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Scientific, Technical and Economic Committee for Fisheries (STECF) - Monitoring the performance of the Common Fisheries Policy (STECF-17-04)

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This report was reviewed by the STECF during its 54th plenary meeting held from 27 to 31 March 2017 in Ispra, Italy.

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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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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF) - Monitoring the performance of the Common Fisheries Policy (STECF-17-04)

The report of the ad hoc Expert group held during February and March 2017 was reviewed during the STECF plenary meeting held in Ispra, Italy, 27-31 March 2017.

Background provided by the Commission

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

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 the JRC Expert Group (EG) developed a large set of analyses, presented in several technical reports dealing with: generating the sampling frame, (used to identify which stocks are of interest for the EU) in the North-East Atlantic (Scott et al., 2017a) and in the Mediterranean region (Mannini et al., 2017); checking the quality of the ICES stock assessment data (Vasilakopoulos and Jardim, 2017); and analysing how the Fisheries Management Zones used by EU to set up TACs is matching (or not) the stock limits used by ICES to provide scientific advice (Scott et al., 2017b). Core indicators where presented in the EG report, while the additional indicators requested by the last STECF plenary were presented in a separate background document. These indicators were added to the EG report afterwards, following the STECF plenary request. STECF notes that the ad hoc Expert Group published all the data and code used, which is an important aspect for ensuring transparency.

All technical reports are available at https://stecf.jrc.ec.europa.eu/plen1701 .

Based on the results presented in these Expert Group reports, STECF first drew a synthetic overview of what is currently known regarding the achievement of the MSY objectives, and then secondly made more general comments on methods used and possible developments.

Trends towards the MSY objectives in the North-East Atlantic and Mediterranean Sea

The overview below describes the trends observed until 2015 for the set of stocks included in the sampling frame described in the technical reports, i.e. primarily the stocks with a full analytical assessment (Category 1).

Stock status in the ICES area

The indicators provided by the JRC EG show that many stocks are still overexploited in the NE Atlantic, but also that stocks status is significantly improving (Figure 1).

In the ICES area, among the 61 to 69 stocks which are fully assessed, the proportion of overexploited stocks (i.e. $F>F_{MSY,}$ red line) decreased from more than 70% to close to 40%, over the last ten years. The proportion of stocks outside the safe biological limits (F>Fpa and/or B<Bpa, blue line), computed for the 40 stocks for which both reference points are available, follows the same decreasing trend, from 65% in 2003 to 38% in 2015.

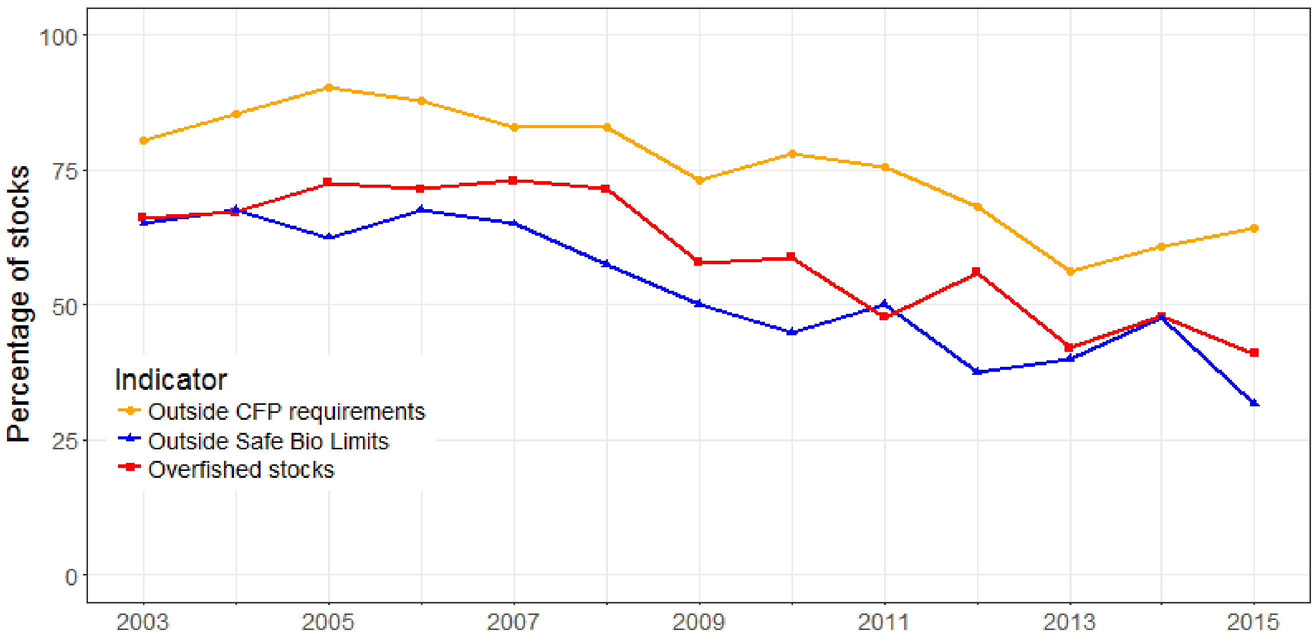

Figure 1 - Trends in stocks status, 2003-2015. Three indicators are presented: Red line: the proportion of overexploited stocks (F>FMSY) within the sampling frame (61 to 69 stocks fully assessed in the NE Atlantic, depending on year); Blue line: the proportion of stocks outside safe biological limits (F>Fpa or B<Bpa) (40 stocks); Orange line: the proportion of stocks outside the current CFP requirements (F>F_{MSY} or B<Bpa)(41 stocks).

Nevertheless, 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 CFP regulation refers to both F_{MSY} and safe biological limits. Thus, the EG calculated an additional indicator, which is the proportion of stocks outside the CFP requirements (i.e. overfished or outside the safe biological limits, or both, with F>F_{MSY} or B<Bpa, orange line). For the 41 stocks for which the required information was available, this proportion decreased from almost 90% to around 60% over the last ten years.

STECF notes that the recent slope of the three indicators suggests that progress until 2015 has been too slow to allow all stocks to be maintained or restored at the precautionary Bpa level or above, and managed according to F_{MSY} by 2020.

STECF also 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. Nevertheless, since B_{MSY} is generally well above Bpa, the proportion of stocks *maintained or restored above a biomass level capable of producing maximum sustainable yield*, according to Article 2 of the CFP Regulation (EU 1380/2013), is expected to be lower than the 2015 level (on the orange line) of 40% stocks that are not overfished and are above Bpa.

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

STECF notes that the Expert Group computes the trends in fishing pressure both using a simple arithmetic mean over all stocks and using a more 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. The arithmetic mean indicator is not presented for the Mediterranean, as it is too noisy and cannot capture trends; therefore, only the model-based indicator can be used for regional comparison between the NE Atlantic and Mediterranean Sea.

In the ICES area, the model-based indicator of the fishing pressure (F/F_{MSY}) shows an overall downward trend over the 2003-2015 period (Figure 2). In the early 2000s, the median fishing mortality was more than 1.5 time larger than F_{MSY}, and is now stabilised around 1.0. This is to be interpreted as that around half of the stocks (median) have reached F_{MSY}. Reaching F_{MSY} for most stocks would require the upper bound of the confidence interval in figure 3.13 in the Expert Group to be around 1. STECF also note 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 11 stocks located in the NE Atlantic, but outside EU waters. This indicator seems to confirm the positive overall trend observed in EU waters, with a median value of the F/F_{MSY} indicator lower than 1 in recent years. However, the EG noted that this last indicator is based on 11 stocks only and thus should be considered with care.

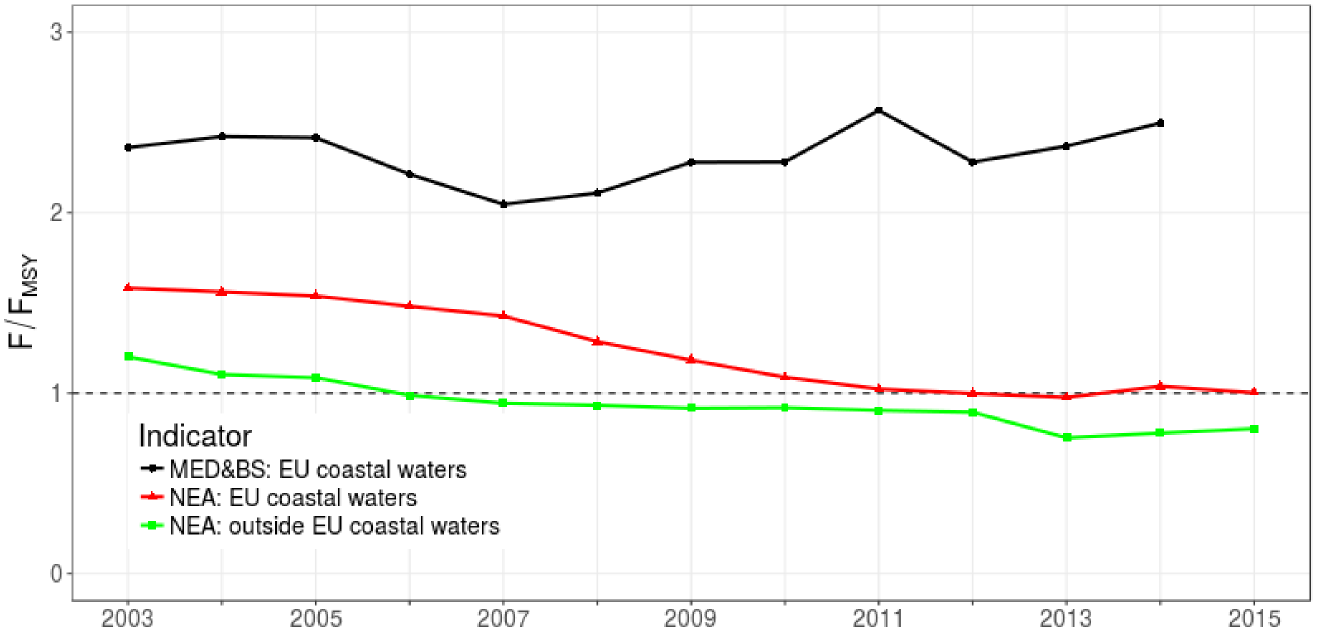

Figure 2 - Trends in the fishing pressure. Three model based indicators F/F_{MSY} are presented (all referring to the median value of the model): one for the sampling frame of 61 to 69 EU stocks included in the ICES area (red line); one for an additional set of 11 stocks also located in the NE Atlantic but outside EU waters (green line), and one for the 33 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 remained at a very high level during the whole 2003-2014 period, with no decreasing trend. Since 2007 there has even been an increase in the median F/F_{MSY} with the two highest points (around 2.5) in 2011 and 2014. Median value of F/F_{MSY} varies around 2.3 indicating that the stocks are being exploited on average at rates well above the CFP objective of exploitation at rates that will deliver MSY.

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 increasing since 2006. For the fully assessed stocks, the median value in 2015 was around 35% higher than in 2003.

A less pronounced but still improving trend is also observed for data poor stocks, according to the preliminary indicator computed by the EG (Figure 5.3, an exploratory indicator based on partial information regarding 26 ICES Category 3 stocks).

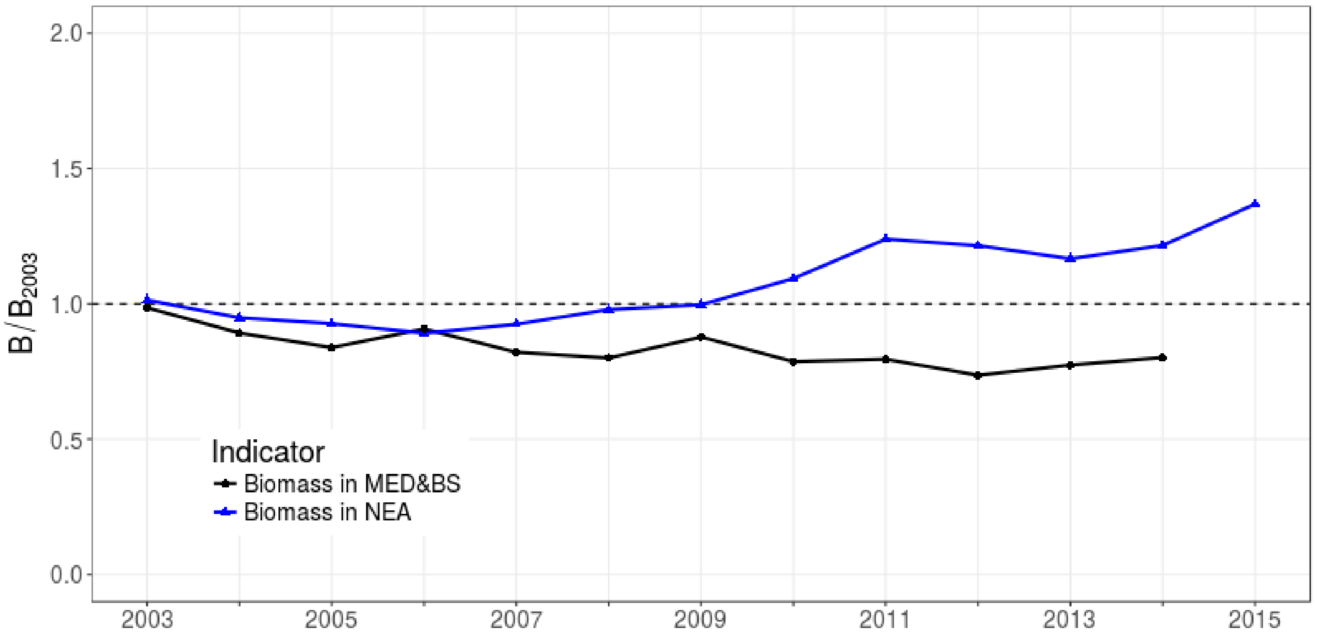

Figure 3 - Trends in the indicators of stock biomass (median values of the model-based estimates relatively to 2003). Two indicators are presented: one for the ICES area (50 stocks considered, blue line); one for the Mediterranean region (33 stocks, black line).

In the Mediterranean and Black Sea, the biomass indicator exhibits a reduction of about 25% over the period. 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 stocks status has improved in all Ecoregions. In 2015, the proportion of overexploited stocks was close to 40 - 45% in all Ecoregions, while the arithmetic mean of the F/F_{MSY} ratio was between 1.05 and 1.25.

Nevertheless, some contrasts in trends can be noticed. According to the indicators presented in the EG report, the fishing pressure decreased consistently over the whole period and the stock status improved in the greater North Sea, in the Baltic Sea and for the widely distributed stocks. In the Celtic Sea, the fishing mortality was at a very high level at the beginning of the time series (F/F_{MSY}>2.2) and decreased significantly; but the proportion of stocks which are outside the CFP requirements has remained around 80%, with no improvement observed over the period. In the Bay of Biscay and Iberian Ecoregion, the situation improved at the beginning of the period, but since 2007 the mean fishing mortality has slightly increased and the stock status has not improved anymore.

Coverage of the scientific advice

Coverage of biological stocks by the CFP monitoring

As stated by the last STECF plenary (STECF PLEN 16-03), the analyses of the progress in achieving MSY objectives the in ICES area should consider all stocks advised by ICES, on the condition of being distributed in EU waters, at least partially. STECF PLEN 16-01 estimated that ICES provides a scientific advice for 183 biological stocks included in EU waters (at least in part). Of these, most stocks are data-poor, without an estimate of MSY reference points (ICES category 3 and above). This means that the present CFP monitoring analysis is restricted to 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, the EG was able to compute indicators for 40 to 69 stocks of category 1 depending on indicators and years. These stocks represent the vast majority of catches. Nevertheless, a large number of biological stocks present in EU waters are still not included in this CFP monitoring.

STECF notes however that the EG computed some additional indicators of trends in abundance index for 26 data poor stocks of category 3. Such indicators are still considered preliminary by the EG and were not yet included in the current synthesis. STECF notes also that MSY reference points are expected to be computed by ICES for a large 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 57 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) have been set up in 2015 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 computed therefore an indicator of advice coverage, where a TAC is considered to be “covered” by a stock advice 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, 51% among the 156 TACs are covered, at least partially, by stock advices that have F_{MSY} (or a proxy e.g. HR_{MSY}) estimates (66 stocks covering 80 TACs) and 43% by advices that have Bpa or a proxy (45 stocks covering 67 TACs).

STECF notes that, using this index, some TACs can be considered as “covered” even if they relate to several assessments aggregated in 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 real advice coverage (i.e. the proportion of TACs based on a single and aligned assessment). This means that the majority of TACs are currently not supported by scientific advice based on F_{MSY} or Bpa reference values. As noted above, this coverage is expected to improve over the next years following ICES progress to derive MSY proxies for data-poor stocks.

Methodological issues

STECF notes that the EG has to a large extent followed the protocol adopted in November 2015 (Jardim et al, 2015) agreed by STECF (2016a) and updated following the discussion in STECF (2016b). However, as a result of problems related to data availability, especially in the Mediterranean and Black Sea region, the protocol was not strictly adhered to.

Sampling frame

STECF suggests that the number of stocks by category for which ICES issued an advice, in the last year of the analysis, to be computed and published in next year's EWG report, in order to assess to which extent the CFP monitoring is covering biological stocks within EU.

STECF notes also that when the new Mediterranean sampling frame (PLEN-16-03) was applied by the EG, 10 stocks assessed by STECF-EWG on Mediterranean assessment were not included, because they were not pre-defined in the sampling frame. As stated during the last plenary, it is agreed that indicators should be calculated taking into account as many stocks as possible, provided that they are of interest for the EU. STECF notes that the sampling frame is a useful process to stabilise the number of stocks included in the annual analysis. Nevertheless, stocks assessed by STECF-EWG may per definition be considered to be of importance to the EU.
Thus, STECF considers that these stocks should be included in the CFP monitoring for 2018, and suggests that all stocks assessed by STECF-EWG should be added to the reference list, if not already included. Criteria used to define the sampling frame should be revised accordingly, and will be discussed in a next STECF plenary meeting.

STECF decided (STECF16-01) to consider a time period of three years, in the selection of stocks included in the analysis, using for each stock the parameters of the last available assessment. STECF recommends that, in case the assessments do not cover the very last year (or the two last years), the time series should be extended with the final year estimates over these years.

Indicators

Based on the current assessment, STECF advises for the next report on CFP monitoring that:

- The three indicators of stock status are useful and should be regularly computed in the coming year (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 be computed, 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. Because the arithmetic mean estimates appeared sensitive to outliers (even if easier to communicate), STECF considers that the model-based indicators should be adopted as the standard method to be used for every time series (including indicators per Ecoregion and indicators for stocks outside EU waters).
- In order to be more readable, indicators of biomass trends should be rescaled with regards to the starting year. Indicators based on fully assessed stocks could be completed by an additional index computed jointly for all stocks of DLS categories 1 to 3 after standardization. The EG is encouraged to explore such extended abundance indicators, which could be discussed during a next plenary meeting.
- According to STECF PLEN16-01, the proportion of stocks from EU waters assessed by ICES for which reference values (F_{MSY}, Bpa and B_{MSY}) are known should also be computed, at least for the least year. According to STECF-PLEN16-03, analyses based both on stock numbers and catches would be useful.
- As much as possible, according to data availability, the same indicators should be computed in the ICES area and in the Mediterranean region.
- Finally, following STECF-PLEN16-03, JRC experts are encouraged to explore other aggregations in order to provide indicators by stock categories (e.g. pelagics versus demersals).

STECF conclusions

STECF acknowledges that monitoring the performance of the CFP is a comprehensive study, which 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 addition of several new indicators. Guidance is provided for further improvements in the coming years.

Regarding the progress made in the achievement of F_{MSY} in line with the CFP, STECF notes that the above results are in line with those reported in the 2016 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 2015 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 even a deterioration observed over the last period.

Finally, STECF noted that the CFP monitoring has improved this year thanks to the addition of several new indicators. Guidance is provided for further improvements in the coming years.

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EXPERT GROUP REPORT

REPORT TO THE STECF

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

Ispra, Italy, February and March 2017

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 2016 (Annex I - Protocol).

An ad hoc Expert Group comprising Experts from the European Commission's Joint Research Centre (JRC) during February and March 2017 to review the most recent results of assessments for fish stocks managed under the CFP, to compute the indicator values in accordance with the 2016 protocol and to report to the STECF plenary meeting scheduled for 27-31 March 2017.

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

The methods applied and the definition of the sampling frames followed the protocol (Jardim et.al, 2015) agreed by STECF (2016a) and updated following the discussion in STECF (2016b) (Annex I - Protocol).

2.1 Data sources

The data sources used referred to the EU waters in FAO areas 27 (Northeast Atlantic) and 37 (Mediterranean). 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, 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). The extraction of data was done through a manual process since the information is not available online in a database or other suitable format.

For the NE Atlantic, the information was downloaded from the ICES website (http://standardgraphs.ices.dk). A thorough process of data quality checks and corrections was performed to assure the information available was in agreement with the summary sheets published online (Vasilakopoulos and Jardim, 2017). Table 6.1 shows the URLs for each stock's report or summary sheet.

The most recent published assessments for each stock were used as of 3 March 2017.

2.1.2 Management units information

For the NE Atlantic, management units are defined by TACs, fishing opportunities for a species or group of species in a Fishing Management Zone (FMZ). The information regarding TACs in 2015 was downloaded from FIDES (http://fides3.fish.cec.eu.int/) reporting system. Posteriorly these 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 (2016a) and updated following the discussion in STECF (2016b) (Annex I - Protocol).

The sampling frame for FAO 27 was developed by selecting the TAC within EU continental waters (see above). The details are presented in Scott *et.al* (2017a).

The sampling frame for FAO 37 was developed by combining the top 10 species in value of landings with the top 10 species in weight of landings by GSA. The details are presented in Mannini, et.al (2017) and the final sampling frame added to the protocol (Annex I - Protocol).

The stock assessments available were filtered through the sampling frame to build the dataset used for computing the indicators. Details on the process for FAO 27 can be found in Scott *et.al* (2017b).

In accordance with STECF (2016b) a new set of indicators were added. The indicators

- "annual value of SSB" which shows the trends in annual estimates of biomass scaled to the first year of the time series (2003),
- "value of F/F_{MSY}" for stocks outside the EU, and

- "CFP requirements" which shows the number of stocks that simultaneously are exploited at or below FMSY and are safely exploited within safe biological limits,

were included in the core set of indicators, while the indicators

- "recruitment trends" which shows the trends in annual estimates of recruitment,
- "biomass trends for data limited stocks" which shows the trends in annual estimates of biomass indices for ICES DLS category 03 stocks, and
- "B/B_{PA} trends" which shows the trends in annual estimates of biomass and B_{PA}

were considered experimental and included in a specific section of the report. These indicators should not be used for policy advice.

2.3 Notes

- Stock assessed with biomass dynamics models don't have F_{PA}, although they may have a B_{PA} proxy (0.5 B_{MSY}), as such they can't be used in the SBL indicator.
- 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 avoiding large changes in each stock, which would create problems to the random effect fit, but it has the disadvantage of excluding data that could improve model fit.
- For all stocks except ANE-BISC MSYBescapement was set at B_{PA} levels by ICES instead of B_{MSY} levels.
- ICES is setting MSYBtrigger to increase the probability of keeping F at F_{MSY} levels. As such it cannot be used as a proxy to B_{PA} and included in the SBL indicator.
- The GLMM fit within the bootstrap procedure does not converge for all resamples, about 10-20% of the fits fail. These fits were not included in the computation of the model-based indicators. The impact in the median estimate are negligable. For the variance estimation more analysis are required.

2.4 Differences from the 2016 CFP monitoring report (STECF 16-03)

2.4.1 Northeast Atlantic

- New indicators introduced in accordance with STECF (2016b): annual value of SSB, F/F_{MSY} for stocks outside the EU waters and CFP requirements.
- NOP 34 uses a probabilistic method to set the catches $C_{y+1}=C|(P[SSB<Blim]=0.05)$. To add this stock the lower boundary of the SSB confidence interval is compared to Blim.
- ANE BISC uses a HCR with Biomass triggers. ICES does not present reference points. The HCR's upper biomass trigger was used as MSYBescapement.
- The SBL indicator is based in PA reference points, both for biomass and for fishing mortality, instead of F_{MSY}, as last year due to data limitations.
- The bootstrap method was revised. A block bootstrap method was applied using stocks as blocks, to be more aligned with the bootstrap assumption of independence among resampling units.

2.4.2 Mediterranean and Black Sea

- A new indicator for annual value of SSB was introduced in accordance with STECF (2016b).
- A new sampling frame was adopted in accordance with the revised protocol adopted by STECF (2016b).
- GFCM stock assessments carried out in 2014 and 2015, which were available in the GFCM stock assessment summary sheets in tabular form, were included in the analysis.
- Stock assessments of Black Sea stocks were included in the analysis.

- The bootstrap method was revised. A block bootstrap method was applied using stocks as blocks, to be more aligned with the bootstrap assumption of independence among resampling units.

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)

The number of stock assessments available increased in relation to last year, reaching a maximum of 69 stock assessments in 2014 (Figure 3.1 and Table 3.1). Figure 3.2 shows the time-series of data available and Figure 3.3 shows the stocks used to compute each indicator.

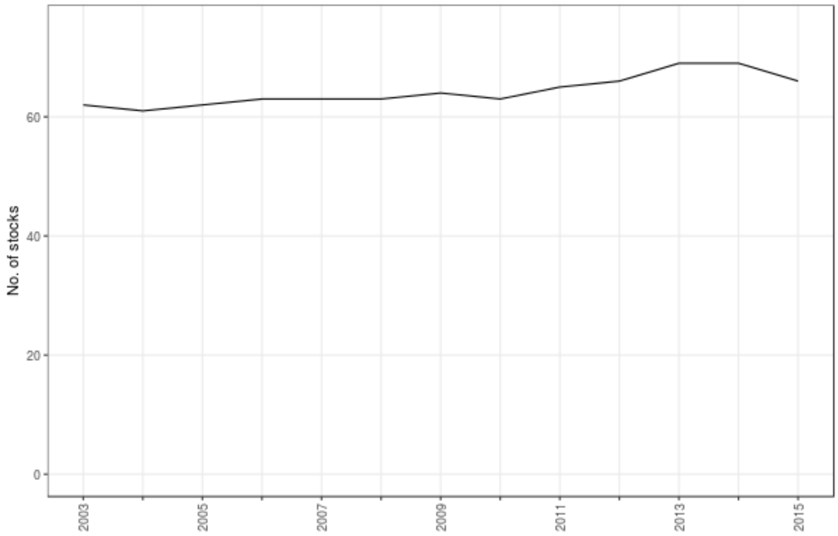

Figure 3.1 Number of stocks in the ICES area for which estimates of F/F_{MSY} are available by year.

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
ALL	62	61	62	63	63	63	64	63	65	66	69	69	66
Baltic Sea	7	7	7	7	7	7	7	7	7	7	7	7	7
BoBiscay & Iberia	8	8	8	8	8	8	8	8	8	8	9	9	9
Celtic Seas	19	18	19	20	20	20	21	20	21	22	24	24	22
Greater North Sea	21	21	21	21	21	21	21	21	22	22	22	22	21
Widely distributed	7	7	7	7	7	7	7	7	7	7	7	7	7

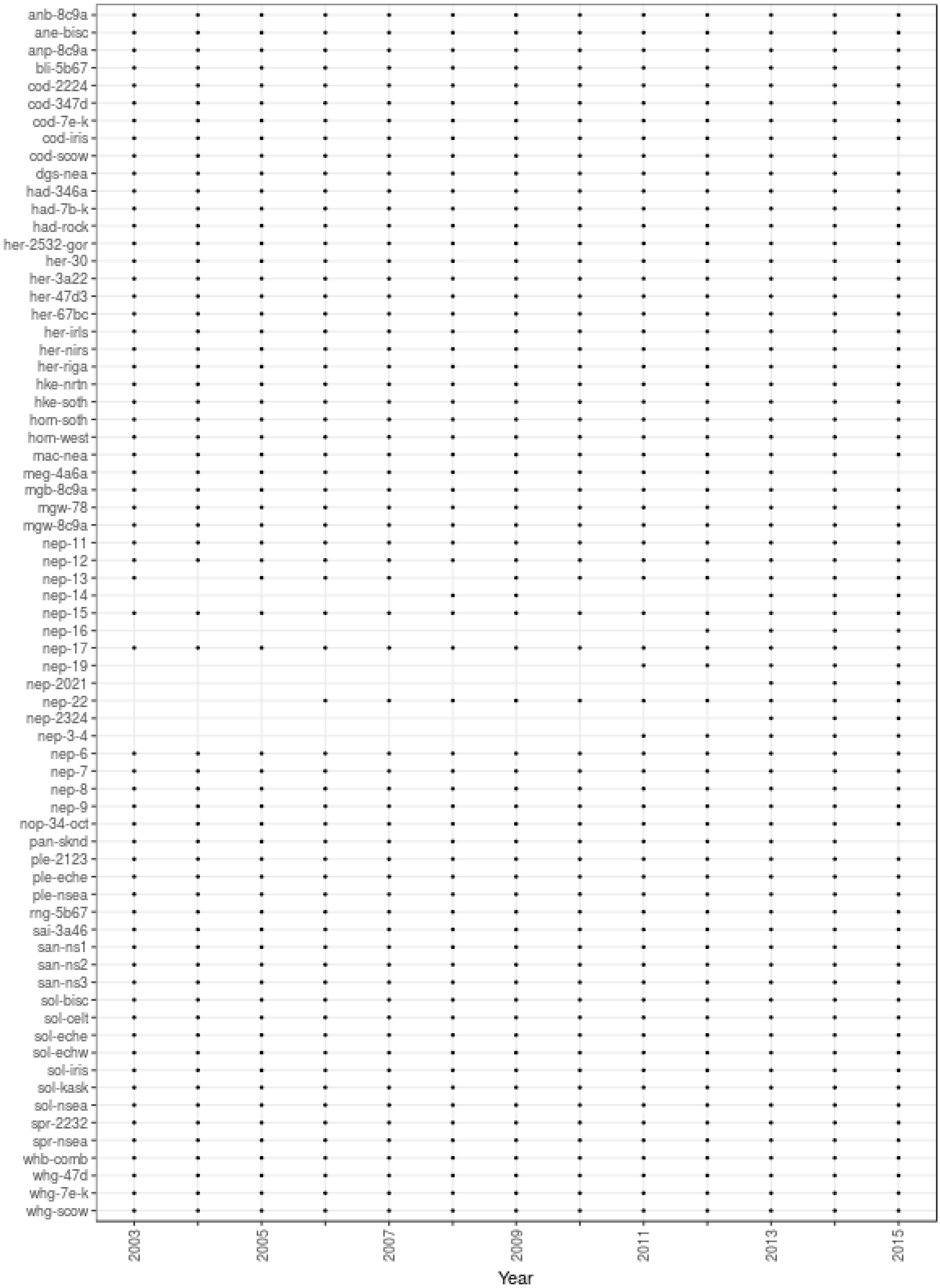

Figure 3.2 Stocks' time series in the ICES area for which estimates of F/F_{MSY} are available by year. Time series of available estimates of F/F_{MSY} by year and stock. Blank records indicate no estimate available for stock and year.

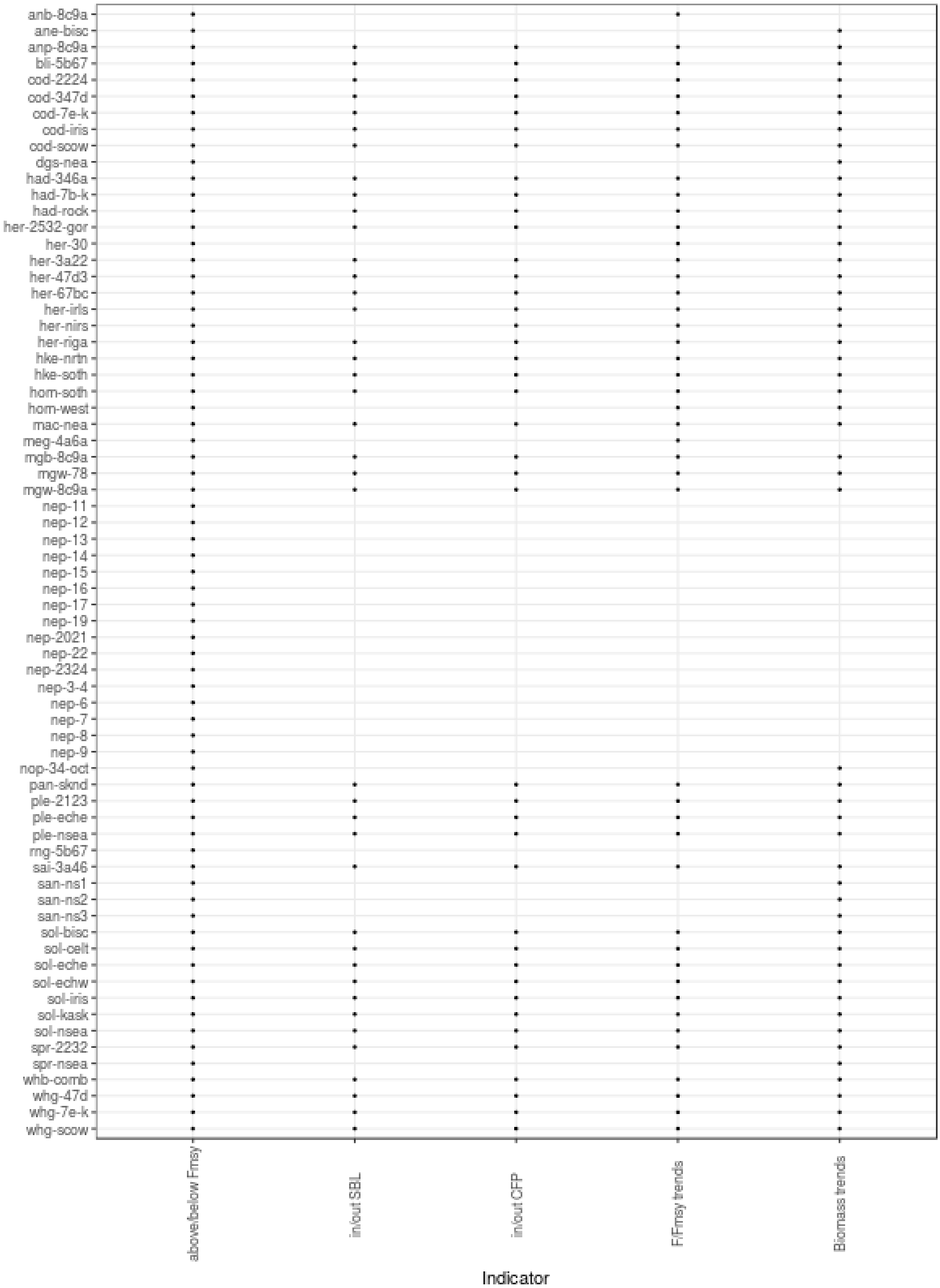

Figure 3.3 – Stocks used in each indicator. Blank records indicate stock not used for indicator.

With relation to the dataset used for the 2016 analysis (STECF, 2016c), several stocks are included in this analysis that were not included previously:

- The stocks dgs-nea, mgw-78, nep-2021 and nep-2324 only became category 1 in 2016 and so were excluded from the analysis last year.

- rng-5b67 was not considered last year as the TACs it is linked to are subspecies special conditions of RTX/5B67 and RTX/8X14.
- whg-47d and whg-scow did not have reference points in 2015.
- ane-bisc doesn't have biologic reference points, only management reference points (HCR parameters). This year the biomass upper trigger is used as a proxy to escapement biomass and as such it is introduced in the analysis.

There are also two stocks that were not assessed in 2015, bli-5b67 and cod-iris, which were assessed in 2016.

These stocks amount to the 10 stocks difference between 2016 and 2017 datasets with regards to the number of stocks available for 2014.

3.1 Indicators of management performance

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

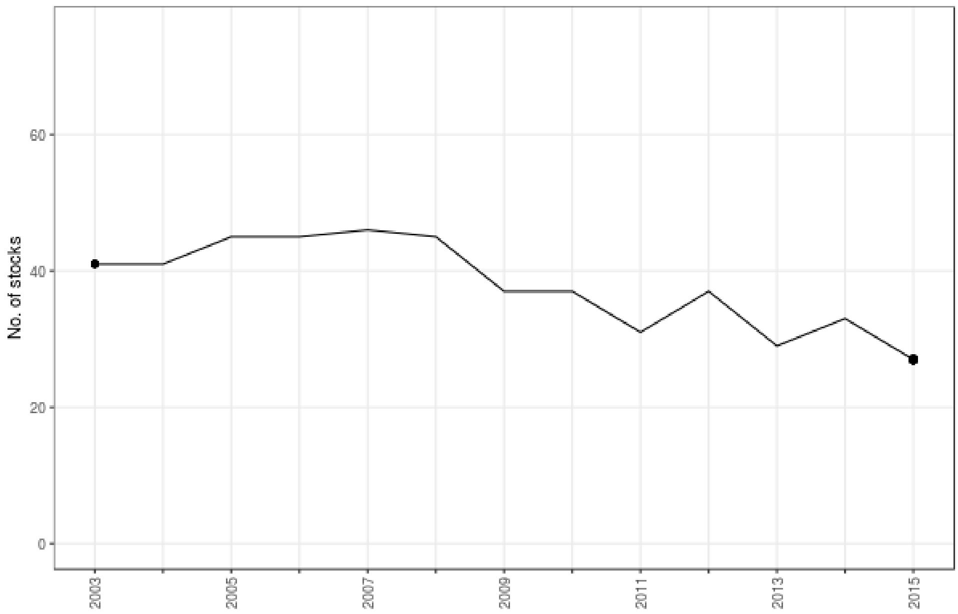

Figure 3.4 Number of stocks where fishing mortality (F) exceeds fishing mortality at MSY (F_{MSY}) by year

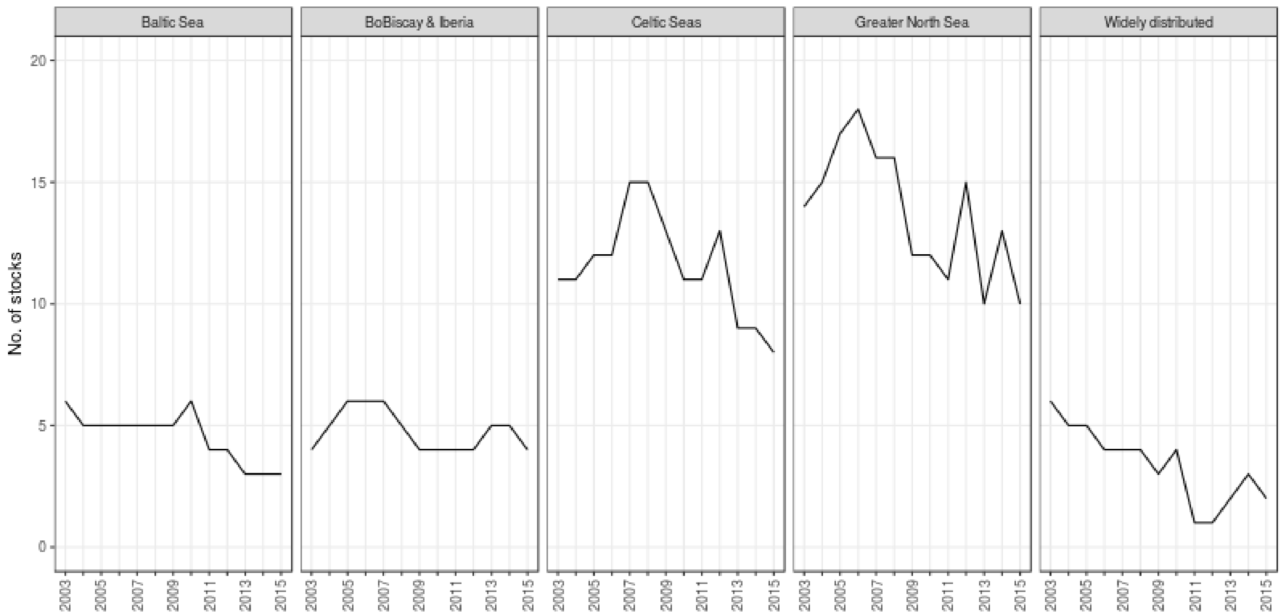

Figure 3.5 Number of stocks where fishing mortality (F) exceeds fishing mortality at MSY (F_{MSY}) by ecoregion and year.

Table 3.2 Number of stocks where fishing mortality (F) exceeds fishing mortality at MSY (F_{MSY}) by ecoregion and year

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ALL	41	41	45	45	46	45	37	37	31	37	29	33	27
Baltic Sea	6	5	5	5	5	5	5	6	4	4	3	3	3
BoBiscay & Iberia	4	5	6	6	6	5	4	4	4	4	5	5	4
Celtic Seas	11	11	12	12	15	15	13	11	11	13	9	9	8
Greater North Sea	14	15	17	18	16	16	12	12	11	15	10	13	10
Widely distributed	6	5	5	4	4	4	3	4	1	1	2	3	2

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

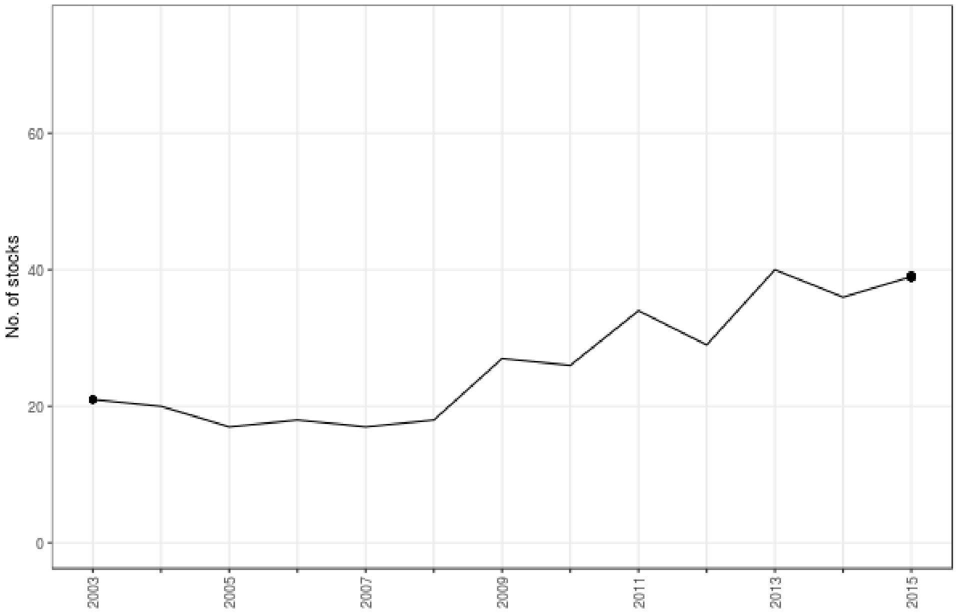

Figure 3.6 Number of stocks where fishing mortality (F) does not exceed fishing mortality at MSY (F_{MSY})

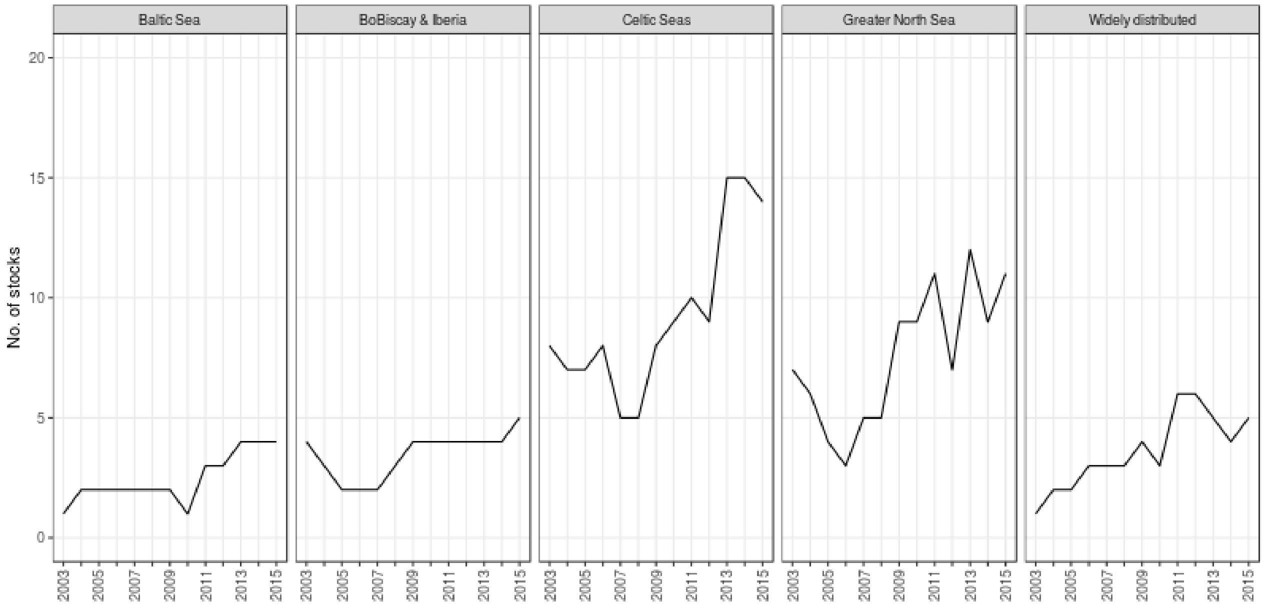

Figure 3.7 Number of stocks where fishing mortality (F) does not exceed fishing mortality at MSY (F_{MSY}) by ecoregion and year.

Table 3.3 Number of stocks where fishing mortality (F) does not exceed fishing mortality at MSY (F_{MSY})

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ALL	21	20	17	18	17	18	27	26	34	29	40	36	39
Baltic Sea	1	2	2	2	2	2	2	1	3	3	4	4	4
BoBiscay & Iberia	4	3	2	2	2	3	4	4	4	4	4	4	5
Celtic Seas	8	7	7	8	5	5	8	9	10	9	15	15	14
Greater North Sea	7	6	4	3	5	5	9	9	11	7	12	9	11
Widely distributed	1	2	2	3	3	3	4	3	6	6	5	4	5

3.1.3 Number of stocks outside safe biological limits

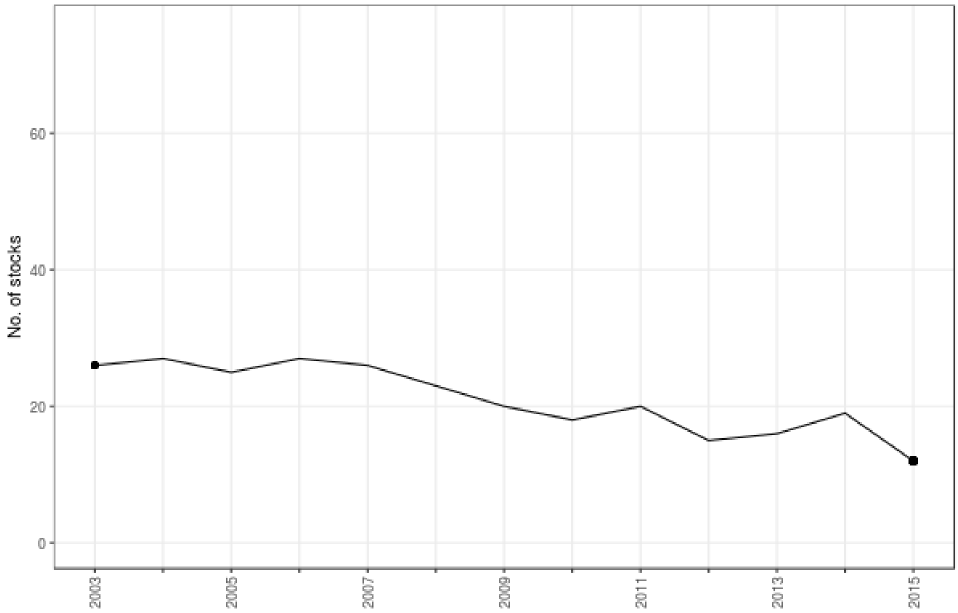

Figure 3.8 Number of stocks outside safe biological limits by year.

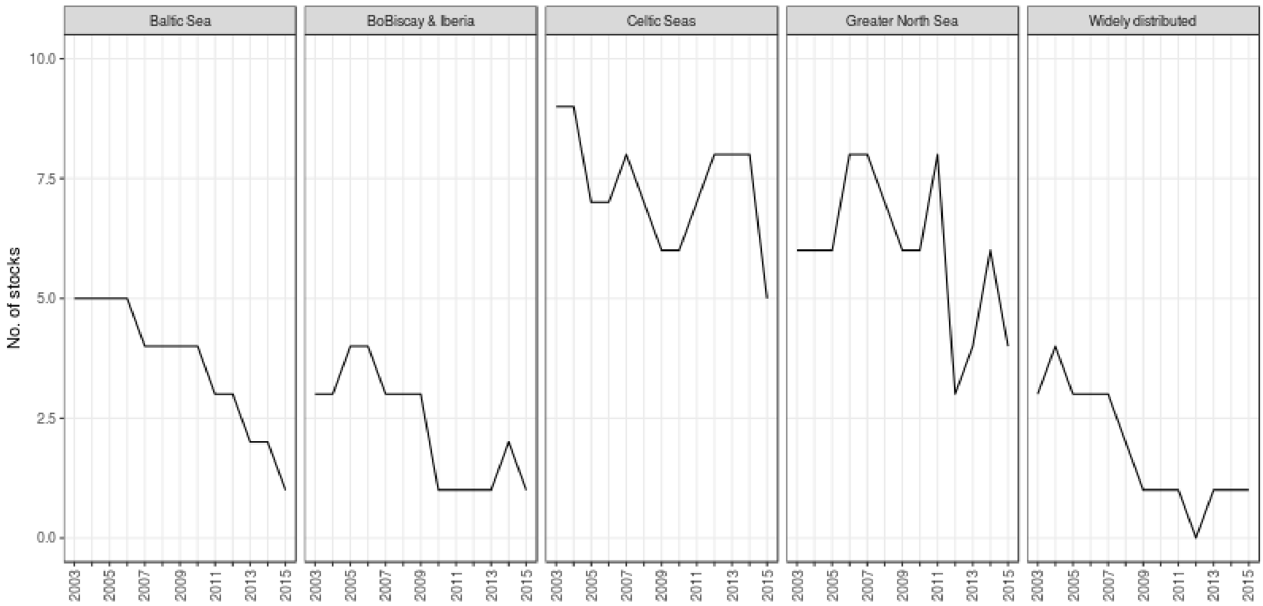

Figure 3.9 Number of stocks outside safe biological limits by ecoregion and year.

Table 3.4 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
ALL	26	27	25	27	26	23	20	18	20	15	16	19	12
Baltic Sea	5	5	5	5	4	4	4	4	3	3	2	2	1
BoBiscay & Iberia	3	3	4	4	3	3	3	1	1	1	1	2	1
Celtic Seas	9	9	7	7	8	7	6	6	7	8	8	8	5
Greater North Sea	6	6	6	8	8	7	6	6	8	3	4	6	4
Widely distributed	3	4	3	3	3	2	1	1	1	0	1	1	1

3.1.4 Number of stocks inside safe biological limits

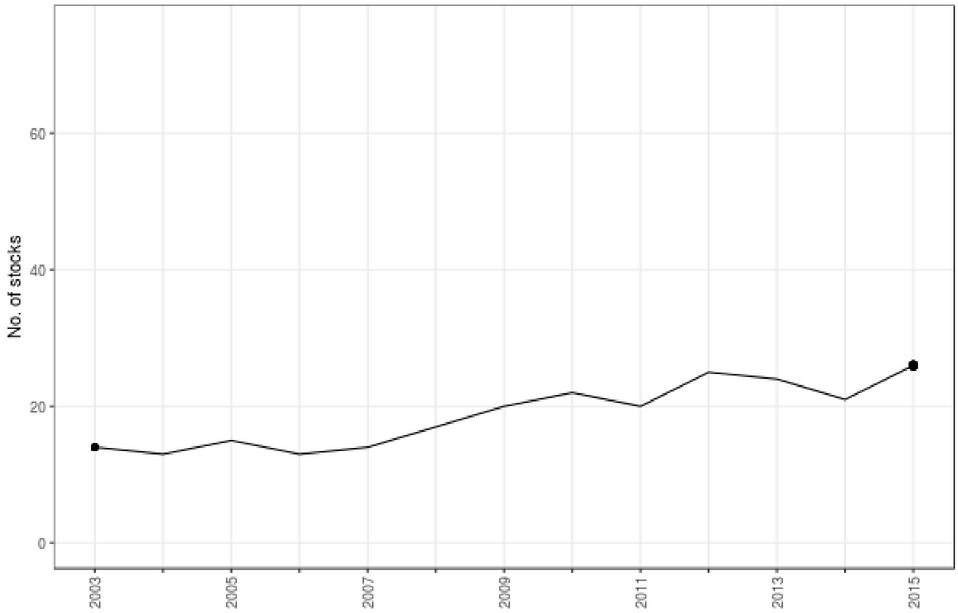

Figure 3.10 Number of stocks inside safe biological limits by year.

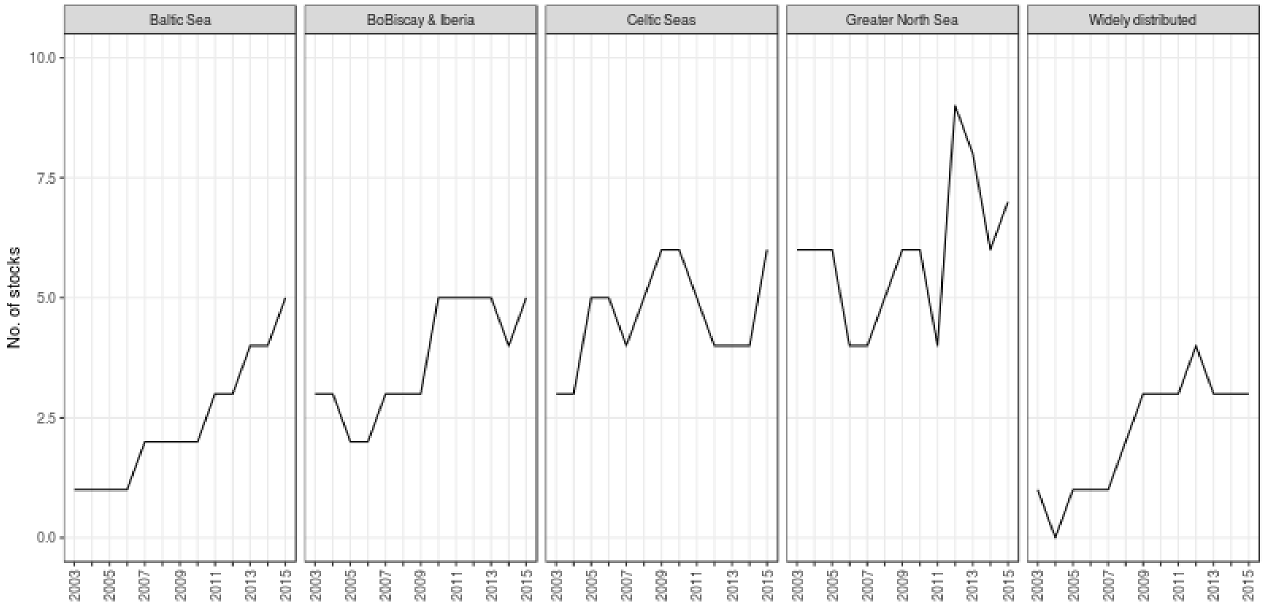

Figure 3.11 Number of stocks inside safe biological limits by ecoregion and year.

Table 3.5 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
ALL	14	13	15	13	14	17	20	22	20	25	24	21	26
Baltic Sea	1	1	1	1	2	2	2	2	3	3	4	4	5
BoBiscay & Iberia	3	3	2	2	3	3	3	5	5	5	5	4	5
Celtic Seas	3	3	5	5	4	5	6	6	5	4	4	4	6
Greater North Sea	6	6	6	4	4	5	6	6	4	9	8	6	7
Widely distributed	1	0	1	1	1	2	3	3	3	4	3	3	3

3.1.5 Number of stocks outside CFP requirements

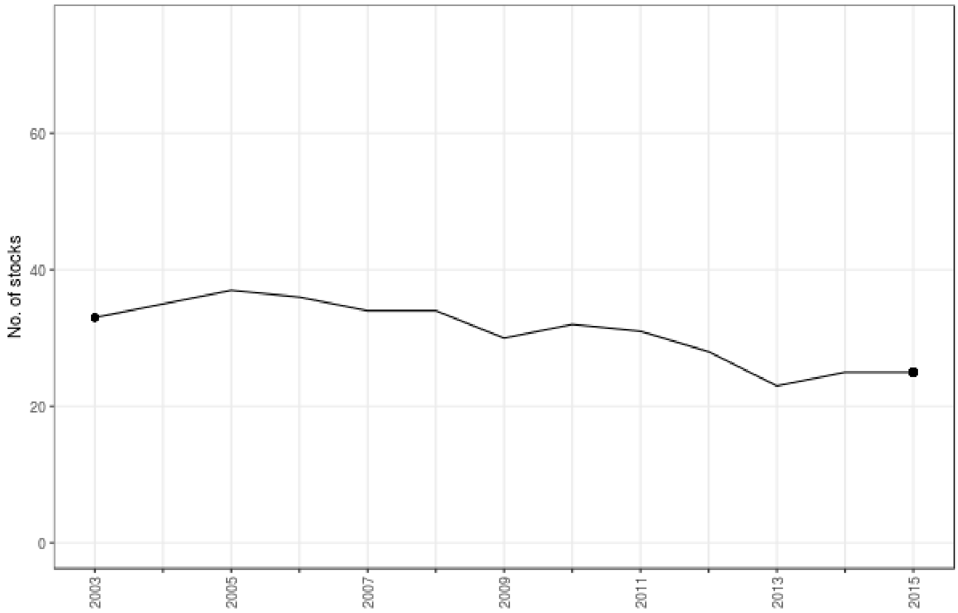

Figure 3.12 Number of stocks outside CFP requirements by year.

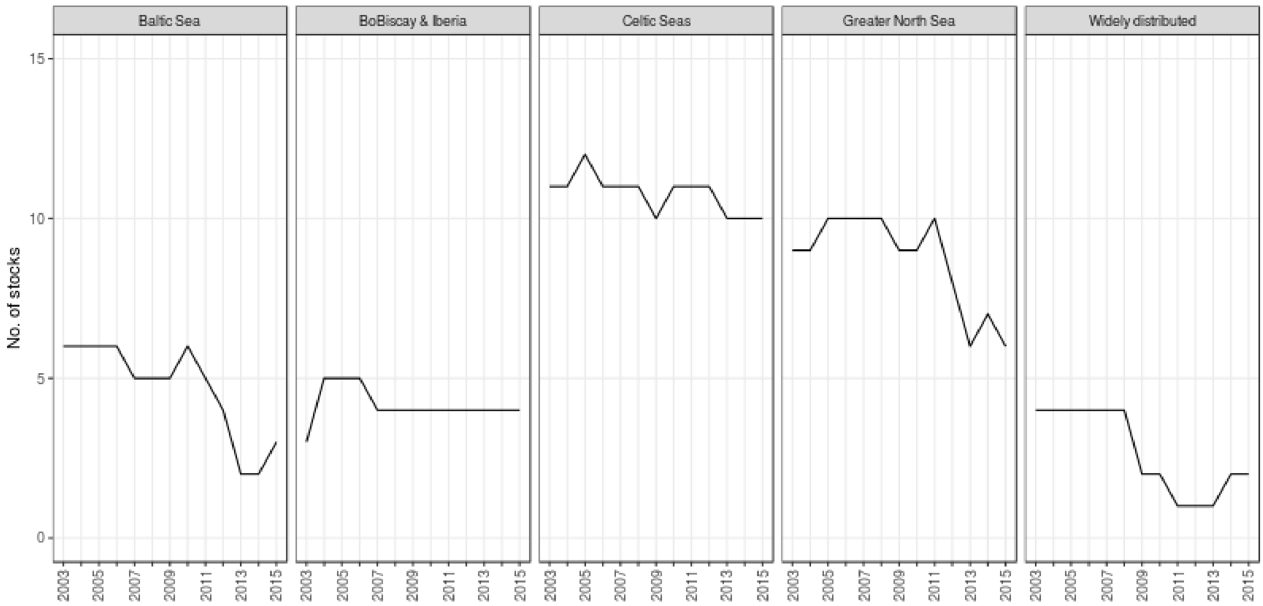

Figure 3.13 Number of stocks outside CFP requirements by ecoregion and year.

Table 3.6 Number of stocks outside CFP requirements by ecoregion and year.

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ALL	33	35	37	36	34	34	30	32	31	28	23	25	25
Baltic Sea	6	6	6	6	5	5	5	6	5	4	2	2	3
BoBiscay & Iberia	3	5	5	5	4	4	4	4	4	4	4	4	4
Celtic Seas	11	11	12	11	11	11	10	11	11	11	10	10	10
Greater North Sea	9	9	10	10	10	10	9	9	10	8	6	7	6
Widely distributed	4	4	4	4	4	4	2	2	1	1	1	2	2

3.1.6 Number of stocks inside CFP requirements

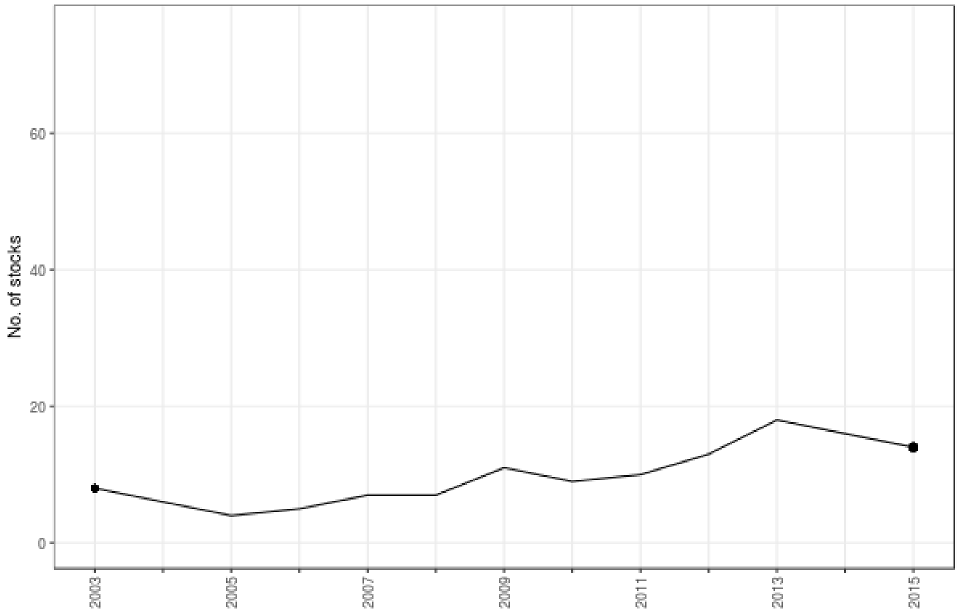

Figure 3.14 Number of stocks inside CFP requirements by year.

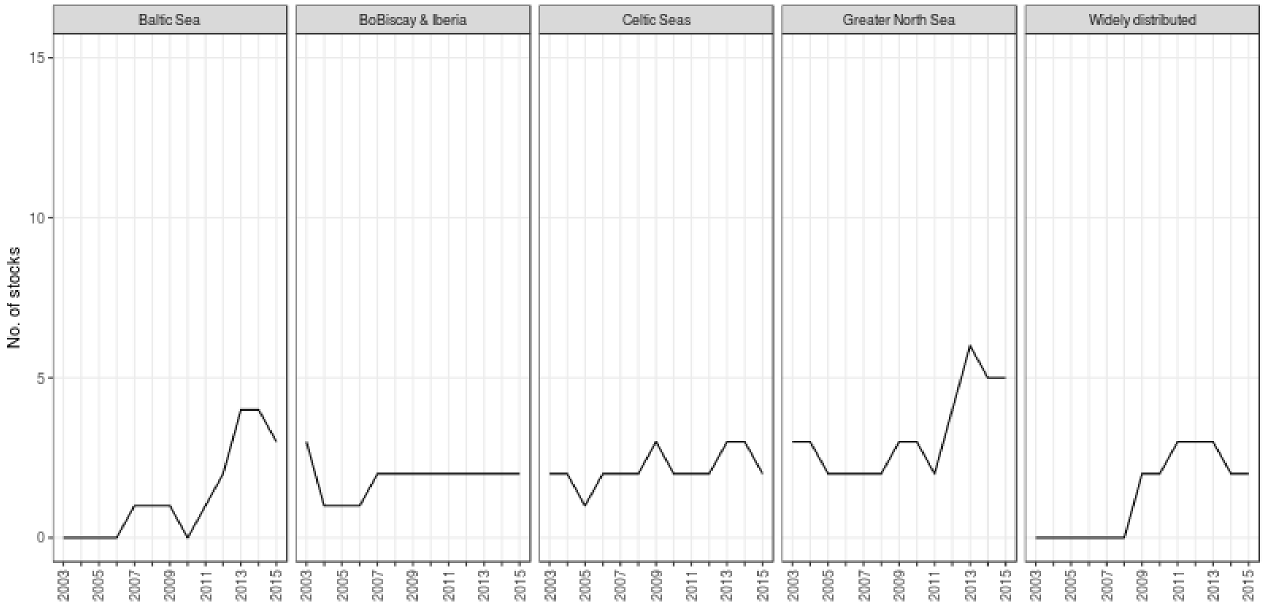

Figure 3.15 Number of stocks inside CFP requirements by ecoregion and year.

Table 3.7 Number of stocks inside CFP requirements by ecoregion and year.

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ALL	8	6	4	5	7	7	11	9	10	13	18	16	14
Baltic Sea	0	0	0	0	1	1	1	0	1	2	4	4	3
BoBiscay & Iberia	3	1	1	1	2	2	2	2	2	2	2	2	2
Celtic Seas	2	2	1	2	2	2	3	2	2	2	3	3	2
Greater North Sea	3	3	2	2	2	2	3	3	2	4	6	5	5
Widely distributed	0	0	0	0	0	0	2	2	3	3	3	2	2

3.1.7 Annual value of F/F_{MSY}

3.1.7.1 Design based indicator

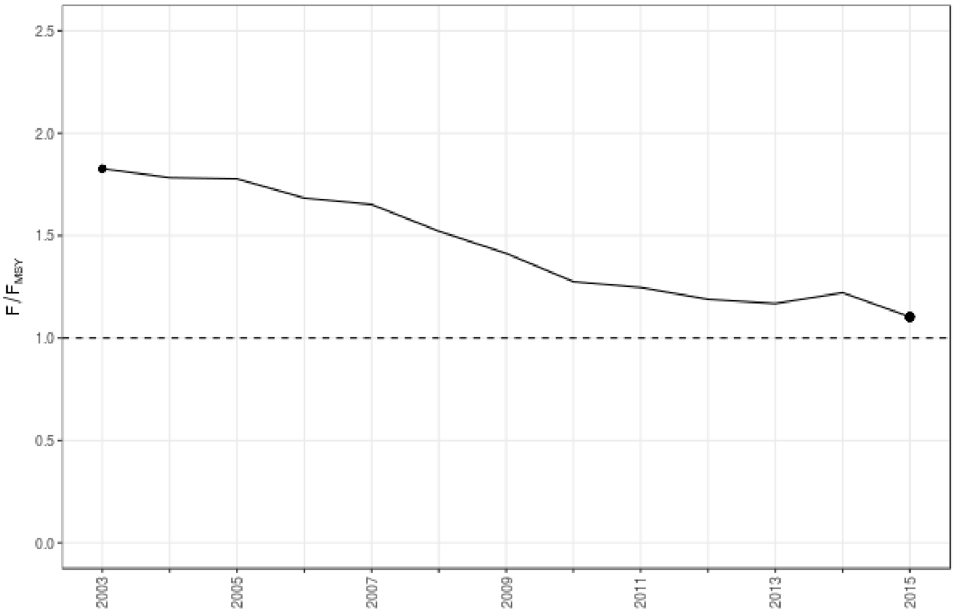

Figure 3.16 Arithmetic mean value of the F/F_{MSY} ratio by year.

Figure 3.17 Arithmetic mean value of F/F_{MSY} by ecoregion and year.

Table 3.8 Arithmetic mean value of F/F_{MSY} by ecoregion and year.

EcoRegion	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ALL	1.83	1.78	1.78	1.68	1.65	1.52	1.41	1.28	1.25	1.19	1.17	1.22	1.10
Baltic Sea	1.89	1.88	1.79	1.71	1.75	1.67	1.68	1.51	1.41	1.33	1.35	1.26	1.25
BoBiscay & Iberia	1.40	1.40	1.46	1.72	1.56	1.42	1.35	1.10	1.25	1.23	1.17	1.34	1.22
Celtic Seas	2.27	2.19	2.22	1.84	1.90	1.79	1.64	1.49	1.49	1.41	1.36	1.41	1.05
Greater North Sea	1.57	1.55	1.50	1.58	1.47	1.33	1.21	1.14	1.09	1.01	0.98	1.04	1.05
Widely distributed	1.70	1.62	1.61	1.41	1.36	1.18	1.00	0.93	0.72	0.74	0.82	0.93	0.96

3.1.7.2 Model based indicator

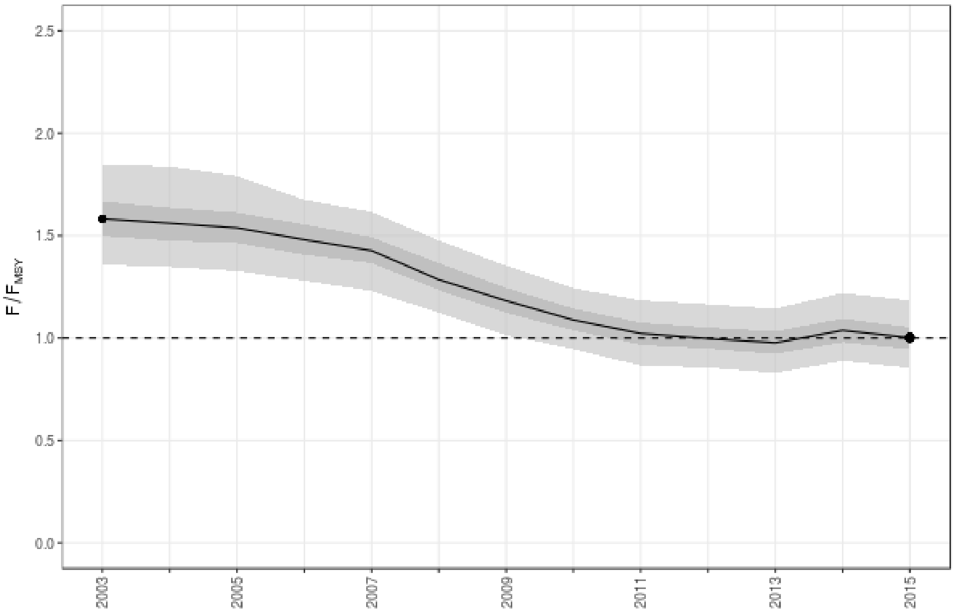

Figure 3.18 Modelled value of F/F_{MSY} by year. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 3.9 Percentiles of F/F_{MSY} by year.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2.5%	1.36	1.35	1.33	1.28	1.23	1.12	1.01	0.95	0.87	0.86	0.83	0.89	0.85
25%	1.50	1.48	1.46	1.41	1.37	1.23	1.12	1.04	0.97	0.95	0.92	0.98	0.95
50%	1.58	1.56	1.54	1.48	1.43	1.29	1.18	1.09	1.02	1.00	0.98	1.04	1.00
75%	1.67	1.64	1.61	1.56	1.49	1.37	1.24	1.14	1.08	1.05	1.03	1.09	1.05
97.5%	1.85	1.84	1.79	1.68	1.62	1.48	1.35	1.24	1.18	1.17	1.14	1.22	1.18

3.1.8 Annual value of SSB (relative to 2003)

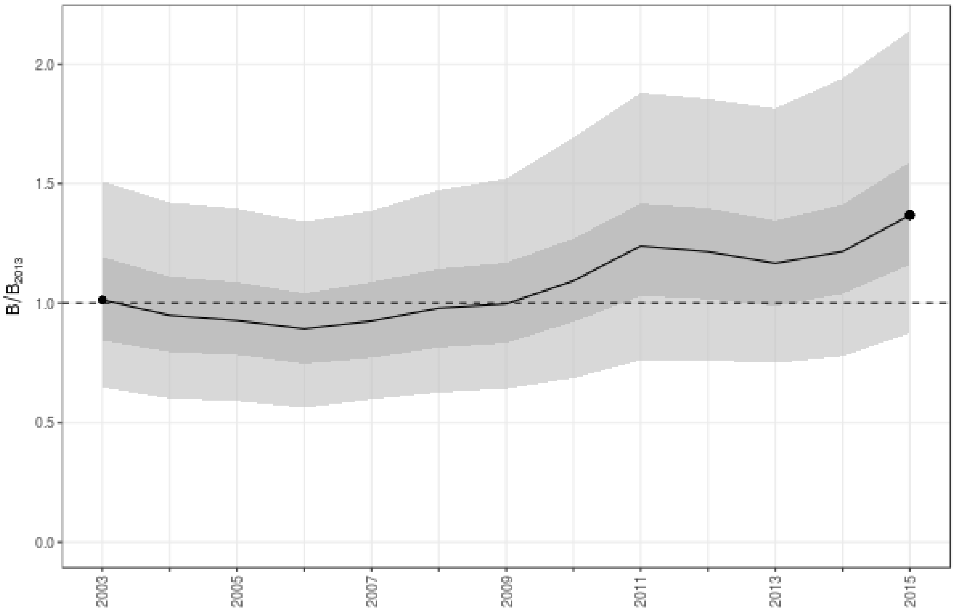

Figure 3.19 Modelled value of SSB by year relative to 2003. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 3.10 Percentiles of SSB by year relative to 2003.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2.5%	0.65	0.60	0.59	0.56	0.60	0.63	0.64	0.69	0.76	0.76	0.75	0.78	0.88
25%	0.84	0.80	0.78	0.75	0.77	0.81	0.83	0.92	1.03	1.02	0.99	1.04	1.16
50%	1.01	0.95	0.93	0.89	0.92	0.98	1.00	1.09	1.24	1.22	1.17	1.22	1.37
75%	1.19	1.11	1.09	1.04	1.09	1.14	1.17	1.27	1.42	1.40	1.35	1.41	1.59
97.5%	1.51	1.42	1.40	1.34	1.39	1.47	1.52	1.69	1.88	1.85	1.82	1.94	2.14

3.1.9 Annual value of F/F_{MSY} for stocks outside the EU waters

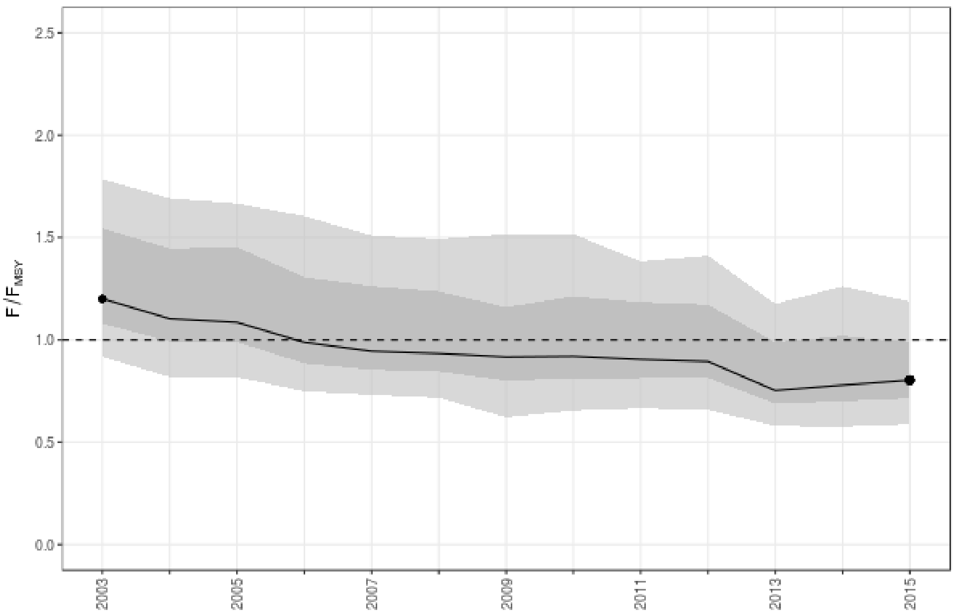

Figure 3.20 Modelled value of F/F_{MSY} for stocks outside the EU waters (see section 2.1 for definition) by year. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 3.11 Percentiles of F/F_{MSY} for stocks outside the EU waters (see section 2.1 for definition) by year.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2.5%	0.92	0.82	0.82	0.75	0.73	0.72	0.62	0.65	0.67	0.66	0.58	0.58	0.59
25%	1.08	0.99	0.99	0.89	0.85	0.85	0.80	0.81	0.81	0.81	0.69	0.70	0.71
50%	1.20	1.10	1.09	0.99	0.94	0.93	0.92	0.92	0.90	0.89	0.75	0.78	0.80
75%	1.54	1.45	1.45	1.31	1.26	1.24	1.16	1.21	1.18	1.17	0.99	1.02	0.99
97.5%	1.79	1.69	1.67	1.60	1.51	1.49	1.52	1.52	1.38	1.41	1.18	1.26	1.19

3.2 Indicators of advice coverage

The advice coverage in the ICES area considered by this analysis accounts for the number of stocks with F_{MSY} or B_{PA} estimates and the number of TACs which are covered by stock assessments. Note that as long as some area of the TAC is covered it's counted as having scientific advice.

Table 3.12 Coverage of TACs by scientific advice. The fraction of TACs considers any fraction of the TAC area covered by a stock assessed by ICES (category 1).

	No of stocks	No of TACs	Fraction of TACs assessed
FMSY	66	156	0.51
Bpa	45	156	0.43

4 MEDITERRANEAN AND BLACK SEAS (FAO REGION 37)

There was a strong increasing trend in the number of stocks assessed each year for years 2003-2009, and a decreasing trend from 2013 with a minimum in 2015. The number of stocks was at a maximum of 37 between 2009 and 2013, and decreasing to 33 in 2014 and 11 in 2015.

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. As such, only the model based indicators are shown.

Nevertheless, the indicators 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 as such should be considered with limitation/care.

Figure 4.1 indicates by year, the number of stocks in the Mediterranean and Black Sea for which estimates of F/F_{MSY} are available. The major reduction in 2015 occurred for a number of reasons:

- the STECF EWG 16-11 assessment meeting for Black Sea stocks was cancelled due to the situation in Turkey and the unavailability of Turkish data and experts;
- the STECF EWG 16-13 Stock assessment in the Mediterranean part I (STECF, 2016d) carried out analytical assessments only for 5 out of 19 stocks.
- the STECF EWG 16-17 Stock assessment in the Mediterranean part II (STECF-16-##) carried out analytical assessment only for 9 out of 17 stocks.
- GFCM assessments performed in 2016 in WGSASP and WGSADM have not yet been reviewed and approved by the GFCM Scientific Advisory Committee, and as such they were not available for this analysis.
- Three stocks that had been included in STECF (2016a) are not included in this analysis:
    - *Nephrops* in GSA11 was not selected in the sample frame
    - Deep-water rose shrimp in GSAs 9 and 10 were dropped in favor of the joint assessment for GSAs 9-10-11.

Regarding 2014, 2 stocks (ARS_9 and MUT_19) were not selected by the new sample frame, while 20 new stocks were added:

- 4 GFCM stocks (HKE_12_13_14_15_16, DPS_12_13_14_15_16, MUT_25, SPR_29)
- 5 EWG Black Sea stocks (ANE_29, DGS_29, HMM_29, MUT_29, TUR_29)
- 11 EWG Mediterranean stocks (ANE_9, ANE_17-18, ANE_6, DPS_1, DPS_9-10-11, MUR_9, NEP_9, NEP_17-18, NEP_6, PIL_6, PIL_17-18)

Regarding 2013, a total of 11 stocks were dropped: 8 stocks (ARS_9, MUT_19, ANK_5, ANK_6, MUT_1, MUT_19, MUT_7, NEP_5, NEP_11) were not selected by the sample frame and 3 other stocks (DPS_9, MUT_18 and NEP_18) were dropped because joint assessment were available. On the other hand, 17 stocks were added:

- 5 GFCM stocks (HKE_12_13_14_15_16, DPS_12_13_14_15_16, MUT_25, SPR_29, ARA_5)
- 5 EWG Black Sea stocks (ANE_29, DGS_29, HMM_29, MUT_29, TUR_29
- 7 EWG Mediterranean stocks (ANE_9, MUR_9, ANE_6, NEP_6, DPS_1, NEP_17-18, DPS_9-10-11)

Since there are no results for 2015 for any of the GFCM or the Black Sea assessments and the indicator values for 2015 are based on the results of only 11 stock assessments, such values are not comparable with those for earlier years of the time-series. Hence in Figure 4.1, the 2015 value is represented as stand-alone, and the indicators are plotted up to 2014 only.

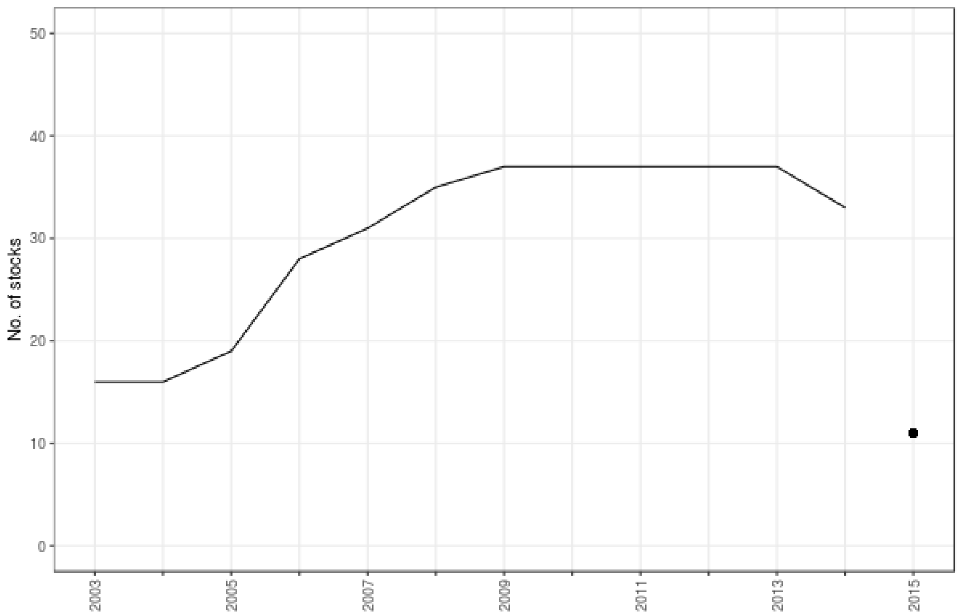

Figure 4.1 Number of stocks in the Mediterranean and Black Sea for which estimates of F/FMSY are available by year. The totals include stocks in the following GSAs only: 1, 5-7, 9, 10-19, 25 and 29.

Considering the stock assessments currently available the sampling frame excludes 10 stocks (Table 4.1).

Table 4.1 Stock assessments excluded by the sampling frame.

Area/GSA	3alpha_code	Scientific_name	English_name	Meeting
9	ARS	*Aristaeomorpha foliacea*	Giant red shrimp	EWG15_11
5	ANK	*Lophius budegassa*	Blackbellied angler	EWG14_19
6	ANK	*Lophius budegassa*	Blackbellied angler	EWG14_19
29	WHG	*Merlangius merlangus*	Whiting	EWG15_12
9	WHB	*Micromesistious poutassou*	Blue whiting	EWG14_09
19	MUT	*Mullus barbatus*	Red mullet	EWG15_16
7	MUT	*Mullus barbatus*	Red mullet	EWG14_09
5	NEP	*Nephrops norvegicus*	Norway lobster	EWG14_19
11	NEP	*Nephrops norvegicus*	Norway lobster	EWG16_17
1	MUT	*Mullus barbatus*	Red mullet	EWG14_19

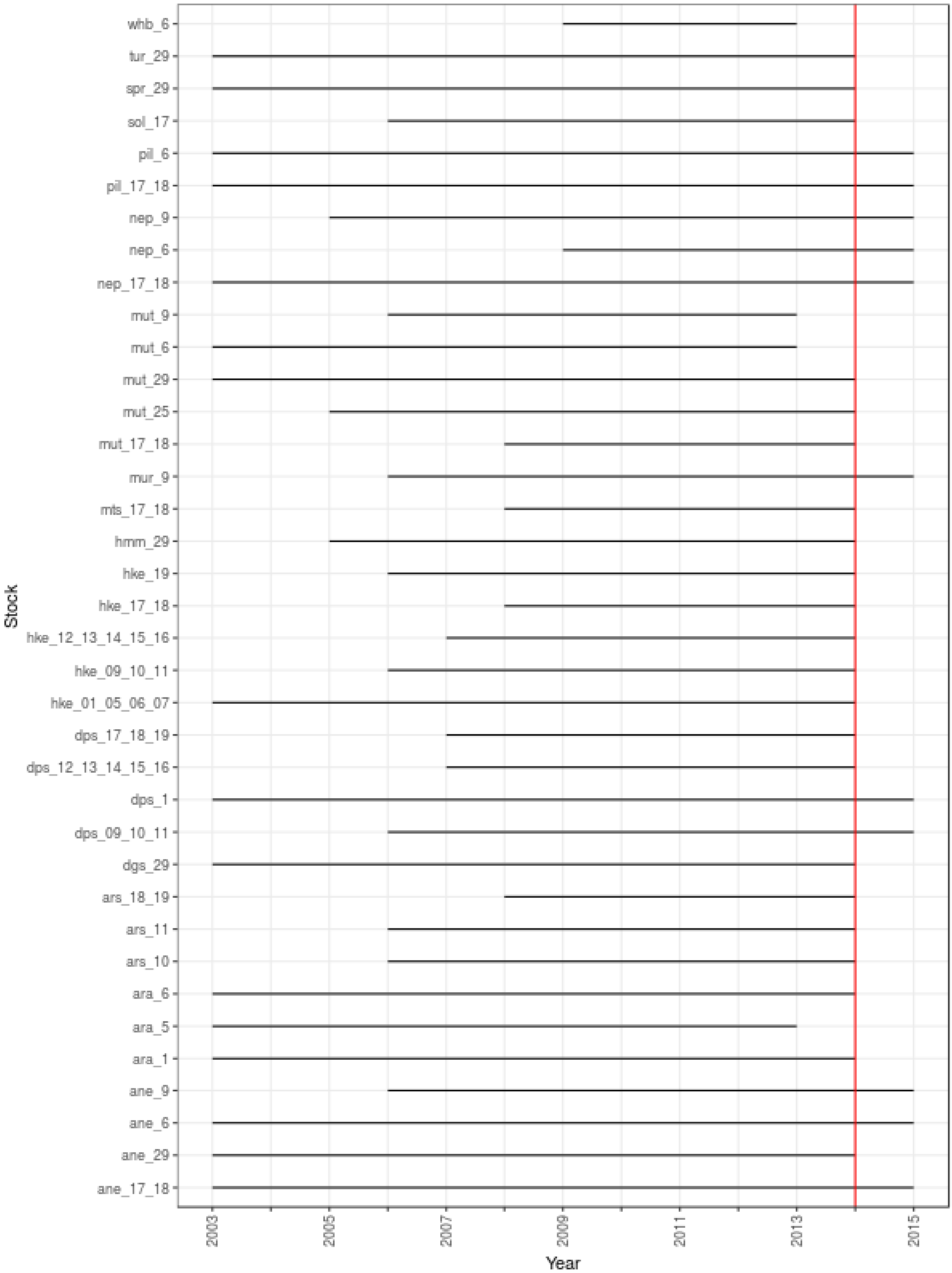

Figure 4.2 Time-series of stock assessments available from both STECF and GFCM for computation of model based CFP monitoring indicators for Mediterranean and Black Seas. The red line indicates that only stock assessment results up to and including 2014 have been used to compute the indicator values.

4.1 Indicators of management performance

4.1.1 Annual value of F/F_{MSY} – model based indicator

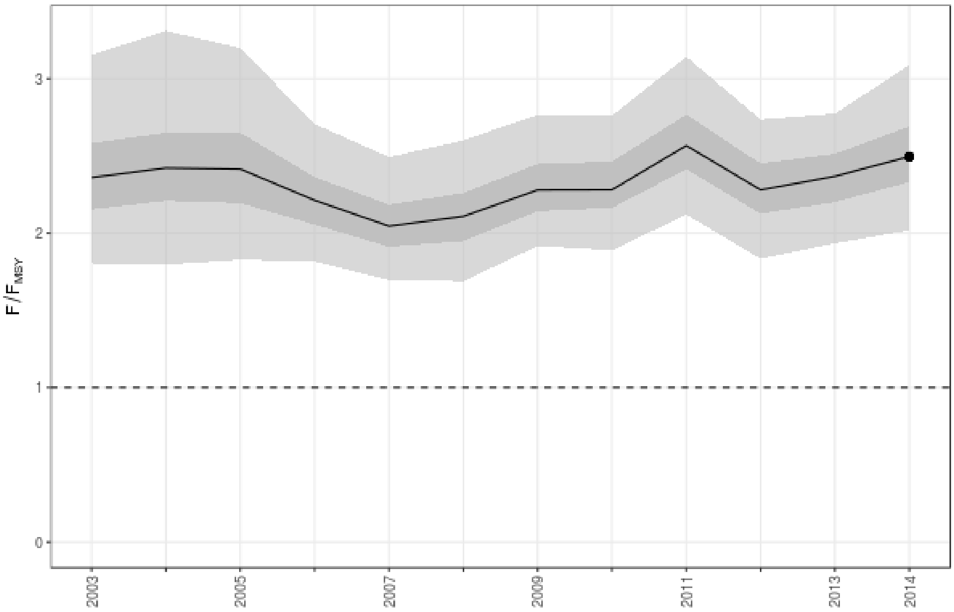

Figure 4.3 Modelled value of F/F_{MSY}. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 4.2 Percentiles of F/F_{MSY} by year.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
2.50%	1.80	1.80	1.83	1.82	1.70	1.69	1.92	1.89	2.12	1.83	1.93	2.02
25%	2.15	2.21	2.20	2.06	1.91	1.95	2.14	2.16	2.41	2.13	2.20	2.33
50%	2.36	2.42	2.42	2.21	2.05	2.11	2.28	2.28	2.57	2.28	2.37	2.50
75%	2.58	2.65	2.65	2.36	2.18	2.26	2.45	2.46	2.77	2.45	2.51	2.69
97.50%	3.15	3.31	3.20	2.71	2.49	2.60	2.77	2.76	3.14	2.74	2.77	3.09

4.1.2 Annual value of SSB (relative to 2003)

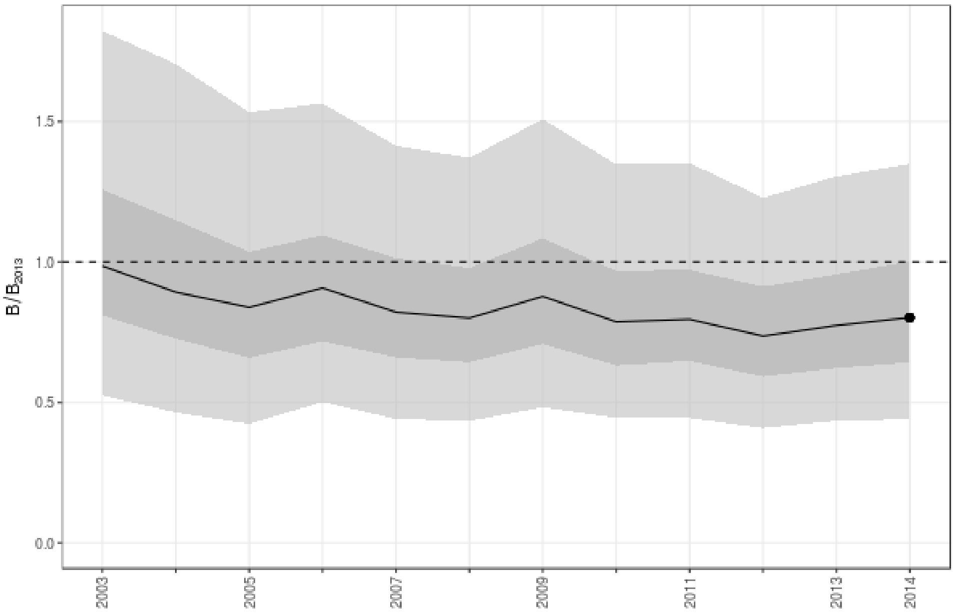

Figure 4.4 Modelled value of SSB by year relative to 2003. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 4.3 Percentiles of SSB by year relative to 2003.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
2.50%	0.53	0.46	0.42	0.50	0.44	0.43	0.48	0.45	0.44	0.41	0.44	0.44
25%	0.81	0.73	0.66	0.72	0.66	0.64	0.71	0.63	0.65	0.59	0.62	0.64
50%	0.99	0.89	0.84	0.91	0.82	0.80	0.88	0.79	0.80	0.74	0.77	0.80
75%	1.26	1.15	1.04	1.10	1.01	0.98	1.08	0.97	0.97	0.91	0.96	1.00
97.5%	1.82	1.71	1.53	1.56	1.41	1.37	1.51	1.35	1.35	1.23	1.30	1.35

4.2 Indicators of advice coverage

In the Mediterranean and the Black Sea 57 species/GSA combinations of the 230 in the sampling frame are covered by stock assessments. This figure is obtained by summing the number of GSAs covered by the stock assessments carried out in 2014 and selected for this analysis. The scientific coverage indicator for the Mediterranean and the Black Sea is 0.25.

5 EXPERIMENTAL INDICATORS

STECF (2016b) required a list of indicators to be computed. From this list a set were chosen to be added to the core sections of the report, while the remaining indicators were considered experimental, in the sense that more data and testing is needed to stabilize the indicators. This section presents those indicators. These indicators should be considered with care.

5.1 Recruitment in the NEA

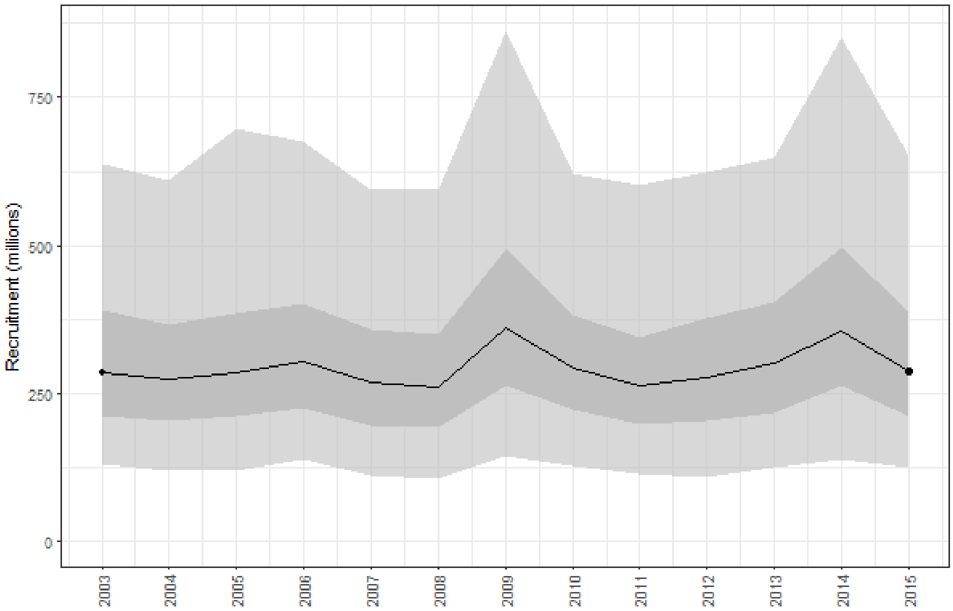

Figure 5.1 Modelled value of Recruitment (millions) by year in the NEA. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 5.1 - Percentiles of Recruitment (milliions) by year in the NEA.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2.5%	129	120	119	137	110	106	143	128	114	109	123	139	125
25%	212	203	210	225	196	191	262	222	198	204	217	263	212
50%	283	275	285	303	267	260	359	291	262	276	301	356	288
75%	390	365	386	402	358	350	494	382	344	376	403	496	387
97.5%	637	609	696	674	595	594	863	621	603	623	647	853	650

5.2 Recruitment in the Mediterranean and Black Sea

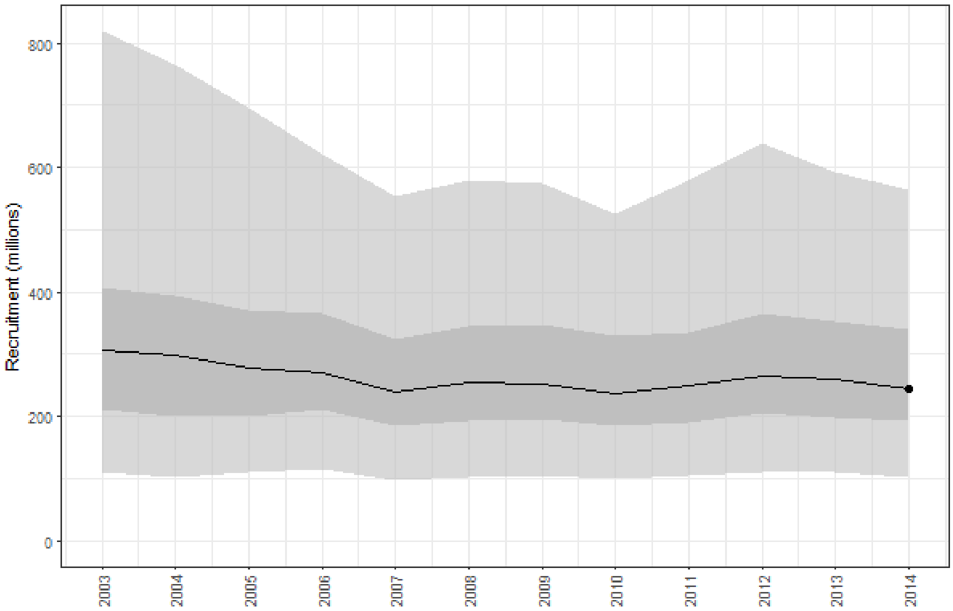

Figure 5.2 Modelled value of Recruitment by year in the Mediterranean and Black Sea. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 5.2 Percentiles of Recruitment (millions) by year in the Mediterranean and Black Sea.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
2.5%	110	102	109	117	98	103	105	100	104	109	110	101
25%	211	201	201	211	185	193	196	184	191	206	198	192
50%	305	298	278	269	239	255	253	238	249	266	259	245
75%	408	395	371	364	325	344	347	329	336	365	352	340
97.5%	820	765	695	622	553	580	576	525	579	640	593	563

5.3 Biomass trends for data limited stocks (ICES DLS category 03) in the NEA

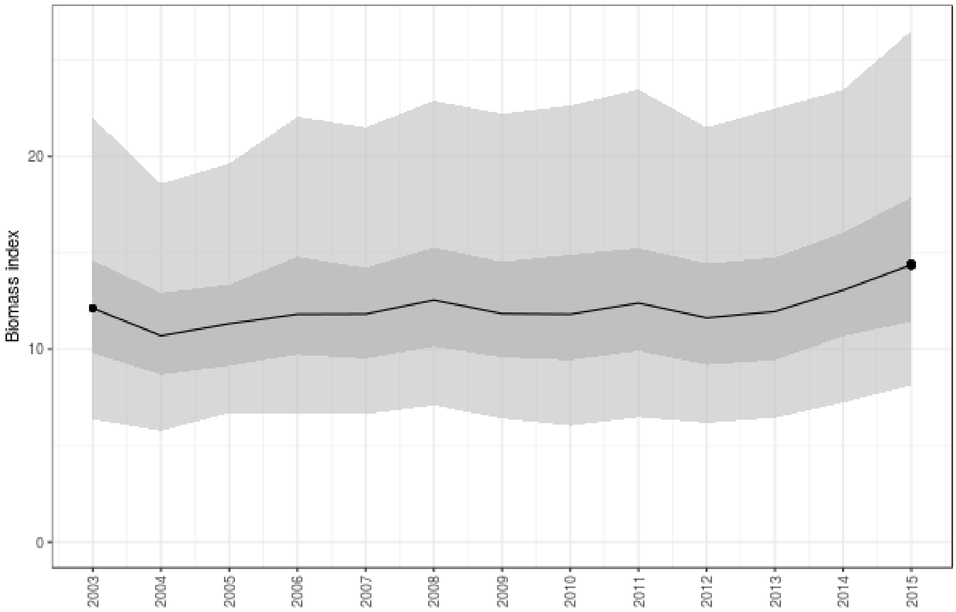

Figure 5.3 Biomass index trends for 26 data limited stocks (ICES DLS category 03) in the NEA. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 5.3 - Percentiles of the biomass index for 26 data limited stocks (ICES DLS category 03).

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2.5%	6.36	5.77	6.70	6.65	6.64	7.09	6.41	6.04	6.48	6.18	6.45	7.23	8.13
25%	9.80	8.68	9.14	9.72	9.51	10.13	9.58	9.43	9.91	9.20	9.43	10.67	11.45
50%	12.12	10.70	11.32	11.81	11.83	12.55	11.84	11.82	12.40	11.63	11.96	13.06	14.38
75%	14.60	12.93	13.35	14.79	14.22	15.27	14.53	14.91	15.24	14.44	14.75	16.04	17.88
97.5%	22.00	18.58	19.63	22.05	21.50	22.89	22.21	22.64	23.47	21.50	22.49	23.45	26.51

5.4 B/B_{PA} trends in the NEA

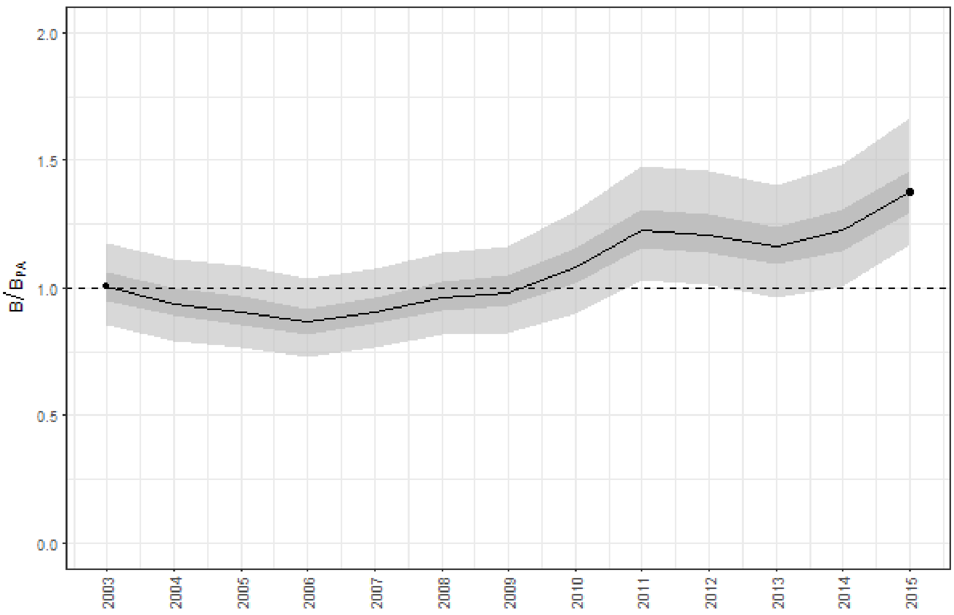

Figure 5.4 Modelled value of B/B_{PA} by year. Dark grey zone shows the 50% confidence interval; the light grey zone shows the 95% confidence interval.

Table 5.4 Percentiles of B/BPA by year.

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
2.5%	6.36	5.77	6.70	6.65	6.64	7.09	6.41	6.04	6.48	6.18	6.45	7.23	8.13
25%	9.80	8.68	9.14	9.72	9.51	10.13	9.58	9.43	9.91	9.20	9.43	10.67	11.45
50%	12.12	10.70	11.32	11.81	11.83	12.55	11.84	11.82	12.40	11.63	11.96	13.06	14.38
75%	14.60	12.93	13.35	14.79	14.22	15.27	14.53	14.91	15.24	14.44	14.75	16.04	17.88
97.5%	22.00	18.58	19.63	22.05	21.50	22.89	22.21	22.64	23.47	21.50	22.49	23.45	26.51

6 STATUS ACROSS ALL STOCKS IN 2016

Table 6.1 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 FMSY (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 '-' for missing information.

EcoRegion	Year	Stock	Description	F ind	F status	SBL	CFP
Black sea	2014	ane_29	European anchovy in GSA 29	1.89		-	-
Black sea	2014	dgs_29	Picked dogfish in GSA 29	2.99		-	-
Black sea	2014	hmm_29	Mediterranean horse mackerel in GSA 29	5.46		-	-
Black sea	2014	mut_29	Red mullet in GSA 29	1.68		-	-
Black sea	2014	tur_29	Turbot in GSA 29	5.39		-	-
Black sea	2014	spr_29	Sprattus sprattus in GSA 29	0.95	o	-	-
Central Med.	2015	ane_17_18	European anchovy in GSA 17, 18	2.77		-	-
Central Med.	2015	nep_17_18	Nephrops in GSA 17, 18	1.28		-	-
Central Med.	2015	pil_17_18	European pilchard(=Sardine) in GSA 17, 18	4.87		-	-
Central Med.	2014	ars_18_19	Giant red shrimp in GSA 18, 19	1.10		-	-
Central Med.	2014	dps_17_18_19	Deep-water rose shrimp in GSA 17, 18, 19	2.21		-	-
Central Med.	2014	hke_17_18	European hake in GSA 17, 18	5.57		-	-
Central Med.	2014	hke_19	European hake in GSA 19	4.86		-	-
Central Med.	2014	mts_17_18	Spottail mantis squillid in GSA 17, 18	1.24		-	-
Central Med.	2014	mut_17_18	Red mullet in GSA 17, 18	1.32		-	-
Central Med.	2014	sol_17	Common sole in GSA 17	2.44		-	-
Central Med.	2014	hke_12_13_14_15_16	Merluccius merluccius in GSA 12, 13, 14, 15, 16	4.22		-	-
Central Med.	2014	dps_12_13_14_15_16	Parapenaeus longirostris in GSA 12, 13, 14, 15, 16	1.15		-	-
Eastern Med.	2014	mut_25	Mullus barbatus in GSA 25	2.50		-	-
Western Med.	2015	ane_9	European anchovy in GSA 9	2.19		-	-
Western Med.	2015	ane_6	Anchovy in GSA 6	0.89	o	-	-
Western Med.	2015	dps_1	Deep-water rose shrimp in GSA 1	0.90	o	-	-
Western Med.	2015	dps_09_10_11	Deep-water rose shrimp in GSA 09, 10, 11	0.95	o	-	-
Western Med.	2015	mur_9	Surmullet in GSA 9	0.95	o	-	-
Western Med.	2015	nep_9	Norway lobster in GSA 9	1.78		-	-
Western Med.	2015	nep_6	Norway lobster in GSA 6	9.49		-	-
Western Med.	2015	pil_6	European pilchard(=Sardine) in GSA 6	2.53		-	-
Western Med.	2014	ara_1	Blue and red shrimp in GSA 1	3.90		-	-
Western Med.	2014	ara_6	Blue and red shrimp in GSA 6	1.23		-	-
Western Med.	2014	ars_10	Giant red shrimp in GSA 10	1.40		-	-
Western Med.	2014	ars_11	Giant red shrimp in GSA 11	1.60		-	-
Western Med.	2014	hke_01_05_06_07	European hake in GSA 01, 05, 06, 07	2.88		-	-

EcoRegion	Year	Stock	Description	F ind	F status	SBL	CFP
Western Med.	2014	hke_09_10_11	European hake in GSA 09, 10, 11	5.26		-	-
Western Med.	2013	mut_6	Red mullet in GSA 6	2.77		-	-
Western Med.	2013	mut_9	Red mullet in GSA 9	1.17		-	-
Western Med.	2013	whb_6	Blue whiting(=Poutassou) in GSA 6	7.88		-	-
Western Med.	2013	ara_5	Aristeus antennatus in GSA 5	1.29		-	-
Baltic Sea	2015	cod-2224	Cod (Gadus morhua) in Subdivisions 22â€“24 (Western Baltic Sea)	3.37			
Baltic Sea	2015	her-2532-gor	Herring in Subdivisions 25 - 29 (excluding Gulf of Riga) and 32	0.83	o	o	o
Baltic Sea	2015	her-30	Herring in Subdivision 30 (Bothnian Sea)	0.97	o	-	-
Baltic Sea	2015	her-3a22	Herring in Division IIIa and Subdivisions 22 - 24 (Western Baltic spring spawners)	0.80	o	o	o
Baltic Sea	2015	her-riga	Herring in Subdivision 28.1 (Gulf of Riga)	1.32		o	
Baltic Sea	2015	ple-2123	Plaice in Subdivisions 21. 22. and 23 (Kattegat. Belts. and Sound)	0.45	o	o	o
Baltic Sea	2015	spr-2232	Sprat in Subdivisions 22 - 32 (Baltic Sea)	1.03		o	
BoBiscay and Iberia	2015	anb-8c9a	Black-bellied anglerfish (Lophius budegassa) in Divisions VIIIc and IXa (Cant. Sea. Atl. Iberian Waters)	0.52	o	-	-
BoBiscay and Iberia	2015	ane-bisc	Anchovy (Engraulis encrasicolus) in Subarea VIII (Bay of Biscay)	*	o	-	-
BoBiscay and Iberia	2015	anp-8c9a	White anglerfish (Lophius piscatorius) in Divisions VIIIc and IXa (Cantabrian Sea. Atlanic Iberian Waters)	0.68	o	o	o
BoBiscay and Iberia	2015	hke-soth	Hake in Division VIIIc and IXa (Southern stock)	2.10		o	
BoBiscay and Iberia	2015	hom-soth	Horse mackerel (Trachurus trachurus) in Division IXa (Southern stock)	0.40	o	o	o
BoBiscay and Iberia	2015	mgb-8c9a	Four-spot megrim (Lepidorhombus boscii) in Divisions VIIIc and IXa	2.14		o	
BoBiscay and Iberia	2015	mgw-8c9a	Megrim (Lepidorhombus whiffiagonis) in Divisions VIIIc and IXa	1.38		o	
BoBiscay and Iberia	2015	nep-2324	Nephrops in Divisions VIIIa.b (Bay of Biscay. FU 23. 24)	0.78	o	-	-
BoBiscay and Iberia	2015	sol-bisc	Sole in Divisions VIIIa.b (Bay of Biscay)	1.34			
Celtic Seas	2015	cod-7e-k	Cod (Gadus morhua) in Divisions VIIeâ€“k (Western English Channel and Southern Celtic Seas)	1.51			
Celtic Seas	2015	cod-iris	Cod (Gadus morhua) in Division VIIa (Irish Sea)	2.91			
Celtic Seas	2015	had-7b-k	Haddock in Divisions VIIb.c.e-k	1.30		o	
Celtic Seas	2015	had-rock	Haddock in Division VIb (Rockall)	1.07		o	
Celtic Seas	2015	her-67bc	Herring (Clupea harengus) in Divisions VIa and VIIb.c (West of Scotland. West of Ireland)	0.44	o		
Celtic Seas	2015	her-irls	Herring in Division VIIa South of 52Â° 30â€™ N and VIIg.h.j.k (Celtic Sea and South of Ireland)	0.73	o	o	o
Celtic Seas	2015	her-nirs	Herring in Division VIIa North of 52Â° 30â€™ N (Irish Sea)	1.01		-	
Celtic Seas	2015	mgw-78	Megrim (Lepidorhombus whiffiagonis) in Divisions VIIb-k and VIIIa.b.d	1.13		o	
Celtic Seas	2015	nep-11	Nephrops in Division VIa (North Minch. FU 11)	0.70	o	-	-
Celtic Seas	2015	nep-12	Nephrops in Division VIa (South Minch. FU 12)	0.55	o	-	-
Celtic Seas	2015	nep-13	Nephrops in the Firth of Clyde + Sound of Jura (FU 13)	0.82	o	-	-
Celtic Seas	2015	nep-14	Nephrops in Division VIIa (Irish Sea East. FU 14)	0.27	o	-	-
Celtic Seas	2015	nep-15	Nephrops in Division VIIa (Irish Sea West. FU 15)	1.10		-	-
Celtic Seas	2015	nep-16	Nephrops in Division VIIb.c.j.k (Porcupine Bank. FU 16)	0.53	o	-	-
Celtic Seas	2015	nep-17	Nephrops in Division VIIb (Aran Grounds. FU 17)	0.40	o	-	-
Celtic Seas	2015	nep-19	Nephrops in Division VIIa.g.j (South East and West of IRL. FU 19)	0.60	o	-	-
Celtic Seas	2015	nep-2021	Nephrops in the FU 20 (Labadie) and FU 21 (Jones and Cockburn)	0.68	o	-	-
Celtic Seas	2015	nep-22	Nephrops in the Smalls (FU 22)	0.79	o	-	-
Celtic Seas	2015	sol-celt	Sole in Divisions VIIf. g (Celtic Sea)	1.13		o	
Celtic Seas	2015	sol-iris	Sole in Division VIIa (Irish Sea)	0.38	o		
Celtic Seas	2015	whg-7e-k	Whiting in ICES Division VIIb. c. e-k	0.73	o	o	o

EcoRegion	Year	Stock	Description	F ind	F status	SBL	CFP
Celtic Seas	2015	whg-scow	Whiting in Division VIa (West of Scotland)	0.32	o		
Celtic Seas	2014	cod-scow	Cod (Gadus morhua) in Division VIa (West of Scotland)	4.69			
Celtic Seas	2014	meg-4a6a	Megrim (Lepidorhombus spp) in Divisions IVa and VIa	0.30	o	-	-
Greater North Sea	2015	cod-347d	Cod (Gadus morhua) in Subarea IV and Divisions VIId and IIIa West (N.Sea. East. Eng. Channel. Skagerrak)	1.12			
Greater North Sea	2015	had-346a	Haddock in Subarea IV and Divisions IIIa West and VIa (North Sea. Skagerrak and West of Scotland)	2.14			
Greater North Sea	2015	her-47d3	Herring in Subarea IV and Divisions IIIa and VIId (North Sea autumn spawners)	0.73	o	o	o
Greater North Sea	2015	nep-3-4	Nephrops in Division IIIa (Skagerak Kattegat. FU 3.4)	0.26	o	-	-
Greater North Sea	2015	nep-6	Nephrops in Division IVb (Farn Deeps. FU 6)	1.44		-	-
Greater North Sea	2015	nep-7	Nephrops in Division IVa (Fladen Ground. FU 7)	0.27	o	-	-
Greater North Sea	2015	nep-8	Nephrops in Division IVb (Firth of Forth. FU 8)	1.03		-	-
Greater North Sea	2015	nep-9	Nephrops in Division IVa (Moray Firth. FU 9)	0.77	o	-	-
Greater North Sea	2015	nop-34-oct	Norway Pout in Subarea IV (North Sea) and IIIa (Skagerrak - Kattegat) - Autumn assessment	*		-	-
Greater North Sea	2015	ple-eche	Plaice in Division VIId (Eastern Channel)	0.49	o	o	o
Greater North Sea	2015	ple-nsea	Plaice Subarea IV (North Sea)	0.91	o	o	o
Greater North Sea	2015	sai-3a46	Saithe in Subarea IV (North Sea) Division IIIa West (Skagerrak) and Subarea VI (West of Scotland and Rockall)	0.74	o	o	o
Greater North Sea	2015	san-ns1	Sandeel in the Dogger Bank area (SA 1)	*		-	-
Greater North Sea	2015	san-ns2	Sandeel in the South Eastern North Sea (SA 2)	*		-	-
Greater North Sea	2015	san-ns3	Sandeel in the Central Eastern North Sea (SA 3)	*	o	-	-
Greater North Sea	2015	sol-eche	Sole in Division VIId (Eastern Channel)	1.73			
Greater North Sea	2015	sol-echw	Sole in Division VIIe (Western Channel)	0.68	o	o	o
Greater North Sea	2015	sol-kask	Sole in Division IIIa and Subdivisions 22-24 (Skagerrak. Kattegat. and the Belts)	0.49	o		
Greater North Sea	2015	sol-nsea	Sole in Subarea IV (North Sea)	1.01		o	
Greater North Sea	2015	spr-nsea	Sprat in Subarea IV (North Sea)	*	o	-	-
Greater North Sea	2015	whg-47d	Whiting Subarea IV (North Sea) and Division VIId (Eastern Channel)	1.52		o	
Greater North Sea	2014	pan-sknd	Northern shrimp (Pandalus borealis) in Divisions IIIa West and IVa East (Skagerrak and Norwegian Deeps)	1.02			
Widely distributed	2015	bli-5b67	Blue ling (Molva dypterygia) in Subareas VI-VII and Division Vb (Celtic Seas. English Channel and Faroes Grounds)	0.28	o	o	o
Widely distributed	2015	dgs-nea	Spurdog (Squalus acanthias) in the Northeast Atlantic	0.40	o	-	-
Widely distributed	2015	hke-nrtn	Hake in Division IIIa. Subareas IV. VI and VII and Divisions VIIIa.b.d (Northern stock)	0.79	o	o	o
Widely distributed	2015	hom-west	Horse mackerel (Trachurus trachurus) in Divisions IIa. IVa. Vb. VIa. VIIa-c. e-k. VIII (Western stock)	0.97	o	-	-
Widely distributed	2015	mac-nea	Mackerel in the Northeast Atlantic (combined Southern. Western and North Sea spawning components)	1.31			
Widely distributed	2015	rng-5b67	Roundnose grenadier (Coryphaenoides rupestris) in Subareas VI and VII. and Divisons Vb and XIIb	0.25	o	-	-
Widely distributed	2015	whb-comb	Blue whiting in Subareas I-IX. XII and XIV (Combined stock)	1.45		o	

7 REPORTS BY STOCK

Table 7.7.1 - URL links to the source reports by stock.

Stock	Assessment year	Report	Source	Area
ane_9	2016	https://stecf.jrc.ec.europa.eu/documents/43805/1517808/2016-12_STECF+16-22+-+MED+assessments+part+1_JRCxxx.pdf	STECF	FAO37
ane_17_18	2016	https://stecf.jrc.ec.europa.eu/documents/43805/1517808/2016-12_STECF+16-22+-+MED+assessments+part+1_JRCxxx.pdf	STECF	FAO37
ane_29	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208033/2015-10_STECF+15-16+-+Black+Sea+assessments_JRC98095.pdf	STECF	FAO37
ane_6	2016	https://stecf.jrc.ec.europa.eu/documents/43805/1517808/2016-12_STECF+16-22+-+MED+assessments+part+1_JRCxxx.pdf	STECF	FAO37
ara_1	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208039/2015-11_STECF+15-18+-+MED+assessments+part+1_JRC98676.pdf	STECF	FAO37
ara_6	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208039/2015-11_STECF+15-18+-+MED+assessments+part+1_JRC98676.pdf	STECF	FAO37
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
dgs_29	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208033/2015-10_STECF+15-16+-+Black+Sea+assessments_JRC98095.pdf	STECF	FAO37
dps_1	2016		STECF	FAO37
dps_09_10_11	2016		STECF	FAO37
dps_17_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
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
hke_17_18	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1291370/2015-05_STECF+16-08+MED+assessments+part+2_JRC101548.pdf	STECF	FAO37
hke_19	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1291370/2015-05_STECF+16-08+MED+assessments+part+2_JRC101548.pdf	STECF	FAO37
hmm_29	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208033/2015-10_STECF+15-16+-+Black+Sea+assessments_JRC98095.pdf	STECF	FAO37
mts_17_18	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1291370/2015-05_STECF+16-08+MED+assessments+part+2_JRC101548.pdf	STECF	FAO37
mur_9	2016		STECF	FAO37
mut_17_18	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1291370/2015-05_STECF+16-08+MED+assessments+part+2_JRC101548.pdf	STECF	FAO37
mut_29	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208033/2015-10_STECF+15-16+-+Black+Sea+assessments_JRC98095.pdf	STECF	FAO37
mut_6	2014	https://stecf.jrc.ec.europa.eu/documents/43805/823106/2014-12_STECF+14-17+-+Med+stock+assessments+-+part+1_JRC93120.pdf	STECF	FAO37
mut_9	2014	https://stecf.jrc.ec.europa.eu/documents/43805/823106/2014-12_STECF+14-17+-+Med+stock+assessments+-+part+1_JRC93120.pdf	STECF	FAO37
nep_9	2016		STECF	FAO37
nep_17_18	2016		STECF	FAO37
nep_6	2016		STECF	FAO37
pil_6	2016	https://stecf.jrc.ec.europa.eu/documents/43805/1517808/2016-12_STECF+16-22+-+MED+assessments+part+1_JRCxxx.pdf	STECF	FAO37
pil_17_18	2016	https://stecf.jrc.ec.europa.eu/documents/43805/1517808/2016-12_STECF+16-22+-+MED+assessments+part+1_JRCxxx.pdf	STECF	FAO37
sol_17	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1291370/2015-05_STECF+16-08+MED+assessments+part+2_JRC101548.pdf	STECF	FAO37
tur_29	2015	https://stecf.jrc.ec.europa.eu/documents/43805/1208033/2015-10_STECF+15-16+-+Black+Sea+assessments_JRC98095.pdf	STECF	FAO37
whb_6	2014	https://stecf.jrc.ec.europa.eu/documents/43805/823106/2014-12_STECF+14-17+-+Med+stock+assessments+-+part+1_JRC93120.pdf	STECF	FAO37
hke_12_13_14_15_16	2014	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2014/HKE_GSA_12-16_2014_ITA_MLT_TUN.pdf	GFCM	FAO37
dps_12_13_14_15_16	2014	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2014/DPS_GSA_12-16_2014_ITA_MLT_TUN.pdf	GFCM	FAO37
mut_25	2015	http://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2015/MUT_GSA25_2015_CYP.pdf	GFCM	FAO37
spr_29	2015	http://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/SmallPelagics/2015/SPR_GSA29_2015_%20TUR_GEO_BGR_UKR_ROU.pdf	GFCM	FAO37
ara_5	2014	https://gfcmsitestorage.blob.core.windows.net/documents/SAC/SAF/DemersalSpecies/2014/ARA_GSA05_2014_ESP.pdf	GFCM	FAO37
anb-8c9a	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/anb-8c9a.pdf	ICES	FAO27

Stock	Assessment year	Report	Source	Area
ane-bisc	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/ane-bisc.pdf	ICES	FAO27
anp-8c9a	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/anp-8c9a.pdf	ICES	FAO27
bli-5b67	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/bli-5b67.pdf	ICES	FAO27
cod-2224	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/cod-2224.pdf	ICES	FAO27
cod-347d	2016	http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/cod-347d_reopen.pdf	ICES	FAO27
cod-7e-k	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/cod-7e-k.pdf	ICES	FAO27
cod-iris	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/cod-iris.pdf	ICES	FAO27
cod-scow	2015	http://www.ices.dk/sites/pub/Publication Reports/Advice/2015/2015/cod-scow.pdf	ICES	FAO27
dgs-nea	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/dgs-nea.pdf	ICES	FAO27
had-346a	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/had-346a.pdf	ICES	FAO27
had-7b-k	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/had-7b-k.pdf	ICES	FAO27
had-rock	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/had-rock.pdf	ICES	FAO27
her-2532-gor	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/her-2532-gor.pdf	ICES	FAO27
her-30	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/her-30.pdf	ICES	FAO27
her-3a22	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/her-3a22.pdf	ICES	FAO27
her-47d3	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/her-47d3.pdf	ICES	FAO27
her-67bc	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/her-67bc.pdf	ICES	FAO27
her-irls	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/her-irls.pdf	ICES	FAO27
her-nirs	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/her-nirs.pdf	ICES	FAO27
her-riga	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/her-riga.pdf	ICES	FAO27
hke-nrtn	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/hke-nrtn.pdf	ICES	FAO27
hke-soth	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/hke-soth.pdf	ICES	FAO27
hom-soth	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/hom-soth.pdf	ICES	FAO27
hom-west	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/hom-west.pdf	ICES	FAO27
mac-nea	2016	http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/mac-nea.pdf	ICES	FAO27
meg-4a6a	2015	http://www.ices.dk/sites/pub/Publication Reports/Advice/2015/2015/meg-4a6a.pdf	ICES	FAO27
mgb-8c9a	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/mgb-8c9a.pdf	ICES	FAO27
mgw-78	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/mgw-78.pdf	ICES	FAO27
mgw-8c9a	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/mgw-8c9a.pdf	ICES	FAO27
nep-11	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-11.pdf	ICES	FAO27
nep-12	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-12.pdf	ICES	FAO27
nep-13	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-13.pdf	ICES	FAO27
nep-14	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-14.pdf	ICES	FAO27
nep-15	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-15.pdf	ICES	FAO27
nep-16	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-16.pdf	ICES	FAO27
nep-17	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-17.pdf	ICES	FAO27
nep-19	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-19.pdf	ICES	FAO27
nep-2021	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-2021.pdf	ICES	FAO27
nep-22	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-22.pdf	ICES	FAO27
nep-2324	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-2324.pdf	ICES	FAO27
nep-3-4	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-3-4.pdf	ICES	FAO27
nep-6	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-6.pdf	ICES	FAO27
nep-7	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-7.pdf	ICES	FAO27

Stock	Assessment year	Report	Source	Area
nep-8	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-8.pdf	ICES	FAO27
nep-9	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nep-9.pdf	ICES	FAO27
nop-34-oct	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/nop-34-oct.pdf	ICES	FAO27
pan-sknd	2015	http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/pand-sknd_2015update.pdf	ICES	FAO27
ple-2123	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/ple-2123.pdf	ICES	FAO27
ple-eche	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/ple-eche.pdf	ICES	FAO27
ple-nsea	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/ple-nsea.pdf	ICES	FAO27
rng-5b67	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/rng-5b67.pdf	ICES	FAO27
sai-3a46	2016	http://ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/sai-3a46_reopen.pdf	ICES	FAO27
san-ns1	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/san-ns1.pdf	ICES	FAO27
san-ns2	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/san-ns2.pdf	ICES	FAO27
san-ns3	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/san-ns3.pdf	ICES	FAO27
sol-bisc	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/sol-bisc.pdf	ICES	FAO27
sol-celt	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/sol-celt.pdf	ICES	FAO27
sol-eche	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/sol-eche.pdf	ICES	FAO27
sol-echw	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/sol-echw.pdf	ICES	FAO27
sol-iris	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/sol-iris.pdf	ICES	FAO27
sol-kask	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/sol-kask.pdf	ICES	FAO27
sol-nsea	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/sol-nsea.pdf	ICES	FAO27
spr-2232	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/spr-2232.pdf	ICES	FAO27
spr-nsea	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/spr-nsea.pdf	ICES	FAO27
whb-comb	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/whb-comb.pdf	ICES	FAO27
whg-47d	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/whg-47d.pdf	ICES	FAO27
whg-7e-k	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/whg-7e-k.pdf	ICES	FAO27
whg-scow	2016	http://www.ices.dk/sites/pub/Publication Reports/Advice/2016/2016/whg-scow.pdf	ICES	FAO27

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STECF. 2016d. Mediterranean assessments part 1 (STECF-16-22). Publications Office of the European Union, Luxembourg; EUR XXXX EN; doi:XXXXXXXX

Vasilakopoulos P., Jardim E. 2017. Compilation and quality check of the ICES stock assessment data. EUR XXXX EN; doi:XXXXXXXX

9 CONTACT DETAILS OF AD HOC EXPERT GROUP PARTICIPANTS

[1] - 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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10 LIST OF ANNEXES

Data and codes are available on:
https://stecf.jrc.ec.europa.eu/reports/review-advice

11 List of Background Documents

Background documents are published on the STECF-PLEN17-01 web site on:
https://stecf.jrc.ec.europa.eu/plen1701

Annex I - Protocol

Protocol for the Monitoring of the Common Fisheries Policy

Version 2.2 — April 2017

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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:

- Selection of stocks: description of the criteria used for assembling the current list of stocks used to compute the indicators and the updating rules;
- 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 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:

- 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 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 Selection of stocks

2.1 List of stocks to monitor

The list of stocks to be used for computing the indicators, hereafter termed the *sampling frame*, must include at least those 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 *sample frames*were adopted:

- 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): Stocks are selected for each GSA if ranked in the top ten in either mean landings or reported economic value over the 2012-2014 period (See section 6).

2.2 Updating rules

Due to changes in scientific knowledge, mostly related with spatial boundaries of stock units, the list of stocks may need to be adjusted in the future. These changes can have an impact on the quantification of the effects of the CFP's implementation. The impact is expected to be small as changes in stock units should not be common and should not unduly affect the overall perspective on trends in time of the indicators.

The following rules should be used to update the sampling frames:

- The updates should consider the stock units existing in the reported year. Exploratory assessments or assessments not yet approved by the advisory bodies are not considered;
- When several stocks are merged in a single stock, the individual stocks must be removed from the list and the new stock added;
- When a stock is split in two (or more), the aggregated stock must be removed and the new ones added to the list;
- Stocks that cross regions will be allocated to the region where most of the stock's biomass is assumed to exist.

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 means of the ratio between fishing mortality F, and the level considered as desirable, F_{MSY}, and (2) conservation status, defined in reference to the precautionary levels of fishing mortality and biomass, F_{PA} and B_{PA}, respectively.

A group of indicators are based on a Generalized Linear Mixed Model (GLMM), where "stock" is a random effect, "year" a fixed effect, the link function is "log" and the response variable follows a Gamma distribution. The indicator value 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[1] and in an application to Mediterranean stocks[2]. The tests showed that this model structure had the best performance in terms of indicator's stability over time.

The analysis will use the following 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;
- 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;
- F^{PA} is the precautionary reference point for fishing mortality;
- 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 sampling frame;
  - $s = 1 \ldots S$ 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.

3.1 Number of stocks where fishing mortality exceeds Fmsy

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

3.2 Number of stocks where fishing mortality is equal to or less than Fmsy

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

[1] Minto, C. 2015. Testing model based indicators for monitoring the CFP performance. Ad-hoc contract report, pp 14.

[2] Chato-Osio, G., Jardim, E., Minto, C., Scott, F. and Patterson, K. 2015. Model based CFP indicators, F/Fmsy and SSB. Mediterranean region case study. JRC Technical Report No XX, pp 26.

3.3 Number of stocks outside safe biological limits

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

3.4 Number of stocks inside safe biological limits

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

3.5 Number of stocks outside CFP requirements

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

3.6 Number of stocks inside CFP requirements

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

3.7 Annual value of 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.

This indicator can have two forms, a design-based form

$$I_t = N^{-1} \sum_{j=1}^{j=N} \frac{f_{jt}}{F_j^{MSY}}$$

or a model-based form

$$I_t = y_t$$

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

where

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

and

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

3.8 Annual value of SSB

For this indicator stocks for which biomass was reported as a relative value or total abundance are not included. This indicator is calculated on a model-based form only and, for presentational purposes, is scaled to the 2003 estimate,

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

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

where

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

and

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

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 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 Experimental indicators

These set of indicators are not fully tested and should be considered with care.

5.1 Annual value of Recruitment

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

$$I_t = y_t$$

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

where

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

and

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

5.2 Biomass trends 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

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

5.3 Annual value of $\frac{b}{B_{PA}}$

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

$$I_t = y_t$$

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

where

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

and

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

6 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.

7 Sampling frame by GSA for Mediterranean and Black Sea

Table 1: Stocks included in the Mediterranean sampling frame for each GSA.

GSA	X3A CODE	Scientific name	Common name
1	ANE	*Engraulis encrasicolus*	European anchovy
	ARA	*Aristeus antennatus*	Blue and red shrimp
	BLT	*Auxis rochei*	Bullet tuna
	DPS	*Parapenaeus longirostris*	Deep-water rose shrimp
	HKE	*Merluccius merluccius*	European hake
	HMM	*Trachurus mediterraneus*	Mediterranean horse mackerel
	HOM	*Trachurus trachurus*	Atlantic horse mackerel
	MAC	*Scomber scombrus*	Atlantic mackerel
	MAS	*Scomber japonicus*	Pacific chub mackerel
	OCC	*Octopus vulgaris*	Common octopus
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
	SAA	*Sardinella aurita*	Round sardinella
	SBR	*Pagellus bogaraveo*	Blackspot(=red) seabream
	SWO	*Xiphias gladius*	Swordfish
5	ANE	*Engraulis encrasicolus*	European anchovy
	ARA	*Aristeus antennatus*	Blue and red shrimp
	DOL	*Coryphaena hippurus*	Common dolphinfish
	HKE	*Merluccius merluccius*	European hake
	HMM	*Trachurus mediterraneus*	Mediterranean horse mackerel
	JOD	*Zeus faber*	John dory
	MUR	*Mullus surmuletus*	Surmullet
	OCC	*Octopus vulgaris*	Common octopus
	RJC	*Raja clavata*	Thornback ray
	JRS	*Raja asterias*	Mediterranean starry ray
	BPI	*Spicara maena*	Blotched picarel
	SPC	*Spicara smaris*	Picarel
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
	RSE	*Scorpaena scrofa*	Red scorpionfish
	SLO	*Palinurus elephas*	Common spiny lobster
	SQR	*Loligo vulgaris*	European squid
6	ANE	*Engraulis encrasicolus*	European anchovy
	ARA	*Aristeus antennatus*	Blue and red shrimp
	BFT	*Thunnus thynnus*	Atlantic bluefin tuna
	EOI	*Eledone cirrhosa*	Horned octopus
	HKE	*Merluccius merluccius*	European hake
	MON	*Lophius piscatorius*	Angler(=Monk)
	MUT	*Mullus barbatus*	Red mullet
	NEP	*Nephrops norvegicus*	Norway lobster
	OCC	*Octopus vulgaris*	Common octopus
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
	SAA	*Sardinella aurita*	Round sardinella
	SBG	*Sparus aurata*	Gilthead seabream
	WHB	*Micromesistius poutassou*	Blue whiting(=Poutassou)
7	ANE	*Engraulis encrasicolus*	European anchovy
	BFT	*Thunnus thynnus*	Atlantic bluefin tuna
	BSS	*Dicentrarchus labrax*	European seabass
	ELE	*Anguilla anguilla*	European eel
	HKE	*Merluccius merluccius*	European hake
	HOM	*Trachurus trachurus*	Atlantic horse mackerel
	MAC	*Scomber scombrus*	Atlantic mackerel
	MON	*Lophius piscatorius*	Angler(=Monk)
	ANK	*Lophius budegassa*	Blackbellied angler
	OCC	*Octopus vulgaris*	Common octopus

Continued on next page

Table 1: *Continued.*

GSA	X3A CODE	Scientific name	Common name
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
	POD	*Trisopterus minutus*	Poor cod
	SBG	*Sparus aurata*	Gilthead seabream
	SOL	*Solea solea*	Common sole
	SQR	*Loligo vulgaris*	European squid
8	DEC	*Dentex dentex*	Common dentex
	ELE	*Anguilla anguilla*	European eel
	HOM	*Trachurus trachurus*	Atlantic horse mackerel
	JOD	*Zeus faber*	John dory
	MUR	*Mullus surmuletus*	Surmullet
	NEP	*Nephrops norvegicus*	Norway lobster
	SCR	*Maja squinado*	Spinous spider crab
	RSE	*Scorpaena scrofa*	Red scorpionfish
	SLO	*Palinurus elephas*	Common spiny lobster
	SOL	*Solea solea*	Common sole
	SWO	*Xiphias gladius*	Swordfish
9	ANE	*Engraulis encrasicolus*	European anchovy
	ARA	*Aristeus antennatus*	Blue and red shrimp
	CTC	*Sepia officinalis*	Common cuttlefish
	DPS	*Parapenaeus longirostris*	Deep-water rose shrimp
	EOI	*Eledone cirrhosa*	Horned octopus
	HKE	*Merluccius merluccius*	European hake
	MTS	*Squilla mantis*	Spottail mantis squillid
	MUR	*Mullus surmuletus*	Surmullet
	MUT	*Mullus barbatus*	Red mullet
	NEP	*Nephrops norvegicus*	Norway lobster
	OCC	*Octopus vulgaris*	Common octopus
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
10	ANE	*Engraulis encrasicolus*	European anchovy
	ARS	*Aristaeomorpha foliacea*	Giant red shrimp
	BFT	*Thunnus thynnus*	Atlantic bluefin tuna
	CTC	*Sepia officinalis*	Common cuttlefish
	DOL	*Coryphaena hippurus*	Common dolphinfish
	DPS	*Parapenaeus longirostris*	Deep-water rose shrimp
	HKE	*Merluccius merluccius*	European hake
	HOM	*Trachurus trachurus*	Atlantic horse mackerel
	HMM	*Trachurus mediterraneus*	Mediterranean horse mackerel
	OCC	*Octopus vulgaris*	Common octopus
	SQM	*Illex coindetii*	Broadtail shortfin squid
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
	SFS	*Lepidopus caudatus*	Silver scabbardfish
	SWO	*Xiphias gladius*	Swordfish
11	ARA	*Aristeus antennatus*	Blue and red shrimp
	ARS	*Aristaeomorpha foliacea*	Giant red shrimp
	BPI	*Spicara maena*	Blotched picarel
	CTC	*Sepia officinalis*	Common cuttlefish
	EDT	*Eledone moschata*	Musky octopus
	HKE	*Merluccius merluccius*	European hake
	MUR	*Mullus surmuletus*	Surmullet
	MUT	*Mullus barbatus*	Red mullet
	OCC	*Octopus vulgaris*	Common octopus
	SLO	*Palinurus elephas*	Common spiny lobster
	SQR	*Loligo vulgaris*	European squid
	SWO	*Xiphias gladius*	Swordfish
15	ARS	*Aristaeomorpha foliacea*	Giant red shrimp

Continued on next page

Table 1: *Continued.*

GSA	X3A CODE	Scientific name	Common name
	BFT	*Thunnus thynnus*	Atlantic bluefin tuna
	BOG	*Boops boops*	Bogue
	DOL	*Coryphaena hippurus*	Common dolphinfish
	MAS	*Scomber japonicus*	Pacific chub mackerel
	MUR	*Mullus surmuletus*	Surmullet
	RPG	*Pagrus pagrus*	Red porgy
	RSE	*Scorpaena scrofa*	Red scorpionfish
	SAA	*Sardinella aurita*	Round sardinella
	SFS	*Lepidopus caudatus*	Silver scabbardfish
	SPR	*Sprattus sprattus*	European sprat
	SWO	*Xiphias gladius*	Swordfish
16	ANE	*Engraulis encrasicolus*	European anchovy
	ARS	*Aristaeomorpha foliacea*	Giant red shrimp
	BFT	*Thunnus thynnus*	Atlantic bluefin tuna
	BPI	*Spicara maena*	Blotched picarel
	CTC	*Sepia officinalis*	Common cuttlefish
	DPS	*Parapenaeus longirostris*	Deep-water rose shrimp
	HKE	*Merluccius merluccius*	European hake
	MUR	*Mullus surmuletus*	Surmullet
	MUT	*Mullus barbatus*	Red mullet
	NEP	*Nephrops norvegicus*	Norway lobster
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
	SFS	*Lepidopus caudatus*	Silver scabbardfish
	SWO	*Xiphias gladius*	Swordfish
17	ANE	*Engraulis encrasicolus*	European anchovy
	VEV	*Venus verrucosa*	Warty venus
	CTC	*Sepia officinalis*	Common cuttlefish
	HKE	*Merluccius merluccius*	European hake
	MTS	*Squilla mantis*	Spottail mantis squillid
	MUT	*Mullus barbatus*	Red mullet
	NEP	*Nephrops norvegicus*	Norway lobster
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
	SOL	*Solea solea*	Common sole
	SVE	*Chamelea gallina*	Striped venus
18	ANE	*Engraulis encrasicolus*	European anchovy
	CTC	*Sepia officinalis*	Common cuttlefish
	DPS	*Parapenaeus longirostris*	Deep-water rose shrimp
	EDT	*Eledone moschata*	Musky octopus
	EOI	*Eledone cirrhosa*	Horned octopus
	HKE	*Merluccius merluccius*	European hake
	MON	*Lophius piscatorius*	Angler(=Monk)
	MTS	*Squilla mantis*	Spottail mantis squillid
	MUT	*Mullus barbatus*	Red mullet
	NEP	*Nephrops norvegicus*	Norway lobster
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
	HMM	*Trachurus mediterraneus*	Mediterranean horse mackerel
	HOM	*Trachurus trachurus*	Atlantic horse mackerel
	MAS	*Scomber japonicus*	Pacific chub mackerel
19	ALB	*Thunnus alalunga*	Albacore
	ANE	*Engraulis encrasicolus*	European anchovy
	ARA	*Aristeus antennatus*	Blue and red shrimp
	ARS	*Aristaeomorpha foliacea*	Giant red shrimp
	BFT	*Thunnus thynnus*	Atlantic bluefin tuna
	BOG	*Boops boops*	Bogue
	BON	*Sarda sarda*	Atlantic bonito

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Table 1: *Continued.*

GSA	X3A CODE	Scientific name	Common name
	CTC	*Sepia officinalis*	Common cuttlefish
	DPS	*Parapenaeus longirostris*	Deep-water rose shrimp
	HKE	*Merluccius merluccius*	European hake
	HOM	*Trachurus trachurus*	Atlantic horse mackerel
	MUR	*Mullus surmuletus*	Surmullet
	SFS	*Lepidopus caudatus*	Silver scabbardfish
	SWO	*Xiphias gladius*	Swordfish
20	ANE	*Engraulis encrasicolus*	European anchovy
	CTC	*Sepia officinalis*	Common cuttlefish
	DEC	*Dentex dentex*	Common dentex
	HKE	*Merluccius merluccius*	European hake
	MUF	*Mugil cephalus*	Flathead grey mullet
	MUT	*Mullus barbatus*	Red mullet
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
	SAA	*Sardinella aurita*	Round sardinella
	SBG	*Sparus aurata*	Gilthead seabream
	SWA	*Diplodus sargus*	White seabream
	TGS	*Penaeus kerathurus*	Caramote prawn
22	ANE	*Engraulis encrasicolus*	European anchovy
	BOG	*Boops boops*	Bogue
	DPS	*Parapenaeus longirostris*	Deep-water rose shrimp
	HKE	*Merluccius merluccius*	European hake
	MAS	*Scomber japonicus*	Pacific chub mackerel
	MUR	*Mullus surmuletus*	Surmullet
	MUT	*Mullus barbatus*	Red mullet
	NEP	*Nephrops norvegicus*	Norway lobster
	OCC	*Octopus vulgaris*	Common octopus
	PIL	*Sardina pilchardus*	European pilchard(=Sardine)
	SAA	*Sardinella aurita*	Round sardinella
	SBG	*Sparus aurata*	Gilthead seabream
	SOL	*Solea solea*	Common sole
	HMM	*Trachurus mediterraneus*	Mediterranean horse mackerel
	HOM	*Trachurus trachurus*	Atlantic horse mackerel
23	BOG	*Boops boops*	Bogue
	CBR	*Serranus cabrilla*	Comber
	CTC	*Sepia officinalis*	Common cuttlefish
	DPS	*Parapenaeus longirostris*	Deep-water rose shrimp
	HKE	*Merluccius merluccius*	European hake
	MUR	*Mullus surmuletus*	Surmullet
	MUT	*Mullus barbatus*	Red mullet
	PAC	*Pagellus erythrinus*	Common pandora
	PRR	*Sparisoma cretense*	Parrotfish
	RPG	*Pagrus pagrus*	Red porgy
	SPC	*Spicara smaris*	Picarel
	SWA	*Diplodus sargus*	White seabream
	BBS	*Scorpaena porcus*	Black scorpionfish
	RSE	*Scorpaena scrofa*	Red scorpionfish
25	ALB	*Thunnus alalunga*	Albacore
	BFT	*Thunnus thynnus*	Atlantic bluefin tuna
	BOG	*Boops boops*	Bogue
	CBR	*Serranus cabrilla*	Comber
	MUR	*Mullus surmuletus*	Surmullet
	MUT	*Mullus barbatus*	Red mullet
	PRR	*Sparisoma cretense*	Parrotfish
	SBA	*Pagellus acarne*	Axillary seabream

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Table 1: *Continued.*

GSA	X3A CODE	Scientific name	Common name
	SWO	*Xiphias gladius*	Swordfish
	BPI	*Spicara maena*	Blotched picarel
	SPC	*Spicara smaris*	Picarel
29	ANE	*Engraulis encrasicolus*	European anchovy
	BLU	*Pomatomus saltatrix*	Bluefish
	BON	*Sarda sarda*	Atlantic bonito
	DGS	*Squalus acanthias*	Picked dogfish
	HMM	*Trachurus mediterraneus*	Mediterranean horse mackerel
	MUT	*Mullus barbatus*	Red mullet
	RPW	*Rapana venosa*	Thomas' rapa whelk
	SPR	*Sprattus sprattus*	European sprat
	TUR	*Psetta maxima*	Turbot

ANNEX II – CODE

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

library(reshape2)
library(ggplot2)
library(lme4)
library(influence.ME)
library(lattice)
library(parallel)
source("funs.R")
theme_set(theme_bw())
options(stringsAsFactors=FALSE)
v0 <- 2003:2015
v0[seq(2,12,2)] <- ""
sc <- scale_x_continuous(breaks=2003:2015, labels=as.character(v0))
th <- theme(axis.text.x  = element_text(angle=90, vjust=0.5), panel.grid.minor = element_blank())
it <- 500
nc <- 8
# to control de seed in mclapply
RNGkind("L'Ecuyer-CMRG")
set.seed(1234)

#====================================================================
# Load data and subset
#====================================================================

#--------------------------------------------------------------------
# load
#--------------------------------------------------------------------

# assessments
isa <- read.csv("../data/ices/2017/ICESstks_polished_v2.csv", stringsAsFactors=FALSE)

# Stocks to retain from matching the sampling frame with ICES assessments
load("../matchTACStocks/report/RData.stksnea")

#--------------------------------------------------------------------
# subset
#--------------------------------------------------------------------
# filtering
saeu <- subset(isa, FishStock %in% stkToRetain)
stkToDrop <- unique(isa[!(isa$FishStock %in% stkToRetain), c("FishStock", "EcoRegion", "Category")])
write.csv(stkToDrop, file="stkToDropBySampFrame-nea.csv")

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

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

# ANE BISC - need to add value from ss, using upper trigger as proxy for MSYBescapement
saeu[saeu$FishStock == "ane-bisc", "MSYBescapement"] <- 89000

# acording to the sumsheets SAN and SPR-NSEA use Bpa for MSYBescapement
saeu[saeu$FishStock %in% c("san-ns1", "san-ns2", "san-ns3", "spr-nsea"),"MSYBescapement"] <- saeu
[saeu$FishStock %in% c("san-ns1", "san-ns2", "san-ns3", "spr-nsea"),"Bpa"]

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

#====================================================================
# Process data
#====================================================================
#--------------------------------------------------------------------
# Bref = Bpa
#--------------------------------------------------------------------
saeu$Bref <- saeu$Bpa
# B escapement as Bref for relevant stocks
saeu$Bref[!is.na(saeu$MSYBescapement)] <- saeu$MSYBescapement[!is.na(saeu$MSYBescapement)]
saeu$Bref <- as.numeric(saeu$Bref)
# set 0 as NA
saeu$Bref[saeu$Bref==0] <- NA

#--------------------------------------------------------------------
# Fref
#--------------------------------------------------------------------
saeu$Fref <- saeu$FMSY
# no Fref for B escapement
saeu$Fref[!is.na(saeu$MSYBescapement)] <- NA
saeu$Fref <- as.numeric(saeu$Fref)
saeu$Fref[saeu$Fref==0] <- NA

saeu$Frefpa <- saeu$Fpa
# no Fref for B escapement
saeu$Frefpa[!is.na(saeu$MSYBescapement)] <- NA
saeu$Frefpa <- as.numeric(saeu$Frefpa)
```

```r
saeu$Frefpa[saeu$Frefpa==0] <- NA

#----------------------------------------------------------------------
# COMPUTE F/Fref and B/Bref | year + stock
#----------------------------------------------------------------------
saeu <- transform(saeu, indF = FishingPressure/Fref, indBpa=StockSize/Bref, indFpa = FishingPressure/
Frefpa)
# in case of escapement strategy MSY evaluated by SSB ~ Blim/Bpa/etc
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$indBpa < 1)
# if one is NA CFP can't be inferred
saeu$CFP[is.na(saeu$indF) | is.na(saeu$indBpa)] <- 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>=2003 & Year<AssessmentYear & sfFind)

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

#----------------------------------------------------------------------
# Number of stocks
#----------------------------------------------------------------------
inStks <- getNoStks(saeu, "FishStock", length)

png("figNEAI0a.png", 600, 400)
ggplot(subset(inStks, EcoRegion=="ALL"), aes(x=Year, y=N)) +
    geom_line() +
    ylab("No. of stocks") +
    xlab("") +
    ylim(c(0,75)) +
    sc +
    th
dev.off()

# time series
png("figNEAI0b.png", 600, 800)
ggplot(saeu, aes(Year, FishStock)) +
    #geom_line() +
    geom_point(size=0.5) +
    ylab("Stock") +
    xlab("Year") +
    sc +
    scale_y_discrete(name="", limits = rev(unique(saeu$FishStock))) +
    th
dev.off()

# table
write.csv(dcast(inStks, EcoRegion~Year, value.var='N'), file="tabNEAI0.csv", row.names=FALSE)

#----------------------------------------------------------------------
# Stocks F > Fmsy
#----------------------------------------------------------------------
fInda <- getNoStks(saeu, "indF", function(x) sum(x>1))
fInda[fInda$EcoRegion=="Bay of Biscay and the Iberian Coast", "EcoRegion"] <- "BoBiscay & Iberia"

# plot
png("figNEAI1.png", 600, 400)
ggplot(subset(fInda, EcoRegion=='ALL'), aes(x=Year, y=N)) +
    geom_line() +
    expand_limits(y=0) +
    geom_point(aes(x=2003, y=N[1])) +
    geom_point(aes(x=2015, y=N[length(N)]), size=2) +
    ylab("No. of stocks") +
    xlab("") +
    ylim(c(0,75)) +
    sc +
    th
```

```
dev.off()

# plot
png("figNEAI1b.png", 800, 400)
ggplot(subset(fInda, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
    geom_line() +
    facet_grid(.~EcoRegion) +
    ylab("No. of stocks") +
    xlab("") +
    sc +
    ylim(0, 20) +
    th
dev.off()

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

#-------------------------------------------------------------------
# Stocks F <= Fmsy
#-------------------------------------------------------------------
fIndb <- getNoStks(saeu, "indF", function(x) sum(x<=1))
fIndb[fIndb$EcoRegion=="Bay of Biscay and the Iberian Coast", "EcoRegion"] <- "BoBiscay & Iberia"

# plot
png("figNEAI2.png", 600, 400)
ggplot(subset(fIndb, EcoRegion=='ALL'), aes(x=Year, y=N)) +
    geom_line() +
    expand_limits(y=0) +
    geom_point(aes(x=2003, y=N[1])) +
    geom_point(aes(x=2015, y=N[length(N)]), size=2) +
    ylab("No. of stocks") +
    xlab("") +
    ylim(c(0,75)) +
    sc +
    th
dev.off()

# plot
png("figNEAI2b.png", 800, 400)
ggplot(subset(fIndb, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
    geom_line() +
    facet_grid(.~EcoRegion) +
    ylab("No. of stocks") +
    xlab("") +
    sc +
    ylim(0, 20) +
    th
dev.off()

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

#-------------------------------------------------------------------
# Stocks outside SBL
#-------------------------------------------------------------------
fIndc <- getNoStks(saeu, "SBL", function(x) sum(!x, na.rm=TRUE))
fIndc[fIndc$EcoRegion=="Bay of Biscay and the Iberian Coast", "EcoRegion"] <- "BoBiscay & Iberia"

# plot
png("figNEAI3.png", 600, 400)
ggplot(subset(fIndc, EcoRegion=='ALL'), aes(x=Year, y=N)) +
    geom_line() +
    expand_limits(y=0) +
    geom_point(aes(x=2003, y=N[1])) +
    geom_point(aes(x=2015, y=N[length(N)]), size=2) +
    ylab("No. of stocks") +
    xlab("") +
    ylim(c(0,75)) +
    sc +
    th
dev.off()

# plot
png("figNEAI3b.png", 800, 400)
ggplot(subset(fIndc, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
    geom_line() +
    facet_grid(.~EcoRegion) +
    ylab("No. of stocks") +
    xlab("") +
    sc +
    ylim(0, 10) +
    th
dev.off()

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

#-------------------------------------------------------------------
# Stocks inside SBL
```

```
#---------------------------------------------------------------------
fIndd <- getNoStks(saeu, "SBL", function(x) sum(x, na.rm=TRUE))
fIndd[fIndd$EcoRegion=="Bay of Biscay and the Iberian Coast", "EcoRegion"] <- "BoBiscay & Iberia"

## plot
png("figNEAI4.png", 600, 400)
ggplot(subset(fIndd, EcoRegion=='ALL'), aes(x=Year, y=N)) +
    geom_line() +
    expand_limits(y=0) +
    geom_point(aes(x=2003, y=N[1])) +
    geom_point(aes(x=2015, y=N[length(N)]), size=2) +
    ylab("No. of stocks") +
    xlab("") +
    ylim(c(0,75)) +
    sc +
    th
dev.off()

# plot
png("figNEAI4b.png", 800, 400)
ggplot(subset(fIndd, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
    geom_line() +
    facet_grid(.~EcoRegion) +
    ylab("No. of stocks") +
    xlab("") +
    sc +
    ylim(0, 10) +
    th
dev.off()

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

#---------------------------------------------------------------------
# Stocks outside CFP objectives
#---------------------------------------------------------------------

fIndf <- getNoStks(saeu, "CFP", function(x) sum(!x, na.rm=TRUE))
fIndf[fIndf$EcoRegion=="Bay of Biscay and the Iberian Coast", "EcoRegion"] <- "BoBiscay & Iberia"

## plot
png("figNEAI7.png", 600, 400)
ggplot(subset(fIndf, EcoRegion=='ALL'), aes(x=Year, y=N)) +
    geom_line() +
    expand_limits(y=0) +
    geom_point(aes(x=2003, y=N[1])) +
    geom_point(aes(x=2015, y=N[length(N)]), size=2) +
    ylab("No. of stocks") +
    xlab("") +
    ylim(c(0,75)) +
    sc +
    th
dev.off()

# plot
png("figNEAI7b.png", 800, 400)
ggplot(subset(fIndf, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
    geom_line() +
    facet_grid(.~EcoRegion) +
    ylab("No. of stocks") +
    xlab("") +
    sc +
    ylim(0, 15) +
    th
dev.off()

# table
write.csv(dcast(fIndf, EcoRegion~Year, value.var='N'), file="tabNEAI7.csv", row.names=FALSE)

#---------------------------------------------------------------------
# Stocks outside CFP objectives
#---------------------------------------------------------------------
fIndfb <- getNoStks(saeu, "CFP", function(x) sum(x, na.rm=TRUE))
fIndfb[fIndfb$EcoRegion=="Bay of Biscay and the Iberian Coast", "EcoRegion"] <- "BoBiscay & Iberia"

## plot
png("figNEAI8.png", 600, 400)
ggplot(subset(fIndfb, EcoRegion=='ALL'), aes(x=Year, y=N)) +
    geom_line() +
    expand_limits(y=0) +
    geom_point(aes(x=2003, y=N[1])) +
    geom_point(aes(x=2015, y=N[length(N)]), size=2) +
    ylab("No. of stocks") +
    xlab("") +
    ylim(c(0,75)) +
    sc +
    th
dev.off()
```

```
# plot
png("figNEAI8b.png", 800, 400)
ggplot(subset(fIndfb, EcoRegion != 'ALL'), aes(x=Year, y=N)) +
    geom_line() +
    facet_grid(.~EcoRegion) +
    ylab("No. of stocks") +
    xlab("") +
    sc +
    ylim(0, 15) +
    th
dev.off()

# table
write.csv(dcast(fIndfb, EcoRegion~Year, value.var='N'), file="tabNEAI8.csv", row.names=FALSE)

#-------------------------------------------------------------------
# F/Fmsy
#-------------------------------------------------------------------
idx <- saeu$FishingPressureDescription %in% c("Fishing Pressure: F/Fmsy", "Fishing Pressure: F")
idx <- idx & is.na(saeu$MSYBescapement)
fInde <- getNoStks(saeu[idx,], "indF", function(x) mean(x, na.rm=TRUE), "F")
fInde[fInde$EcoRegion=="Bay of Biscay and the Iberian Coast", "EcoRegion"] <- "BoBiscay & Iberia"

# plot
png("figNEAI5.png", 600, 400)
ggplot(subset(fInde, EcoRegion=='ALL'), aes(x=Year, y=F)) +
    geom_line() +
    expand_limits(y=0) +
    geom_point(aes(x=2003, y=F[1])) +
    geom_point(aes(x=2015, y=F[length(F)]), size=2) +
    geom_hline(yintercept=1, linetype=2) +
    ylab(expression(F/F[MSY])) +
    ylim(0, 2.5) +
    xlab("") +
    sc +
    th
dev.off()

# plot
png("figNEAI5b.png", 800, 400)
ggplot(subset(fInde, EcoRegion != 'ALL'), aes(x=Year, y=F)) +
    geom_line() +
    geom_hline(yintercept=1, linetype=2) +
    facet_grid(.~EcoRegion) +
    ylab(expression(F/F[MSY])) +
    xlab("") +
    ylim(0, 2.5) +
    sc +
    th
dev.off()

# table
write.csv(dcast(fInde, EcoRegion~Year, value.var='F'), file="tabNEAI5.csv", row.names=FALSE)

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

#-------------------------------------------------------------------
# F/Fmsy model
#-------------------------------------------------------------------
idx <- saeu$FishingPressureDescription %in% c("Fishing Pressure: F/Fmsy", "Fishing Pressure: F")
saeu$sfI5 <- idx & is.na(saeu$MSYBescapement)
df0 <- saeu[saeu$sfI5,]
df0[df0$EcoRegion=="Bay of Biscay and the Iberian Coast", "EcoRegion"] <- "BoBiscay & Iberia"
df0$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, "diagNEAI5.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)
```

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

# plot
png("figNEAI5mod.png", 600, 400)
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
df0 <- t(ifitq)[-1,]
colnames(df0) <- ifitq[,1]
write.csv(df0, file="tabNEAI5mod.csv")

#-------------------------------------------------------------------
# SSB model
#-------------------------------------------------------------------
saeu$sfI6 <- saeu$StockSizeDescription %in% c("Stock Size: SSB", "Stock Size: TSB")
df0 <- saeu[saeu$sfI6,]
df0[df0$EcoRegion=="Bay of Biscay and the Iberian Coast", "EcoRegion"] <- "BoBiscay & Iberia"
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, "diagNEAI6.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, c(0.025, 0.25, 0.50, 0.75, 0.975), na.rm=TRUE)
ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))

# plot
png("figNEAI6.png", 600, 400)
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[2013])) +
  xlab("") +
  theme(legend.position = "none") +
  sc +
  th
dev.off()

# table
df0 <- t(ifitq)[-1,]
colnames(df0) <- ifitq[,1]
write.csv(df0, file="tabNEAI6.csv")

#-------------------------------------------------------------------
# F/Fmsy stocks outside EU
#-------------------------------------------------------------------
df0 <- subset(isa, EcoRegion %in% c("Iceland Sea and Greenland Sea",
    "Barents Sea and Norwegian Sea","Faroes") | FishStock=="her-noss")
df0$Fref <- df0$FMSY
df0 <- transform(df0, indF = FishingPressure/Fref, sfFind=!is.na(FishingPressure/Fref))
```

```r
df0 <- subset(df0, Year>=2003 & Year<AssessmentYear & sfFind)
idx <- df0$FishingPressureDescription %in% c("Fishing Pressure: F/Fmsy", "Fishing Pressure: F" )
df0 <- df0[idx,]
df0$Year <- factor(df0$Year)
yrs <- levels(df0$Year)
nd <- data.frame(Year=factor(yrs))
# fit
ifitout <- glmer(indF ~ Year + (1|FishStock), data = df0, family = Gamma("log"), control=glmerControl(optimizer="nlminbwrap"))
runDiagsME(ifit, "FishStock", df0, "diagNEAI8.pdf", nc, nd)

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

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

# plot
png("figNEAI9.png", 600, 400)
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) +
  ylab(expression(F/F[MSY])) +
  geom_hline(yintercept = 1, linetype=2) +
  ylim(0, 2.5) +
  xlab("") +
  theme(legend.position = "none") +
  sc +
  th
dev.off()

# table
df0 <- t(ifitq)[-1,]
colnames(df0) <- ifitq[,1]
write.csv(df0, file="tabNEAI9.csv")

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

df0 <- melt(saeu, c('Year', 'FishStock'), c('sfFind', 'sfSBL', 'sfCFP', 'sfI5', 'sfI6'))
df0 <- subset(df0, Year=='2014' & value==TRUE)

levels(df0$variable) <- c('above/below Fmsy', 'in/out SBL', 'in/out CFP', 'F/Fmsy trends', 'Biomass trends')

png("figNEAI0c.png", 600, 800)
ggplot(df0, aes(variable, FishStock)) +
    #geom_line() +
    geom_point(size=0.5) +
    ylab("Stock") +
    xlab("Indicator") +
    scale_y_discrete(name="", limits = rev(unique(df0$FishStock))) +
    th
dev.off()

#==============================================================
# Coverage
#==============================================================

# All stocks of relevance
stocks <- subset(saeu, Year==2015)$FishStock
# All stocks with B indicator
bind_stocks <- subset(saeu, Year==2015 & !is.na(indBpa))$FishStock
# All stocks with F indicator - Same as stocks
find_stocks <- subset(saeu, Year==2015 & !is.na(indF))$FishStock

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

# 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)]

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

# Set dropped stocks to NA in FishStock column
sf_ass$FindFishStock <- sf_ass$FishStock
sf_ass[sf_ass$FindFishStock %in% drop_stock_f,"FindFishStock"] <- as.character(NA)
sf_ass$BindFishStock <- sf_ass$FishStock
sf_ass[sf_ass$BindFishStock %in% drop_stock_b ,"BindFishStock"] <- as.character(NA)

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

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

coverage <- data.frame(No_stocks = c(length(find_stocks), length(bind_stocks)),
           No_TACs = length(unique(sf_ass$TAC_id)),
           Frac_TACs_assessed = c(mean(outf$x),mean(outb$x))
)
rownames(coverage) <- c("F_indicator", "B_indicator")
write.csv(coverage, "coverage.csv")

#=====================================================================
# Exporting and saving
#=====================================================================

write.csv(saeu[,-which(names(saeu) %in% c("X","X.1","X.2"))], file="saeu.csv")
save.image("RData.nea")
```

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

library(ggplot2)
library(lme4)
library(influence.ME)
library(lattice)
library(parallel)
source("funs.R")
theme_set(theme_bw())
options(stringsAsFactors=FALSE)
th <- theme(axis.text.x  = element_text(angle=90, vjust=0.5), panel.grid.minor = element_blank())
it <- 500
nc <- 8
# to control de seed in mclapply
RNGkind("L'Ecuyer-CMRG")

#====================================================================
# Load data, subset and transform
#====================================================================

#--------------------------------------------------------------------
# load
#--------------------------------------------------------------------
# Sampling frame
sfm <- read.csv("../medSampFrame/MED_SF_09.02.2017.csv")
sfm$stk <- tolower(paste(sfm$X3A_CODE, sfm$GSA, sep="_"))

# GFCM
msa <- read.csv("../data/gfcm/2017-GFCMstockSumm.csv")
msa <- transform(msa,
    Area = gsub(",", "_", GSA),
    Fref = ifelse(is.na(Fmsy), F01, Fmsy),
    Bref = NA,
    R = NA,
    Stock = substr(stock, 1, 3),
    asses_year = report.year,
    SSB=ssb,
    Meeting="GFCM",
    Assessment_URL=Link.to.pdf,
    Species=species
)

msa <- msa[,c("Stock", "Area", "year", "R", "SSB", "F", "Fref", "Blim", "Bref", "asses_year",
"Meeting", "Assessment_URL", "Species")]

# STECF
load("../data/med_stecf/cfp2017.RData")
cfp2017$source <- rep("STECF", length(cfp2017$year))

# both
msa <- rbind(cfp2017[,c("Stock", "Area", "year", "R", "SSB", "F", "Fref", "Blim", "Bref",
"asses_year", "Meeting", "Assessment_URL", "Species")], msa)
msa[msa$Meeting!="GFCM","Meeting"] <- "STECF"
names(msa)
names(msa)[names(msa)=="Meeting"] <- "source"

#--------------------------------------------------------------------
# transform
#--------------------------------------------------------------------
msa$stk <- tolower(paste(msa$Stock, msa$Area, sep="_"))
msa$StockDescription <- paste(msa$Species, "in GSA", gsub("_", ", ",  msa$Area))
msa <- transform(msa, indF = F/Fref)
msa <- transform(msa, sfFind=!is.na(indF))

#--------------------------------------------------------------------
# subset
#--------------------------------------------------------------------
# filtering through the sampling frame
v0 <- unique(msa$stk)
lst <- strsplit(v0, "_")
lst <- lapply(lst, function(x) paste(x[1], as.numeric(x[-1]), sep="_")) # need the numeric coerce to
get rid of leading zero
df0 <- data.frame(msastk=rep(v0, unlist(lapply(lst, length))), stk=do.call("c", lst))
stkToRetain <- unique(df0[df0$stk %in% sfm$stk, "msastk"])
stkToDrop <- v0[!(v0 %in% stkToRetain)]
write.csv(stkToDrop, file="stkToDropBySampFrame-med.csv")
msa <- subset(msa, stk %in% stkToRetain)

# keep last three years of assessments
sam <- msa[!is.na(msa$indF) & msa$year >=2003 & msa$asses_year %in% c("2016", "2015", "2014"),]

#--------------------------------------------------------------------
# remove old assessments and single GSA assessment when there's combined one
#--------------------------------------------------------------------
# drop ARA in 6 2014, there's a more recent assessment
sam <- subset(sam, !(stk=="ara_6" & asses_year==2014))
```

```
# drop TUR in 29 2014, there's a more recent assessment
sam <- subset(sam, !(stk=="tur_29" & asses_year==2014))
# drop DPS and HKE in 09 and 07, there are combined assessments
sam <- subset(sam, !(stk %in% c("dps_9", "hke_9", "hke_7")))
# check that stocks with more than one assessment are not in the table
# must return FALSE
sum(apply(table(sam[,c("stk","asses_year")]), 1, function(x) sum(x>0))>1)>0

#-------------------------------------------------------------------
# remove duplicated assessments in the same year
#-------------------------------------------------------------------
# drop STECF assessment of sprat in 29
sam <- subset(sam, !(stk=="spr_29" & source=="STECF"))
# check that stocks assessed by STECF and GFCM in the same year are not in the table
# must return FALSE
sum(apply(table(sam[,c("stk","year")]), 1, ">", 1))>0

#===================================================================
# Indicators
#===================================================================
v0 <- 2003:2015
v0[seq(2,12,2)] <- ""
sc <- scale_x_continuous(breaks=2003:2015, labels=as.character(v0))

#-------------------------------------------------------------------
# Number of stocks
#-------------------------------------------------------------------
mnStks <- aggregate(stk~year, sam, length)
names(mnStks) <- c('year', 'N')

# plot
png("figMedI7a.png", 600, 400)
ggplot(subset(mnStks, year!=2015), aes(x=year, y=N)) +
    geom_line() +
    ylab("No. of stocks") +
    xlab("") +
    ylim(c(0,50)) +
    sc +
    th +
    geom_point(aes(x=2015, y=mnStks$N[length(mnStks$N)]), size=2)
dev.off()

png("figMedI7b.png", 600, 800)
ggplot(sam, aes(year,stk)) +
    geom_line() +
    ylab("Stock") +
    xlab("Year") +
    sc +
    th +
    geom_vline(xintercept = 2014, col = "red")
dev.off()

#-------------------------------------------------------------------
# F/Fmsy model based indicator
#-------------------------------------------------------------------
v0 <- 2003:2014
v0[seq(2,10,2)] <- ""
sc <- scale_x_continuous(breaks=2003:2014, labels=as.character(v0))
idx <- sam$year!=2015
df0 <- sam[idx,]
df0$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, "diagMedI5.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)

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("figMedI5mod.png", 600, 400)
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
df0 <- t(mfitq)[-1,]
colnames(df0) <- mfitq[,1]
write.csv(df0, file="tabMedI5mod.csv")

#------------------------------------------------------------------
# SSB indicator
#------------------------------------------------------------------
# model
samb <- msa[!is.na(msa$SSB) & msa$year >=2003 & msa$asses_year %in% c("2016", "2015", "2014"),]
idx <- samb$year!=2015
df0 <- samb[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"), control=glmerControl
(optimizer="nlminbwrap"))
runDiagsME(mfitb, "stk", df0, "diagMedI6.pdf", nc, nd)

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

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)))

# plot
png("figMedI6.png", 600, 400)
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(B/B[2013])) +
    xlab("") +
    theme(legend.position = "none") +
    sc +
    th
dev.off()

df0 <- t(mfitq)[-1,]
colnames(df0) <- mfitq[,1]
write.csv(df0, file="tabMedI6.csv")

write.csv(sam, file="sam.csv")
save.image("RData.med")
```

```r
######################################################################
# EJ(20170302)
# Auxiliary function
######################################################################

getNoStks <- function(data, var, fun, var.name="N"){
    df0 <- aggregate(as.formula(paste(var, "~Year")), data, fun)
    df0$EcoRegion <- "ALL"
    df0 <- rbind(df0, aggregate(as.formula(paste(var, "~Year+EcoRegion")), data, fun))
    nms <- names(df0)
    nms[nms==var] <- var.name
    names(df0) <- nms
    df0
}

runDiagsME <- function(fit, me, data, file, nc, nd){
    require(lme4)
    require(influence.ME)
    require(lattice)
    pdf(file, paper="a4")
    # check homogeneity of variance
    # overall
    print(xyplot(residuals(fit)~predict(fit), main="homogeneity of variance"))
    # conditional
    print(xyplot(residuals(fit)~predict(fit)|data[,me], main="homogeneity of variance", scales=list(x=list(relation="free"))))
    # check normality
    pfun <- function(x, ...){
        panel.qqmathline(x, col="gray50")
        panel.qqmath(x, ...)
    }
    # overall
    print(qqmath(residuals(fit), panel=pfun, main="normality of residuals", pch=19, cex=0.5))
    # conditional
    print(qqmath(~residuals(fit)|data[,me], panel=pfun, main="normality of residuals", pch=19, cex=0.5))
    # assessing the random effects
    print(dotplot(ranef(fit, condVar = TRUE), sub="Ramdom effects", main=FALSE))
    # influence
    ifl <- influence(fit, me)
    # dfbetas
    print(plot(ifl, "dfbetas", main="Influence measures - dfbetas"))
    # Cook's distance
    print(plot(ifl, "cook", main="Influence measures - cook's distance"))
    # stks influence in fixed effects
    ifl.stk <- influence.stk(fit, data, me, nc, nd)
    print(dotplot(eval(parse(text=paste(me, "~sd"))), data=ifl.stk, main="Influence in fixed effect \"year\""))
    dev.off()

}

influence.stk <- function(fit, data, me, nc, nd){
    require(parallel)
    stks <- unique(data[,me])
    stks <- split(stks, stks)
    lst <- mclapply(stks, function(x){
        refit <- update(fit, data=subset(data, eval(parse(text=paste(me, "!=x")))))
        sd(predict(refit, re.form=~0, type="response", newdata=nd)/predict(fit, re.form=~0, type="response", newdata=nd))
    }, mc.cores=nc)
    df0 <- data.frame(names(lst), unlist(lst))
    names(df0) <- c(me, "sd")
    df0
}
```

```r
####################################################################
# EJ(20170329)
# experimental indicators
####################################################################

library(lme4)
library(ggplot2)
library(lattice)
library(latticeExtra)
library(reshape2)
library(parallel)
library(influence.ME)
library(xtable)
load("../analysis/RData.nea")
load("../analysis/RData.med")
source("../analysis/funs.R")
options(stringsAsFactors=FALSE, width = 60)
theme_set(theme_bw())
sc <- scale_x_continuous(breaks=2003:2015)
th <- theme(axis.text.x  = element_text(angle=90, vjust=0.5))
nc <- 8
it <- 500
# to control de seed in mclapply
RNGkind("L'Ecuyer-CMRG")
set.seed(1234)

#===================================================================
# SSB trends for Cat03 stocks
#===================================================================
#-------------------------------------------------------------------
# load assessment data
#-------------------------------------------------------------------

#subset cat 03 stocks of EU Ecoregions in 2003-2015
df0 <- subset(isa, !(EcoRegion %in% c("Iceland Sea and Greenland Sea", "Barents Sea and Norwegian Sea", "Faroes")) & Category=="3" & Year>=2003 & Year<2016)

#-------------------------------------------------------------------
# Types of indices and units
#-------------------------------------------------------------------

df0$fStockSizeDescription <- as.factor(df0$StockSizeDescription)

df0$fStockSizeUnits <- as.factor(df0$StockSizeUnits)
levels(df0$fStockSizeUnits)[1] <- "NA"

df0$IndexType <- df0$fStockSizeDescription
levels(df0$IndexType)[1] <- "Abundance Index"
levels(df0$IndexType)[2] <- "Biomass Index"
levels(df0$IndexType)[3:8] <- "Relative Index"

# Adding two levels of index types to separate abundance index in millions
# and biomass index in tonnes (different scale and standardisation type than the others)
levels(df0$IndexType)[4] <- "Abundance index (millions)"
levels(df0$IndexType)[5] <- "Biomass index (tonnes)"
df0[df0$fStockSizeUnits=="millions",]$IndexType <- "Abundance index (millions)"
df0[df0$fStockSizeUnits=="tonnes",]$IndexType <- "Biomass index (tonnes)"

#-------------------------------------------------------------------
# biomass index model
#-------------------------------------------------------------------

df0$Year <- factor(df0$Year)
yrs <- levels(df0$Year)
nd <- data.frame(Year=factor(yrs))

df1 <- df0[df0$IndexType=="Biomass Index" & !is.na(df0$StockSize),]

# fit the GLMM
ifit03 <- glmer(StockSize ~ Year + (1|FishStock), data = df1, family = Gamma("log"), control=glmerControl(optimizer="nlminbwrap"))
#runDiagsME(ifit03, "FishStock", df1, "diagNEAIcat03BI.pdf", nc, nd)

# bootstrap
stk <- unique(df1$FishStock)
ifit03.bs <- split(1:it, 1:it)
ifit03.bs <- mclapply(ifit03.bs, function(x){
    stk <- sample(stk, replace=TRUE)
    df1 <- df0[0,]
    for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
    fit <- glmer(StockSize ~ Year + (1|FishStock), data = df1,
    family = Gamma("log"), control=glmerControl(optimizer="nlminbwrap"))
    v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
    if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
    v0
}, mc.cores=nc)

ifitm <- do.call("rbind", ifit03.bs)
#ifitm <- exp(log(ifitm)-mean(log(ifitm[,1]), na.rm=TRUE))
```

```
ifitq <- apply(ifitm, 2, quantile, c(0.025, 0.25, 0.50, 0.75, 0.975), na.rm=TRUE)
ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))

# plot
png("figNEAIcat03.png", 600, 400)
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) +
  ylab("Biomass index") + xlab("") +
  theme(legend.position = "none") + sc + th
dev.off()

# table
BItab <- t(ifitq)[-1,]
colnames(BItab) <- ifitq[,1]
write.csv(BItab, file="tabNEAIcat03BI.csv")

# StockTable
write.csv(df0, file='stockTableCat03.csv')

#====================================================================
# Recruitment model
# (in millions)
#====================================================================
#--------------------------------------------------------------------
# NEA
#--------------------------------------------------------------------
# ane-bisc reports R in weight not numbers
idx <- !is.na(saeu$Recruitment) & saeu$FishStock!='ane-bisc'
df0 <- saeu[idx,]
df0 <- transform(df0, Year=factor(df0$Year), Recruitment=Recruitment/1000)

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, "diagNEAIR.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)
ifitq <- apply(ifitm, 2, quantile, c(0.025, 0.25, 0.50, 0.75, 0.975), na.rm=TRUE)
ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))

# plot
png("figNEAIR.png", 600, 400)
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) +
  ylab("Recruitment (millions)") +
  xlab("") +
  theme(legend.position = "none") + sc + th
dev.off()

# table
df0 <- t(ifitq)[-1,]
colnames(df0) <- ifitq[,1]
write.csv(df0, file="tabNEAIR.csv")

#--------------------------------------------------------------------
# MED
#--------------------------------------------------------------------
idx <- sam$year!=2015 & !is.na(sam$R)
df0 <- sam[idx,]
df0 <- transform(df0, year=factor(df0$year), R=R/1000)
yrs <- levels(df0$year)
nd <- data.frame(year=factor(yrs))
# model
mfitr <- glmer(R ~ year + (1|stk), data =  df0, family = Gamma("log"), control=glmerControl
(optimizer="nlminbwrap"))
```

```r
runDiagsME(mfitr, "stk", df0, "diagMEDIR.pdf", nc, nd)

# bootstrap
stk <- unique(df0$stk)
mfitr.bs <- split(1:it, 1:it)
mfitr.bs <- mclapply(mfitr.bs, function(x){
    stk <- sample(stk, replace=TRUE)
    df1 <- df0[0,]
    for(i in stk) df1 <- rbind(df1, subset(df0, stk==i))
    fit <- glmer(R ~ year + (1|stk), data = df1, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
    v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
    if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
    v0
}, mc.cores=nc)
mfitm <- do.call("rbind", mfitr.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("figMedIR.png", 600, 400)
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) +
    ylab("Recruitment (millions)") +
    xlab("") +
    theme(legend.position = "none") +
    scale_x_continuous(breaks=2003:2014) +
    th
dev.off()

# table
df0 <- t(mfitq)[-1,]
colnames(df0) <- mfitq[,1]
write.csv(df0, file="tabMEDIR.csv")

#====================================================================
# SSB/Bpa
#====================================================================
idx <- !is.na(saeu$indBpa)
df0 <- saeu[idx,]
df0$Year <- factor(df0$Year)
yrs <- levels(df0$Year)
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, "diagNEAIbpa.pdf", nc, nd)

# bootstrap
stk <- unique(df0$FishStock)
ifitbpa.bs <- split(1:it, 1:it)
ifitbpa.bs <- mclapply(ifitbpa.bs, function(x){
    stk <- sample(stk, replace=TRUE)
    df1 <- df0[0,]
    for(i in stk) df1 <- rbind(df1, subset(df0, FishStock==i))
    fit <- glmer(indBpa ~ Year + (1|FishStock), data = df1, family = Gamma("log"),
control=glmerControl(optimizer="nlminbwrap"))
    v0 <- predict(fit, re.form=~0, type="response", newdata=nd)
    if(length(fit@optinfo$conv$lme4)>0) v0[] <- NA
    v0
}, mc.cores=nc)
ifitm <- do.call("rbind", ifitbpa.bs)
ifitq <- apply(ifitm, 2, quantile, c(0.025, 0.25, 0.50, 0.75, 0.975), na.rm=TRUE)
ifitq <- cbind(Year=as.numeric(yrs), as.data.frame(t(ifitq)))

# plot
png("figNEAIBpa.png", 600, 400)
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%`)) +
  ylim(c(0,2)) +
  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("") +
  theme(legend.position = "none") + sc + th
dev.off()

# table
df0 <- t(ifitq)[-1,]
colnames(df0) <- ifitq[,1]
write.csv(df0, file="tabNEAIBpa.csv")
```

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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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