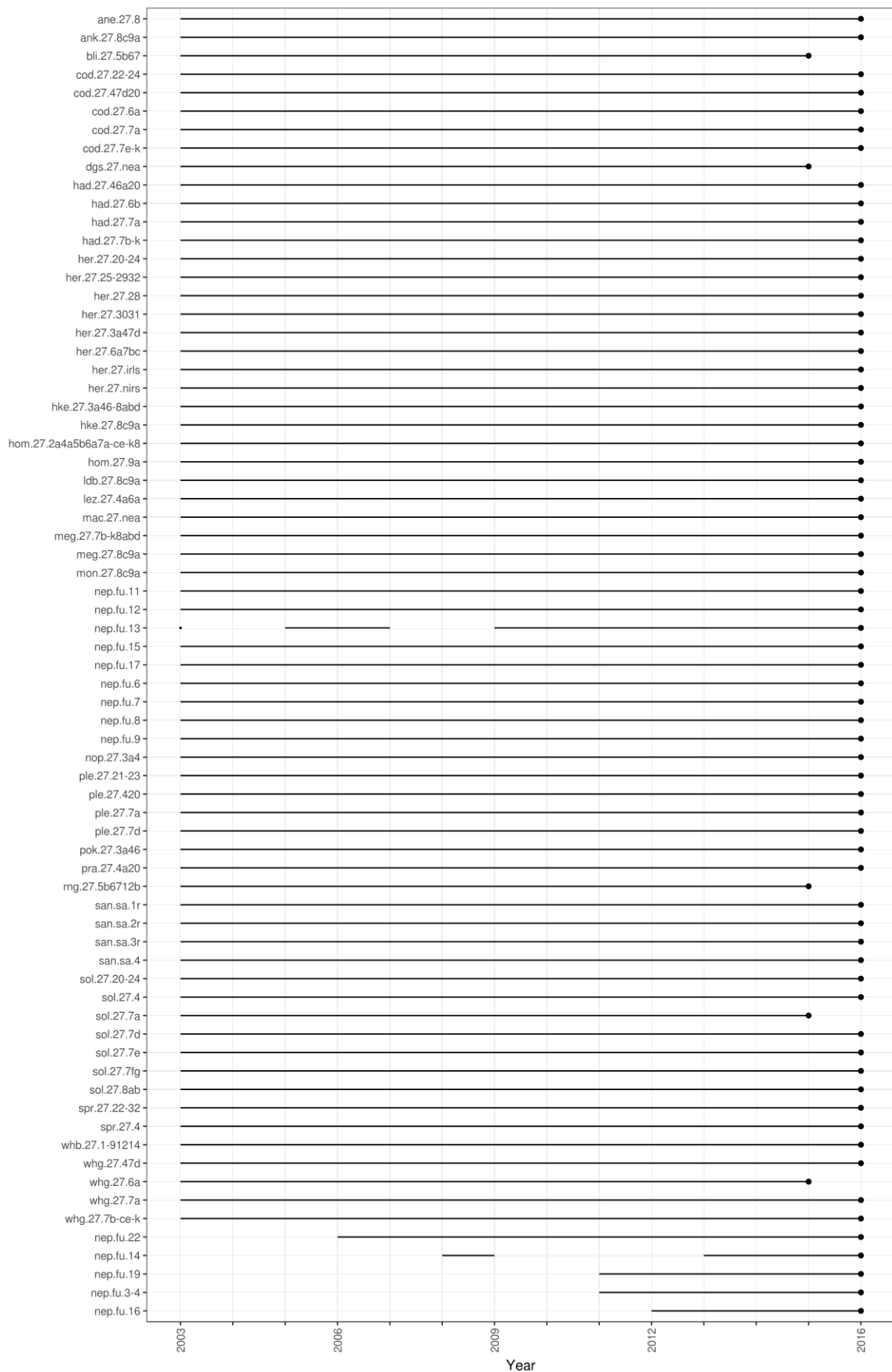
Figure 3.2 Time series of stock assessment results in the ICES area for which estimates of F/F$_{MSY}$ are available by year. Blank records indicate no estimate available for stock and year.

Compared to the dataset used for the 2017 analyses (STECF, 2017b), the analyses presented in this report include the results from assessments for the following additional stocks of categories 01 and 02:

- had-iris (had.27.7a), ple-iris (ple.27.7a), whg-iris (whg.27.7a) and san-ns4 (san.sa.4), which were upgraded from category 03 in 2016 to category 01 in 2017.
- her.27.30.31 which appeared in 2017 for the first time, as a result of merging stocks her-30 and her-31.

Meanwhile, there were some stocks included in the 2017 analyses (STECF 2017b) which were excluded from the present analyses:

- her-30 which has now been merged with her-31 into her.27.30.31.
- nep-2021 (nep.fu.2021) and nep-2324 (nep.fu.2324) due to having less than five years of data available.

ICES revised the eco-region classification of the stocks. For consistency with the 2017 report (STECF, 2017b), the widely distributed stocks were kept the same as last year and the stocks of had.27.46a20, pok.27.3a46 and sol.27.7e were kept in the Greater North Sea eco-region.

In total, 71 stocks of categories 01 and 02 were included in the present analysis.

Table 3.2 Indicators computed for each stocks.

Stock	Year	above/below Fmsy	in/out SBL	B wrt MSYB$_{trigger}$ or F wrt F$_{MSY}$	F/Fmsy trends	Biomass trends	SSB/Bpa trends	Recruitment trends	Biomass data category 1-3 trends	Biomass data category 3 trends
ane.27.8	2016	X				X		X	X	
ane.27.9a	2016								X	X
anf.27.3a46	2016								X	X
ank.27.78ab	2015								X	X
ank.27.8c9a	2016	X		X	X		X		X	
aru.27.5b6a	2016								X	X
aru.27.6b7-1012	2016								X	X
bli.27.5b67	2015	X	X	X	X	X	X	X	X	
bll.27.3a47de	2016								X	X
boc.27.6-8	2016								X	X
bss.27.4bc7ad-h	2016								X	
bss.27.8ab	2016								X	X
cod.27.21	2016								X	X
cod.27.22-24	2016	X	X	X	X	X	X	X	X	
cod.27.25-32	2016								X	X
cod.27.47d20	2016	X	X	X	X	X	X	X	X	
cod.27.6a	2016	X	X	X	X	X	X	X	X	
cod.27.7a	2016	X	X	X	X	X	X	X	X	
cod.27.7e-k	2016	X	X	X	X	X	X	X	X	
dab.27.22-32	2016								X	X
dab.27.3a4	2016								X	X
dgs.27.nea	2015	X		X		X		X	X	
fle.27.2223	2016								X	X
fle.27.2425	2016								X	X
fle.27.2628	2016								X	X
fle.27.2729-32	2016								X	X
fle.27.3a4	2016								X	X
gfb.27.nea	2015								X	X
gug.27.3a47d	2016								X	X
had.27.46a20	2016	X	X	X	X	X	X	X	X	
had.27.6b	2016	X	X	X	X	X	X	X	X	
had.27.7a	2016	X	X	X	X	X	X	X	X	
had.27.7b-k	2016	X	X	X	X	X	X	X	X	
her.27.1-24a514a	2016								X	
her.27.20-24	2016	X	X	X	X	X	X	X	X	
her.27.25-2932	2016	X	X	X	X	X	X	X	X	
her.27.28	2016	X	X	X	X	X	X	X	X	
her.27.3031	2016	X	X	X	X	X	X	X	X	

Stock	Year	above/below Fmsy	in/out SBL	B wrt MSYB$_{trigger}$ or F wrt F$_{MSY}$	F/Fmsy trends	Biomass trends	SSB/Bpa trends	Recruitment trends	Biomass data category 1-3 trends	Biomass data category 3 trends
her.27.3a47d	2016	X	X	X	X	X	X	X	X	
her.27.6a7bc	2016	X	X	X	X	X	X	X	X	
her.27.irls	2016	X	X	X	X	X	X	X	X	
her.27.nirs	2016	X	X	X	X	X	X	X	X	
hke.27.3a46-8abd	2016	X	X	X	X	X	X	X	X	
hke.27.8c9a	2016	X	X	X	X	X	X	X	X	
hom.27.2a4a5b6a7a-ce-k8	2016	X	X	X	X	X	X	X	X	
hom.27.9a	2016	X	X	X	X	X	X	X	X	
jaa.27.10a2	2015								X	X
ldb.27.8c9a	2016	X	X	X	X	X	X	X	X	
lem.27.3a47d	2016								X	X
lez.27.4a6a	2016	X		X	X		X		X	
lez.27.6b	2016								X	X
lin.27.3a4a6-91214	2016								X	X
lin.27.5b	2016								X	X
mac.27.nea	2016	X	X	X	X	X	X	X	X	
meg.27.7b-k8abd	2016	X	X	X	X	X	X	X	X	
meg.27.8c9a	2016	X	X	X	X	X	X	X	X	
mon.27.78ab	2015								X	X
mon.27.8c9a	2016	X	X	X	X	X	X	X	X	
mur.27.3a47d	2016								X	X
nep.fu.11	2016	X		X						
nep.fu.12	2016	X		X						
nep.fu.13	2016	X		X						
nep.fu.14	2016	X		X						
nep.fu.15	2016	X		X						
nep.fu.16	2016	X								
nep.fu.17	2016	X		X						
nep.fu.19	2016	X		X						
nep.fu.22	2016	X		X						
nep.fu.25	2015								X	X
nep.fu.2627	2015								X	X
nep.fu.2829	2016								X	X
nep.fu.3-4	2016	X								
nep.fu.31	2015								X	X
nep.fu.6	2016	X		X						
nep.fu.7	2016	X		X						
nep.fu.8	2016	X		X						
nep.fu.9	2016	X		X						
nop.27.3a4	2016	X				X	X	X	X	

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Stock	Year	above/below Fmsy	in/out SBL	B wrt MSYB$_{trigger}$ or F wrt F$_{MSY}$	F/Fmsy trends	Biomass trends	SSB/Bpa trends	Recruitment trends	Biomass data category 1-3 trends	Biomass data category 3 trends
pil.27.8abd	2016								X	X
pil.27.8c9a	2016								X	
ple.27.21-23	2016	X	X	X	X	X	X	X	X	
ple.27.24-32	2016								X	X
ple.27.420	2016	X	X	X	X	X	X	X	X	
ple.27.7a	2016	X	X	X	X	X	X	X	X	
ple.27.7d	2016	X	X	X	X	X	X	X	X	
ple.27.7e	2016								X	X
ple.27.7fg	2016								X	X
ple.27.7h-k	2016								X	X
pok.27.3a46	2016	X	X	X	X	X	X	X	X	
pra.27.4a20	2016	X	X	X	X	X	X	X	X	
reb.2127.dp	2016								X	X
rjc.27.3a47d	2016								X	X
rjc.27.8	2015								X	X
rjc.27.9a	2015								X	X
rjh.27.9a	2015								X	X
rjm.27.3a47d	2016								X	X
rjm.27.8	2015								X	X
rjm.27.9a	2015								X	X
rjn.27.3a4	2016								X	X
rjn.27.67	2015								X	X
rjn.27.8c	2015								X	X
rjn.27.9a	2015								X	X
rju.27.7de	2015								X	X
rng.27.5b6712b	2015	X		X			X		X	
san.sa.1r	2016	X				X	X	X	X	
san.sa.2r	2016	X				X	X	X	X	
san.sa.3r	2016	X				X	X	X	X	
san.sa.4	2016	X				X	X	X	X	
sbr.27.9	2015								X	X
sdv.27.nea	2016								X	X
sho.27.67	2016								X	X
sho.27.89a	2016								X	X
sol.27.20-24	2016	X	X	X	X	X	X	X	X	
sol.27.4	2016	X	X	X	X	X	X	X	X	
sol.27.7a	2015	X	X	X	X	X	X	X	X	
sol.27.7d	2016	X	X	X	X	X	X	X	X	
sol.27.7e	2016	X	X	X	X	X	X	X	X	
sol.27.7fg	2016	X	X	X	X	X	X	X	X	

Stock	Year	above/below Fmsy	in/out SBL	B wrt $MSYB_{trigger}$ or F wrt F_{MSY}	F/Fmsy trends	Biomass trends	SSB/Bpa trends	Recruitment trends	Biomass data category 1–3 trends	Biomass data category 3 trends
sol.27.7h-k	2016								X	X
sol.27.8ab	2016	X	X	X	X	X	X	X	X	
spr.27.22-32	2016	X	X	X	X	X	X	X	X	
spr.27.4	2016	X				X	X	X	X	
syc.27.3a47d	2016								X	X
syc.27.67a-ce-j	2016								X	X
syc.27.8abd	2016								X	X
syc.27.8c9a	2016								X	X
tur.27.3a	2016								X	X
tur.27.4	2016								X	X
usk.27.3a45b6a7-912b	2016								X	X
whb.27.1-91214	2016	X	X	X	X	X	X	X	X	
whg.27.47d	2016	X	X	X	X	X	X	X	X	
whg.27.6a	2015	X	X	X	X	X	X	X	X	
whg.27.7a	2016	X	X	X	X	X	X	X	X	
whg.27.7b-ce-k	2016	X	X	X	X	X	X	X	X	
wit.27.3a47d	2016								X	X
Total		**71**	**46**	**62**	**48**	**54**	**55**	**54**	**121**	**61**

3.2 Indicators of management performance

3.2.1 Number of stocks by year where fishing mortality exceeded F_{MSY}
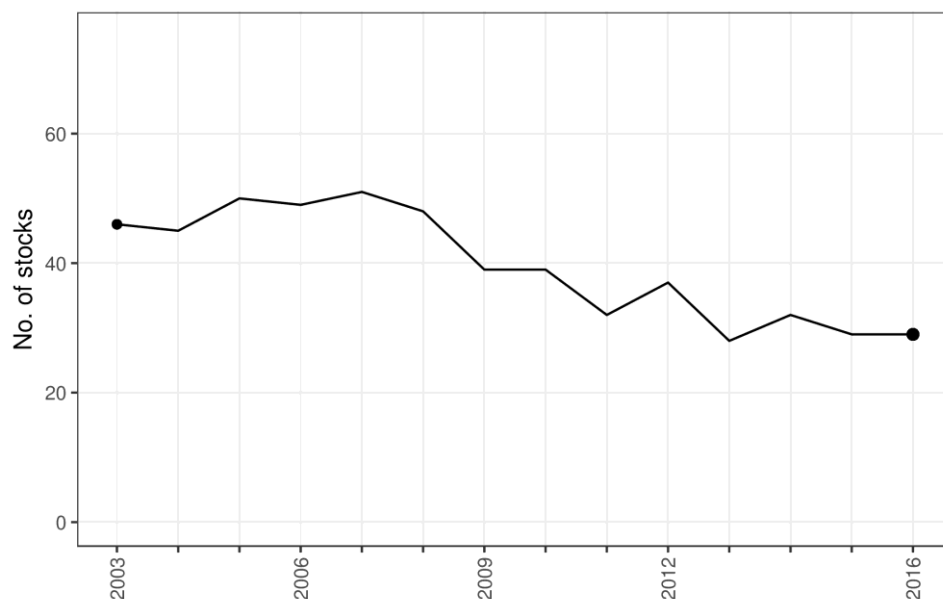
Figure 3.3 Number of stocks by year for which fishing mortality (F) exceeded F_{MSY}.
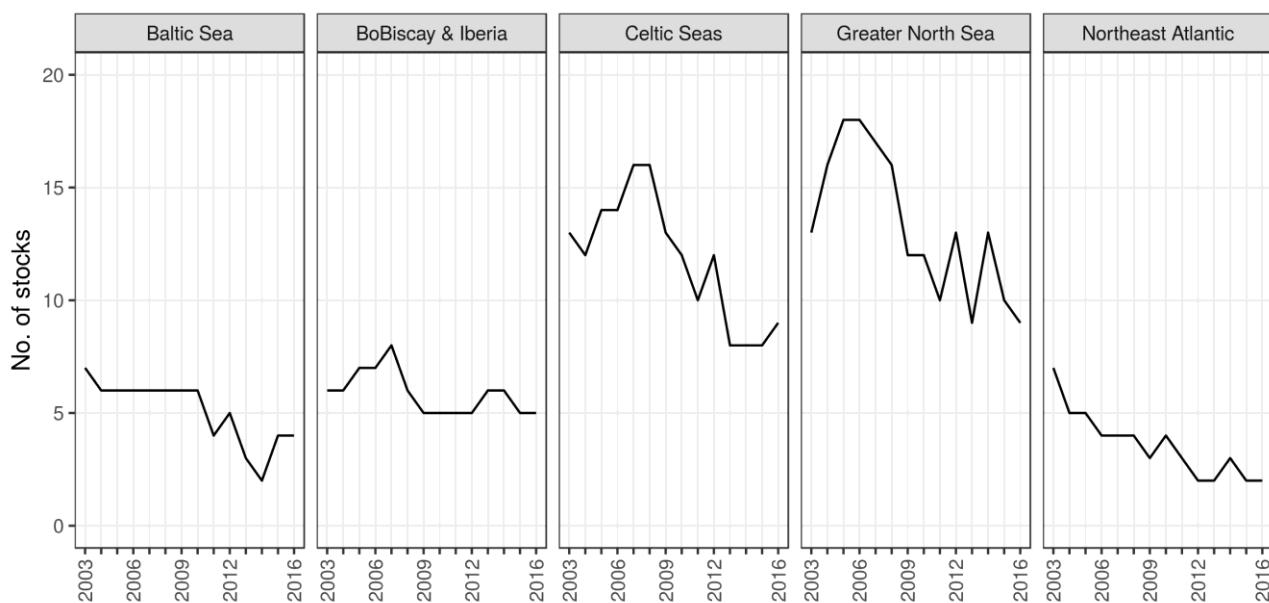
Figure 3.4 Number of stocks by year and ecoregion for which fishing mortality (F) exceeded F_{MSY}.

Table 3.3 Number of stocks by year and ecoregion for which fishing mortality (F) exceeded F_{MSY}.

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ALL	46	45	50	49	51	48	39	39	32	37	28	32	29	29
Baltic Sea	7	6	6	6	6	6	6	6	4	5	3	2	4	4
BoBiscay & Iberia	6	6	7	7	8	6	5	5	5	5	6	6	5	5
Celtic Seas	13	12	14	14	16	16	13	12	10	12	8	8	8	9
Greater North Sea	13	16	18	18	17	16	12	12	10	13	9	13	10	9
Widely distributed	7	5	5	4	4	4	3	4	3	2	2	3	2	2

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3.2.2 Number of stocks by year for which fishing mortality was equal to, or less than F_{MSY}
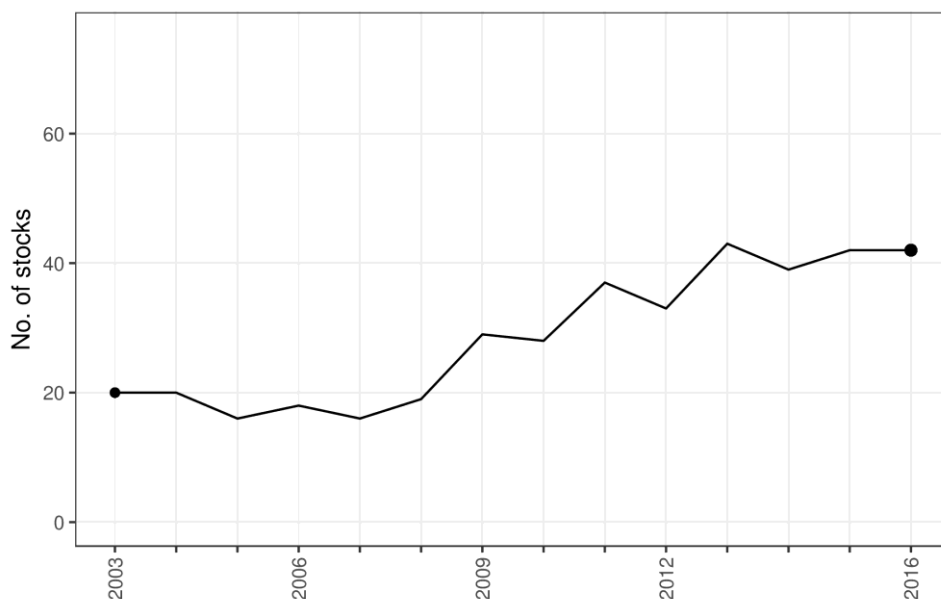
Figure 3.5 Number of stocks by year for which fishing mortality (F) did not exceed F_{MSY}.
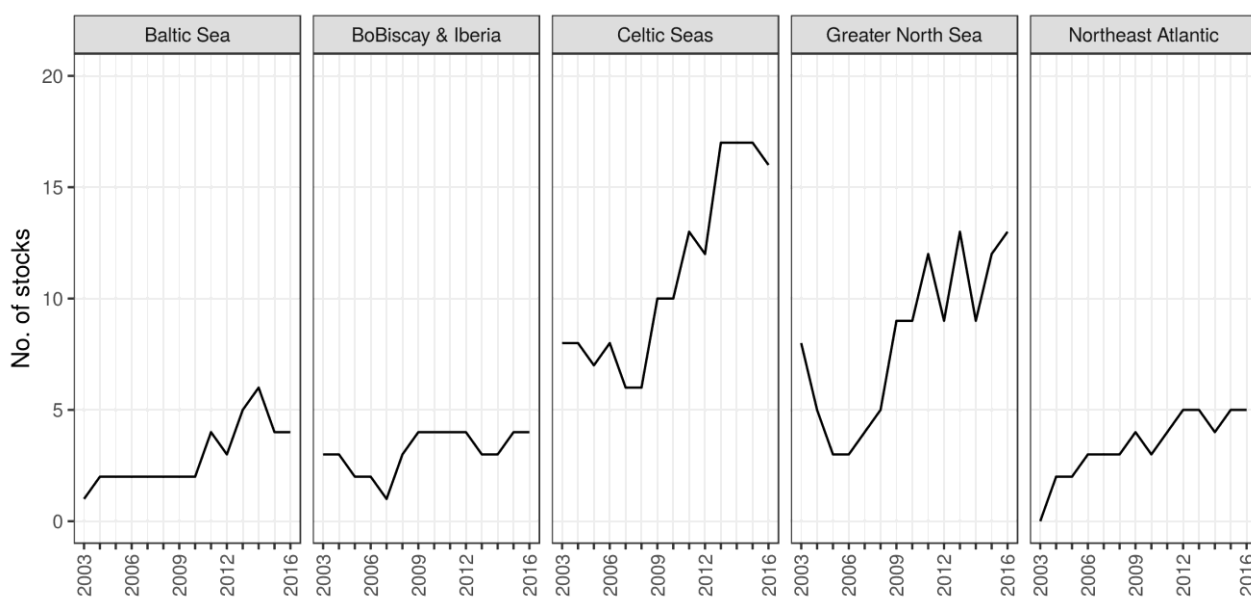
Figure 3.6 Number of stocks by year and ecoregion for which fishing mortality (F) did not exceed F_{MSY}.

Table 3.4 Number of stocks by year and ecoregion for which fishing mortality (F) did not exceed F_{MSY}.

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ALL	20	20	16	18	16	19	29	28	37	33	43	39	42	42
Baltic Sea	1	2	2	2	2	2	2	2	4	3	5	6	4	4
BoBiscay & Iberia	3	3	2	2	1	3	4	4	4	4	3	3	4	4
Celtic Seas	8	8	7	8	6	6	10	10	13	12	17	17	17	16
Greater North Sea	8	5	3	3	4	5	9	9	12	9	13	9	12	13
Widely distributed	0	2	2	3	3	3	4	3	4	5	5	4	5	5

3.2.3 Number of stocks outside safe biological limits
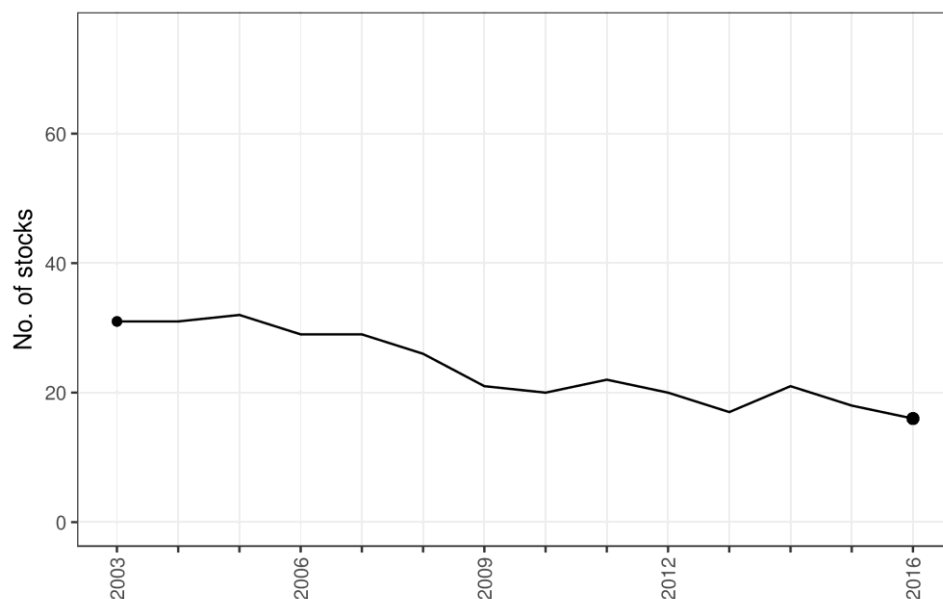
Figure 3.7 Number of stocks outside safe biological limits by year.
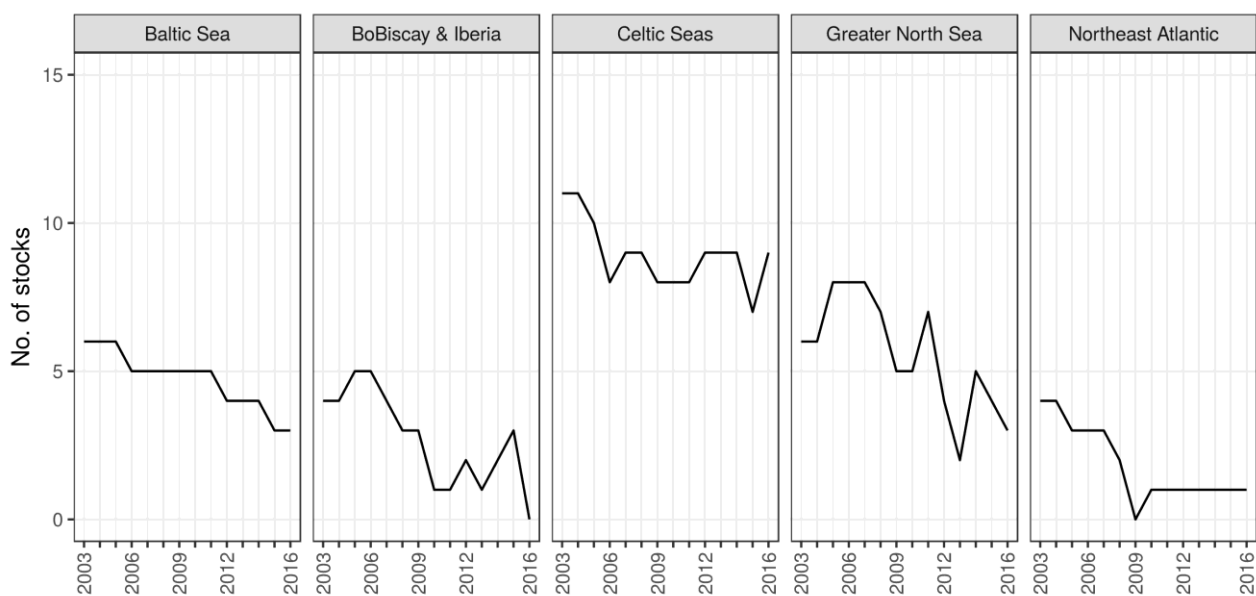
Figure 3.8 Number of stocks outside safe biological limits by ecoregion and year.

Table 3.5 Number of stocks outside safe biological limits by ecoregion and year.

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ALL	31	31	32	29	29	26	21	20	22	20	17	21	18	16
Baltic Sea	6	6	6	5	5	5	5	5	5	4	4	4	3	3
BoBiscay & Iberia	4	4	5	5	4	3	3	1	1	2	1	2	3	0
Celtic Seas	11	11	10	8	9	9	8	8	8	9	9	9	7	9
Greater North Sea	6	6	8	8	8	7	5	5	7	4	2	5	4	3
Widely distributed	4	4	3	3	3	2	0	1	1	1	1	1	1	1

3.2.4 Number of stocks inside safe biological limits
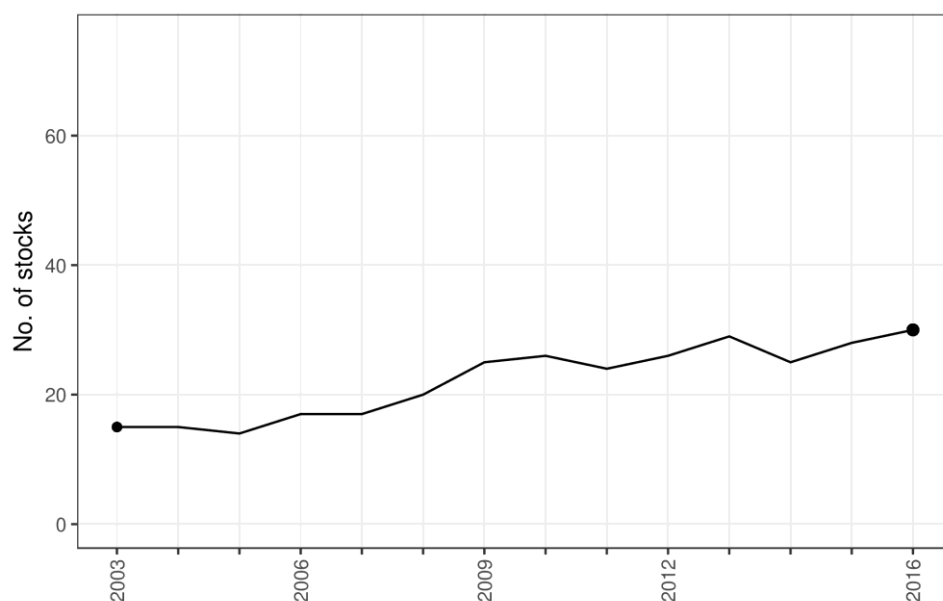
Figure 3.9 Number of stocks inside safe biological limits by year.
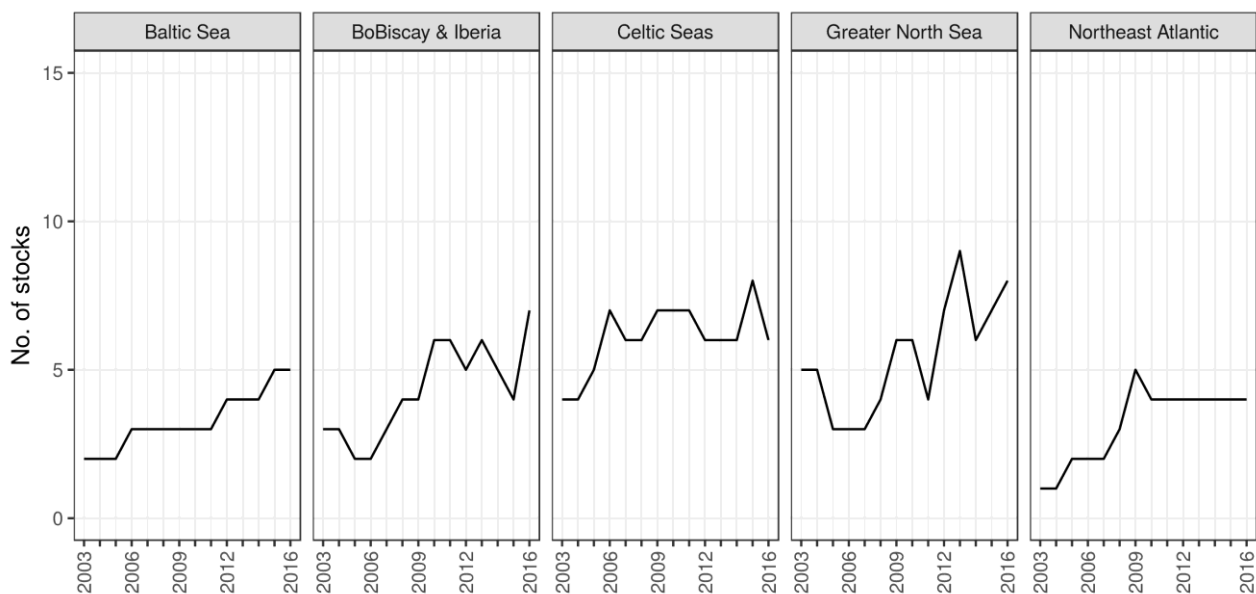
Figure 3.10 Number of stocks inside safe biological limits by ecoregion and year.

Table 3.6 Number of stocks inside safe biological limits by ecoregion and year.

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ALL	15	15	14	17	17	20	25	26	24	26	29	25	28	30
Baltic Sea	2	2	2	3	3	3	3	3	3	4	4	4	5	5
BoBiscay & Iberia	3	3	2	2	3	4	4	6	6	5	6	5	4	7
Celtic Seas	4	4	5	7	6	6	7	7	7	6	6	6	8	6
Greater North Sea	5	5	3	3	3	4	6	6	4	7	9	6	7	8
Widely distributed	1	1	2	2	2	3	5	4	4	4	4	4	4	4

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3.2.5 Trend in F/F_{MSY}

Indicators of trends show the average progress of the process they represent, including its uncertainty in terms of 50% and 95% confidence intervals. In the former case corresponding to the range between the 25% and 75% percentiles, and for the latter between the 2.5% and 97.5% percentiles.

Trends in F/F_{MSY} by ecoregion and year are given in Figure 3.11 and the associated percentiles are given in Table 3.7. Figure 3.11 shows the indicator value in 2016 close to 1, which means that over all stocks, on average, the exploitation levels are close to F_{MSY}. Nevertheless, there are still about 40% of the stocks which are being exploited above F_{MSY} (see sections 3.2.1 and 3.2.2).
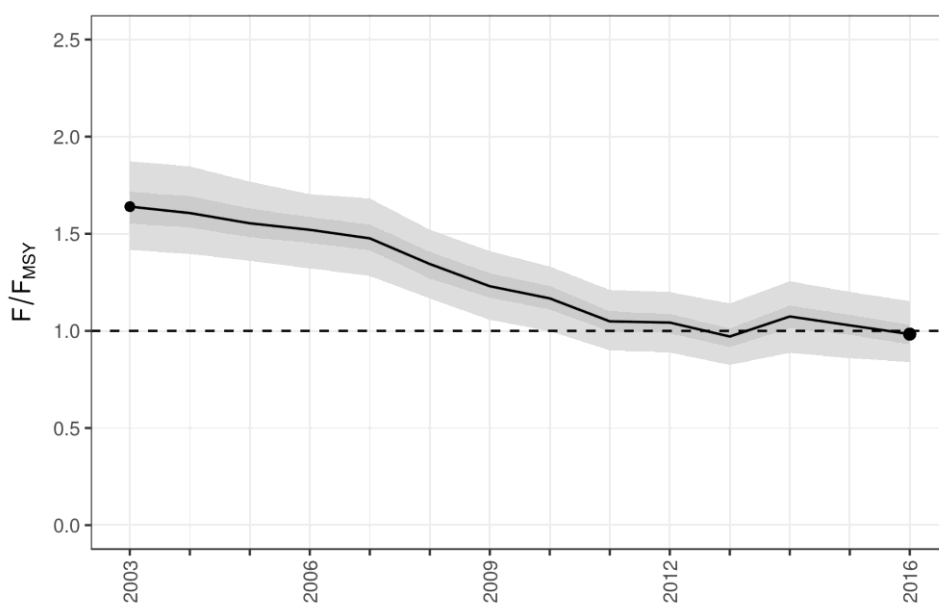
Figure 3.11 Trend in F/FMSY. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 3.7 Percentiles for F/FMSY by year.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2.5%	1.42	1.40	1.36	1.32	1.28	1.17	1.06	1.00	0.90	0.89	0.82	0.89	0.86	0.84
25%	1.55	1.53	1.48	1.45	1.42	1.27	1.17	1.11	1.00	0.99	0.92	1.02	0.98	0.93
50%	1.64	1.61	1.55	1.52	1.48	1.34	1.23	1.17	1.05	1.04	0.97	1.07	1.03	0.98
75%	1.71	1.69	1.63	1.58	1.55	1.41	1.30	1.23	1.10	1.09	1.01	1.13	1.08	1.03
97.5%	1.87	1.85	1.77	1.70	1.68	1.52	1.41	1.33	1.21	1.20	1.14	1.26	1.20	1.15

Trends in F/F$_{MSY}$ by ecoregion are given in Figure 3.13 and Table 3.8. The regional analysis was carried out using the same model applied to regional datasets. Due to the small number of stocks in each ecoregion it was not possible to compute confidence intervals.
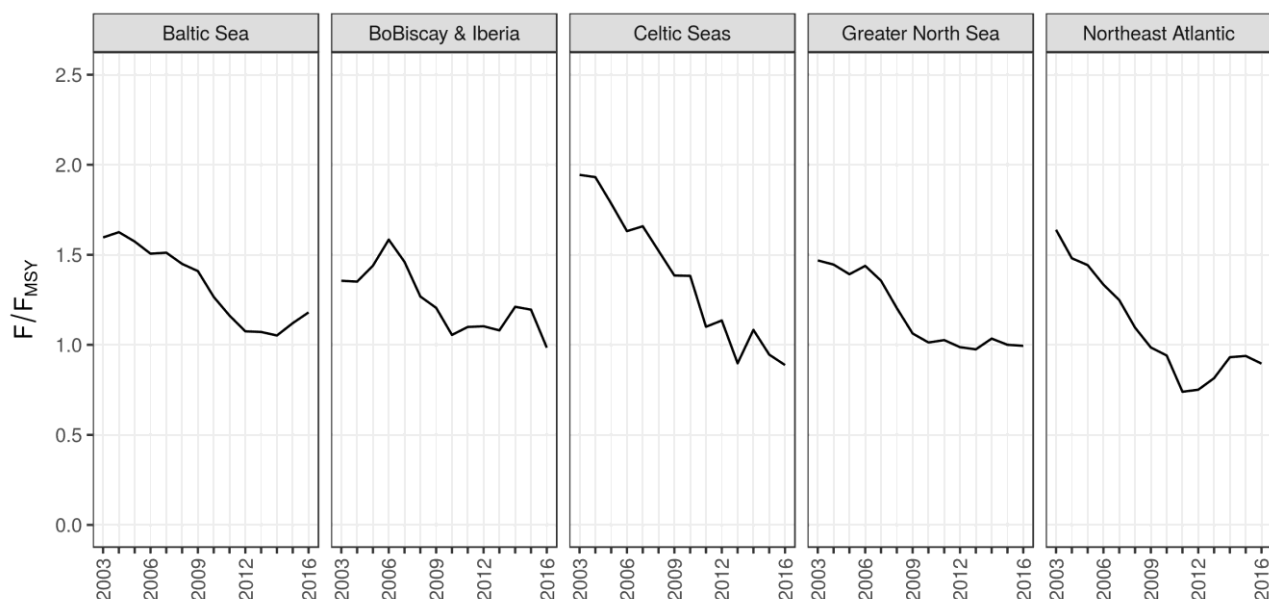
Figure 3.12 Trend in F/FMSY by ecoregion.

Table 3.8. Trend in F/FMSY by ecoregion and year

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ALL	1.64	1.61	1.55	1.52	1.48	1.34	1.23	1.17	1.05	1.04	0.97	1.07	1.03	0.98
Baltic Sea	1.60	1.63	1.57	1.51	1.51	1.45	1.41	1.27	1.16	1.07	1.07	1.05	1.12	1.18
BoBiscay & Iberia	1.36	1.35	1.44	1.58	1.46	1.27	1.21	1.05	1.10	1.10	1.08	1.21	1.20	0.98
Celtic Seas	1.94	1.93	1.78	1.63	1.66	1.52	1.38	1.38	1.10	1.14	0.90	1.08	0.95	0.89
Greater North Sea	1.47	1.45	1.39	1.44	1.36	1.20	1.06	1.01	1.03	0.99	0.97	1.03	1.00	0.99
Widely distributed	1.64	1.48	1.44	1.33	1.25	1.10	0.99	0.94	0.74	0.75	0.81	0.93	0.94	0.90

3.2.6 Trend in SSB (relative to 2003)

Indicators of trends show the average progress of the process they represent, including its uncertainty in terms of 50% and 95% confidence intervals. In the former case corresponding to the range between the 25% and 75% percentiles, and for the latter between the 2.5% and 97.5% percentiles.

Figure 3.13 and Table 3.9 present the evolution of SSB over the period of the study, scaled to the initial (2003) value for presentation purposes. Over the time series, SSB shows a generally increasing pattern.
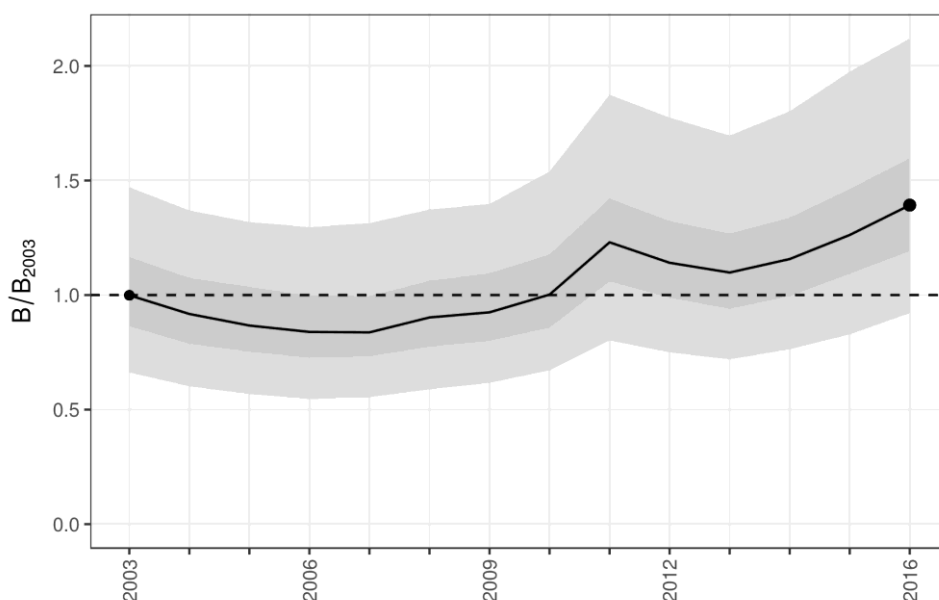
Figure 3.13 Trend in SSB relative to 2003. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 3.9 Percentiles for SSB by year relative to 2003.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2.5%	0.66	0.60	0.57	0.55	0.55	0.59	0.62	0.67	0.80	0.75	0.72	0.76	0.83	0.92
25%	0.86	0.79	0.75	0.73	0.73	0.78	0.80	0.86	1.06	0.99	0.94	1.00	1.09	1.19
50%	1.00	0.92	0.87	0.84	0.84	0.90	0.92	1.00	1.23	1.14	1.10	1.16	1.26	1.39
75%	1.17	1.07	1.03	1.00	0.99	1.06	1.09	1.18	1.42	1.32	1.27	1.34	1.46	1.60
97.5%	1.47	1.37	1.32	1.30	1.31	1.37	1.40	1.54	1.87	1.77	1.70	1.80	1.97	2.12

Trends in SSB by ecoregion and year are given in Figure 3.14 and Table 3.10. The regional analysis was carried out using the same model applied to regional datasets. Due to the small number of stocks in each ecoregion it wasn't possible to compute confidence intervals.
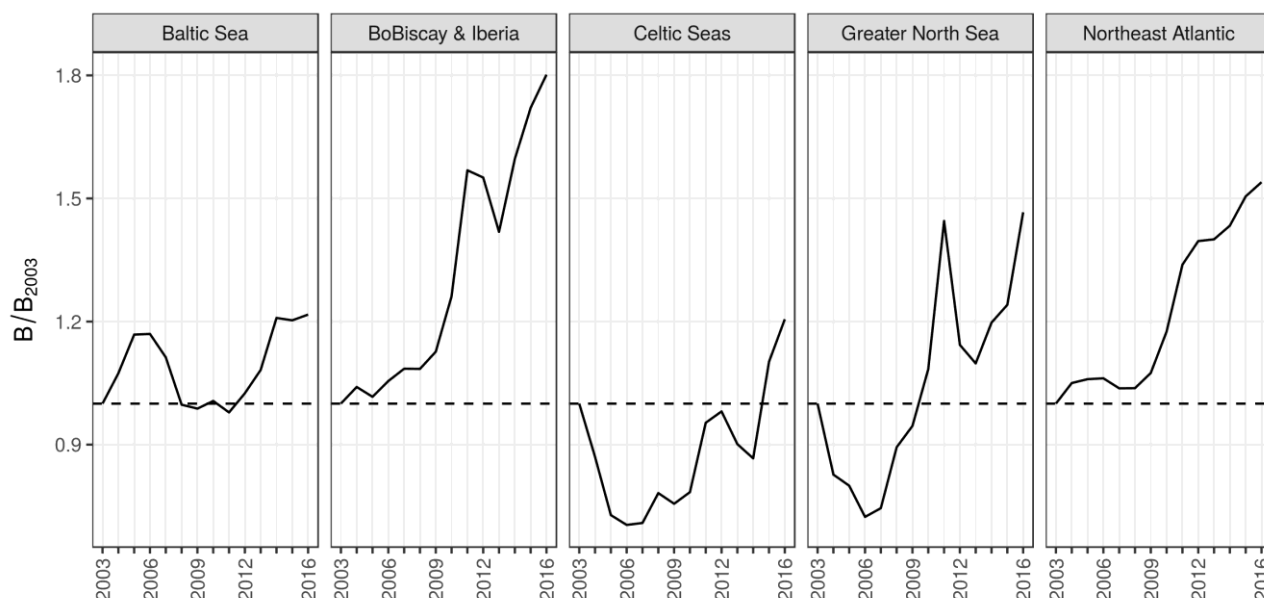
Figure 3.14 Trend in SSB by ecoregion relative to 2003.

Table 3.10 SSB relative to 2003 by ecoregion.

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ALL	1.00	0.92	0.87	0.84	0.84	0.90	0.92	1.00	1.23	1.14	1.10	1.16	1.26	1.39
Baltic Sea	1.00	1.07	1.17	1.17	1.11	1.00	0.99	1.01	0.98	1.03	1.08	1.21	1.20	1.22
BoBiscay & Iberia	1.00	1.04	1.02	1.06	1.08	1.08	1.13	1.26	1.57	1.55	1.42	1.60	1.72	1.80
Celtic Seas	1.00	0.87	0.73	0.70	0.71	0.78	0.76	0.78	0.95	0.98	0.90	0.87	1.10	1.21
Greater North Sea	1.00	0.83	0.80	0.72	0.75	0.89	0.95	1.08	1.45	1.14	1.10	1.20	1.24	1.47
Widely distributed	1.00	1.05	1.06	1.06	1.04	1.04	1.07	1.18	1.34	1.40	1.40	1.43	1.51	1.54

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3.3 Experimental indicators

STECF (2017a) required a list of experimental indicators to be computed, similar to the 2017 exercise (STECF, 2017b). The estimates obtained for these indicators are not stable and should be considered with care.

3.3.1 Number of stocks with F above Fmsy or SSB below MSYBtrigger
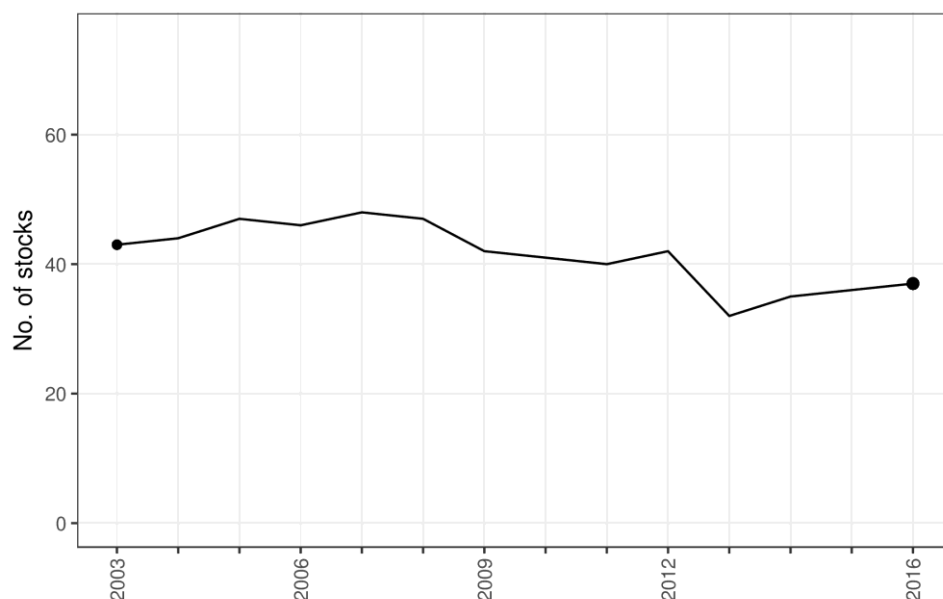
Figure 3.15 Number of stocks with F above F$_{msy}$ or SSB below MSYB$_{trigger}$ by year.
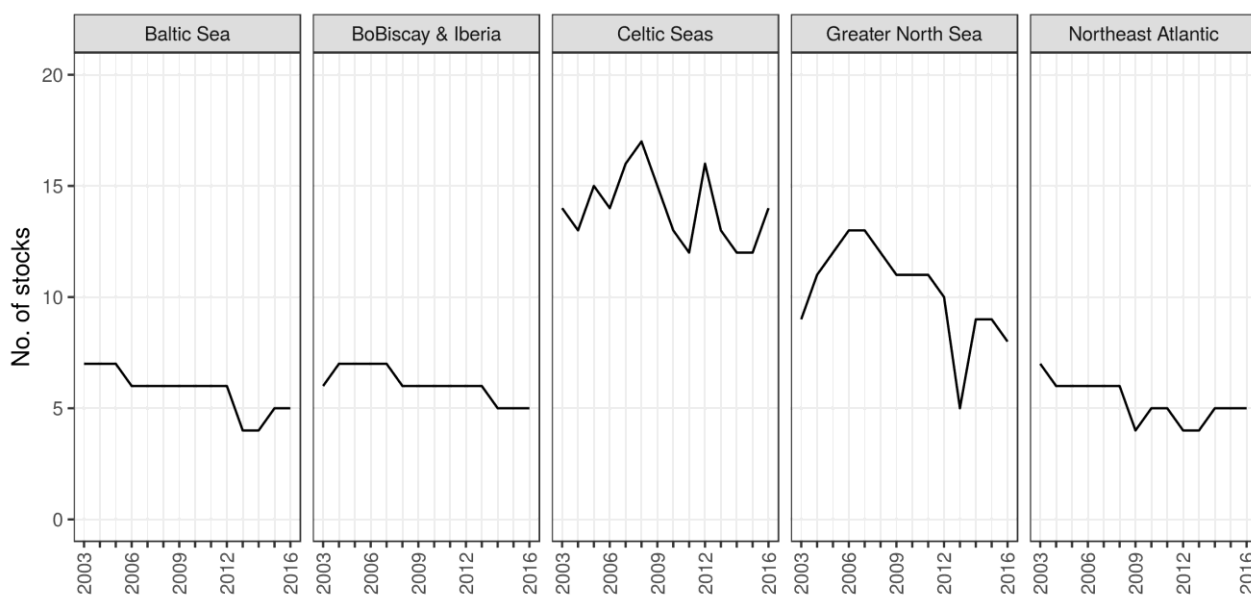
Figure 3.16 Number of stocks with F above F$_{msy}$ or SSB below MSYB$_{trigger}$ by ecoregion and year.

Table 3.11 Number of stocks with F above F$_{msy}$ or SSB below MSYB$_{trigger}$ by ecoregion and year.

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ALL	43	44	47	46	48	47	42	41	40	42	32	35	36	37
Baltic Sea	7	7	7	6	6	6	6	6	6	6	4	4	5	5
BoBiscay & Iberia	6	7	7	7	7	6	6	6	6	6	6	5	5	5
Celtic Seas	14	13	15	14	16	17	15	13	12	16	13	12	12	14
Greater North Sea	9	11	12	13	13	12	11	11	11	10	5	9	9	8
Widely distributed	7	6	6	6	6	6	4	5	5	4	4	5	5	5
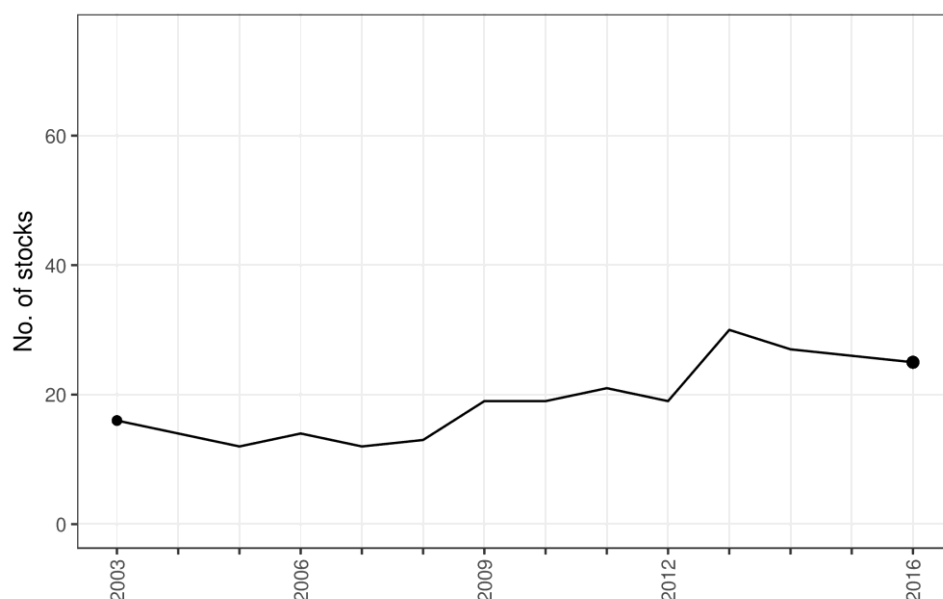
Figure 3.17 Number of stocks with F below or equal to F_{msy} and SSB above or equal to $MSYB_{trigger}$.
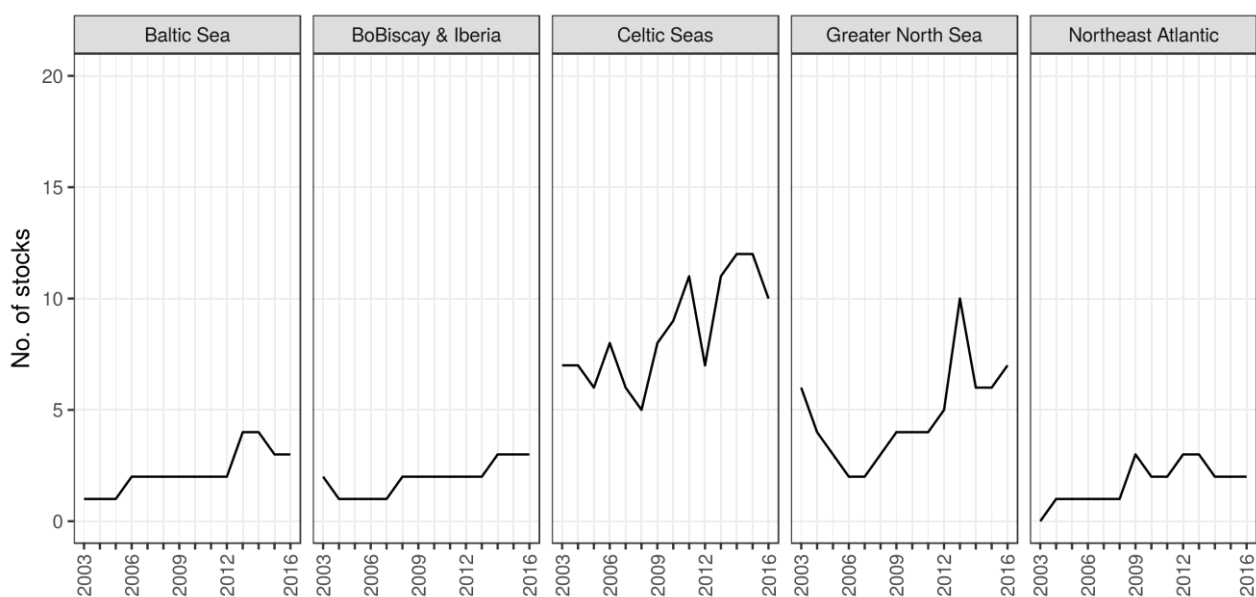
Figure 3.18 Number of stocks with F below or equal to F_{msy} and SSB above or equal to $MSYB_{trigger}$ by ecoregion and year.

Table 3.12 Number of stocks with F below or equal to F_{msy} and SSB above or equal to $MSYB_{trigger}$ by ecoregion and year.

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ALL	16	14	12	14	12	13	19	19	21	19	30	27	26	25
Baltic Sea	1	1	1	2	2	2	2	2	2	2	4	4	3	3
BoBiscay & Iberia	2	1	1	1	1	2	2	2	2	2	2	3	3	3
Celtic Seas	7	7	6	8	6	5	8	9	11	7	11	12	12	10
Greater North Sea	6	4	3	2	2	3	4	4	4	5	10	6	6	7
Widely distributed	0	1	1	1	1	1	3	2	2	3	3	2	2	2

3.3.3 Trend in F/F_{MSY} for stocks outside the EU coastal waters

Indicators of trends show the average progress of the process they represent, including its uncertainty in terms of 50% and 95% confidence intervals. In the former case corresponding to the range between the 25% and 75% percentiles, and for the latter between the 2.5% and 97.5% percentiles.

This indicator was based on 9 stocks. The Northern shrimp stock (pra.27.1-2) was removed from the computation of the indicator F/F_{MSY} outside the EU coastal waters, because the indicator values were heavily influenced by the outlier behaviour of this stock (STECF, 2017a).
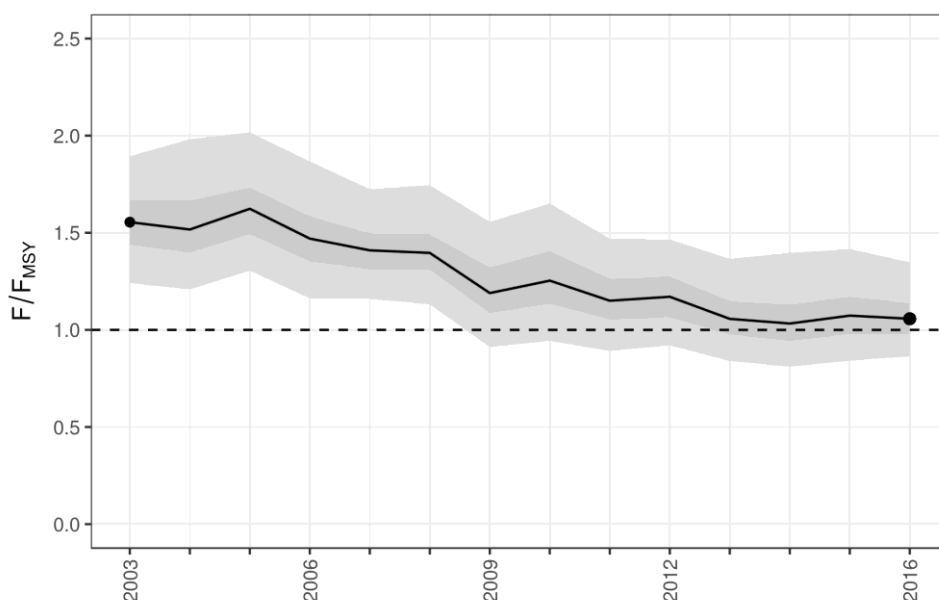
Figure 3.19 Trend in F/FMSY for stocks outside the EU coastal waters. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 3.13 Percentiles for F/FMSY for stocks outside the EU coastal waters by year.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2.5%	1.24	1.21	1.30	1.16	1.16	1.13	0.91	0.94	0.89	0.92	0.84	0.81	0.84	0.86
25%	1.44	1.40	1.50	1.35	1.31	1.31	1.09	1.14	1.05	1.07	0.98	0.94	0.98	0.98
50%	1.55	1.52	1.62	1.47	1.41	1.40	1.19	1.25	1.15	1.17	1.06	1.03	1.07	1.06
75%	1.67	1.66	1.73	1.58	1.50	1.49	1.32	1.40	1.26	1.27	1.15	1.13	1.17	1.14
97.5%	1.89	1.98	2.02	1.87	1.72	1.75	1.56	1.65	1.47	1.47	1.37	1.40	1.42	1.35

3.3.4 Trend in SSB/B$_{pa}$

Indicators of trends show the average progress of the process they represent, including its uncertainty in terms of 50% and 95% confidence intervals. In the former case corresponding to the range between the 25% and 75% percentiles, and for the last between the 2.5% and 97.5% percentiles.
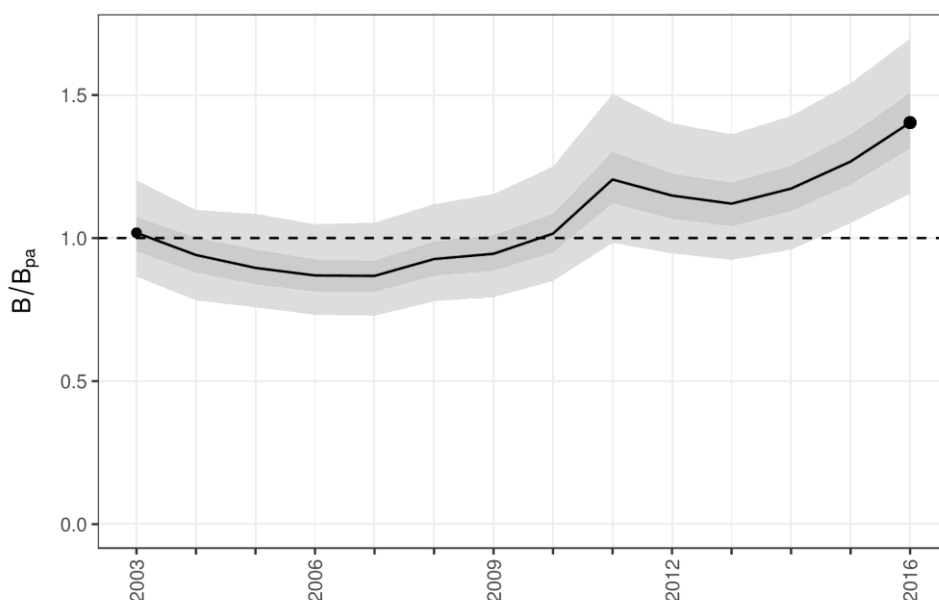
Figure 3.20 Trend in SSB/Bpa. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 3.14 Percentiles for SSB/Bpa by year.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2.5%	0.87	0.78	0.76	0.73	0.73	0.78	0.79	0.85	0.98	0.95	0.92	0.96	1.05	1.15
25%	0.95	0.88	0.84	0.81	0.81	0.87	0.89	0.95	1.12	1.07	1.04	1.10	1.19	1.31
50%	1.02	0.94	0.90	0.87	0.87	0.93	0.95	1.02	1.20	1.15	1.12	1.17	1.27	1.40
75%	1.07	1.00	0.96	0.92	0.92	0.99	1.01	1.08	1.30	1.22	1.19	1.25	1.36	1.51
97.5%	1.20	1.10	1.09	1.05	1.05	1.12	1.15	1.25	1.50	1.40	1.36	1.43	1.54	1.70

3.3.5 Trend in recruitment (relative to 2003)

Indicators of trends show the average progress of the process they represent, including its uncertainty in terms of 50% and 95% confidence intervals. In the former case corresponding to the range between the 25% and 75% percentiles, and for the latter between the 2.5% and 97.5% percentiles.
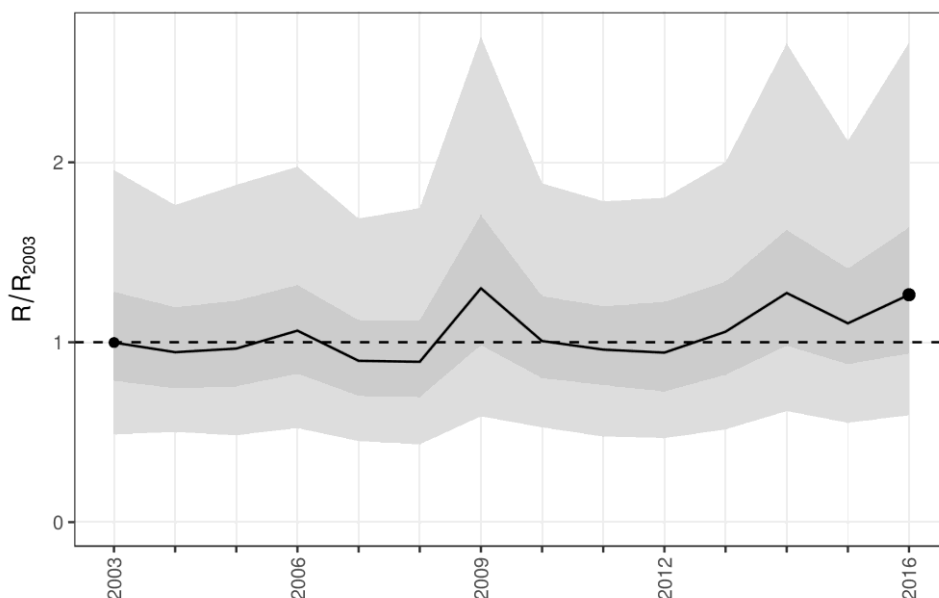
Figure 3.21 Trend in R/R2003 . Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 3.15 Percentiles for R/R2003 by year.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2.5%	0.49	0.50	0.48	0.52	0.45	0.43	0.59	0.53	0.48	0.47	0.52	0.62	0.55	0.59
25%	0.79	0.75	0.76	0.83	0.70	0.70	0.99	0.80	0.76	0.73	0.82	0.98	0.88	0.94
50%	1.00	0.94	0.96	1.06	0.90	0.89	1.30	1.01	0.96	0.94	1.06	1.27	1.11	1.26
75%	1.28	1.19	1.23	1.32	1.12	1.12	1.71	1.25	1.20	1.22	1.34	1.62	1.41	1.64
97.5%	1.96	1.76	1.88	1.98	1.69	1.75	2.70	1.88	1.78	1.80	2.00	2.66	2.12	2.67

3.3.6   Trend in SSB or biomass index for stocks of data category 1-3 (relative to 2003)

Indicators of trends show the average progress of the process they represent, including its uncertainty in terms of 50% and 95% confidence intervals. In the former case corresponding to the range between the 25% and 75% percentiles, and for the latter between the 2.5% and 97.5% percentiles.

Note that the bootstrap procedure failed in 223 over 500 iterations, which is a sign of the poor fit of the model to the dataset. It also explains the value of 0.96 in 2003 (Table 3.16), which derives from the skewed distribution obtained for this indicator.
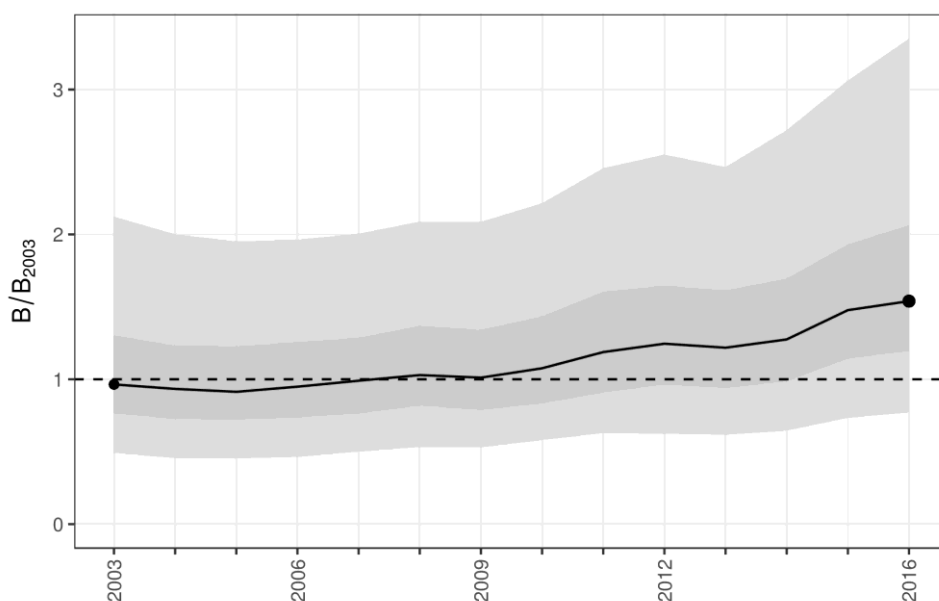
Figure 3.22 Trend in SSB relative to 2003 for category 1-3 stocks. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 3.16 Percentiles for SSB relative to 2003 by year for category 1-3 stocks.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2.5%	0.49	0.45	0.45	0.46	0.50	0.53	0.53	0.58	0.63	0.62	0.62	0.64	0.73	0.77
25%	0.77	0.73	0.72	0.74	0.76	0.82	0.79	0.83	0.91	0.97	0.94	0.99	1.14	1.20
50%	0.96	0.93	0.91	0.95	0.99	1.03	1.01	1.08	1.19	1.25	1.22	1.28	1.48	1.54
75%	1.30	1.23	1.23	1.26	1.29	1.37	1.34	1.43	1.60	1.65	1.61	1.69	1.93	2.06
97.5%	2.12	2.00	1.95	1.96	2.01	2.09	2.09	2.22	2.46	2.55	2.47	2.72	3.06	3.35

3.3.7 Trend in SSB or biomass index for stocks of data category 3 (relative to 2003)

Indicators of trends show the average progress of the process they represent, including its uncertainty in terms of 50% and 95% confidence intervals. In the former case corresponding to the range between the 25% and 75% percentiles, and for the latter between the 2.5% and 97.5% percentiles.

Figure 3.23 Trend in SSB relative to 2003 for category 3 stocks. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 3.17 Percentiles for SSB relative to 2003 by year for category 3 stocks.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2.5%	0.59	0.62	0.63	0.66	0.73	0.75	0.71	0.76	0.77	0.90	0.89	0.93	1.08	1.11
25%	0.82	0.84	0.84	0.92	0.99	1.04	0.99	1.04	1.09	1.24	1.23	1.29	1.53	1.56
50%	1.01	1.02	1.03	1.10	1.18	1.27	1.18	1.25	1.29	1.47	1.47	1.55	1.85	1.87
75%	1.21	1.19	1.18	1.29	1.37	1.50	1.40	1.47	1.52	1.74	1.72	1.82	2.15	2.21
97.5%	1.80	1.74	1.74	1.92	2.03	2.13	2.01	2.09	2.18	2.57	2.52	2.64	3.12	3.22

3.4 Indicators of advice coverage

The indicator of advice coverage computes the number of stocks for which the reference points, F_{MSY}, F_{PA}, $MSYB_{trigger}$ and B_{PA} are available and the number of associated TACs. Note that provided part of a given TAC management area overlaps with part of a stock assessment area, the setting of the TAC is considered as being based on the relevant stock assessment. Consequently, the advice coverage indicator is biased upwards if compared with the full spatial coverage of TAC areas by stock assessments.

Table 3.18 Coverage of TACs by scientific advice (ICES categories 1+2).

	No of stocks	No of TACs	No of TACs based on stock assessments	Fraction of TACs based on stock assessments
Fmsy	71	156	87	0.56
MSYBtrigger	69	156	86	0.55
Fpa	46	156	72	0.46
Bpa	55	156	79	0.51

4   MEDITERRANEAN AND BLACK SEAS (FAO REGION 37)

There was a strong increasing trend in the number of stocks assessed for years 2003-2009, from 22 up to 47; the number of stock assessments kept stable until 2014 and decreased to 39 in 2015 and 21 in 2016 (Figure 4.1 and Figure 4.2).

This situation renders the interpretation of the deterministic indicators misleading. With such differences in the number of stocks assessed each year, the trends in the indicators are confounded with the number of stocks available for their computation. Consequently, only the model-based indicators are shown.

Nevertheless, the indicator values presented (Figure 4.3 and Figure 4.4) are not very robust due to the large changes in the number of stocks available to fit the model, and therefore the results should be interpreted with caution.

Figure 4.1 indicates by year, the number of stocks in the Mediterranean and Black Seas for which estimates of F/F_{MSY} are available. The major reduction in 2016 is due to:

- the STECF EWG part I carried out analytical assessments for only 8 out of 11 stocks (STECF 2017c).
- the STECF EWG part II carried out analytical assessment for 5 out of 19 stocks (STECF, 2018).
- GFCM assessments performed in 2017 in WGSASP and WGSADM have not yet been reviewed and approved by the GFCM Scientific Advisory Committee. Consequently, they were not included in the present analysis.

Table 4.1 shows the stocks added to the current exercise.

Since there are no results for 2016 for any of the GFCM stock assessments and the indicator values for 2016 are based on the results of only 21 stock assessments, such values are not comparable with those for earlier years of the time-series. Hence in Figure 4.1, the 2016 value is represented as stand-alone, and the indicators are plotted up to 2015 only.
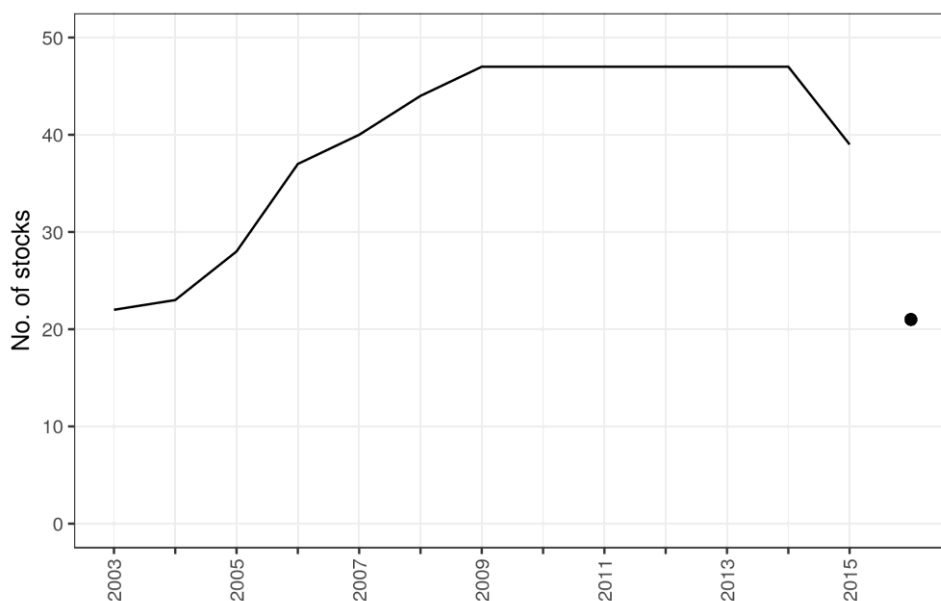
Figure 4.1 Number of stock assessments in the Mediterranean and Black Sea by year. The totals include stocks in the following GSAs only: 1, 5-7, 9, 10-19, 22-23, 25 and 29.
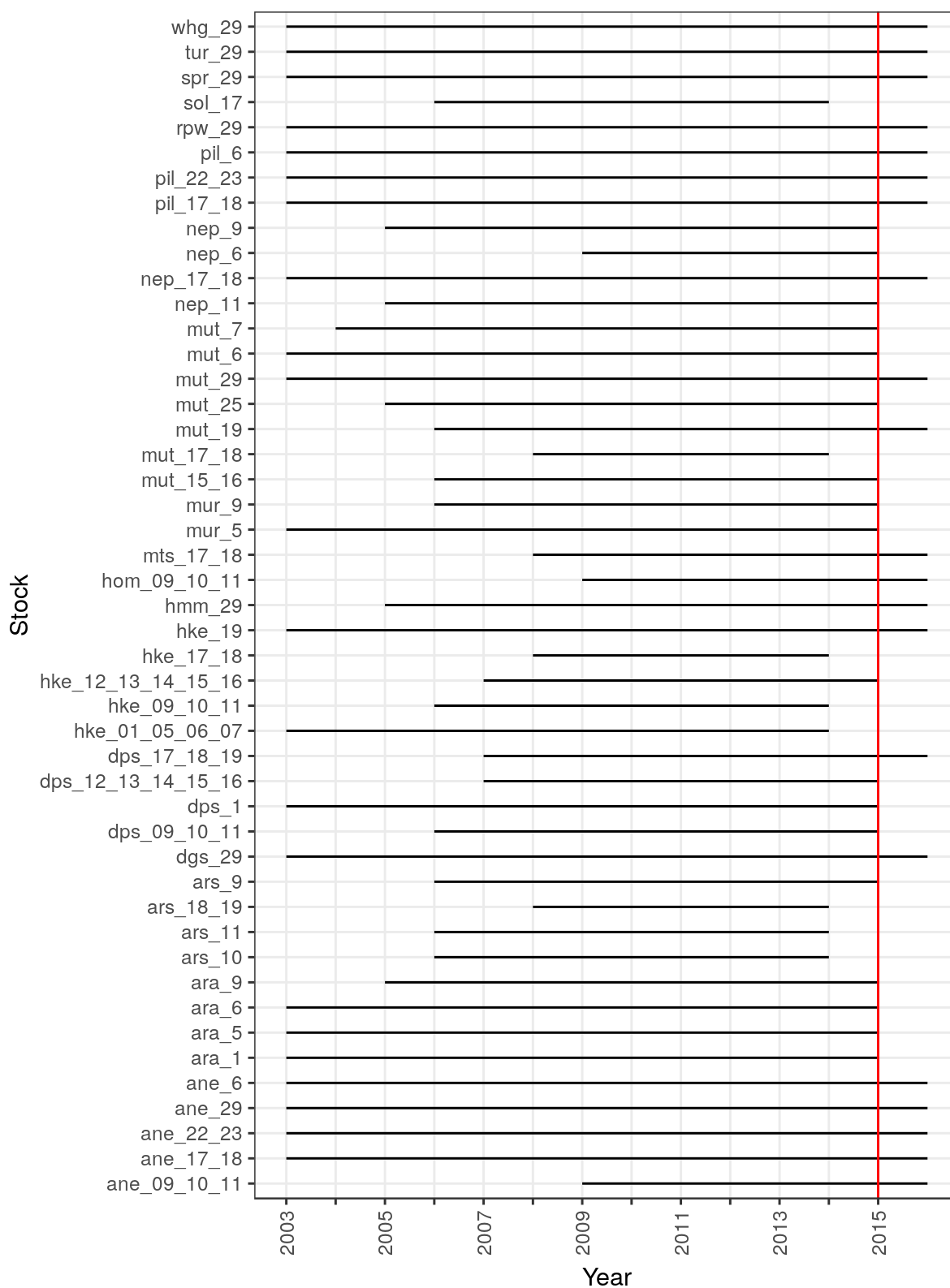
Figure 4.2 Time-series of stock assessments available from both STECF and GFCM for computation of model based CFP monitoring indicators for Mediterranean and Black Seas. The red line indicates that only stock assessment results up to and including 2015 have been used to compute the indicator values.

Table 4.1 Stocks added to the current exercise with relation to previous report.

EcoRegion	Year	Stock	Description	Updated	New	Source
Black sea	2014	ane_29	European anchovy in GSA 29	2016	N	STECF
Black sea	2014	dgs_29	Picked dogfish in GSA 29	2016	N	STECF
Black sea	2014	hmm_29	Mediterranean horse mackerel in GSA 29	2016	N	STECF
Black sea	2014	mut_29	Red mullet in GSA 29	2016	N	STECF
Black sea	2016	rpw_29	Rapana whelk in GSA 29	2016	Y	STECF
Black sea	2014	tur_29	Turbot in GSA 29	2016	N	STECF
Black sea	2014	spr_29	Sprattus sprattus in GSA 29	2016	N	STECF
Black sea	2016	whg_29	Whiting in GSA 29	2016	Y	STECF
Central Med.	2015	ane_17_18	European anchovy in GSA 17, 18	2016	N	STECF
Central Med.	2015	nep_17_18	Nephrops in GSA 17, 18	2016	N	STECF
Central Med.	2015	pil_17_18	European pilchard(=Sardine) in GSA 17, 18	2016	N	STECF
Central Med.	2014	ars_18_19	Giant red shrimp in GSA 18, 19	2014	N	STECF
Central Med.	2014	dps_17_18_19	Deep-water rose shrimp in GSA 17, 18, 19	2016	N	STECF
Central Med.	2014	hke_17_18	European hake in GSA 17, 18	2014	N	STECF
Central Med.	2014	hke_19	European hake in GSA 19	2016	N	STECF
Central Med.	2014	mts_17_18	Spottail mantis squillid in GSA 17, 18	2016	N	STECF
Central Med.	2014	mut_17_18	Red mullet in GSA 17, 18	2014	N	STECF
Central Med.	2014	sol_17	Common sole in GSA 17	2014	N	STECF
Central Med.	2015	mut_15_16	Red mullet in GSA 15,16	2015	Y	GFCM
Central Med.	2016	mut_19	Red mullet in GSA 19	2016	Y	STECF
Central Med.	2014	hke_12_13_14_15_16	Merluccius merluccius in GSA 12, 13, 14, 15, 16	2015	N	GFCM
Central Med.	2014	dps_12_13_14_15_16	Parapenaeus longirostris in GSA 12, 13, 14, 15, 16	2015	N	GFCM
Eastern Med.	2016	ane_22_23	European anchovy in GSA 22, 23	2016	Y	STECF
Eastern Med.	2016	pil_22_23	European pilchard(=Sardine) in GSA 22, 23	2016	Y	STECF
Eastern Med.	2014	mut_25	Mullus barbatus in GSA 25	2015	N	GFCM
Western Med.	2016	ane_09_10_11	European anchovy in GSA 09, 10, 11	2016	Y	STECF
Western Med.	2015	ane_6	Anchovy in GSA 6	2016	N	STECF
Western Med.	2015	dps_1	Deep-water rose shrimp in GSA 1	2015	N	STECF
Western Med.	2015	mut_7	Red mullet in GSA 7	2015	Y	GFCM
Western Med.	2015	dps_09_10_11	Deep-water rose shrimp in GSA 09, 10, 11	2015	N	STECF
Western Med.	2015	mur_9	Surmullet in GSA 9	2015	N	STECF
Western Med.	2015	ara_9	Blue and red shrimp in GSA 9	2015	Y	GFCM
Western Med.	2015	ars_9	Giant red shrimp in GSA 9	2015	Y	GFCM
Western Med.	2015	nep_9	Norway lobster in GSA 9	2015	N	STECF
Western Med.	2015	nep_6	Norway lobster in GSA 6	2015	N	STECF
Western Med.	2015	nep_11	Norway lobster in GSA 11	2015	Y	STECF
Western Med.	2015	ara_1	Blue and red shrimp in GSA 1	2015	Y	GFCM
Western Med.	2015	mur_5	Striped red mullet in GSA 5	2015	Y	GFCM
Western Med.	2015	pil_6	European pilchard(=Sardine) in GSA 6	2016	N	STECF
Western Med.	2014	ara_6	Blue and red shrimp in GSA 6	2015	N	GFCM
Western Med.	2014	ars_10	Giant red shrimp in GSA 10	2014	N	STECF
Western Med.	2014	ars_11	Giant red shrimp in GSA 11	2014	N	STECF
Western Med.	2014	hke_01_05_06_07	European hake in GSA 01, 05, 06, 07	2014	N	STECF
Western Med.	2014	hke_09_10_11	European hake in GSA 09, 10, 11	2014	N	STECF
Western Med.	2016	hom_09_10_11	Atlantic horse mackerel in GSA 09, 10, 11	2016	Y	STECF
Western Med.	2013	mut_6	Red mullet in GSA 6	2015	N	GFCM
Western Med.	2013	ara_5	Aristeus antennatus in GSA 5	2015	N	GFCM

4.1 Indicators of management performance

4.1.1 *Trend in F/FMSY*

Indicators of trends show the average progress of the process they represent, including its uncertainty in terms of 50% and 95% confidence intervals. In the former case corresponding to the range between the 25% and 75% percentiles, and for the latter between the 2.5% and 97.5% percentiles.
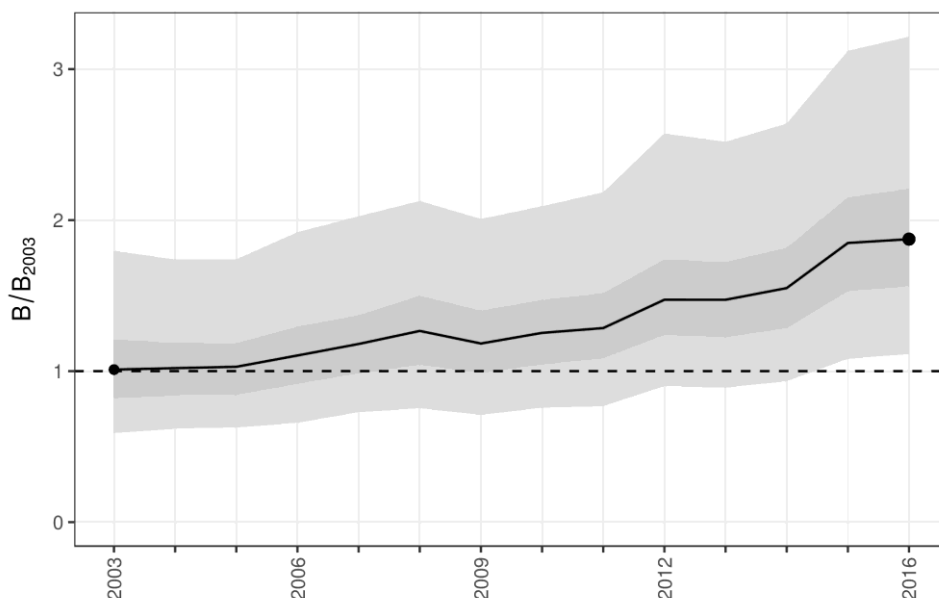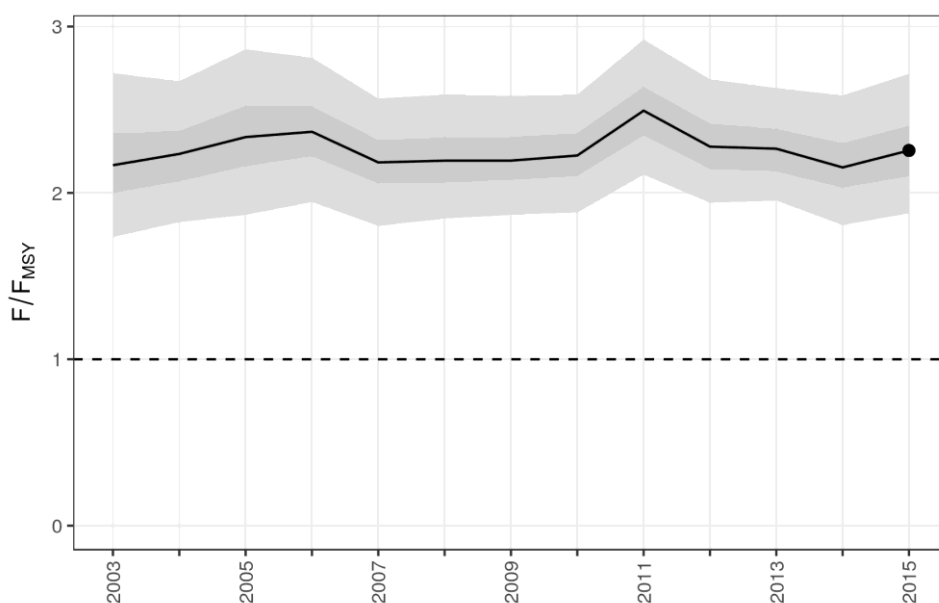

Figure 4.3 Trend in F/F$_{MSY}$. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 4.2 Percentiles for F/FMSY by year.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2.50%	1.73	1.82	1.87	1.94	1.80	1.85	1.87	1.88	2.11	1.94	1.95	1.81	1.88
25%	2.00	2.07	2.16	2.22	2.06	2.06	2.08	2.10	2.35	2.14	2.13	2.03	2.10
50%	2.17	2.23	2.34	2.37	2.18	2.19	2.19	2.22	2.49	2.28	2.27	2.15	2.25
75%	2.36	2.37	2.52	2.52	2.32	2.33	2.33	2.36	2.64	2.42	2.38	2.30	2.40
97.50%	2.72	2.67	2.86	2.81	2.57	2.59	2.58	2.59	2.92	2.68	2.63	2.59	2.72

The model used is a mixed linear model, described in the protocol (Annex I). Values for 2016 were removed from the model fit. Bootstrapped quantiles of F/F$_{MSY}$ are displayed (Figure 4.3 and Table 4.1). The 50% quantile (black line), which is equivalent to the median, shows a median level slightly varying around of F/F$_{MSY}$ ≈ 2.3 for the full time series. In the Mediterranean and Black Seas assessments, a more conservative proxy for F$_{MSY}$, such as F$_{0.1}$, is commonly used resulting in a higher ratio for F/F$_{MSY}$. The lower quantile is above F/F$_{MSY}$ = 1, indicating that the stocks are exploited well above the CFP management objectives. There is no trend, to indicate any improvement in exploitation since the implementation of the 2003 reform of the CFP.

4.1.2 Trend in SSB (relative to 2003)

Indicators of trends show the average progress of the process they represent, including its uncertainty in terms of 50% and 95% confidence intervals. In the former case corresponding to the range between the 25% and 75% percentiles, and for the latter between the 2.5% and 97.5% percentiles.
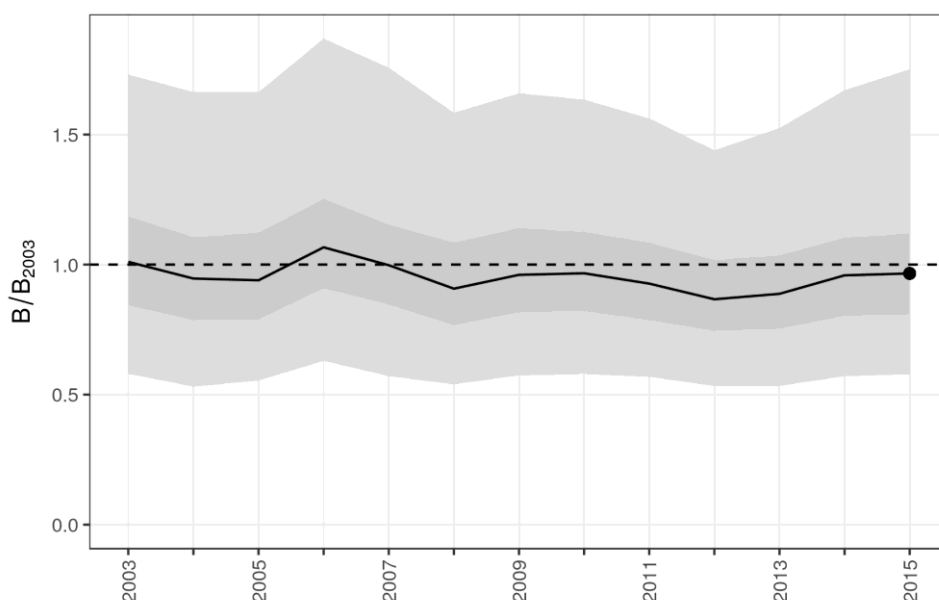
Figure 4.4 Trend in SSB relative to 2003. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 4.3 Percentiles for SSB by year relative to 2003.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2.50%	0.58	0.53	0.55	0.63	0.57	0.54	0.57	0.58	0.57	0.53	0.53	0.57	0.58
25%	0.84	0.79	0.79	0.91	0.85	0.77	0.82	0.82	0.79	0.75	0.75	0.80	0.81
50%	1.01	0.95	0.94	1.07	1.00	0.91	0.96	0.97	0.93	0.87	0.89	0.96	0.97
75%	1.18	1.10	1.12	1.25	1.15	1.08	1.14	1.12	1.08	1.02	1.03	1.10	1.12
97.5%	1.73	1.66	1.66	1.87	1.76	1.58	1.66	1.63	1.56	1.44	1.52	1.67	1.75

The 50% quantile (black line), has varied around $B/B_{2003} \approx 0.95$ (only in 2006 was the ratio above 1.0). However, the quantiles are large, representing a high level of uncertainty.

4.2 Indicators of advice coverage

In the Mediterranean and the Black Seas a total of 241 stocks were considered for the current exercise, of which 72 have stock assessments carried out between 2015-2017. The advice coverage for the Mediterranean and the Black Sea is 0.30.

5 STATUS ACROSS ALL STOCKS IN 2016

Table 5.1 Stock status for all stocks in the analysis. Columns refer to ecoregion, last year for which the estimated was obtained, stock code and description, value of F/F$_{MSY}$ ratio (F ind), if F is lower than F$_{MSY}$ (F status), if the stock is inside safe biological limits (SBL), and if the stock is inside the CFP requirements (CFP). Stocks managed under escapement strategies dot not have an estimate of F/F$_{MSY}$. Symbol 'o' stands for 'YES', an empty cell stands for 'NO' and '-' unknown due to missing information.

Region	EcoRegion	Year	Stock	Description	F ind	F status	SBL
FAO37	Black Sea	2015	ane_29	European anchovy in GSA 29	1.46		-
FAO37	Black Sea	2015	dgs_29	Piked dogfish in GSA 29	19.05		-
FAO37	Black Sea	2015	hmm_29	Horse mackerel in GSA 29	3.39		-
FAO37	Black Sea	2015	mut_29	Red mullet in GSA 29	0.88	o	-
FAO37	Black Sea	2015	whg_29	Whiting in GSA 29	2.14		-
FAO37	Black Sea	2015	tur_29	Turbot in GSA 29	2.81		-
FAO37	Black Sea	2015	spr_29	European sprat in GSA 29	1.82		-
FAO37	Black Sea	2015	rpw_29	Rapana whelk in GSA 29	1.93		-
FAO37	Central Med.	2014	sol_17	Common sole in GSA 17	2.44		-
FAO37	Central Med.	2015	hke_19	European hake in GSA 19	10.43		-
FAO37	Central Med.	2015	mut_19	Red mullet in GSA 19	2.72		-
FAO37	Central Med.	2015	ane_17_18	European anchovy in GSA 17, 18	2.49		-
FAO37	Central Med.	2015	pil_17_18	Sardine in GSA 17, 18	3.18		-
FAO37	Central Med.	2015	nep_17_18	Norway lobster in GSA 17, 18	1.49		-
FAO37	Central Med.	2014	hke_17_18	European hake in GSA 17, 18	5.57		-
FAO37	Central Med.	2015	mts_17_18	Spottail mantis shrimp in GSA 17, 18	2.20		-
FAO37	Central Med.	2015	dps_17_18_19	Deep-water rose shrimp in GSA 17, 18, 19	2.06		-
FAO37	Central Med.	2014	ars_18_19	Giant red shrimp in GSA 18, 19	1.10		-
FAO37	Central Med.	2014	mut_17_18	Red mullet in GSA 17, 18	1.32		-
FAO37	Central Med.	2015	hke_12_13_14_15_16	European hake in GSA 12, 13, 14, 15, 16	6.83		-
FAO37	Central Med.	2015	dps_12_13_14_15_16	Deep water rose shrimp in GSA 12, 13, 14, 15, 16	1.44		-
FAO37	Central Med.	2015	mut_15_16	Red mullet in GSA 15, 16	1.71		-
FAO37	Eastern Med.	2015	ane_22_23	European anchovy in GSA 22, 23	1.30		-
FAO37	Eastern Med.	2015	pil_22_23	Sardine in GSA 22, 23	1.39		-
FAO37	Eastern Med.	2015	mut_25	Red mullet in GSA 25	1.03		-
FAO37	Western Med.	2015	dps_1	Deep-water rose shrimp in GSA 1	0.90	o	-
FAO37	Western Med.	2015	dps_09_10_11	Deep-water rose shrimp in GSA 09, 10, 11	0.95	o	-
FAO37	Western Med.	2015	mur_9	Striped red mullet in GSA 9	0.95	o	-
FAO37	Western Med.	2015	nep_9	Norway lobster in GSA 9	1.78		-
FAO37	Western Med.	2015	nep_11	Norway lobster in GSA 11	2.07		-
FAO37	Western Med.	2015	nep_6	Norway lobster in GSA 6	9.49		-
FAO37	Western Med.	2015	ane_6	European anchovy in GSA 6	1.17		-
FAO37	Western Med.	2015	pil_6	Sardine in GSA 6	1.73		-
FAO37	Western Med.	2015	ane_09_10_11	European anchovy in GSA 09, 10, 11	2.04		-
FAO37	Western Med.	2015	hom_09_10_11	Atlantic horse mackerel in GSA 09, 10, 11	3.78		-
FAO37	Western Med.	2015	ars_9	Giant red shrimp in GSA 9	0.78	o	-

Region	EcoRegion	Year	Stock	Description	F ind	F status	SBL
FAO37	Western Med.	2015	ara_5	Blue and red shrimp in GSA 5	1.01		-
FAO37	Western Med.	2015	ara_6	Blue and red shrimp in GSA 6	2.43		-
FAO37	Western Med.	2015	ara_9	Blue and red shrimp in GSA 9	0.84	o	-
FAO37	Western Med.	2015	mut_6	Red mullet in GSA 6	1.56		-
FAO37	Western Med.	2015	mut_7	Red mullet in GSA 7	2.26		-
FAO37	Western Med.	2015	mur_5	Striped red mullet in GSA 5	3.51		-
FAO37	Western Med.	2015	ara_1	Blue and red shrimp in GSA 1	1.92		-
FAO37	Western Med.	2014	ars_10	Giant red shrimp in GSA 10	1.40		-
FAO37	Western Med.	2014	ars_11	Giant red shrimp in GSA 11	1.60		-
FAO37	Western Med.	2014	hke_01_05_06_07	European hake in GSA 01, 05, 06, 07	2.88		-
FAO37	Western Med.	2014	hke_09_10_11	European hake in GSA 09, 10, 11	5.26		-
FAO27	Baltic Sea	2016	cod.27.22-24	Cod (*Gadus morhua*) in subdivisions 22-24. western Baltic stock (western Baltic Sea)	3.58		
FAO27	Baltic Sea	2016	her.27.20-24	Herring (*Clupea harengus*) in subdivisions 20-24. spring spawners (Skagerrak. Kattegat. and western Baltic)	1.27		
FAO27	Baltic Sea	2016	her.27.25-2932	Herring (*Clupea harengus*) in subdivisions 25-29 and 32. excluding the Gulf of Riga (central Baltic Sea)	0.92	o	o
FAO27	Baltic Sea	2016	her.27.28	Herring (*Clupea harengus*) in Subdivision 28.1 (Gulf of Riga)	1.25		o
FAO27	Baltic Sea	2016	her.27.3031	Herring (*Clupea harengus*) in subdivisions 30 and 31 (Gulf of Bothnia)	1.10		o
FAO27	Baltic Sea	2016	ple.27.21-23	Plaice (*Pleuronectes platessa*) in subdivisions 21-23 (Kattegat. Belt Seas. and the Sound)	0.76	o	o
FAO27	Baltic Sea	2016	sol.27.20-24	Sole (*Solea solea*) in subdivisions 20-24 (Skagerrak and Kattegat. western Baltic Sea)	0.75	o	
FAO27	Baltic Sea	2016	spr.27.22-32	Sprat (*Sprattus sprattus*) in subdivisions 22-32 (Baltic Sea)	0.86	o	o
FAO27	BoBiscay & Iberia	2016	ane.27.8	Anchovy (*Engraulis encrasicolus*) in Subarea 8 (Bay of Biscay)	-	o	-
FAO27	BoBiscay & Iberia	2016	ank.27.8c9a	Black-bellied anglerfish (*Lophius budegassa*) in divisions 8.c and 9.a (Cantabrian Sea. Atlantic Iberian waters)	0.45	o	-
FAO27	BoBiscay & Iberia	2016	hke.27.8c9a	Hake (*Merluccius merluccius*) in divisions 8.c and 9.a. Southern stock (Cantabrian Sea and Atlantic Iberian waters)	2.27		o
FAO27	BoBiscay & Iberia	2016	hom.27.9a	Horse mackerel (*Trachurus trachurus*) in Division 9.a (Atlantic Iberian waters)	0.70	o	o
FAO27	BoBiscay & Iberia	2016	ldb.27.8c9a	Four-spot megrim (*Lepidorhombus boscii*) in divisions 8.c and 9.a (southern Bay of Biscay and Atlantic Iberian waters East)	1.14		o
FAO27	BoBiscay & Iberia	2016	meg.27.7b-k8abd	Megrim (*Lepidorhombus whiffiagonis*) in divisions 7.b-k. 8.a-b. and 8.d (west and southwest of Ireland. Bay of Biscay)	1.14		o
FAO27	BoBiscay & Iberia	2016	meg.27.8c9a	Megrim (*Lepidorhombus whiffiagonis*) in divisions 8.c and 9.a (Cantabrian Sea and Atlantic Iberian waters)	1.11		o
FAO27	BoBiscay & Iberia	2016	mon.27.8c9a	White anglerfish (*Lophius piscatorius*) in divisions 8.c and 9.a (Cantabrian Sea and Atlantic Iberian waters)	0.68	o	o
FAO27	BoBiscay & Iberia	2016	sol.27.8ab	Sole (*Solea solea*) in divisions 8.a-b (northern and central Bay of Biscay)	1.10		o
FAO27	Celtic Seas	2016	cod.27.6a	Cod (*Gadus morhua*) in Division 6.a (West of Scotland)	5.65		
FAO27	Celtic Seas	2016	cod.27.7a	Cod (*Gadus morhua*) in Division 7.a (Irish Sea)	0.09	o	
FAO27	Celtic Seas	2016	cod.27.7e-k	Cod (*Gadus morhua*) in divisions 7.e-k (eastern English Channel and southern Celtic Seas)	1.24		
FAO27	Celtic Seas	2016	had.27.6b	Haddock (*Melanogrammus aeglefinus*) in Division 6.b (Rockall)	0.50	o	o
FAO27	Celtic Seas	2016	had.27.7a	Haddock (*Melanogrammus aeglefinus*) in Division 7.a (Irish Sea)	0.39	o	o
FAO27	Celtic Seas	2016	had.27.7b-k	Haddock (*Melanogrammus aeglefinus*) in divisions 7.b-k (southern Celtic Seas and English Channel)	1.69		o
FAO27	Celtic Seas	2016	her.27.6a7bc	Herring (*Clupea harengus*) in divisions 6.a and 7.b-c (West of Scotland. West of Ireland)	0.31	o	
FAO27	Celtic Seas	2016	her.27.irls	Herring (*Clupea harengus*) in divisions 7.a South of 52°30'N. 7.g-h. and 7.j-k (Irish Sea. Celtic Sea. and southwest of Ireland)	1.56		

Region	EcoRegion	Year	Stock	Description	F ind	F status	SBL
FAO27	Celtic Seas	2016	her.27.nirs	Herring (*Clupea harengus*) in Division 7.a North of 52°30′N (Irish Sea)	0.66	o	o
FAO27	Celtic Seas	2016	lez.27.4a6a	Megrim (*Lepidorhombus* spp.) in divisions 4.a and 6.a (northern North Sea. West of Scotland)	0.35	o	-
FAO27	Celtic Seas	2016	nep.fu.11	Norway lobster (*Nephrops norvegicus*) in Division 6.a. Functional Unit 11 (West of Scotland. North Minch)	0.99	o	-
FAO27	Celtic Seas	2016	nep.fu.12	Norway lobster (*Nephrops norvegicus*) in Division 6.a. Functional Unit 12 (West of Scotland. South Minch)	0.81	o	-
FAO27	Celtic Seas	2016	nep.fu.13	Norway lobster (*Nephrops norvegicus*) in Division 6.a. Functional Unit 13 (West of Scotland. the Firth of Clyde and Sound of Jura)	1.16		-
FAO27	Celtic Seas	2016	nep.fu.14	Norway lobster (*Nephrops norvegicus*) in Division 7.a. Functional Unit 14 (Irish Sea. East)	0.35	o	-
FAO27	Celtic Seas	2016	nep.fu.15	Norway lobster (*Nephrops norvegicus*) in Division 7.a. Functional Unit 15 (Irish Sea. West)	0.85	o	-
FAO27	Celtic Seas	2016	nep.fu.16	Norway lobster (*Nephrops norvegicus*) in divisions 7.b-c and 7.j-k. Functional Unit 16 (west and southwest of Ireland. Porcupine Bank)	0.90	o	-
FAO27	Celtic Seas	2016	nep.fu.17	Norway lobster (*Nephrops norvegicus*) in Division 7.b. Functional Unit 17 (west of Ireland. Aran grounds)	1.09		-
FAO27	Celtic Seas	2016	nep.fu.19	Norway lobster (*Nephrops norvegicus*) in divisions 7.a. 7.g. and 7.j. Functional Unit 19 (Irish Sea. Celtic Sea. eastern part of southwest of Ireland)	0.81	o	-
FAO27	Celtic Seas	2016	nep.fu.22	Norway lobster (*Nephrops norvegicus*) in divisions 7.g and 7.f. Functional Unit 22 (Celtic Sea. Bristol Channel)	1.78		-
FAO27	Celtic Seas	2016	ple.27.7a	Plaice (*Pleuronectes platessa*) in Division 7.a (Irish Sea)	0.29	o	o
FAO27	Celtic Seas	2016	sol.27.7fg	Sole (*Solea solea*) in divisions 7.f and 7.g (Bristol Channel. Celtic Sea)	1.35		
FAO27	Celtic Seas	2016	whg.27.7a	Whiting (*Merlangius merlangus*) in Division 7.a (Irish Sea)	2.59		
FAO27	Celtic Seas	2016	whg.27.7b-ce-k	Whiting (*Merlangius merlangus*) in divisions 7.b -c and 7.e-k (southern Celtic Seas and eastern English Channel)	0.83	o	o
FAO27	Celtic Seas	2015	sol.27.7a	Sole (*Solea solea*) in Division 7.a (Irish Sea)	0.38	o	
FAO27	Celtic Seas	2015	whg.27.6a	Whiting (*Merlangius merlangus*) in Division 6.a (West of Scotland)	0.32	o	
FAO27	Greater North Sea	2016	cod.27.47d20	Cod (*Gadus morhua*) in Subarea 4. Division 7.d. and Subdivision 20 (North Sea. eastern English Channel. Skagerrak)	1.22		
FAO27	Greater North Sea	2016	had.27.46a20	Haddock (*Melanogrammus aeglefinus*) in Subarea 4. Division 6.a. and Subdivision 20 (North Sea. West of Scotland. Skagerrak)	1.49		
FAO27	Greater North Sea	2016	her.27.3a47d	Herring (*Clupea harengus*) in Subarea 4 and divisions 3.a and 7.d. autumn spawners (North Sea. Skagerrak and Kattegat. eastern English Channel)	0.78	o	o
FAO27	Greater North Sea	2016	nep.fu.3-4	Norway lobster (*Nephrops norvegicus*) in Division 3.a. Functional units 3 and 4 (Skagerrak and Kattegat)	0.39	o	-
FAO27	Greater North Sea	2016	nep.fu.6	Norway lobster (*Nephrops norvegicus*) in Division 4.b. Functional Unit 6 (central North Sea. Farn Deeps)	1.64		-
FAO27	Greater North Sea	2016	nep.fu.7	Norway lobster (*Nephrops norvegicus*) in Division 4.a. Functional Unit 7 (northern North Sea. Fladen Ground)	0.19	o	-
FAO27	Greater North Sea	2016	nep.fu.8	Norway lobster (*Nephrops norvegicus*) in Division 4.b. Functional Unit 8 (central North Sea. Firth of Forth)	0.75	o	-
FAO27	Greater North Sea	2016	nep.fu.9	Norway lobster (*Nephrops norvegicus*) in Division 4.b. Functional Unit 9 (central North Sea. Moray Firth)	1.08		-
FAO27	Greater North Sea	2016	nop.27.3a4	Norway pout (*Trisopterus esmarkii*) in Subarea 4 and Division 3.a (North Sea. Skagerrak and Kattegat)	-		-
FAO27	Greater North Sea	2016	ple.27.420	Plaice (*Pleuronectes platessa*) in Subarea 4 (North Sea) and Subdivision 20 (Skagerrak)	0.96	o	o
FAO27	Greater North Sea	2016	ple.27.7d	Plaice (*Pleuronectes platessa*) in Division 7.d (eastern English Channel)	0.53	o	o
FAO27	Greater North Sea	2016	pok.27.3a46	Saithe (*Pollachius virens*) in subareas 4. 6 and Division 3.a (North Sea. Rockall and West of	0.78	o	o

Region	EcoRegion	Year	Stock	Description	F ind	F status	SBL
FAO27	Greater North Sea	2016	pra.27.4a20	Scotland. Skagerrak and Kattegat) Northern shrimp (*Pandalus borealis*) in Division 4.a East and Subdivision 20 (northern North Sea in the Norwegian Deep and Skagerrak)	1.03		o
FAO27	Greater North Sea	2016	san.sa.1r	Sandeel (*Ammodytes* spp.) in divisions 4.b and 4.c. Sandeel Area 1r (central and southern North Sea. Dogger Bank)	-	o	-
FAO27	Greater North Sea	2016	san.sa.2r	Sandeel (*Ammodytes* spp.) in divisions 4.b and 4.c. and Subdivision 20. Sandeel Area 2r (Skagerrak. central and southern North Sea)	-		-
FAO27	Greater North Sea	2016	san.sa.3r	Sandeel (*Ammodytes* spp.) in divisions 4.a and 4.b. and Subdivision 20. Sandeel Area 3r (Skagerrak. northern and central North Sea)	-	o	-
FAO27	Greater North Sea	2016	san.sa.4	Sandeel (*Ammodytes* spp.) in divisions 4.a and 4.b. Sandeel Area 4 (northern and central North Sea)	-	o	-
FAO27	Greater North Sea	2016	sol.27.4	Sole (*Solea solea*) in Subarea 4 (North Sea)	1.08		o
FAO27	Greater North Sea	2016	sol.27.7d	Sole (*Solea solea*) in Division 7.d (eastern English Channel)	0.90	o	o
FAO27	Greater North Sea	2016	sol.27.7e	Sole (*Solea solea*) in Division 7.e (western English Channel)	0.74	o	o
FAO27	Greater North Sea	2016	spr.27.4	Sprat (*Sprattus sprattus*) in Subarea 4 (North Sea)	-	o	-
FAO27	Greater North Sea	2016	whg.27.47d	Whiting (*Merlangius merlangus*) in Subarea 4 and Division 7.d (North Sea and Eastern English Channel)	1.63		o
FAO27	Northeast Atlantic	2016	hke.27.3a46-8abd	Hake (*Merluccius merluccius*) in subareas 4. 6. and 7. and divisions 3.a. 8.a-b. and 8.d. Northern stock (Greater North Sea. Celtic Seas. and the northern Bay of Biscay)	0.96	o	o
FAO27	Northeast Atlantic	2016	hom.27.2a4a5b6a7a-ce-k8	Horse mackerel (*Trachurus trachurus*) in Subarea 8 and divisions 2.a. 4.a. 5.b. 6.a. 7.a-c.e-k (the Northeast Atlantic)	0.83	o	
FAO27	Northeast Atlantic	2016	mac.27.nea	Mackerel (*Scomber scombrus*) in subareas 1-8 and 14 and Division 9.a (the Northeast Atlantic and adjacent waters)	1.53		o
FAO27	Northeast Atlantic	2016	whb.27.1-91214	Blue whiting (*Micromesistius poutassou*) in subareas 1-9. 12. and 14 (Northeast Atlantic and adjacent waters)	1.35		o
FAO27	Northeast Atlantic	2015	bli.27.5b67	Blue ling (*Molva dypterygia*) in subareas 6-7 and Division 5.b (Celtic Seas, English Channel, and Faroes grounds)	0.28	o	o
FAO27	Northeast Atlantic	2015	dgs.27.nea	Spurdog (*Squalus acanthias*) in Subareas 1-10, 12 and 14 (the Northeast Atlantic and adjacent waters)	0.40	o	-
FAO27	Northeast Atlantic	2015	rng.27.5b6712b	Roundnose grenadier (*Coryphaenoides rupestris*) in subareas 6-7, and in Divisions 5.b and 12.b (Celtic Seas and the English Channel, Faroes grounds, and western Hatton Bank)	0.25	o	-

6   REPORTS BY STOCK

Table 6.1 - URL links to the source reports by stock.

Stock	Assessment year	Report	Source	Area
ars_10	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208039/2015-11_STECF+15-18+-+MED+assessments+part+1_JRC98676.pdf	STECF	FAO37
ars_11	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208039/2015-11_STECF+15-18+-+MED+assessments+part+1_JRC98676.pdf	STECF	FAO37
ars_18_19	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1291370/2015-05_STECF+16-08+MED+assessments+part+2_JRC101548.pdf	STECF	FAO37
dps_1	2016		STECF	FAO37
dps_09_10_11	2016		STECF	FAO37
hke_01_05_06_07	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208039/2015-11_STECF+15-18+-+MED+assessments+part+1_JRC98676.pdf	STECF	FAO37
hke_09_10_11	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208039/2015-11_STECF+15-18+-+MED+assessments+part+1_JRC98676.pdf	STECF	FAO37
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nep_11	2016		STECF	FAO37
nep_6	2016		STECF	FAO37
ane_29	2017		STECF	FAO37
dgs_29	2017		STECF	FAO37
hmm_29	2017		STECF	FAO37
mut_29	2017		STECF	FAO37
whg_29	2017		STECF	FAO37
tur_29	2017		STECF	FAO37
spr_29	2017		STECF	FAO37
rpw_29	2017		STECF	FAO37
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sol_17	2017		STECF	FAO37
hke_19	2017		STECF	FAO37
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mts_17_18	2017		STECF	FAO37
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Stock	Assessment year	Report	Source	Area
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ara_9	2016	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/ARA_GSA_09_2015_ITA.pdf	GFCM	FAO37
hke_12_13_14_15_16	2016	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/HKE_GSA_12-16_2015_ITA_MLT_TUN.pdf	GFCM	FAO37
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mut_7	2016	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/MUT_GSA_07_2015_ESP_FRA.pdf	GFCM	FAO37
mut_25	2016	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/MUT_GSA_25_2015_CYP.pdf	GFCM	FAO37
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mut_15_16	2016	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/MUT_GSA_15-16_2015_MLT_ITA.pdf	GFCM	FAO37
mur_5	2016	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/MUR_GSA_05_2015_ESP.pdf	GFCM	FAO37
ara_1	2016	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2016/ARA_GSA_01_2015_ESP.pdf	GFCM	FAO37
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Stock	Assessment year	Report	Source	Area
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nep.fu.17	2017	http://www.ices.dk/sites/pub/Publication Reports/Advice/2017/2017/nep.fu.17.pdf	ICES	FAO27
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8 CONTACT DETAILS OF AD HOC EXPERT GROUP PARTICIPANTS

Information on EWG participant's affiliations is displayed for information only. In any case, Members of the STECF, invited experts, and JRC experts shall act independently. In the context of the STECF work, the committee members and other experts do not represent the institutions/bodies they are affiliated to in their daily jobs. STECF members and experts also declare at each meeting of the STECF and of its Expert Working Groups any specific interest which might be considered prejudicial to their independence in relation to specific items on the agenda. These declarations are displayed on the public meeting's website if experts explicitly authorized the JRC to do so in accordance with EU legislation on the protection of personnel data. For more information: http://stecf.jrc.ec.europa.eu/adm-declarations

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9   LIST OF ANNEXES

Data and code are available in https://stecf.jrc.ec.europa.eu/reports/cfp-monitoring.

ANNEX I - PROTOCOL

Protocol for the Monitoring of the Common Fisheries Policy
Version 3.0

April 24, 2018

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Contents

1 Introduction

The monitoring of the Common Fisheries Policy (CFP, Reg (EU) 1380/2013) implementation is of utmost importance for the European Union (EU), European Commission (EC) and its Directorate-General for Maritime Affairs and Fisheries (DG MARE).

The European Commission Scientific, Technical and Economic Committee for Fisheries (STECF), as the major scientific advisory body on fisheries policy to the EC, has the task of reporting on the CFP implementation through the estimation and publication of a series of indicators.

To make the process as consistent as possible, the following set of rules were developed to be used as a guiding protocol for computing the required indicators. The rules also contribute to the transparency of the process.

The protocol covers the three major elements in the process:

- Data issues: data sources, reference list of stocks, selection of stocks, etc;

- Indicators of management performance: description of the indicators, procedures for their computation and presentation format;

- Indicators of changes in advice coverage: description of the indicators, procedures for their computation and presentation format.

1.1 Scope

The monitoring of the CFP should cover all areas were fleets operate under the flag of any EU member state. However, due to limitations on data and the mitigated responsibility of the EU on management decisions on waters outside the EU EEZ (Exclusive Economic Zone), the analysis will mainly focus on stocks within the EU EEZ in the FAO areas 27 (NEA: Northeast Atlantic and Adjacent Seas) and 37 (MED: Mediterranean and Black Sea).

The analysis will have two perspectives, at the global EU level and a regional overview where the indicators are computed for the following regions, if enough data is available:

- Baltic Sea (NEA)

- Greater North Sea (NEA)

- Celtic Sea (NEA)

- Bay of Biscay and Iberian Waters (NEA)

- Widely distributed stocks (NEA)

- Western Mediterranean (MED)

- Eastern Mediterranean (MED)

- Central Mediterranean (MED)

- Black Sea (MED)

1.2 Definitions

- f represents fishing mortality;

- b represents biomass, either as total stock biomass or spawning stock biomass (SSB);

- k represents a standardized biomass index, which is considered by experts to represent the evolution of biomass over time;

- r represents recruitment (young individuals entering the fishery) in number of individuals;

- F_{MSY} represents fishing mortality that produces catches at the level of MSY in an equilibrium situation, or a proxy;

- F_{PA} is the precautionary reference point for fishing mortality;

- B_{MSY} is the biomass expected to produce MSY when fished at F_{MSY} in an equilibrium situation, but also any other relevant proxy considered by the scientific advice body;

- B_{PA} is the precautionary reference point for spawning stock biomass;

- indices:

  - $j = 1 \ldots N$ indexes stocks, where N is the total number of stocks selected for the analysis;
  - $t = 1 \ldots T$ indexes years, where T is the number of years in the reported time series;
  - $m = 1 \ldots M$ indexes sampling units, where M is the total number of stocks in the reference list;
  - $s = 1 \ldots S$ indexes bootstrap simulations;

- operations:

  - $\vee$ stands for *or* in Boolean logic;
  - $\wedge$ stands for *and* in Boolean logic;

- model parameters:

  - u is a random effect;
  - y is a fixed effect on year.

2 Data

2.1 Data sources

All indicators are computed using results from single species quantitative stock assessments. Time series of estimates of fishing mortality, spawning stock biomass, and the adopted biological reference points for each stock are to be provided by the International Council for the Exploration of the Sea (ICES), the General Fisheries Commission for the Mediterranean (GFCM) and STECF.

Results from surplus production models and delay-difference models, which are mostly reported as ratios between F and F_{MSY} and/or B over B_{MSY}, are also included in the analysis.

Results from pseudo-cohort analysis and similar methods are not included. These models do not estimate time series of fishing mortality or spawning stock biomass.

Results from methods that directly estimate total abundance and/or harvest rate may be used for the computation of some indicators.

2.2 Reference list of stocks

The list of stocks to be used for computing indicators, hereafter termed the *reference list*, is used to stabilize the basis on which the indicators are computed. It assures that the relevant stocks are considered and constitutes the base for computing the scientific coverage of the advise. The reference list must include at least those stocks that are subject to direct management from the EU, as changes in their status can be linked more clearly to the implementation of the CFP.

Because of the differences in the nature and availability of data and information in different regions, region-specific reference lists were adopted for the EU waters:

- Northeast Atlantic (FAO area 27): The list of stocks comprises all stocks subject to management by Total Allowable Catch (TAC) limits.

- Mediterranean and Black Seas (FAO area 37): the list of stocks[1] comprises all stocks of the species

    - anchovy (*Engraulis encrasicolus*)
    - blackbellied angler (*Lophius budegassa*)
    - blue and red shrimp (*Aristeus antennatus*)
    - giant red shrimp (*Aristaeomorpha foliacea*)
    - deep-water rose shrimp (*Parapenaeus longirostriss*)
    - hake (*Merluccius merluccius*)
    - striped red mullet (*Mullus surmuletus*)
    - red mullet (*Mullus barbatus*)
    - Norway lobster (*Nephrops norvegicus*)
    - sardine (*Sardina pilchardus*)
    - common sole (*Solea solea*)
    - sprat (*Sprattus sprattus*)
    - turbot (*Psetta maxima*)
    - blue whiting (*Micromesistius poutassou*)
    - whiting (*Merlangius merlangus*)

    plus the stocks ranked in the top ten in either landings or reported economic value over the 2012-2014 period.

2.3   Selection of stock assessments

- The stock assessments to be selected include all stock assessments carried out in the three years before the analysis, are listed in the reference list and have at least 5 years of estimates.

- Exploratory assessments or assessments not yet approved by the advisory bodies are not considered;

- When several stocks are merged in a single stock only the aggregated stock is considered, the reference list must be updated accordingly;

- When a stock is split in two (or more) stocks only the disaggregated stocks are considered, the reference list must be updated accordingly;

- If two assessments for the same stock exist the most recent one is kept.

- if two assessments in the same year for the same stock exist the one from the relevant RFMO is kept.

Selected stocks of which the stock assessment results don't cover the recent period of evaluation, the most recent estimates available will be expanded up to the last year of the analysis.

3   Indicators of management performance

The indicators employed to monitor the performance of the CFP management regime reflect the evolution of:

1. exploitation levels
   by comparing fishing mortality F with the target level F_{MSY};

2. conservation status
   by comparing fishing mortality F and spawning stock biomass SSB with the precautionary levels of fishing mortality and biomass, F_{PA} and B_{PA}, respectively;

---

[1]To be discussed and agreed with the Med members

3. biomass levels
  by comparing spawning stock biomass SSB with the target level B_{MSY}.

A group of indicators, hereafter referred to as *model based*, are computed with a Generalized Linear Mixed Model (GLMM), using *stock* as a random effect, *year* as a fixed effect, and a Gamma distribution with a *log* link. The indicator is the model prediction of the *year* effect, and the indicator's uncertainty is computed with a block bootstrap procedure using *stock* as blocks. This model was tested in a simulation study[2] and in an application to Mediterranean stocks[3].

3.1 Number of stocks where fishing mortality exceeds F_{MSY}

$$I_t = \sum_{j=1}^{j=N}(f_{jt} > F_{MSY})$$

3.2 Number of stocks where fishing mortality is equal to or less than F_{MSY}

$$I_t = \sum_{j=1}^{j=N}(f_{jt} \leq F_{MSY})$$

3.3 Number of stocks outside safe biological limits

$$I_t = \sum_{j=1}^{j=N}(f_{jt} > F_{PA} \vee b_{jt} < B_{PA})$$

3.4 Number of stocks inside safe biological limits

$$I_t = \sum_{j=1}^{j=N}(f_{jt} \leq F_{PA} \wedge b_{jt} \geq B_{PA})$$

3.5 Number of stocks where F is above F_{MSY} or SSB is below B_{MSY}

$$I_t = \sum_{j=1}^{j=N}(f_{jt} > F_{MSY} \vee b_{jt} < B_{MSY})$$

where in FAO 27

$$B_{MSY} = MSYB_{trigger}$$

3.6 Number of stocks where F is below or equal to F_{MSY} and SSB is above or equal to B_{MSY}

$$I_t = \sum_{j=1}^{j=N}(f_{jt} \leq F_{MSY} \wedge b_{jt} \geq B_{MSY})$$

where in FAO 27

$$B_{MSY} = MSYB_{trigger}$$

---

[2]Minto, C. 2015. Testing model based indicators for monitoring the CFP performance. Ad-hoc contract report, pp 14.
[3]Chato-Osio, G., Jardim, E., Minto, C., Scott, F. and Patterson, K. 2015. Model based CFP indicators, F/F_{MSY} and SSB. Mediterranean region case study. JRC Technical Report No XX, pp 26.

3.7 Trend in F/F_{MSY}

For these indicators stocks managed under escapement strategies and stocks for which fishing mortality was reported as a harvest rate are not included.

$$I_t = y_t$$

$$z_{jt} = \beta_0 + y_t + u_j$$

where

$$z_{jt} = \log E[\frac{f_{jt}}{F_{MSY}}]$$

and

$$\frac{f_{jt}}{F_{MSY}} \sim Gamma(\alpha, \beta)$$

3.8 Trend in SSB

For this indicator stocks for which biomass was reported as a relative value or total abundance are not included. This indicator is scaled to the 2003 estimate for presentational purposes.

$$I_t = \exp(y_{ts} - S^{-1} \sum_{s=1}^{s=S} y_{2003,s})$$

$$z_{jt} = \beta_0 + y_t + u_j$$

where

$$z_{jt} = \log E[b_{jt}]$$

and

$$b_{jt} \sim Gamma(\alpha, \beta)$$

3.9 Trend in B/B_{PA}

$$I_t = y_t$$

$$z_{jt} = \beta_0 + y_t + u_j$$

where

$$z_{jt} = \log E[\frac{b_{jt}}{B_{PA}}]$$

and

$$\frac{b_{jt}}{B_{PA}} \sim Gamma(\alpha, \beta)$$

3.10 Trend in recruitment

For this indicator stocks for which biomass was reported as a relative value or total abundance are not included. This indicator is scaled to the 2003 estimate for presentational purposes.

$$I_t = \exp(y_{ts} - S^{-1} \sum_{s=1}^{s=S} y_{2003,s})$$

$$z_{jt} = \beta_0 + y_t + u_j$$

where

$$z_{jt} = \log E[r_{jt}]$$

and

$$r_{jt} \sim Gamma(\alpha, \beta)$$

3.11 Trend in biomass

This indicator uses biomass trends extracted from SSB estimates for category 1 and 2 stocks, together with biomass indices published by ICES for stocks of category 3.

$$I_t = y_t$$

$$z_{jt} = \beta_0 + y_t + u_j$$

where

$$z_{jt} = \log E[k_{jt}]$$

and

$$k_{jt} \sim Gamma(\alpha, \beta)$$

3.12 Trend in biomass for data limited stocks

This indicator uses biomass indices computed from scientific surveys or CPUE (catch per unit of effort) considered by experts to represent the evolution of biomass in time. The data is build from the list of biomass indices published by ICES for data limited stocks category 3.

The indicator is calculated on a model-based form only,

$$I_t = y_t$$

$$z_{jt} = \beta_0 + y_t + u_j$$

where

$$z_{jt} = \log E[k_{jt}]$$

and

$$k_{jt} \sim Gamma(\alpha, \beta)$$

4 Indicators of changes in advice coverage

These indicators are computed for the last year of the analysis only.

4.1 Number of stocks for which estimates of F_{MSY} exist

$$I = \sum_{j=1}^{j=N} (x_j = \lambda)$$

$$\lambda = \begin{cases} x = 1 & F_{MSY} \, exists \\ x = 0 & otherwise \end{cases}$$

4.2 Number of stocks for which estimates of B_{PA} exist

$$I = \sum_{j=1}^{j=N} (x_j = \lambda)$$

$$\lambda = \begin{cases} x = 1 & B_{PA} \, exists \\ x = 0 & otherwise \end{cases}$$

4.3 Number of stocks for which estimates of B_{MSY} exist

$$I = \sum_{j=1}^{j=N} (x_j = \lambda)$$

$$\lambda = \begin{cases} x = 1 & B_{MSY} \, exists \\ x = 0 & otherwise \end{cases}$$

4.4 Fraction of TACs covered by stock assessments

This indicator considers that a sampling frame unit is covered by a stock assessment if there is at least a partial overlap between its spatial distribution and the spatial distribution of the stock.

$$I = M^{-1} \sum_{m=1}^{m=M} (x_m = \lambda)$$

$$\lambda = \begin{cases} x = 1 & spatial \, overlap \, exists \\ x = 0 & otherwise \end{cases}$$

5 Transparency

Changes or additions to this protocol shall be approved by STECF.

To promote transparency of scientific advice and allow the public in general, and stakeholders in particular, to have access to the data and analysis carried out, all code and data part of this analysis must be published online once approved by the STECF plenary.

ANNEX II - CODE

```
###################################################################
# EJ(20170302)
# NEA indicators
###################################################################

library(reshape2)
library(ggplot2)
library(lme4)
library(influence.ME)
library(lattice)
library(parallel)
library(rgdal)
library(reshape2)
library(plyr)
source("funs.R")

#===============================================================
# Setup
#===============================================================

# year when assessments were performed
assessmentYear <- 2017
# final data year with estimations from stock assessments
fnlYear <- assessmentYear - 1
# initial data year with estimations from stock assessments
iniYear <- 2003
# vector of years
dy <- iniYear:fnlYear
# vector of years for valid assessments
vay <- (assessmentYear-2):assessmentYear
# vector of years for stock status projection
vpy <- (fnlYear-2):fnlYear
# options for reading data
options(stringsAsFactors=FALSE)
# number of simulations for mle bootstrap
it <- 500
# number of cores for mle bootstrap parallel
nc <- 6
# quantiles to be computed
qtl <- c(0.025, 0.25, 0.50, 0.75, 0.975)
# to control de seed in mclapply
RNGkind("L'Ecuyer-CMRG")
set.seed(1234)
# to make plots consistent
vp <- dy
vp[c(2,3,5,6,8,9,11,12,13)] <- ""
theme_set(theme_bw())
sc <- scale_x_continuous(breaks=dy, labels=as.character(vp))
th <- theme(axis.text.x  = element_text(angle=90, vjust=0.5), panel.grid.minor =
element_blank())

#===============================================================
# load & pre-process
#===============================================================

#---------------------------------------------------------------
# assessments
#---------------------------------------------------------------
isa <- read.csv("../data/ices/Dataset.csv", stringsAsFactors=FALSE)
# extract the main ecoregion but keep the list
er <- strsplit(isa[,"EcoRegion"], ",")
isa$EcoRegionList <- isa$EcoRegion
isa$EcoRegion <- unlist(lapply(er, function(x) x[1]))
er <- strsplit(isa[,"EcoRegion"], " ")
isa$EcoRegion <- unlist(lapply(er, function(x) paste(x[-length(x)], collapse=" ")))
isa[isa$EcoRegion=="Bay of Biscay and the Iberian Coast", "EcoRegion"] <- "BoBiscay &
Iberia"

# widely distributed to keep coherent with previous years (taken from 2017's files)
isa[isa$OldFishStock %in% c("arg-rest", "bli-5b67", "boc-nea", "bsf-nea", "dgs-nea",
"gfb-comb", "her-noss", "hke-nrtn", "hom-west", "lin-oth", "mac-nea", "rng-5b67", "smn-
dp", "trk-nea", "usk-oth", "whb-comb"), "EcoRegion"] <- "Northeast Atlantic"

# fix codes for stock size and fishing mortality
# f
isa[isa$FishingPressureDescription %in% c("Fishing Pressure: F"),
"FishingPressureDescription"] <- "F"
isa[isa$FishingPressureDescription %in% c("Harvest Rate", "Harvest rate"),
```

```
     "FishingPressureDescription"] <- "HR"

75   # biomass
     isa[isa$StockSizeDescription %in% c("TSB/Bmsy"), "StockSizeDescription"] <- "B/Bmsy"

     # order by year
     isa <- isa[order(isa$Year),]
80
     # reporting stk by data category
     stBydc <- unique(subset(isa, Year %in% vpy)[,c("FishStock", "DataCategory",
     "EcoRegion")])
     stBydc <- transform(stBydc, cat=as.integer(DataCategory))
     write.csv(table(stBydc[,c("EcoRegion","cat")]), file="stBydc.csv")
85
     #----------------------------------------------------------------------
     # ICES rectangles data
     #----------------------------------------------------------------------

90   rectangles <- readOGR("../data/ices_areas", layer=
     "ICES_StatRec_map_Areas_Full_20170124")
     rectangles <- rectangles@data[,c("Area_27", "AreasList", "ICESNAME")]
     colnames(rectangles) <- c("Max_Area","Area_List", "Rectangle")
     rectangles <- subset(rectangles, !is.na(Max_Area))
     # A new column is added based on Max_Area so that it is comparable across the other
     data sets
95   rectangles$Area <- paste("27.",toupper(as.character(rectangles$Max_Area)),sep="")
     # Check that each rectangle is unique and only appears once in the data
     # i.e. each rectangle is uniquely assigned to one area
     length(unique(rectangles$Rectangle)) == nrow(rectangles)


100  #----------------------------------------------------------------------
     # sampling frame (TACs)
     #----------------------------------------------------------------------

     load("../data/ices/sframe.RData")
105  # fmz is the frame of all TACs
     # For consistency
     colnames(fmz)[colnames(fmz) == "area"] <- "Area"
     colnames(fmz)[colnames(fmz) == "spp"] <- "Species"
     colnames(fmz)[colnames(fmz) == "stock_id"] <- "TAC_id"
110  sframe <- subset(fmz, TAC_id %in% sframe_TAC)

     # Each ICES area should only appear once for each FMZ stock (to prevent the appearance
     of duplicate rectangles when merging with the ICES rectangle data later). We check this
     here:

     unarea <- daply(sframe, .(TAC_id), function(x){
115      return(length(unique(x$Area))==nrow(x))
     })
     all(unarea)


     #======================================================================
120  # Stocks to retain
     # matches sampling frame and ICES assessments through ICES rectangles
     #======================================================================

     #----------------------------------------------------------------------
125  # subset assessments and ecoregions, add areas
     #----------------------------------------------------------------------

     # remove 3+
     cols <- c("FishStock","ICES.Areas..splited.with.character....." , "SpeciesName",
     "SGName", "DataCategory", "EcoRegion")
130  isa12 <- isa[isa$DataCategory<3, cols]
     colnames(isa12)[colnames(isa12) == "ICES.Areas..splited.with.character....."] <- "Areas"
     # Drop duplicates
     isa12 <- unique(isa12)
     # Remove white space and any capital letters from assessment name
135  isa12[,"FishStock"] <- tolower(gsub("\\s", "", isa12[,"FishStock"]))
     # Make a species column from the assessment name
     spp <- strsplit(isa12[,"FishStock"], "\\.")
     isa12$Species <- toupper(unlist(lapply(spp, function(x) x[1])))
     # Split ICES area by ~
140  areas <- strsplit(isa12[,"Areas"], "~")
     names(areas) <- isa12[,"FishStock"]
     areas <- melt(areas)
     colnames(areas) <- c("Area","FishStock")
     isa12 <- merge(isa12, areas)
```

```r
145     # keep relevant columns only
        isa12 <- isa12[,c("FishStock","Area", "Species", "SpeciesName", "SGName",
        "DataCategory", "EcoRegion")]
        isa12[,"Area"] <- toupper(gsub("\\s", "", isa12[,"Area"]))
        # remove ecoregions outside EU waters
        isa12 <- subset(isa12, !(EcoRegion %in% c("Arctic Ocean", "Greenland Sea", "Faroes",
        "Iceland Sea")))
150     # drop if ecoregion is NA
        isa12 <- subset(isa12, !is.na(EcoRegion))
        # remove her-noss which is widely distributed but mainly norway
        isa12 <- subset(isa12, FishStock!="her.27.1-24a514a")

155     #-------------------------------------------------------------------
        # fix area codes
        #-------------------------------------------------------------------

        # fix Baltic area codes
160     rectangles[rectangles$Area == "27.3.A.20","Area"] <- "27.3.A"
        rectangles[rectangles$Area == "27.3.A.21","Area"] <- "27.3.A"
        rectangles[rectangles$Area == "27.3.B.23","Area"] <- "27.3.B"
        rectangles[rectangles$Area == "27.3.C.22","Area"] <- "27.3.C"

165     isa12[isa12$Area == "27.3.A.20","Area"] <- "27.3.A"
        isa12[isa12$Area == "27.3.A.21","Area"] <- "27.3.A"
        isa12[isa12$Area == "27.3.B.23","Area"] <- "27.3.B"
        isa12[isa12$Area == "27.3.C.22","Area"] <- "27.3.C"

170     sframe[sframe$Area == "27.3.20","Area"] <- "27.3.A"
        sframe[sframe$Area == "27.3.21","Area"] <- "27.3.A"
        sframe[sframe$Area == "27.3.23","Area"] <- "27.3.B"
        sframe[sframe$Area == "27.3.22","Area"] <- "27.3.C"

175     # Check: shouldn't have any 24.x.x areas
        # Areas in ICES assessment but missing in rectangles
        unique(isa12$Area)[!(unique(isa12$Area) %in% unique(rectangles$Area))]
        # Areas in FMZ but missing in rectangles
        unique(sframe$Area)[!(unique(sframe$Area) %in% unique(rectangles$Area))]
180
        #-------------------------------------------------------------------
        # fix species codes
        #-------------------------------------------------------------------

185     # Horse mackerel
        isa12[isa12$Species=="HOM","Species"] <- "JAX"
        # ANK & MON - Anglerfish - species to genus
        isa12[isa12$Species=="ANK","Species"] <- "ANF"
        isa12[isa12$Species=="MON","Species"] <- "ANF"
190     # Megrim - species and genus to genus
        isa12[isa12$Species=="MEG","Species"] <- "LEZ"
        isa12[isa12$Species=="LDB","Species"] <- "LEZ"
        # rays
        isa12[isa12$Species=="RNG","Species"] <- "RTX"
195     # missing species
        sort(unique(isa12$Species)[!(unique(isa12$Species) %in% unique(sframe$Species))])

        #-------------------------------------------------------------------
        # merge assessments,tacs/sf and rectangles
200     #-------------------------------------------------------------------

        # merge assessments with rectangles
        isa12r <- merge(isa12, rectangles[,c("Area","Rectangle")], by="Area")

205     # Do we have all the assessments?
        all(sort(unique(isa12$FishStock)) == sort(unique(isa12r$FishStock)))

        # Merge sampling frame with rectangles
        sfr <- merge(sframe, rectangles[,c("Area","Rectangle")], by="Area")
210
        # Do we have all the TACs?
        all(sort(unique(sframe$TAC_id)) == sort(unique(sfr$TAC_id)))

        # merge assessments with sampling frame
215     isa12sf <- merge(sfr, isa12r[,c("Species","Rectangle","FishStock","DataCategory")], by=c
        ("Species","Rectangle"), all.x = TRUE)

        #-------------------------------------------------------------------
        # final stock list
        #-------------------------------------------------------------------
```

```
220
        # remove stocks with short time series
        sts <- subset(isa, Year %in% dy & !is.na(FishingPressure))$FishStock
        # remove short time series
        sts <- table(sts)
225     sts <- names(sts)[sts<5]

        # stocks to retain
        stkToRetain <- unique(isa12sf$FishStock)[-1]
        stkToRetain <- stkToRetain[!(stkToRetain %in% sts)]
230
        #-------------------------------------------------------------------
        # subset assessments
        #-------------------------------------------------------------------
        # filtering
235     saeu <- subset(isa, FishStock %in% stkToRetain)

        # reporting
        stkToDrop <- unique(isa[!(isa$FishStock %in% stkToRetain), c("FishStock", "EcoRegion",
        "DataCategory")])
        write.csv(stkToDrop, file="stkToDropBySampFrame-nea.csv")
240     stkToRetain <- unique(isa[isa$FishStock %in% stkToRetain, c("FishStock", "EcoRegion",
        "DataCategory")])
        write.csv(stkToRetain, file="stkToRetainBySampFrame-nea.csv")

        # check what's available
        table(saeu[,c("FishingPressureDescription","StockSizeDescription")])
245
        #===================================================================
        # process data for indicators
        #===================================================================

250     #-------------------------------------------------------------------
        # fixing BMSYescapment not reported by ICES
        #-------------------------------------------------------------------
        saeu$MSYBescapement <- NA

255     # NOP 34
        saeu[saeu$FishStock == "nop.27.3a4", c("StockSize", "MSYBescapement")] <- saeu[saeu
        $FishStock == "nop.27.3a4", c("Low_StockSize", "Blim")]

        # ANE BISC - need to add value from ss, using upper trigger as proxy for MSYBescapement
        saeu[saeu$FishStock == "ane.27.8", "MSYBescapement"] <- 89000
260
        # acording to the sumsheets SAN and SPR-NSEA use Bpa for MSYBescapement
        saeu[saeu$FishStock %in% c
        ("san.sa.1r","san.sa.2r","san.sa.3r","san.sa.4","spr.27.4"),"MSYBescapement"] <- saeu
        [saeu$FishStock %in% c("san.sa.1r","san.sa.2r","san.sa.3r","san.sa.4","spr.27.4"),"Bpa"]

        #-------------------------------------------------------------------
265     # fixing Recruitments of 0
        #-------------------------------------------------------------------
        saeu[saeu$Recruitment==0 & !is.na(saeu$Recruitment),"Recruitment"] <- NA

        #-------------------------------------------------------------------
270     # Bref
        #-------------------------------------------------------------------
        saeu$Bref <- saeu$MSYBtrigger
        # B escapement as Bref for relevant stocks
        saeu$Bref[!is.na(saeu$MSYBescapement)] <- saeu$MSYBescapement[!is.na(saeu
        $MSYBescapement)]
275     saeu$Bref <- as.numeric(saeu$Bref)
        # set 0 as NA
        saeu$Bref[saeu$Bref==0] <- NA
        # if relative Bref = 1
        saeu[saeu$StockSizeDescription == "B/Bmsy", "Bref"] <- 1
280
        saeu$Brefpa <- saeu$Bpa
        # B escapement as Brefpa for relevant stocks (already in Bpa)
        #saeu$Brefpa[!is.na(saeu$MSYBescapement)] <- saeu$MSYBescapement[!is.na(saeu
        $MSYBescapement)]
        #saeu$Brefpa <- as.numeric(saeu$Brefpa)
285     # set 0 as NA
        saeu$Brefpa[saeu$Brefpa==0] <- NA
        # if relative Brefpa = 0.5
        saeu[saeu$StockSizeDescription == "B/Bmsy", "Brefpa"] <- 0.5

290     #-------------------------------------------------------------------
```

```r
# Fref
#---------------------------------------------------------------------
saeu$Fref <- saeu$FMSY
# no Fref for B escapement
saeu$Fref[!is.na(saeu$MSYBescapement)] <- NA
saeu$Fref <- as.numeric(saeu$Fref)
# set 0 as NA
saeu$Fref[saeu$Fref==0] <- NA
# if relative Fmsy must be 1
saeu[saeu$FishingPressureDescription %in% c("F/Fmsy", "HR/HRmsy"), "Fref"] <- 1

saeu$Frefpa <- saeu$Fpa
# no Fref for B escapement
saeu$Frefpa[!is.na(saeu$MSYBescapement)] <- NA
saeu$Frefpa <- as.numeric(saeu$Frefpa)
# set 0 as NA
saeu$Frefpa[saeu$Frefpa==0] <- NA
# if relative Fparef must be NA
saeu[saeu$FishingPressureDescription %in% c("F/Fmsy", "HR/HRmsy"), "Frefpa"] <- NA

#---------------------------------------------------------------
# COMPUTE F/Fref and B/Bref | year + stock
#---------------------------------------------------------------
saeu <- transform(saeu,
    indF = FishingPressure/Fref,
    indB=StockSize/Bref,
    indBpa=StockSize/Brefpa,
    indFpa = FishingPressure/Frefpa)

# in case of escapement strategy MSY evaluated by SSB ~ Bref
saeu$indF[!is.na(saeu$MSYBescapement)] <- saeu$Bref[!is.na(saeu$MSYBescapement)]/saeu
$StockSize[!is.na(saeu$MSYBescapement)]
saeu <- transform(saeu, sfFind=!is.na(indF))

#---------------------------------------------------------------
# COMPUTE SBL | year + FishStock
#---------------------------------------------------------------
saeu$SBL <- !(saeu$indFpa > 1 | saeu$indBpa < 1)
# if one is NA SBL can't be inferred
saeu$SBL[is.na(saeu$indFpa) | is.na(saeu$indBpa)] <- NA
# no SBL for B escapement
saeu$SBL[!is.na(saeu$MSYBescapement)] <- NA
saeu <- transform(saeu, sfSBL=!is.na(SBL))

#---------------------------------------------------------------
# COMPUTE CFP objectives | year + FishStock
#---------------------------------------------------------------
saeu$CFP <- !(saeu$indF > 1 | saeu$indB < 1)
# if one is NA CFP can't be inferred
saeu$CFP[is.na(saeu$indF) | is.na(saeu$indB)] <- NA
# no CFP for B escapement
saeu$CFP[!is.na(saeu$MSYBescapement)] <- NA
saeu <- transform(saeu, sfCFP=!is.na(CFP))

#---------------------------------------------------------------
# final dataset
#---------------------------------------------------------------
saeu <- subset(saeu, Year>=iniYear & Year <=fnlYear & AssessmentYear %in% vay & sfFind)

#---------------------------------------------------------------
# project stock status up to last year in cases missing
#---------------------------------------------------------------

saeu <- projectStkStatus(saeu, vpy)

#===============================================================
# Indicators (design based)
#===============================================================

#---------------------------------------------------------------
# Number of stocks (remove projected years)
#---------------------------------------------------------------
df0 <- saeu[!saeu$projected,]
inStks <- getNoStks(df0, "FishStock", length)

png("figNEAI0a.png", 1800, 1200, res=300)
ggplot(subset(inStks, EcoRegion=="ALL"), aes(x=Year, y=N)) +
    geom_line() +
```

```r
            ylab("No. of stocks") +
            xlab("") +
370         ylim(c(0,75)) +
            sc +
            th
      dev.off()

375   # time series
      # NEEDS CHECK, YAXIS IS NOT REVERSED
      png("figNEAI0b.png", 3000, 4500, res=300, bg = "transparent")
      ggplot(df0, aes(Year, FishStock)) +
            geom_line() +
380     geom_point(data=aggregate(df0$Year, by=list(FishStock=df0$FishStock), max),
            aes(x, FishStock))+
            geom_line(data=data.frame(Year=2009:2013, FishStock="nep.fu.14"), color="white") +
            geom_line(data=data.frame(Year=2007:2009, FishStock="nep.fu.13"), color="white") +
            geom_line(data=data.frame(Year=2003:2005, FishStock="nep.fu.13"), color="white") +
385         geom_point(data=data.frame(Year=2003, FishStock="nep.fu.13"), size=0.3) +
            ylab("Stock") +
            xlab("Year") +
            sc +
            scale_y_discrete(name="", limits = rev(unique(df0$FishStock))) +
390         th
      dev.off()

      # table
      write.csv(dcast(inStks, EcoRegion~Year, value.var='N'), file="tabNEAI0.csv",
      row.names=FALSE)
395
      #-------------------------------------------------------------------
      # (I1) Stocks F > Fmsy
      #-------------------------------------------------------------------
      fInda <- getNoStks(saeu, "indF", function(x) sum(x>1))
400
      # plot
      png("figNEAI1.png", 1800, 1200, res=300)
      ggplot(subset(fInda, EcoRegion=='ALL'), aes(x=Year, y=N)) +
            geom_line() +
405     expand_limits(y=0) +
            geom_point(aes(x=iniYear, y=N[1])) +
            geom_point(aes(x=fnlYear, y=N[length(N)]), size=2) +
            ylab("No. of stocks") +
            xlab("") +
410     ylim(c(0,75)) +
            sc +
            th
      dev.off()

415   # plot
      png("figNEAI1b.png", 2400, 1200, res=300)
      ggplot(subset(fInda, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
            geom_line() +
            facet_grid(.~EcoRegion) +
420     ylab("No. of stocks") +
            xlab("") +
            sc +
            ylim(0, 20) +
            th
425   dev.off()

      # table
      write.csv(dcast(fInda, EcoRegion~Year, value.var='N'), file="tabNEAI1.csv",
      row.names=FALSE)

430   #-------------------------------------------------------------------
      # (I2) Stocks F <= Fmsy
      #-------------------------------------------------------------------
      fIndb <- getNoStks(saeu, "indF", function(x) sum(x<=1))

435   # plot
      png("figNEAI2.png", 1800, 1200, res=300)
      ggplot(subset(fIndb, EcoRegion=='ALL'), aes(x=Year, y=N)) +
            geom_line() +
            expand_limits(y=0) +
440     geom_point(aes(x=iniYear, y=N[1])) +
            geom_point(aes(x=fnlYear, y=N[length(N)]), size=2) +
            ylab("No. of stocks") +
            xlab("") +
```

```r
          ylim(c(0,75)) +
445       sc +
          th
      dev.off()


      # plot
450   png("figNEAI2b.png", 2400, 1200, res=300)
      ggplot(subset(fIndb, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
          geom_line() +
          facet_grid(.~EcoRegion) +
          ylab("No. of stocks") +
455       xlab("") +
          sc +
          ylim(0, 20) +
          th
      dev.off()
460

      # table
      write.csv(dcast(fIndb, EcoRegion~Year, value.var='N'), file="tabNEAI2.csv",
      row.names=FALSE)


      #---------------------------------------------------------------------
465   # (I3) Stocks outside SBL
      #---------------------------------------------------------------------
      fIndc <- getNoStks(saeu, "SBL", function(x) sum(!x, na.rm=TRUE))

      # plot
470   png("figNEAI3.png", 1800, 1200, res=300)
      ggplot(subset(fIndc, EcoRegion=='ALL'), aes(x=Year, y=N)) +
          geom_line() +
          expand_limits(y=0) +
          geom_point(aes(x=iniYear, y=N[1])) +
475       geom_point(aes(x=fnlYear, y=N[length(N)]), size=2) +
          ylab("No. of stocks") +
          xlab("") +
          ylim(c(0,75)) +
          sc +
480       th
      dev.off()


      # plot
      png("figNEAI3b.png", 2400, 1200, res=300)
485   ggplot(subset(fIndc, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
          geom_line() +
          facet_grid(.~EcoRegion) +
          ylab("No. of stocks") +
          xlab("") +
490       sc +
          ylim(0, 15) +
          th
      dev.off()


495   # table
      write.csv(dcast(fIndc, EcoRegion~Year, value.var='N'), file="tabNEAI3.csv",
      row.names=FALSE)


      #---------------------------------------------------------------------
      # (I4) Stocks inside SBL
500   #---------------------------------------------------------------------
      fIndd <- getNoStks(saeu, "SBL", function(x) sum(x, na.rm=TRUE))

      ## plot
      png("figNEAI4.png", 1800, 1200, res=300)
505   ggplot(subset(fIndd, EcoRegion=='ALL'), aes(x=Year, y=N)) +
          geom_line() +
          expand_limits(y=0) +
          geom_point(aes(x=iniYear, y=N[1])) +
          geom_point(aes(x=fnlYear, y=N[length(N)]), size=2) +
510       ylab("No. of stocks") +
          xlab("") +
          ylim(c(0,75)) +
          sc +
          th
515   dev.off()


      # plot
      png("figNEAI4b.png", 2400, 1200, res=300)
      ggplot(subset(fIndd, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
```

```
520         geom_line() +
            facet_grid(.~EcoRegion) +
            ylab("No. of stocks") +
            xlab("") +
            sc +
525         ylim(0, 15) +
            th
        dev.off()

        # table
530     write.csv(dcast(fIndd, EcoRegion~Year, value.var='N'), file="tabNEAI4.csv",
        row.names=FALSE)

        #-------------------------------------------------------------------
        # (I5) Stocks outside CFP objectives
        #-------------------------------------------------------------------
535     fIndf <- getNoStks(saeu, "CFP", function(x) sum(!x, na.rm=TRUE))

        ## plot
        png("figNEAI5.png", 1800, 1200, res=300)
        ggplot(subset(fIndf, EcoRegion=='ALL'), aes(x=Year, y=N)) +
540         geom_line() +
            expand_limits(y=0) +
            geom_point(aes(x=iniYear, y=N[1])) +
            geom_point(aes(x=fnlYear, y=N[length(N)]), size=2) +
            ylab("No. of stocks") +
545         xlab("") +
            ylim(c(0,75)) +
            sc +
            th
        dev.off()
550
        # plot
        png("figNEAI5b.png", 2400, 1200, res=300)
        ggplot(subset(fIndf, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
            geom_line() +
555         facet_grid(.~EcoRegion) +
            ylab("No. of stocks") +
            xlab("") +
            sc +
            ylim(0, 20) +
560         th
        dev.off()

        # table
        write.csv(dcast(fIndf, EcoRegion~Year, value.var='N'), file="tabNEAI5.csv",
        row.names=FALSE)
565
        #-------------------------------------------------------------------
        # (I6) Stocks inside CFP objectives
        #-------------------------------------------------------------------
        fIndfb <- getNoStks(saeu, "CFP", function(x) sum(x, na.rm=TRUE))
570
        # plot
        png("figNEAI6.png", 1800, 1200, res=300)
        ggplot(subset(fIndfb, EcoRegion=='ALL'), aes(x=Year, y=N)) +
            geom_line() +
575         expand_limits(y=0) +
            geom_point(aes(x=iniYear, y=N[1])) +
            geom_point(aes(x=fnlYear, y=N[length(N)]), size=2) +
            ylab("No. of stocks") +
            xlab("") +
580         ylim(c(0,75)) +
            sc +
            th
        dev.off()

585     # plot
        png("figNEAI6b.png", 2400, 1200, res=300)
        ggplot(subset(fIndfb, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
            geom_line() +
            facet_grid(.~EcoRegion) +
590         ylab("No. of stocks") +
            xlab("") +
            sc +
            ylim(0, 20) +
            th
595     dev.off()
```

```r
    # table
    write.csv(dcast(fIndfb, EcoRegion~Year, value.var='N'), file="tabNEAI6.csv",
    row.names=FALSE)

    #=================================================================
    # Indicators (model based)
    #=================================================================

    #-----------------------------------------------------------------
    # (I7) F/Fmsy model
    #-----------------------------------------------------------------
    idx <- saeu$FishingPressureDescription %in% c("F", "F/Fmsy")
    saeu$sfI7 <- idx & is.na(saeu$MSYBescapement)
    df0 <- saeu[saeu$sfI7,]
    df0$Year <- factor(df0$Year)
    yrs <- levels(df0$Year)
    nd <- data.frame(Year=factor(yrs))

    # fit
    ifit <- glmer(indF ~ Year + (1|FishStock), data = df0, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
    runDiagsME(ifit, "FishStock", df0, "diagNEAI7.pdf", nc, nd)

    # bootstrap
    stk <- unique(df0$FishStock)
    ifit.bs <- split(1:it, 1:it)

    ifit.bs <- mclapply(ifit.bs, function(x){
        stk <- sample(stk, replace=TRUE)
        df1 <- df0[0,]
        for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
        fit <- glmer(indF ~ Year + (1|FishStock), data = df1, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
        v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
        if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
        v0
    }, mc.cores=nc)

    ifitm <- do.call("rbind", ifit.bs)
    ifitq <- apply(ifitm, 2, quantile, qtl, na.rm=TRUE)
    ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))

    # plot
    png("figNEAI7.png", 1800, 1200, res=300)
    ggplot(ifitq, aes(x=Year)) +
      geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
      geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
      geom_line(aes(y=`50%`)) + expand_limits(y=0) +
      geom_point(aes(x=Year[1], y=`50%`[1])) +
      geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
      geom_hline(yintercept = 1, linetype=2) +
      ylab(expression(F/F[MSY])) +
      ylim(0, 2.5) +
      xlab("") +
      theme(legend.position = "none") +
      sc +
      th
    dev.off()

    # table
    tb0 <- t(ifitq)[-1,]
    colnames(tb0) <- ifitq[,1]
    write.csv(tb0, file="tabNEAI7.csv")

    #-----------------------------------------------------------------
    # (I7b) F/Fmsy model regional
    #-----------------------------------------------------------------
    df0 <- saeu[saeu$sfI7,]
    df0$Year <- factor(df0$Year)
    yrs <- levels(df0$Year)
    nd <- data.frame(Year=factor(yrs))

    ifitRegional <- lapply(split(df0, df0$EcoRegion), function(x){
        # fit model
        ifit <- glmer(indF ~ Year + (1|FishStock), data = x, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
        # no variance with bootstrap due to small number of stocks
```

```
670        ifit.pred <- predict(ifit, re.form=~0, type="response", newdata=nd)
           # output
           list(ifit=ifit, ifit.pred=ifit.pred)
       })

675    lst0 <- lapply(ifitRegional, "[[", "ifit.pred")
       fIndfr <- data.frame(EcoRegion=rep(names(lst0), lapply(lst0, length)), N=unlist(lst0),
       Year=as.numeric(as.character(nd[,1])))

       # plot
       png("figNEAI7b.png", 2400, 1200, res=300)
680    ggplot(fIndfr, aes(x=Year, y=N)) +
           geom_line() +
           facet_grid(.~EcoRegion) +
           ylab(expression(F/F[MSY])) +
           xlab("") +
685        sc +
           ylim(0, 2.5) +
           th
       dev.off()

690    # table
       write.csv(dcast(fIndfr, EcoRegion~Year, value.var='N'), file="tabNEAI7b.csv",
       row.names=FALSE)

       #-------------------------------------------------------------------
       # (I7out) F/Fmsy stocks outside EU
695    #-------------------------------------------------------------------
       df0 <- subset(isa, (EcoRegion %in% c("Arctic Ocean", "Greenland Sea", "Faroes",
       "Iceland Sea") | FishStock=="her.27.1-24a514a") & FishStock!="pra.27.1-2" &
       Year>=iniYear & Year<=fnlYear & AssessmentYear %in% vay)
       df0$Fref <- df0$FMSY
       df0 <- transform(df0, indF = FishingPressure/Fref, sfFind=!is.na(FishingPressure/Fref))
       idx <- df0$FishingPressureDescription %in% c("F", "F/Fmsy") & df0$sfFind
700    df0 <- df0[idx,]

       # check data series is complete
       table(df0[,c("FishStock","Year")])

705    # create year variable for prediction
       df0$Year <- factor(df0$Year)
       yrs <- levels(df0$Year)
       nd <- data.frame(Year=factor(yrs))

710    # fit
       ifitout <- glmer(indF ~ Year + (1|FishStock), data = df0, family = Gamma("log"),
       control=glmerControl(optimizer="nlminbwrap"))
       runDiagsME(ifitout, "FishStock", df0, "diagNEAI7out.pdf", nc, nd)

       # bootstrap
715    stk <- unique(df0$FishStock)
       ifitout.bs <- split(1:it, 1:it)
       ifitout.bs <- mclapply(ifitout.bs, function(x){
           stk <- sample(stk, replace=TRUE)
           df1 <- df0[0,]
720        for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
           fit <- glmer(indF ~ Year + (1|FishStock), data = df1, family = Gamma("log"),
       control=glmerControl(optimizer="nlminbwrap"))
           v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
           if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
           v0
725    }, mc.cores=nc)

       ifitm <- do.call("rbind", ifitout.bs)
       ifitq <- apply(ifitm, 2, quantile, qtl, na.rm=TRUE)
       ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))
730
       # plot
       png("figNEAI7out.png", 1800, 1200, res=300)
       ggplot(ifitq, aes(x=Year)) +
         geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
735      geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
         geom_line(aes(y=`50%`)) + expand_limits(y=0) +
         geom_point(aes(x=Year[1], y=`50%`[1])) +
         geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
         ylab(expression(F/F[MSY])) +
740      geom_hline(yintercept = 1, linetype=2) +
         ylim(0, 2.5) +
```

```r
        xlab("") +
        theme(legend.position = "none") +
        sc +
        th
    dev.off()

    # table
    tb0 <- t(ifitq)[-1,]
    colnames(tb0) <- ifitq[,1]
    write.csv(tb0, file="tabNEAI7out.csv")

    #------------------------------------------------------------------
    # (I8) SSB model
    #------------------------------------------------------------------
    saeu$sfI8 <- saeu$StockSizeDescription %in% c("SSB", "TSB")
    df0 <- saeu[saeu$sfI8,]
    df0$Year <- factor(df0$Year)
    yrs <- levels(df0$Year)
    nd <- data.frame(Year=factor(yrs))

    # fit
    ifitb <- glmer(StockSize ~ Year + (1|FishStock), data = df0, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
    runDiagsME(ifitb, "FishStock", df0, "diagNEAI8.pdf", nc, nd)

    # bootstrap
    stk <- unique(df0$FishStock)
    ifitb.bs <- split(1:it, 1:it)
    ifitb.bs <- mclapply(ifitb.bs, function(x){
        stk <- sample(stk, replace=TRUE)
        df1 <- df0[0,]
        for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
        fit <- glmer(StockSize ~ Year + (1|FishStock), data = df1, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
        v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
        if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
        v0
    }, mc.cores=nc)

    ifitm <- do.call("rbind", ifitb.bs)
    ifitm <- exp(log(ifitm)-mean(log(ifitm[,1]), na.rm=TRUE))
    ifitq <- apply(ifitm, 2, quantile, qtl, na.rm=TRUE)
    ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))

    # plot
    png("figNEAI8.png", 1800, 1200, res=300)
    ggplot(ifitq, aes(x=Year)) +
        geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
        geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
        geom_line(aes(y=`50%`)) +
        expand_limits(y=0) +
        geom_point(aes(x=Year[1], y=`50%`[1])) +
        geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
        geom_hline(yintercept = 1, linetype=2) +
        ylab(expression(B/B[2003])) +
        xlab("") +
        theme(legend.position = "none") +
        sc +
        th
    dev.off()

    # table
    tb0 <- t(ifitq)[-1,]
    colnames(tb0) <- ifitq[,1]
    write.csv(tb0, file="tabNEAI8.csv")

    #------------------------------------------------------------------
    # (I8b) SSB model regional
    #------------------------------------------------------------------
    df0 <- saeu[saeu$sfI8,]
    df0$Year <- factor(df0$Year)
    yrs <- levels(df0$Year)
    nd <- data.frame(Year=factor(yrs))

    ifitbRegional <- lapply(split(df0, df0$EcoRegion), function(x){
        # fit model
        ifitb <- glmer(StockSize ~ Year + (1|FishStock), data = x, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
```

```
            # no variance with bootstrap due to small number of stocks
            ifitb.pred <- predict(ifitb, re.form=~0, type="response", newdata=nd)
            # output
820         list(ifitb=ifitb, ifitb.pred=ifitb.pred/ifitb.pred[nd==iniYear])
        })

        lst0 <- lapply(ifitbRegional, "[[", "ifitb.pred")
        fIndbr <- data.frame(EcoRegion=rep(names(lst0), lapply(lst0, length)), N=unlist(lst0),
        Year=as.numeric(as.character(nd[,1])))
825
        # plot
        png("figNEAI8b.png", 2400, 1200, res=300)
        ggplot(fIndbr, aes(x=Year, y=N)) +
            geom_line() +
830         facet_grid(.~EcoRegion) +
            geom_hline(yintercept = 1, linetype=2) +
            ylab(expression(B/B[2003])) +
            xlab("") +
            theme(legend.position = "none") +
835         sc +
            th
        dev.off()


        # table
840     write.csv(dcast(fIndbr, EcoRegion~Year, value.var='N'), file="tabNEAI8b.csv",
        row.names=FALSE)


        #--------------------------------------------------------------------
        # (I9) SSB/Bpa model
        #--------------------------------------------------------------------
845     idx <- saeu$StockSizeDescription %in% c("SSB", "TSB", "B/Bmsy")
        saeu$sfI9 <- idx & !is.na(saeu$indBpa)
        df0 <- saeu[saeu$sfI9,]
        df0$Year <- factor(df0$Year)
        yrs <- levels(df0$Year)
850     nd <- data.frame(Year=factor(yrs))

        # fit
        ifitbpa <- glmer(indBpa ~ Year + (1|FishStock), data =  df0, family = Gamma("log"),
        control=glmerControl(optimizer="nlminbwrap"))
        runDiagsME(ifitbpa, "FishStock", df0, "diagNEAI9.pdf", nc, nd)
855
        # bootstrap
        stk <- unique(df0$FishStock)
        ifitbpa.bs <- split(1:it, 1:it)
        ifitbpa.bs <- mclapply(ifitbpa.bs, function(x){
860         stk <- sample(stk, replace=TRUE)
            df1 <- df0[0,]
            for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
            fit <- glmer(indBpa ~ Year + (1|FishStock), data = df1, family = Gamma("log"),
        control=glmerControl(optimizer="nlminbwrap"))
            v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
865         if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
            v0
        }, mc.cores=nc)

        ifitm <- do.call("rbind", ifitbpa.bs)
870     ifitq <- apply(ifitm, 2, quantile, qtl, na.rm=TRUE)
        ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))

        # plot
        png("figNEAI9.png", 1800, 1200, res=300)
875     ggplot(ifitq, aes(x=Year)) +
            geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
            geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
            geom_line(aes(y=`50%`)) +
            expand_limits(y=0) +
880         geom_point(aes(x=Year[1], y=`50%`[1])) +
            geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
            geom_hline(yintercept = 1, linetype=2) +
            ylab(expression(B/B[pa])) +
            xlab("") +
885         theme(legend.position = "none") +
            sc +
            th
        dev.off()

890     # table
```

```r
    tb0 <- t(ifitq)[-1,]
    colnames(tb0) <- ifitq[,1]
    write.csv(tb0, file="tabNEAI9.csv")

    #--------------------------------------------------------------------
    # (I10) Recruitment model (same data as SSB trends)
    #--------------------------------------------------------------------
    saeu$sfI10 <- saeu$sfI8 & !is.na(saeu$Recruitment)
    df0 <- saeu[saeu$sfI10,]
    df0$Year <- factor(df0$Year)
    yrs <- levels(df0$Year)
    nd <- data.frame(Year=factor(yrs))

    # fit
    ifitr <- glmer(Recruitment ~ Year + (1|FishStock), data = df0, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
    runDiagsME(ifitr, "FishStock", df0, "diagNEAI10.pdf", nc, nd)

    # bootstrap
    stk <- unique(df0$FishStock)
    ifitr.bs <- split(1:it, 1:it)
    ifitr.bs <- mclapply(ifitr.bs, function(x){
        stk <- sample(stk, replace=TRUE)
        df1 <- df0[0,]
        for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
        fit <- glmer(Recruitment ~ Year + (1|FishStock), data = df1, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
        v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
        if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
        v0
    }, mc.cores=nc)

    ifitm <- do.call("rbind", ifitr.bs)
    ifitm <- exp(log(ifitm)-mean(log(ifitm[,1]), na.rm=TRUE))
    ifitq <- apply(ifitm, 2, quantile, qtl, na.rm=TRUE)
    ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))

    # plot
    png("figNEAI10.png", 1800, 1200, res=300)
    ggplot(ifitq, aes(x=Year)) +
      geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
      geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
      geom_line(aes(y=`50%`)) +
      expand_limits(y=0) +
      geom_point(aes(x=Year[1], y=`50%`[1])) +
      geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
      geom_hline(yintercept = 1, linetype=2) +
      ylab(expression(R/R[2003])) +
      xlab("") +
      theme(legend.position = "none") +
      sc +
      th
    dev.off()

    # table
    tb0 <- t(ifitq)[-1,]
    colnames(tb0) <- ifitq[,1]
    write.csv(tb0, file="tabNEAI10.csv")

    #--------------------------------------------------------------------
    # (I11) SSB model for cat 1-3
    #--------------------------------------------------------------------
    df0 <- subset(isa, !(EcoRegion %in% c("Arctic Ocean", "Greenland Sea", "Faroes",
    "Iceland Sea")) & DataCategory<4 & StockSize>0 & Year>=iniYear & Year <= fnlYear &
    AssessmentYear %in% vay & StockSizeDescription %in% c("Biomass Index", "SSB", "TSB",
    "Relative BI (comb)", "B/Bmsy", "Relative SSB", "standardized CPUE", "Relative BI",
    "Biomass Index (comb)", "LPUE"))

    # remove stocks with short time series
    sts <- table(df0$FishStock, df0$Year)
    sts <- rownames(sts)[apply(sts, 1, sum)<5]
    df0 <- subset(df0, !(FishStock %in% sts))

    # id
    sfI11 <- tapply(df0$Year, df0$FishStock, max)
    sfI11 <- data.frame(FishStock=names(sfI11), Year=sfI11, variable="sfI11", value=TRUE)

    # project for stocks without 2015, 2016 estimates
```

```
        df0 <- projectStkStatus(df0, vpy)

965     # pre process for model
        df0$Year <- factor(df0$Year)
        yrs <- levels(df0$Year)
        nd <- data.frame(Year=factor(yrs))

970     # fit
        ifitb123 <- glmer(StockSize ~ Year + (1|FishStock), data =  df0, family = Gamma("log"),
        control=glmerControl(optimizer="nlminbwrap"))
        runDiagsME(ifitb123, "FishStock", df0, "diagNEAI11.pdf", nc, nd)

        # bootstrap
975     stk <- unique(df0$FishStock)
        ifitb123.bs <- split(1:it, 1:it)
        ifitb123.bs <- mclapply(ifitb123.bs, function(x){
            stk <- sample(stk, replace=TRUE)
            df1 <- df0[0,]
980         for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
            fit <- glmer(StockSize ~ Year + (1|FishStock), data = df1, family = Gamma("log"),
        control=glmerControl(optimizer="nlminbwrap"))
            v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
            if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
            v0
985     }, mc.cores=nc)

        ifitm <- do.call("rbind", ifitb123.bs)
        ifitm <- exp(log(ifitm)-mean(log(ifitm[,1]), na.rm=TRUE))
        ifitq <- apply(ifitm, 2, quantile, qtl, na.rm=TRUE)
990     ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))

        # plot
        png("figNEAI11.png", 1800, 1200, res=300)
        ggplot(ifitq, aes(x=Year)) +
995       geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
          geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
          geom_line(aes(y=`50%`)) +
          expand_limits(y=0) +
          geom_point(aes(x=Year[1], y=`50%`[1])) +
1000      geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
          geom_hline(yintercept = 1, linetype=2) +
          ylab(expression(B/B[2003])) +
          xlab("") +
          theme(legend.position = "none") +
1005      sc +
          th
        dev.off()

        # table
1010    tb0 <- t(ifitq)[-1,]
        colnames(tb0) <- ifitq[,1]
        write.csv(tb0, file="tabNEAI11.csv")

        #-----------------------------------------------------------------------
1015    # (I12) SSB model for cat 3
        #-----------------------------------------------------------------------
        df0 <- subset(isa, !(EcoRegion %in% c("Arctic Ocean", "Greenland Sea", "Faroes",
        "Iceland Sea")) & DataCategory>2 & DataCategory<4 & StockSize>0 &  Year>=iniYear & Year
        <= fnlYear & AssessmentYear %in% vay & StockSizeDescription %in% c("Biomass Index",
        "SSB", "TSB", "Relative BI (comb)", "B/Bmsy", "Relative SSB", "standardized CPUE",
        "Relative BI", "Biomass Index (comb)", "LPUE"))

        # remove stocks with short time series
1020    sts <- table(df0$FishStock, df0$Year)
        sts <- rownames(sts)[apply(sts, 1, sum)<5]
        df0 <- subset(df0, !(FishStock %in% sts))

        # id
1025    sfI12 <- tapply(df0$Year, df0$FishStock, max)
        sfI12 <- data.frame(FishStock=names(sfI12), Year=sfI12, variable="sfI12", value=TRUE)

        # project for stocks without 2015, 2016 estimates
        df0 <- projectStkStatus(df0, vpy)
1030
        # pre process for model
        df0$Year <- factor(df0$Year)
        yrs <- levels(df0$Year)
        nd <- data.frame(Year=factor(yrs))
```

```r
1035      # fit
          ifitb3 <- glmer(StockSize ~ Year + (1|FishStock), data =  df0, family = Gamma("log"),
          control=glmerControl(optimizer="nlminbwrap"))
          runDiagsME(ifitb3, "FishStock", df0, "diagNEAI12.pdf", nc, nd)

1040      # bootstrap
          stk <- unique(df0$FishStock)
          ifitb3.bs <- split(1:it, 1:it)
          ifitb3.bs <- mclapply(ifitb3.bs, function(x){
              stk <- sample(stk, replace=TRUE)
1045          df1 <- df0[0,]
              for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
              fit <- glmer(StockSize ~ Year + (1|FishStock), data = df1, family = Gamma("log"),
          control=glmerControl(optimizer="nlminbwrap"))
              v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
              if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
1050          v0
          }, mc.cores=nc)

          ifitm <- do.call("rbind", ifitb3.bs)
          ifitm <- exp(log(ifitm)-mean(log(ifitm[,1]), na.rm=TRUE))
1055      ifitq <- apply(ifitm, 2, quantile, qtl, na.rm=TRUE)
          ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))

          # plot
          png("figNEAI12.png", 1800, 1200, res=300)
1060      ggplot(ifitq, aes(x=Year)) +
            geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
            geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
            geom_line(aes(y=`50%`)) +
            expand_limits(y=0) +
1065        geom_point(aes(x=Year[1], y=`50%`[1])) +
            geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
            geom_hline(yintercept = 1, linetype=2) +
            ylab(expression(B/B[2003])) +
            xlab("") +
1070        theme(legend.position = "none") +
            sc +
            th
          dev.off()

1075      # table
          tb0 <- t(ifitq)[-1,]
          colnames(tb0) <- ifitq[,1]
          write.csv(tb0, file="tabNEAI12.csv")

1080      #=================================================================
          # Stocks used in each indicator
          #=================================================================

          df0 <- melt(saeu[!saeu$projected,], c('FishStock', 'Year'), c('sfFind', 'sfSBL',
          'sfCFP', 'sfI7', 'sfI8', 'sfI9', 'sfI10'))
1085      df0 <- do.call("rbind", lapply(split(df0, df0$FishStock), function(x) subset(x,
          Year==max(x$Year))))
          df0 <- rbind(df0, sfI11, sfI12)
          levels(df0$variable) <- c('above/below Fmsy', 'in/out SBL', 'in/out CFP', 'F/Fmsy
          trends', 'Biomass trends', 'SSB/Bpa trends', "Recruitment trends", "Biomass data
          category 1-3 trends", "Biomass data category 3 trends")
          stkPerIndicator <- dcast(df0, FishStock+Year~variable, value.var='value')

1090      # NOTE: this file must be fixed "by hand" to remove duplications
          # created for the cat 1 stocks which were projected
          # (no time to right code now ...)
          write.csv(stkPerIndicator, file="stkPerIndicator.csv")

1095      #=================================================================
          # Coverage
          #=================================================================

          # All stocks of relevance
1100      stocks <- subset(saeu, Year==fnlYear)$FishStock
          # All stocks with B indicator
          bind_stocks <- subset(saeu, Year==fnlYear & !is.na(indB))$FishStock
          # All stocks with F indicator - Same as stocks
          find_stocks <- subset(saeu, Year==fnlYear & !is.na(indF))$FishStock
1105      # All stocks with Bpa indicator
          bpaind_stocks <- subset(saeu, Year==fnlYear & !is.na(indBpa))$FishStock
```

```r
      # All stocks with Fpa indicator - Same as stocks
      fpaind_stocks <- subset(saeu, Year==fnlYear & !is.na(indFpa))$FishStock

1110  # Current list
      all_stocks <- unique(isa12sf$FishStock)
      # ignore NA
      all_stocks <- all_stocks[!is.na(all_stocks)]

1115  # Which stocks to drop from all stocks
      drop_stock <- all_stocks[!(all_stocks %in% stocks)]

      # Which stocks to drop as no f indicator
      drop_stock_f <- all_stocks[!(all_stocks %in% find_stocks)]
1120
      # Which stocks to drop as no b indicator
      drop_stock_b <- all_stocks[!(all_stocks %in% bind_stocks)]

      # Which stocks to drop as no fpa indicator
1125  drop_stock_fpa <- all_stocks[!(all_stocks %in% fpaind_stocks)]

      # Which stocks to drop as no bpa indicator
      drop_stock_bpa <- all_stocks[!(all_stocks %in% bpaind_stocks)]

1130  # Set dropped stocks to NA in FishStock column
      isa12sf$FindFishStock <- isa12sf$FishStock
      isa12sf[isa12sf$FindFishStock %in% drop_stock_f,"FindFishStock"] <- as.character(NA)
      isa12sf$BindFishStock <- isa12sf$FishStock
      isa12sf[isa12sf$BindFishStock %in% drop_stock_b ,"BindFishStock"] <- as.character(NA)
1135  isa12sf$FpaindFishStock <- isa12sf$FishStock
      isa12sf[isa12sf$FpaindFishStock %in% drop_stock_fpa,"FpaindFishStock"] <- as.character
      (NA)
      isa12sf$BpaindFishStock <- isa12sf$FishStock
      isa12sf[isa12sf$BpaindFishStock %in% drop_stock_bpa,"BpaindFishStock"] <- as.character
      (NA)

1140  # Proportion of TACs that have at least one rectangle assessed by FindFishStock and
      BindFishStock
      outf <- aggregate(isa12sf$FindFishStock, by=list(isa12sf$TAC_id), function(x) {
              no_rect_ass_find <- sum(!is.na(x))
              assessed_find <- no_rect_ass_find > 1
              return(assessed_find)
1145  })

      outb <- aggregate(isa12sf$BindFishStock, by=list(isa12sf$TAC_id), function(x) {
              no_rect_ass_bind <- sum(!is.na(x))
              assessed_bind <- no_rect_ass_bind > 1
1150          return(assessed_bind)
      })

      outfpa <- aggregate(isa12sf$FpaindFishStock, by=list(isa12sf$TAC_id), function(x) {
              no_rect_ass_find <- sum(!is.na(x))
1155          assessed_find <- no_rect_ass_find > 1
              return(assessed_find)
      })

      outbpa <- aggregate(isa12sf$BpaindFishStock, by=list(isa12sf$TAC_id), function(x) {
1160          no_rect_ass_bind <- sum(!is.na(x))
              assessed_bind <- no_rect_ass_bind > 1
              return(assessed_bind)
      })

1165  coverage <- data.frame(
          No_stocks = c(length(find_stocks), length(bind_stocks), length(fpaind_stocks),
      length(bpaind_stocks)),
          No_TACs = length(unique(isa12sf$TAC_id)),
          No_TACs_assessed = c(sum(outf$x), sum(outb$x), sum(outfpa$x), sum(outbpa$x)),
          Frac_TACs_assessed = c(mean(outf$x),mean(outb$x), mean(outfpa$x), mean(outbpa$x))
1170  )
      rownames(coverage) <- c("F_indicator", "B_indicator", "Fpa_indicator", "Bpa_indicator")

      write.csv(coverage, "coverage.csv")

1175  # number of stocks for which MSYBtrigger==Bpa
      #df0 <- transform(saeu, bb=Bpa/MSYBtrigger==1)
      #length(unique(subset(df0, bb==TRUE)$FishStock))

      #==================================================================
1180  # Exporting and saving
```

```
#===================================================================

write.csv(saeu, file="saeu.csv")
save.image("RData.nea")
```

```r
###############################################################
# EJ(20170302)
# MED indicators
###############################################################

library(reshape2)
library(ggplot2)
library(lme4)
library(influence.ME)
library(lattice)
library(parallel)
library(rgdal)
library(reshape2)
library(plyr)
source("funs.R")


#=============================================================
# Setup
#=============================================================

# year when assessments were performed
assessmentYear <- 2017
# final year with estimations from stock assessments
fnlYear <- assessmentYear - 1
# initial year with estimations from stock assessments
iniYear <- 2003
# vector of years
dy <- iniYear:fnlYear
# vector of years for valid assessments
vay <- (assessmentYear-2):assessmentYear
# vector of years for stock status projection
vpy <- (fnlYear-2):fnlYear
# options for reading data
options(stringsAsFactors=FALSE)
# number of simulations for mle bootstrap
it <- 500
# number of cores for mle bootstrap parallel
nc <- 6
# quantiles to be computed
qtl <- c(0.025, 0.25, 0.50, 0.75, 0.975)
# to control de seed in mclapply
RNGkind("L'Ecuyer-CMRG")
set.seed(1234)
# to make plots consistent
vp <- dy
vp[c(2,3,5,6,8,9,11,12,13)] <- ""
theme_set(theme_bw())
sc <- scale_x_continuous(breaks=dy, labels=as.character(vp))
th <- theme(axis.text.x  = element_text(angle=90, vjust=0.5), panel.grid.minor =
element_blank())


#=============================================================
# load & pre-process
#=============================================================

#-------------------------------------------------------------
# load and pre-process
#-------------------------------------------------------------

# assessments
gfcm <- read.csv("../data/med/GFCM_SA.csv")
gfcm$Meeting <- "GFCM"
#gfcm$Fref <- gfcm$Fref_point
stecf <- read.csv("../data/med/STECF_CFP_2018.csv")
msa <- rbind(stecf, gfcm)
msa$Fref <- msa$Fref_point

# keep only one hake 1718 and sol17 assessment, must be adjusted
# based on plen decision
msa <- subset(msa, !(key %in% c("SOL_17_EWG17_15", "HKE_17_18_EWG17_15") &
Method=="SS3"))

# keep relevant columns only
msa <- msa[,c("Stock", "Area", "Year", "R", "SSB", "F", "Fref", "Blim", "Bref",
"asses_year", "Meeting", "Assessment_URL", "Species", "EcoRegion")]

# id assessment source
msa[msa$Meeting!="GFCM","Meeting"] <- "STECF"
```

```r
    names(msa)[names(msa)=="Meeting"] <- "source"

    #-----------------------------------------------------------------
    # recode and compute indicators
    #-----------------------------------------------------------------
    msa$stk <- tolower(paste(msa$Stock, msa$Area, sep="_"))
    msa$StockDescription <- paste(msa$Species, "in GSA", gsub("_", ", ",  msa$Area))
    msa$Fref <- as.numeric(msa$Fref)
    msa <- transform(msa, indF = F/Fref)
    msa <- transform(msa, sfFind=!is.na(indF), i1=indF>1, i2=indF<=1)

    #-----------------------------------------------------------------
    # subset
    # (filtering through the sampling frame done during data harvesting)
    #-----------------------------------------------------------------
    sam <- msa[!is.na(msa$indF) & msa$Year >=iniYear & msa$Year <= fnlYear & msa$asses_year
    %in% vay,]

    #-----------------------------------------------------------------
    # project stock status
    # (check fnlYear < assessmentYear-1)
    #-----------------------------------------------------------------
    sam$projected <- FALSE

    # use y-2 for stocks missing in y-1
    sy2 <- sam[sam$Year==sort(vpy)[1], "stk"]
    sy1 <- sam[sam$Year==sort(vpy)[2], "stk"]
    v0 <- sy2[!(sy2 %in% sy1)]
    if(length(v0)>0){
        df0 <- subset(sam, Year==sort(vpy)[1] & stk %in% v0)
        df0$Year <- sort(vpy)[2]
        df0$projected <- TRUE
        sam <- rbind(sam, df0)
    }

    # use y-1 for stocks missing in y
    sy <- sam[sam$Year==sort(vpy)[3], "stk"]
    v0 <- sy1[!(sy1 %in% sy)]
    if(length(v0)>0){
        df0 <- subset(sam, Year==sort(vpy)[2] & stk %in% v0)
        df0$Year <- sort(vpy)[3]
        df0$projected <- TRUE
        sam <- rbind(sam, df0)
    }

    #=================================================================
    # Indicators
    #=================================================================
    #-----------------------------------------------------------------
    # Number of stocks (remove projected years)
    #-----------------------------------------------------------------
    df0 <- sam[!sam$projected,]
    mnStks <- aggregate(stk~Year, df0, length)
    names(mnStks) <- c("Year", "N")

    # plot
    png("figMedI0.png", 1800, 1200, res=300)
    ggplot(subset(mnStks, Year!=fnlYear), aes(x=Year, y=N)) +
        geom_line() +
        ylab("No. of stocks") +
        xlab("") +
        ylim(c(0,50)) +
        sc +
        th +
        geom_point(aes(x=fnlYear, y=mnStks$N[length(mnStks$N)]), size=2)
    dev.off()

    png("figMedI0b.png", 1200, 1600, res=200)
    ggplot(sam[!sam$projected,], aes(Year,stk)) +
        geom_line() +
        ylab("Stock") +
        xlab("Year") +
        sc +
        th +
        geom_vline(xintercept = fnlYear-1, col = "red")
    dev.off()

    write.csv(dcast(df0, EcoRegion~Year, value.var='stk', margins=TRUE,
```

```r
    fun.aggregate=length), file="tabMedI0.csv", row.names=FALSE)

    #-------------------------------------------------------------------------
    #  drop final assessment year, redo scales for plotting
    #-------------------------------------------------------------------------
    sam <- sam[sam$Year!=fnlYear,]

    vp <- iniYear:I(fnlYear-1)
    vp[seq(2,13,2)] <- ""
    sc <- scale_x_continuous(breaks=iniYear:I(fnlYear-1), labels=as.character(vp))

    #-------------------------------------------------------------------------
    # (I7) F/Fmsy model based indicator
    #-------------------------------------------------------------------------
    df0 <- sam
    df0$Year <- factor(df0$Year)
    yrs <- levels(df0$Year)
    nd <- data.frame(Year=factor(yrs))

    # model
    mfit <- glmer(indF ~ Year + (1|stk), data = df0, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
    runDiagsME(mfit, "stk", df0, "diagMedI7.pdf", nc, nd)

    # bootstrap
    set.seed(1234)
    stk <- unique(df0$stk)
    mfit.bs <- split(1:it, 1:it)
    mfit.bs <- mclapply(mfit.bs, function(x){
        stk <- sample(stk, replace=TRUE)
        df1 <- df0[0,]
        for(i in stk) df1 <- rbind(df1, subset(df0, stk==i))
        fit <- glmer(indF ~ Year + (1|stk), data = df1, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
        v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
        if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
        v0
    }, mc.cores=nc)
    # remove failed iters
    mfit.bs <- mfit.bs[unlist(lapply(mfit.bs, is.numeric))]

    mfitm <- do.call("rbind", mfit.bs)
    mfitq <- apply(mfitm, 2, quantile, c(0.025, 0.25, 0.50, 0.75, 0.975), na.rm=TRUE)
    mfitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(mfitq)))

    # plot
    png("figMedI7.png", 1800, 1200, res=300)
    ggplot(mfitq, aes(x=Year)) +
        geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
        geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
        geom_line(aes(y=`50%`)) +
        expand_limits(y=0) +
        geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
        geom_hline(yintercept = 1, linetype=2) +
        ylab(expression(F/F[MSY])) +
        xlab("") +
        theme(legend.position = "none") +
        sc +
        th
    dev.off()

    # table
    tb0 <- t(mfitq)[-1,]
    colnames(tb0) <- mfitq[,1]
    write.csv(tb0, file="tabMedI7.csv")

    #-------------------------------------------------------------------------
    # (I8) SSB indicator
    #-------------------------------------------------------------------------
    # model
    idx <- !is.na(sam$SSB)
    df0 <- sam[idx,]
    df0$Year <- factor(df0$Year)
    yrs <- levels(df0$Year)
    nd <- data.frame(Year=factor(yrs))

    # model
    mfitb <- glmer(SSB ~ factor(Year) + (1|stk), data =  df0, family = Gamma("log"),
```

```r
        control=glmerControl(optimizer="nlminbwrap"))
        runDiagsME(mfitb, "stk", df0, "diagMedI8.pdf", nc, nd)

230     # bootstrap
        set.seed(1234)
        stk <- unique(df0$stk)
        mfitb.bs <- split(1:it, 1:it)
        mfitb.bs <- mclapply(mfitb.bs, function(x){
235         stk <- sample(stk, replace=TRUE)
            df1 <- df0[0,]
            for(i in stk) df1 <- rbind(df1, subset(df0, stk==i))
            fit <- glmer(SSB ~ Year + (1|stk), data = df1, family = Gamma("log"),
        control=glmerControl(optimizer="nlminbwrap"))
            v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
240         if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
            v0
        }, mc.cores=nc)
        # remove failed iters
        mfitb.bs <- mfitb.bs[unlist(lapply(mfitb.bs, is.numeric))]
245
        mfitm <- do.call("rbind", mfitb.bs)
        mfitm <- exp(log(mfitm)-mean(log(mfitm[,1]), na.rm=TRUE))
        mfitq <- apply(mfitm, 2, quantile, c(0.025, 0.25, 0.50, 0.75, 0.975), na.rm=TRUE)
        mfitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(mfitq)))
250
        # plot
        png("figMedI8.png", 1800, 1200, res=300)
        ggplot(mfitq, aes(x=Year)) +
            geom_ribbon(aes(ymin = `2.5%`, ymax = `97.5%`), fill="gray", alpha=0.60) +
255         geom_ribbon(aes(ymin = `25%`, ymax = `75%`), fill="gray", alpha=0.95) +
            geom_line(aes(y=`50%`)) +
            expand_limits(y=0) +
            geom_point(aes(x=Year[length(Year)], y=`50%`[length(`50%`)]), size=2) +
            geom_hline(yintercept = 1, linetype=2) +
260         ylab(expression(B/B[2003])) +
            xlab("") +
            theme(legend.position = "none") +
            sc +
            th
265     dev.off()

        tb0 <- t(mfitq)[-1,]
        colnames(tb0) <- mfitq[,1]
        write.csv(tb0, file="tabMedI8.csv")
270
        write.csv(sam, file="sam.csv")
        save.image("RData.med")
```

ANNEX III – QUALITY CONTROL OF ICES DATASET

ICES data quality issues corrected prior to the analysis

By: Paris Vasilakopoulos

4 April 2018

The stock assessment graphs (SAG) dataset found at http://standardgraphs.ices.dk/stockList.aspx was used to extract the ICES data needed for the CFP indicators analysis. Prior to the analysis, an extensive data quality check was carried out on the data relevant to the analysis. During this data quality check the following fields were checked and corrected:

- Stock size, fishing pressure and reference points of stocks cat. 1-3 (data moved from custom columns when needed).
- Stock size description, stock size units, fishing pressure description, fishing pressure units of stocks cat 1-2.
- Stock size description of stocks cat 3.

There are still issues to be corrected in the ICES SAG dataset which were not addressed here due to time limitations and because they were not very relevant to our analysis. For example, we noticed inconsistencies and errors in stock units, fishing pressure description and fishing pressure units of many cat 3 stocks.

Category 1-2 stocks

ane.27.8
Fishing Pressure Units corrected from "NA" to 'Proportion'

ank.27.8c9a
Stock size description corrected to TSB/Bmsy
Stock size units corrected to 'Relative to Bmsy'
Fishing Pressure Units corrected to 'Relative to Fmsy'

ghl.27.1-2
Stock size description corrected to TSB
Fishing Pressure Units corrected from "NA" to 'Proportion'

ghl.27.561214
Stock size units corrected to 'Relative to Bmsy'
Fishing Pressure Units corrected to 'Relative to Fmsy'

lin.27.5a
Fishing Pressure Units corrected from "NA" to 'Proportion'
HRlim, HRmsy, HRpa moved from custom columns to their right place

usk.27.5a14
Fishing Pressure Units corrected from "NA" to 'Proportion'
HRlim, HRmsy, HRpa moved from custom columns to their right place

lez.27.4a6a
Stock size units corrected to 'Relative to Bmsy'
Fishing Pressure Units corrected to 'Relative to Fmsy'

pil.27.8abd
Stock size units corrected to 'Relative to mean'
Fishing Pressure Units corrected to 'Relative to mean'

rng.27.5b6712b
Stock size units corrected to 'Relative to Bmsy'
Fishing Pressure Units corrected to 'Relative to HRmsy'

bss.27.4bc7ad-h
Fishing Pressure Units corrected from blank to 'Year-1'

had.27.46a20
Fishing Pressure Units corrected from blank to 'Year-1'

sol.27.8ab
Fishing Pressure Description corrected to F
Fishing Pressure Units corrected from blank to 'Year-1'

whg.27.47d
Fishing Pressure Units corrected from blank to 'Year-1'

cap.27.1-2
Fishing Pressure Description corrected to NA
Fishing Pressure Units corrected to NA

cap.27.2a514
Fishing Pressure Description corrected to NA
Fishing Pressure Units corrected to NA

pok.27.5a
Stock size description corrected to SSB

pra.27.1-2
Stock size units corrected to 'Relative to Bmsy'
Fishing Pressure Units corrected to 'Relative to Fmsy'

pra.27.4a20
Stock size description corrected to SSB
Fishing Pressure Description corrected to F

reg.27.1-2
Stock size units corrected to 'Relative to mean'
Fishing Pressure Units corrected to 'Relative to mean'

dgs.27.nea
Stock size description corrected from ' TSB' to 'TSB'
Fishing Pressure Description corrected to Harvest rate

hom.27.2a4a5b6a7a-ce-k8
ICES Areas splited with character field is blank. Corrected to 27.2.a.1 ~ 27.2.a.2 ~ 27.4.a ~ 27.5.b.1.a ~ 27.5.b.1.b ~ 27.5.b.2 ~ 27.6.a ~ 27.7.a ~ 27.7.b ~ 27.7.c.1 ~ 27.7.c.2 ~ 27.7.e ~ 27.7.f ~ 27.7.g ~ 27.7.h ~ 27.7.j.1 ~ 27.7.j.2 ~ 27.7.k.1 ~ 27.7.k.2 ~ 27.8.a ~ 27.8.b ~ 27.8.c ~ 27.8.d.1 ~ 27.8.d.2 ~ 27.8.e.1 ~ 27.8.e.2

nep.fu.11
Stock size description corrected to Abundance
Stock size units corrected to millions

nep.fu.12
Stock size description corrected to Abundance
Stock size units corrected to millions

nep.fu.13
Stock size description corrected to Abundance
Stock size units corrected to millions

nep.fu.14
Stock size description corrected to Abundance
Stock size units corrected to millions
Fishing Pressure Description corrected to Harvest rate

nep.fu.15
Stock size description corrected to Abundance
Stock size units corrected to billions
Fishing Pressure Units corrected to Percent

nep.fu.16
Stock size description corrected to Abundance
Stock size units corrected to millions

nep.fu.17
Stock size description corrected to Abundance
Stock size units corrected millions

nep.fu.19
Stock size description corrected to Abundance
Stock size units corrected to millions

nep.fu.2021
Stock size description corrected to Abundance
Stock size units corrected to millions

nep.fu.22
Stock size description corrected to Abundance
Stock size units corrected to millions

nep.fu.2324
Stock size description corrected to Abundance
Stock size units corrected to millions

nep.fu.3-4
Stock size description corrected to Abundance
Stock size units corrected to millions
Fishing Pressure Units corrected to Percent

nep.fu.6
Stock size description corrected to Abundance
Stock size units corrected to millions
Fishing Pressure Description corrected to Harvest rate

nep.fu.7
Stock size units corrected to billions
Fishing Pressure Description corrected to Harvest rate

nep.fu.8
Stock size description corrected to Abundance
Stock size units corrected to millions

nep.fu.9
Stock size description corrected to Abundance

Stock size units corrected to millions
Fishing Pressure Units corrected to Percent

cod.27.1-2
cod.27.22-24
cod.27.5a
cod.27.5b1
cod.27.6a
cod.27.7a
cod.27.7e-k
had.27.1-2
had.27.5a
had.27.5b
had.27.6b
had.27.7a
had.27.7b-k
her.27.20-24
her.27.25-2932
her.27.28
her.27.3031
her.27.3a47d
her.27.5a
her.27.6a7bc
her.27.irls
her.27.nirs
hke.27.3a46-8abd
hke.27.8c9a
hom.27.2a4a5b6a7a-ce-k8
hom.27.9a
ldb.27.8c9a
mac.27.nea
meg.27.7b-k8abd
meg.27.8c9a
ple.27.21-23
ple.27.7a
ple.27.7d
pok.27.1-2
pok.27.3a46
pok.27.5a
pok.27.5b
pra.27.4a20
reb.27.1-2
reg.27.561214
san.sa.1r
san.sa.2r
san.sa.3r
san.sa.4
sol.27.20-24
sol.27.4
sol.27.7a
sol.27.7d
sol.27.7e
sol.27.7fg
spr.27.4
spr.27.22-32
whb.27.1-91214
whg.27.7a
whg.27.7b-ce-k

Fishing Pressure Units corrected from 'per year' to 'Year-1'

Category 3 stocks

sbr.27.10
The old sbr-x stock should be updated to sbr.27.10 (according to http://sd.ices.dk/services/odata4/StockListDWs4). Also, based on this http://ices.dk/sites/pub/Publication%20Reports/Advice/2017/Special_requests/EU_sbr-x_review.pdf its DataCategory needs to be updated to 3 (rather than current 5.2), and the abundance index value and description in the SAG dataset moved from Custom1 and CustomName1 columns to StockSize and StockSizeDescription, respectively.
Also, stock size description was corrected to Abundance Index

bss.27.8ab
Stock size moved from custom column
Stock size description corrected to LPUE
Stock size unit corrected to kg/day
Fishing pressure corrected to NA

ele.2737.nea
No info in designated columns, everything in custom columns
Stock size description corrected to 'NA'

wit.27.3a47d
Stock Size moved from custom column (IBTS Q3-the optimal index according to advice sheet)
Stock size description corrected to Biomass index
Stock size unit corrected to kg/h

ane.27.9a
Stock size description corrected to Biomass Index (comb)

rjr.27.23a4
Stock size description corrected from ' Relative AI (comb)' to 'Relative AI (comb)'

rjn.27.9a
Stock size description corrected from ' Relative BI (comb)' to 'Relative BI (comb)'

rjh.27.9a
Stock size description corrected from ' Relative BI' to 'Relative BI'

rjc.27.8
Stock size description corrected from ' Relative BI (comb)' to 'Relative BI (comb)'

rjc.27.9a
Stock size description corrected from ' Relative BI (comb)' to 'Relative BI (comb)'

gfb.27.nea
Stock size description corrected from ' Relative BI (comb)' to 'Relative BI (comb)'

cod.27.21
Stock size description corrected to Relative SSB

dab.27.3a4
Stock size description corrected to Relative SSB

fle.27.2223
Stock size description corrected to Biomass Index

fle.27.2425
Stock size description corrected to Biomass Index

fle.27.2729-32
Stock size description corrected to Biomass Index
Stock size unit corrected to kg/fishing station

ple.27.24-32
Stock size description corrected to Relative SSB

sdv.27.nea
Stock size description corrected to Relative BI (comb)

spr.27.3a
Stock size description corrected to Abundance Index

spr.27.7de
Stock size description corrected to Relative BI

syc.27.67a-ce-j
Stock size description corrected to Relative BI (comb)
Stock size unit corrected to kg/hour

tur.27.4
Stock size description corrected to Relative SSB

bll.27.22-32
Stock size description corrected to Abundance Index

STECF

The Scientific, Technical and Economic Committee for Fisheries (STECF) has been established by the European Commission. The STECF is being consulted at regular intervals on matters pertaining to the conservation and management of living aquatic resources, including biological, economic, environmental, social and technical considerations.

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