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Reporting needs under the new Common Fisheries Policy (STECF-14-23)

Edited by John Casey

This report was reviewed by the STECF by Written Procedure during December 2014.

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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

Reporting needs under the new Common Fisheries Policy (STECF-14-23)

THIS REPORT WAS REVIEWED DURING BY THE STECF BY WRITTEN PROCEDURE DURING DECEMBER 2014

Background

Background

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:

1. Review the metrics and indicators that have already been developed by the Commission to assess various aspects of performance of the CFP in the Northeast Atlantic and Baltic Seas and assess the suitability for such metrics and indicators in evaluating performance against the objectives of the 2012 CFP reform (Regulation (EU) No 1380/2013 of the European Parliament and of the Council).

2. In the light of that review, and if necessary, develop and propose appropriate alternative indicators to evaluate progress towards achieving maximum sustainable yield including in the Mediterranean Sea and the Black Sea and on the situation of fish stocks in accordance with Article 50 of Regulation (EU) No 1380/2013 of the European Parliament and of the Council, taking into account the requirements that such indicators should as far as practically possible should be:

- *Stable and comparable over time*
- *Objective*
- *Thoroughly documented*
- *Based as closely as possible on raw data*
- *Have a minimum of intermediate processsing*
- *Ideally, also be usable by EUROSTAT*
- *Reproducible*

3. Describe the utility of the indices developed under point 2 above regarding their suitability to meet with the requirements of Article 50 of the CFP (Regulation (EU) No 1380/2013 of the European

Parliament and of the Council). In particular assess the suitability of each indicator as a measure of performance for stocks that fall into the different categories of the ICES data limited stocks classification.

4. Test the available bio-economic models and their potential for an economic assessment of the MSY policy for a limited number of stocks.

5. Suggest an appropriate reporting format for the proposed indices for all sea areas.

Observations of the STECF

STECF notes that the Expert Group discussed the utility and suitability of the indicators currently used to monitor progress towards CFP objectives for the North Atlantic (ICES area) and the Mediterranean and Black Seas, and proposed that the majority of such indicators be retained in the future reporting procedure. In addition the names of some of the indicators were modified to make them more explicit.

Noting that the availability of suitable and reliable data and metrics to calculate the proposed indicators vary between sea areas, the Expert Group report outlines the rationale and choices for its proposals. The Expert Group Report also provides commentaries on the rationale for its proposals for the sampling frames on which to base the indicators separately for the Atlantic and the Mediterranean and Black Seas.

In relation to the North Atlantic, the group notes that the current sampling frame is based on the availability of relevant data and information in 2004 and proposes an alternative approach. While the basic unit on which to base the indictors (stock management area) essentially remains the same, the Expert group proposes that the results from the most recent assessments be used to determine which stock management units should be included in the sampling frame. The implications are that the most recent assessment results will be used to revise the whole time-series of indicator values. While recognising that adopting such an approach implies that the status of some stocks may appear to change from one year to the next, it will provide the most appropriate indication of progress towards achieving CFP objectives.

For the Mediterranean and Black Seas, the Expert Group’s proposals for suitable indicators are supported by a discussion on the availability of appropriate assessment results and MSY-based reference points.

In addition candidate model-based indicators to examine trends in for F/FMSY, B/BMSY and Biomass over time are also proposed but the group concluded that further work on the stability and sensitivity of such indicators to annual changes in data availability needs to be undertaken before they are used as a reliable indicator of progress towards achieving CFP objectives. Furthermore, the utility of an index based proxies for Bmsy and MSY derived from biomass per recruit and yield per recruit models, is worthy of further investigation.

Bioeconomic modelling approaches to derive indicators

In relation to bioeconomic modelling approaches to provide indicators on the progress towards achieving CFP objectives, STECF notes the thorough discussion given in the Expert Group report on the pros and cons of different models and approaches that currently exist together with the implied resource implications and likely time-scales associated with the different approaches.

STECF notes that there are a large number of existing bio-economic models which can be adapted to assess progress towards achieving the social and economic objectives of the CFP. STECF also notes that while each of the existing models is designed for specific purposes, there is a need to clearly specify the precise aims of any analysis requested, in order to ensure that the most appropriate model is chosen. It is also vital that specific social and economic objectives of the CFP are clearly defined in order that progress towards achieving such objectives can be objectively measured.

Notwithstanding the above observation, the Expert Group proposed that the following indicators be reported annually as a means to inform on progress of the CFP in achieving its social and economic objectives:

- Relative Landings Value (RLV)
- Potential Economic Gain (PEG)
- Income or Value of Landings
- Gross Value Added (GVA)
- Profits
- Employment

STECF also notes that in principle, and if required, one or more of the bioeconomic models that have already been developed may be appropriate to undertake short-term forecasts (over 1-3 years) for a number of economic indicators for years for which Member States' economic data are unavailable.

Conclusions of the STECF

1. *Review of metrics and indicators developed by the Commission.*

Based on the Report of the EWG 14-20, STECF concludes that the indicators developed and used by DG MARE to monitor the state of stocks since 2004 will inform on the progress towards achieving CFP objectives and should be retained for future reporting. STECF agrees that re-naming of some of such indicators is appropriate to make them more explicit. In addition, STECF concludes that the number of stocks where both criteria, fishing mortality equal or less than Fmsy and stock within biological limits, are simultaneously met should also be estimated.

In addition STECF agrees that the Expert Group's proposal to change the basis of the sampling frame used to derive the indicator values for stocks in the North Atlantic (ICES area) is sensible and concludes that the proposal to revise the time series of indicators on an annual basis depending on the availability of relevant assessment results, will provide the best measure of progress to achieving CFP objectives. There are some indicators however, e.g. number and proportion of stocks for which their status is know, that require a fixed sampling frame (a sample population of stocks that remains constant over time), although the Expert Group did not address the composition of such a sampling frame. STECF therefore considers that this might best be addressed at the time the proposed indicators listed below are calculated.

The Expert groups rationale for the proposed sampling frame for the Mediterranean also appears logical and constitutes a representative sample of stocks for which relevant assessment results are likely to be available to calculate the proposed indicators.

On the basis of the arguments presented by the Expert Group on stock assessments in the Mediterranean and Black Seas, STECF agrees that the indicators proposed by the expert group would appear to be the most appropriate. STECF also agrees that where possible, the indicators used for the North Atlantic are also calculated for stocks in the Mediterranean and Black Seas.

In conclusion STECF proposes that the indicators developed and currently used by DG MARE to monitor the state of stocks since 2004, as modified and listed in the Report of the EWG 14-20 be retained for reporting on progress towards achieving CFP objectives. These are listed below.

Proposed indicators for the North Atlantic (ICES area)

Indicators for stock (exploitation) status with respect to MSY exploitation rate (F_{MSY}) or suitable proxy

- No. of stocks for which status with respect to F_{MSY} is known
- No of stocks where fishing mortality exceeds F_{MSY}
- No of stocks where fishing mortality is equal to or less than F_{MSY}
- Proportion of stocks for which fishing mortality exceeds F_{MSY}

STECF agrees with the Expert Group that while similar indicators could in principle be derived in relation to B_{MSY}, in practice, given the absence of reliable estimates for B_{MSY}, at present such indicators are unlikely to be informative. Should further work indicate that this is not the case, STECF also agrees that with the Expert group, that such indicators also be reported.

Indicators for stocks with respect to safe biological limits

- No. stocks outside safe biological limits*
- No. stocks inside safe biological limits**
- Proportion of stocks inside safe biological limits
- Number of stocks for which the state of the stock is unknown
- Stocks unknown + stocks assessed with respect to safe biological limits
- Proportion of stocks of known status with respect to safe biological limits
- Number of stocks where fishing mortality is equal to or less than Fmsy and the stock is within biological limits.

* Outside safe biological limits means that SSB in year-1 is equal to or less than Bpa and F in year-1 is equal to or higher than Fpa.

** Inside safe biological limits is determined according to Definition 18 Under Article 4 of the 2013 CFP(Regulation (EU) 1308/2013 of 11 December 2013), which is interpreted to mean that SSB at the end of year-1 is higher than Bpa, and F in year-1 is less than Fpa.

Indicator for stocks for which scientific advice is to stop fishing (or similar words)

- Number of stocks for which scientific advice is to stop fishing

Indicator for difference between agreed TACs and advised catches

- Percentage excess of TAC over advised catch (%)

Indicators summarising the scientific advice about fishing opportunities*

- Stocks for which stock size and catches can be forecast
- Stocks for which quantified scientific advice concerning fishing opportunities is available
- Stocks for which no quantitative advice on fishing opportunities is available
- Stocks which do not have full assessments but for which quantitative advice is provided
- Stocks for which scientific advice is to stop fishing (or similar words)

* Where scientific advice for a stock concerns two or more TAC (management) areas, it is only counted once

Proposed indicators for the Mediterranean and Black Seas

STECF concludes that where possible, the indicators proposed above for the ICES area be calculated and reported for the Mediterranean and Black Seas.

In addition, STECF proposes that where appropriate the following additional indicators be calculated and reported

- Trends in F/F_{MSY}
- Trends in SSB
- Trends in Catch/Biomass ratios (C/B ratio)
- L_{50} as a weighted average size indicator of the catch.

The rationale and methodology to calculate the indicators to monitor trends in F/F_{MSY} and SSB are those described in Section 3.1 of the EWG14-20 Report.

In addition the Expert Group proposes that where possible, the values for those indicators proposed for the ICES area above should also be reported for the Mediterranean and Black Seas.

2. *Develop and propose appropriate alternative indicators to evaluate progress towards achieving maximum sustainable yield.*

In addition to the indicators proposed under 1 above, STECF agrees with the Expert Group’s proposal that model-based indices to monitor trends in F/FMSY, B/BMSY and Biomass would provide a valuable means to report on progress towards achieving CFP objectives 'and may also contribute to reporting in relation to MSFD Descriptor 3.

However, in keeping with the opinion of the Expert Group, STECF concludes that there is need to undertake further work to investigate the properties of such indices, especially regarding the sensitivity and stability of the index values to changes in annual availability of appropriate input estimates. Furthermore, the utility of an index based proxies for Bmsy and MSY derived from biomass per recruit and yield per recruit models, should also be investigated.

STECF therefore concludes that pending the outcome of the further work referred to above, and assuming that the indicators prove to be stable, and that appropriate and reliable input estimates are available, model-based indicators of trends in F/FMSY, B/BMSY and Biomass be reported in future.

3. Describe the utility of the indices developed under point 2

For all stocks in the sampling frame in each sea area, the model-based indicators proposed in 2 above will in principle, give an overview of the overall trend in the following:

- Exploitation rate in relation to the MSY exploitation rate (or suitable proxy); this will inform fisheries managers of the overall progress towards achieving the exploitation rate consistent with achieving the biomass that is capable of producing MSY for the whole sea area.
- Biomass in relation to the Biomass that is capable of delivering MSY; this will inform fisheries managers on the progress towards achieving the biomass that is capable of producing MSY for the whole sea area.
- Biomass; in the absence of estimates of BMSY, this indicator will provide an indication of the response in overall biomass to measures established under the CFP.

STECF notes that given appropriate input data and information, such indices could be reported at a regional scale, should managers wish to monitor progress towards achieving CFP objectives at regional scales smaller than the Entire, North Atlantic and Mediterranean and Black Seas.

4. Test the available bio-economic models and their potential for an economic assessment of the MSY policy for a limited number of stocks.

STECF agrees with the Expert Group's proposal that the following indicators be reported annually as a means to inform on progress of the CFP in achieving its social and economic objectives:

- Relative Landings Value (RLV)
- Potential Economic Gain (PEG)
- Income or Value of Landings
- Gross Value Added (GVA)
- Profits
- Employment

STECF also concludes that in principle, and if required, one or more of the bioeconomic models that have already been developed may be appropriate to undertake short-term forecasts (over 1-3 years) for a number of economic indicators for years for which Member States' economic data are unavailable.

5. Suggest an appropriate reporting format for the proposed indices for all sea areas.

The Expert group did not specifically address this item during its meeting. However, STECF concludes that the initial reporting format would best be developed on the first occasion the proposed indicators are calculated and reported (See proposed next steps below). STECF also notes that the future reporting format is likely to evolve as the scope and availability of appropriate data and information to calculate the indicators changes.

Next steps

Recognising that the Commission will wish to begin reporting on progress under the new CFP early in 2015 (Article 50 of Regulation EU 1380/2013 refers), and taking account of the conclusions listed above, STECF suggests that there is a need to adopt a 2-stage approach to the process for calculating the indicators. A first stage is to report those indicators that have previously been reported by DG MARE, but taking into account proposed renaming and the associated sampling frames. The second stage would be to undertake the further work required to investigate the properties of the model-based trend indicators for F/FMSY, B/BMSY and Biomass.

Recognising the current and anticipated demands of the STECF available resource limitations both in terms of manpower to undertake the work, and the limit on the number of potential STECF EWG, STECF suggests that there are a number of ways that such a two stage process might be best undertaken. These are outlined below for consideration by DG MARE.

1. An Expert group could be convened by under the auspices of the STECF early in 2015 to undertake both stages as described above i.e.
    - Step 1: Report those indicators that have previously been reported by DG MARE, but taking into account proposed renaming and the associated sampling frames and
    - Step 2: Undertake the further work required to investigate the properties of the model-based trend indicators for F/FMSY, B/BMSY and Biomass

STECF considers that given the anticipated demand in 2015 for Expert groups to address equally pressing issues, this option is probably not the most favourable solution.

2. For Step 1, DG MARE may choose to request that reporting on those indicators that have previously been reported by DG MARE be undertaken through ad hoc contract. However, given that there is sufficient appropriate expertise within the Maritime Affairs Unit of the JRC, it may prove to be the most expedient solution to request that the JRC undertake to calculate the indicators and report to the STECF who could then advise DG MARE accordingly.
3. For Step 2, STECF considers that either an Expert group be convened to examine the properties of the proposed model–based indicators, or the work be put out to ad hoc contract. In either case, the report of the investigations should be reviewed by the STECF who would then advise on their utility. Given the potential utility of model-based indicators as an objective means to report on progress to achieving CFP objectives for a range of stocks simultaneously, STECF considers that the work required to assess their properties be given reasonable priority by DG MARE.

Recognising that the Commission will wish to report to the Council and Parliament as early as possible in 2015, STECF suggests that for this year option 2 above is likely to prove to be the most expedient solution.

REPORT TO THE STECF

EXPERT WORKING GROUP ON REPORTING NEEDS UNDER THE NEW COMMON FISHERIES POLICY

(EWG-14-20)

Varese, Italy, 29 September to 3 October 2014

1 INTRODUCTION

Background

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."

To facilitate such a report the Commission requested the STECF to review and give advice on suitable metrics and indicators. EWG 14-20 was convened to undertake this task and report to the STECF.

1.1 Terms of Reference for EWG-14-20

STECF is requested to:

1. Review the metrics and indicators that have already been developed by the Commission to assess various aspects of performance of the CFP in the Northeast Atlantic and Baltic Seas and assess the suitability for such metrics and indicators in evaluating performance against the objectives of the 2012 CFP reform (Regulation (EU) No 1380/2013 of the European Parliament and of the Council).

2. In the light of that review, and if necessary, develop and propose appropriate alternative indicators to evaluate progress towards achieving maximum sustainable yield including in the Mediterranean Sea and the Black Sea and on the situation of fish stocks in accordance with Article 50 of Regulation (EU) No 1380/2013 of the European Parliament and of the Council, taking into account the requirements that such indicators should as far as practically possible should be:

- *Stable and comparable over time*
- *Objective*
- *Thoroughly documented*
- *Based as closely as possible on raw data*
- *Have a minimum of intermediate processsing*
- *Ideally, also be usable by EUROSTAT*
- *Reproducible*

3. Describe the utility of the indices developed under point 2 above regarding their suitability to meet with the requirements of Article 50 of the CFP (Regulation (EU) No 1380/2013 of the European Parliament and of the Council). In particular assess the suitability of each indicator as a measure of performance for stocks that fall into the different categories of the ICES data limited stocks classification.

4. Test the available bio-economic models and their potential for an economic assessment of the MSY policy for a limited number of stocks.

5. Suggest an appropriate reporting format for the proposed indices for all sea areas.

2 RATIONALE AND APPROACH

2.1 General considerations

In addressing the Terms of Reference, the Expert Group recognises that indicators are required to assess two main elements prescribed in Article 50 of the CFP namely:

- Indicators to assess progress on achieving maximum sustainable yield and
- Indicators to assess the situation of fish stocks

The EWG rationale to address each of these elements is outlined below.

Progress on achieving MSY

Article 2(2) of the CFP outlines the objectives of the CFP in relation to maximum sustainable yield and states the following:

The CFP shall apply the precautionary approach to fisheries management, and shall aim to ensure that exploitation of living marine biological resources restores and maintains populations of harvested species above levels which can produce the maximum sustainable yield.

In order to reach the objective of progressively restoring and maintaining populations of fish stocks above biomass levels capable of producing maximum sustainable yield, the maximum sustainable yield exploitation rate shall be achieved by 2015 where possible and, on a progressive, incremental basis at the latest by 2020 for all stocks.

The EWG has interpreted this to mean that that while the primary objective is to restore and maintain populations of harvested species above levels which can produce the maximum sustainable yield (B_{MSY}), the means to achieve this objective is to attain the maximum sustainable yield exploitation rate for fish stocks (F_{MSY}) by 2015 where possible and, on a progressive, incremental basis at the latest by 2020 for all stocks.

Hence, in order to describe progress in achieving MSY, the EWG considers that appropriate indicators for the following are required:

1. Indicators to describe progress towards achieving F_{MSY}; the means to restore and maintain populations of harvested species above levels which can produce the maximum sustainable yield.
2. Indicators to describe progress towards achieving B_{MSY}; the level of population (stock|) biomass that can produce the MSY and the evolution of sustainable catch.

The Expert group notes that the suitability and appropriateness of such indicators will be dependent on the data and information available for different fish stocks in different Sea areas. Such aspects are explored separately in the Sections 4 and 5 of this report for the NE Atlantic and Mediterranean respectively.

On the situation of fish stocks

The EWG notes that the term “on the situation of fish stocks” is open to interpretation, but in relation to the CFP objectives, the EWG considers it would be informative to be able to provide an indication of developments in stock status in response to management under the CFP. In line with the Commission’s rationale behind the indicators currently being used as described in (Patterson, 2014), the Expert group considers that the broad questions to address would appear to be twofold:

- Is the state of fish stocks improving or worsening?
- Is the knowledge regarding the state of the fish stocks improving or worsening?

Furthermore, it would also seem appropriate to monitor whether management decisions are taken in line with scientific advice.

In relation to the above the Expert group notes that the Commission's rationale behind the indicators currently being is as follows (Patterson, 2014):

Is the state of fish stocks improving or worsening?

Answering this question requires a tight definition of an indicator that will be as stable as possible over time. To this end, a sampling frame of a large number of stocks was defined early on, and no new stocks were admitted to the calculation over time. Several indicators were developed for the northeast Atlantic, the main ones being:

- The number (and proportion) of stocks above or below FMSY
- The number (and proportion) of stocks within or outside safe biological limits
- The number of stocks subject to a closure advice (="lowest possible level" or similar).

In addition, The Expert Group notes that a further indicator has been used to monitor whether management decisions have been taken in line with scientific advice vis:

- The extent to which scientific advice has been followed (as average of TAC adopted divided by science advice)

Their purpose was similar but their usefulness has varied over time. At the start of the time series very few stocks were under FMSY and this indicator was irrelevant for most stocks; presently many stocks have moved into this domain and it is the main indicator of interest. The other indicators mostly provide information about the levels of risk currently experienced by overfished stocks.

The expert group considers that the above indicators could be usefully retained under the new reporting procedure but that they could also be supplemented with additional model-based indicators to show overall temporal trends in progress towards achieving CFP objectives for a variety of stocks in each ecoregion.

Is the knowledge regarding the state of the fish stocks improving or worsening?

Two key indicators have been used:

- The proportion of stocks with quantitative analysis and forecasts (i.e. a catch option table is provided), or
- A quantitative advice has been provided.

The two indicators are not congruent. Some stocks have had catch option tables but no quantitative advice. Some stocks in the data-limited category have had quantitative advice but no quantitative assessment.

Rationale for change.

The EWG recognises that the indicators currently used, while in themselves are still relevant, the sampling frame from which they are derived needs to be reviewed and revised in the light of developments in scientific advice since 2004 when the current sampling frame was developed. In particular, stock assessments and advice are now available for more stocks in the ICES area and in the

Mediterranean than in 2004 and the number of stocks for which estimates of MSY-based reference points are available has also increased. Given the availability of appropriate data with which to calculate proposed indicators for the ICES area and the Mediterranean Sea, it proved necessary to develop separate approaches for the two areas. Such approaches are elaborated further in Sections 4 and 5 below.

Furthermore, the aim is to report on overall progress to achieving MSY, it would be desirable to produce model-based indices on progress towards doing so for each ecoregion.

The expert group has therefore explored the possibility of producing a time series of model-based indicators to report on progress towards achieving F_{MSY} and B_{MSY} for all stocks for which such estimates exist. The derivation of such model-based indicators is outlined below.

Deriving model-based indicators on progress towards achieving MSY

Model-based indicator for F/F_{MSY}

One way to monitor the performance of fisheries management under the CFP for stocks in a given sea area, is to evaluate the overall trend in the ratio between the annual fishing mortality for selected age classes (F_{bar}) and the fishing mortality that will deliver MSY (F_{MSY} or a suitable proxy e.g. $F_{0.1}$). Using the ratio (F/F_{MSY}) solves the problem of F_{bar} being at different levels for different stocks, by scaling them to a comparable format.

To estimate a general trend over time for all stocks for which assessments are available, it is necessary to devise a framework capable of handling patchiness of the assessment data and variations in the number of statistical areas, which may cause problems with sampling imbalance. To devise such a framework, the Expert group has developed a generalized additive random model (GAMM) as follows:

F/Fmsy~s(Year)+random (Stock + Area)

The fitted smoother of this model returns the standardized trend as depicted in Figure 2.1

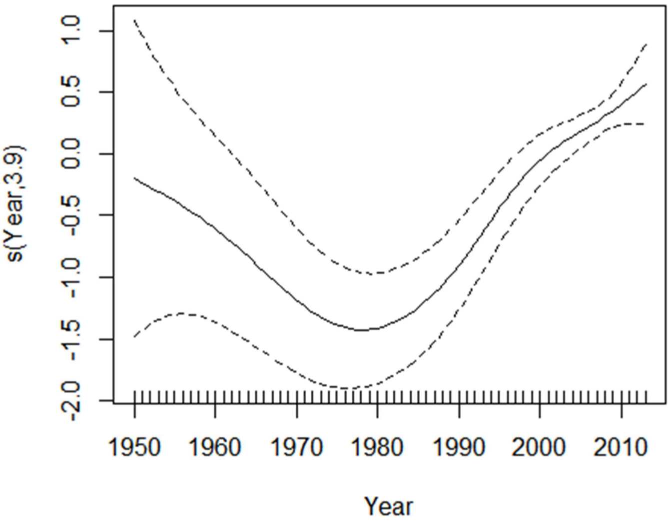

Figure 2.1. Standardized F/F$_{MSY}$ in residual scale for results from STECF assessments of stocks in the Mediterranean Sea.

However, because the standardised trend is returned on a relative/residual scale, it is difficult to relate it to the desired exploitation rate to achieve MSY (where F/F$_{MSY}$=1) would be to . A more informative approach would be to derive a fitted trend on the original F/F$_{MSY}$ scale as shown in Figure 2.2. Hence, a prediction is made on the original scale of F/Fmsy (response scale) so that the overall level of exploitation can be easily appreciated. The prediction is done for the population level of all stocks, e.g. the overall mean of all stocks, and is performed using the fixed components of the model.

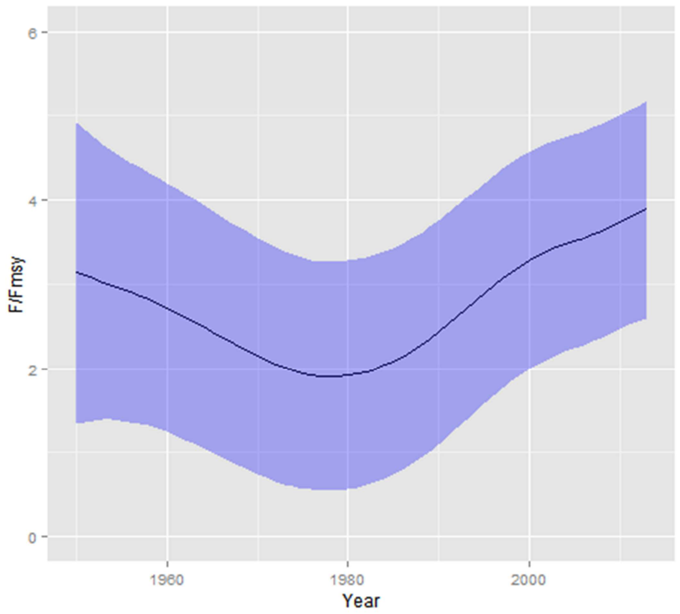

Figure 2.2. Standardized trend of F/F$_{MSY}$ in original scaling for results from STECF assessments of stocks in the Mediterranean Sea. Solid blue line represents the mean trend and the light blue shading represents the 95% confidence intervals of the mean estimates

The predicted confidence intervals (CIs, Figure 3.2) are likely to be a poor characterization of the uncertainty and in general CIs are problematic to extract from GAMMs and alternative solutions need to be found. For example the standard errors could be derived from the square root of the diagonal of the approximate variance-covariance matrix of the fitted lme4 model. More solutions can be found here -http://glmm.wikidot.com/faq

In R terms, the model is expressed as follows, and the effects of Species (Stock) and Area (GSA) are treated separately:

```
library(gamm4); library(ggplot2)

groups$dum1<-rep(1, length(groups$Year)) # creat a dummy variable for prediction at population level.

bam1 <- bam(F_Fmsy ~ s(Year)+ s(GSA, bs="re", by=dum1)+s(Stock, bs="re", by=dum1), data= groups)


plot(bam1)


newdata<- expand.grid(Year=seq(1950, 2013, 1), dum1=0, GSA=factor(unique(groups$GSA)), Stock=factor(unique(groups$Stock))) # to get groupwise predictions


frpred<-predict(bam1, newdata, type="response", se.fit=TRUE)

fit<-frpred$fit

SE<-frpred$se.fit

new<-cbind(fit,newdata)

new$se.up<-(fit+(1.96*SE))

new$se.lo<-(fit-(1.96*SE))
```

```
new2<-as.data.frame(unique(cbind(fit=new$fit,       se.up=new$se.up,       se.lo=new$se.lo, Year=new$Year)))

ggplot(new2, aes(Year, fit))+geom_line()+

 geom_ribbon(data=new2,aes(ymin=se.lo,ymax=se.up),alpha=0.3,fill="blue")+

  ylab("F/Fmsy")+ ylim(0,6)
```

The Expert group concluded that while the above approach appears to be a promising means to derive a model-based indicator for F/F_{MSY}, further investigation into the properties of the indicator especially regarding its sensitivity and stability to changes in annual availability of appropriate input estimates.

Model-based indicators for B/B_{MSY}

The Expert Group suggests that the same approach as outlined for deriving a model-based indicator for F/Fmsy could be applied to derive an equivalent indicator that estimates the overall annual B/B_{MSY} for the assessed stocks. However estimates for B_{MSY} are currently unavailable for the majority of stocks and further work is required to ascertain whether such an approach will prove informative and reliable. Furthermore, as for the model-based indicator for F/FMSY, further exploration of the properties of the model-based indicator for B/BMSY is also required.

Model-based indicator for Biomass

For a large number of stocks, estimates of appropriate biological reference points are not available. In such cases evaluating the progress towards CFP objectives following its implementation becomes challenging, as there is no objective target to be used as reference of success. This is the case for about half of the stocks in the ICES region and most of the stocks in the Mediterranean and Black Sea regions.

The Expert Group discussed the characteristics of alternative indicators that could be used for such stocks. The discussion focused on indicators for spawning stock biomass, the major conservation objective of the CFP. The rationale was to build an indicator that reflects the time trend in biomass, and although such an indicator is considered less suitable as an indicator of the policy’s success, compared to the indicators for B/B_{MSY}, it is still sufficiently informative to monitor the development in biomass following implementation of the CFP.

The indicator is built by fitting a generalized additive model to the stock biomass estimates, using stock as factor, but split into a factor for the species and another for the management unit (GSA in the Mediterranean, TAC management area in the ICES area). The data are weighted by the number of stocks for which there are biomass estimates in each year to account for the annual variation in the number of stocks for which biomass estimates are available.

A major problem with this approach is that as for the model-based indicators for F/F_{MSY} and B/B_{MSY} the data are not scaled, as in the case of B/B_{MSY}. The Expert Group discussed two possible solutions, both of which need further investigation:

(i) scaling the time series of biomass estimates to have mean zero and variance 1 before fitting the model, or
(ii) use a reference stock to compute the indicator after fitting the model to the unscaled dataset.

The first has the advantage of making the fit simpler and providing a better indicator of the time trends. The disadvantage is that the scale becomes difficult to understand and conclusions about the proportional changes are not straightforward. The proportional change in a normal distribution with mean 0 and variance 1 cannot simply be scaled up to the stock's biomass.

The second has the advantage of providing results in a natural scale, about which statements about proportional changes can be easily made. However, it requires a reference stock to be chosen, which could be a real stock or a virtual stock reflecting the mean trend.

The Expert Group concluded that while the approach to derive model-based indicators to report on progress towards achieving CFP objectives for MSY, there is a need for further investigative work on their stability and sensitivity to annual data revisions.

3 INDICATORS FOR THE ICES AREA

3.1 Basis for calculating indicators and sampling frame

The Expert group discussed at length the pros and cons of various approaches to calculate indicators and in particular on the appropriate sampling frame to do so. There are arguments for and against different approaches and the Expert Group's proposed choices and rationale are summarised in Table 3.1 below, together with the choices and rationale currently adopted by the Commission for comparison (Patterson, 2014)

Most of the proposals from the Expert group were easily decided upon but with regard to the sampling frame, there is a fundamental difference between the Expert Group's proposal and the rationale currently adopted by the Commission. The current sampling frame is defined by a fixed set of stocks based on the information available in 2004. This was to ensure a stable and consistent sampling frame to directly monitor changes over time. Furthermore, the indicators currently used by the Commission, reflect the knowledge that was available at the time the indicators were calculated. In other words, the indicator values remain fixed over time. The Expert Group however, proposes that the sampling frame need not be fixed and will ideally reflect the most up-to-date information available. This is based on the argument that the most recent assessment results better reflect the situation regarding the status of stocks in the past than the assessment results that were available at that time. In other words, the most recent knowledge is the best knowledge which to base an assessment of progress towards achieving CFP objectives.

The implications therefore are that the availability of most recent information will to a large extent determine which stocks are to be included in the calculation of the indicators and the most recent assessment results will be used to revise the whole time-series of indicator values. While recognising that adopting such an approach implies that the status of some stocks may appear to change from one year to the next, it will provide the most appropriate indication of progress towards achieving CFP objectives.

Table 3.1. Choices for calculating indicators currently in use and proposed choices and rationale for future reporting. Those **cells shaded blue** indicate no change from current choices, although the rationale for the EWG proposal may be further elaborated.

Issue	**Approach currently used by DG MARE**	**Reasoning used by DG MARE**	**Possible alternatives suggested by DG MARE**	**EWG 14-20 proposal for future reporting**
Choice of basic	TAC	This is the	Base the analysis	Use TAC/unit/area

measurement unit		operational management area- this choice makes it possible to directly compare scientific TAC advice with actual outcomes.	on biological stocks, which is computationally much simpler as the units are already well defined. Direct comparison with management actions could be more difficult.	for making comparisons between outcome and management decision, but scientific advice will relate to biological stock assessment unit.
Which stocks to cover ?	EU exclusive stocks managed by TACs, and some shared stocks with a large EU interest (North Sea herring, blue whiting, mackerel).	These are the stocks of principal EU management effort under the Common Fisheries Policy.	1) All fish stocks in EU waters 2) All commercial stocks in EU waters 3) All fish stocks in EU and contiguous shared stocks	EU exclusive stocks managed by TACs, and some shared stocks with a large EU interest (North Sea herring, blue whiting, mackerel).
Information source	ICES annual advice sheets for each year	This is the information on which the management is based and which is provided formally. It was preferred to keep the historic data stable.	Use the best available current estimates from the latest analysis. This means the entire time-series would be updated each year.	Most recent year's ICES/GFCM/STECF assessment results and advice.
Sampling frame	A set of fish stocks chosen according to availability of science advice in 2004. New stocks have not been added. Deep Sea species not included.	Fixing a consistent sampling frame is necessary for consistency over time.	1) Use all the latest estimates. This is less consistent over time but provides a more complete picture of the present. 2) Update the sampling frame and re-start a new time series.	Sampling frame to be updated each year based on availability of assessments and advice. Recalculate indices for whole of time series based on most recent data.

Qualitative assessments taken into account (e.g. advice that "stock is below possible reference points")	Not used	This form of advice was developed halfway through the time series and using it would probably introduce a bias.	Recalculate a new, shorter time-series with a new starting point.	Not used
An assessment means that the state of the stock has been assessed and a quantitative forecast has been provided. And reference points are available	A full quantitative analysis is available.	Only the full, rigorous assessments meet this definition but it is unambiguous.	Include stocks which have assessments but no forecasts.	A full quantitative analysis is available. The following metrics will ideally be available. F, F_{MSY}, SSB, Bpa, Fpa, B_{MSY} If available B/B_{MSY} would be preferred over B_{pa}
When two stocks are fished on one TAC, which estimate should be used ?	Use only the most abundant Stock with highest SSB on average over timeframe.	Use only one statistic as one TAC = one management decision.	1) Take account of both stocks. 2) Classify according to a weighted average.	Use only the most abundant, where abundant relates to the stock with highest SSB on average over available time series
When one stock is fished on several TACs, count the TACs separately ?	No	They are linked and follow from a single management decision.		No
Reference points for comparison	Fmsy, Fpa and Bpa	Safe biological limits were the key criteria from 2002-2014 but we have now moved to MSY	1) Fmsy and Bmsy 2) Fmsy and Btrigger 3) Fmsy, Fpa, Bmsy	Fmsy, F_{pa} and B_{pa} SSB, B_{MSY} If available B/B_{MSY} would be preferred over B_{pa}
Method of comparison	Counts of stocks above and below the reference point.	Simple and easily understandable. Qualitative advice could in principle	1) Mean value divided by the reference point. 2) Some quantile	Counts of stocks above and below the reference point. Model-based indices

		be used.	of the ratio above.	for F/F_{MSY} and B(see Section 3 of this report)
Classification of "inside safe biological limits"	$F<=F_{pa}$ and $B>= B_{pa}$	"safe" interpreted as ICES pa framework. Both F and B are important.	1) Use B only 2) use F only	$F<=F_{pa}$ and $B>= B_{pa}$ In accordance with CFP definition
Treatment of "closure advice" as quantitative	Considered as quantitative	Considered the same as zero catch	Treat as qualitative	Considered as quantitative
Assessment of non-zero catch when advice is zero	Considered as a 100% overshoot	Arbitrary limitation	1) Ignore 2) Use another arbitrary limit.	Ignore
Stocks principally managed under effort limits	Not included	The analysis was biased to monitoring the efficiency of TAC management	Include – provided relevant metrics are available	Include – provided relevant metrics are available.
Stocks with no MSY estimation	Record and report on unknowns	It is important to report on coverage of the analysis as this is variable between areas.	This is problematic for the Mediterranean Sea, where the no. of stocks of unknown status is itself unknown.	Record and report on unknowns.

3.2 Proposed indicators for the ICES area

The expert Group proposes that the following indicators be included in future reporting on progress towards achieving CFP objectives.

1. **Stock (exploitation) status with respect to MSY exploitation rate (F_{MSY}) or suitable proxy**

- No. of stocks for which status with respect to F_{MSY} is known
- No of stocks where fishing mortality exceeds F_{MSY}
- No of stocks where fishing mortality is equal to or less than F_{MSY}

- Proportion of stocks for which fishing mortality exceeds F_{MSY}

The expert group considers that while similar indicators could in principle be derived in relation to B_{MSY}, in practice, given the absence of reliable estimates for BMSY, at present such indicators are unlikely to be informative. Should further work indicate that this is not the case, the Expert group proposes that such indicators also be reported.

2. State of stocks with respect to safe biological limits

- No. stocks outside safe biological limits*
- No. stocks inside safe biological limits**
- Proportion of stocks inside safe biological limits*
- Number of stocks for which the state of the stock is unknown
- Stocks unknown + stocks assessed with respect to safe biological limits
- Proportion of stocks of known status with respect to safe biological limits

* Outside safe biological limits means that SSB in year-1 is equal to or less than Bpa and F in year-1 is equal to or higher than Fpa.

** Inside safe biological limits is determined according to Definition 18 Under Article 4 of the 2013 CFP(Regulation (EU) 1308/2013 of 11 December 2013), which is interpreted to mean that SSB at the end of year-1 is higher than Bpa, and F in year-1 is less than Fpa.

3. Stocks for which scientific advice is to stop fishing (or similar words*)

- Number of stocks for which scientific advice is to stop fishing

* E.g. where scientific advice is for no directed fisheries and/or catches should be minimised

4. Difference between agreed TACs and advised catches

- Percentage excess of TAC over advised catch (%)
-

5. Summary of the scientific advice about fishing opportunities*

- Stocks for which stock size and catches can be forecast
- Stocks for which quantified scientific advice concerning fishing opportunities is available
- Stocks for which no quantitative advice on fishing opportunities is available
- Stocks which do not have full assessments but for which quantitative advice is provided
- Stocks for which scientific advice is to stop fishing (or similar words)

* Where scientific advice for a stock concerns two or more TAC (management) areas, it is only counted once

6. Model-based indicators on progress to achieving MSY

The Expert group proposes that pending the outcome of the further work referred to in section 3.1 above, and assuming appropriate and reliable input estimates are available, model-based indicators of trends in F/F_{MSY}, B/B_{MSY} and Biomass should be reported in future.

4 INDICATORS FOR THE MEDITERRANEAN AND BLACK SEAS

4.1 Basis for calculating indicators and sampling frame

In order to evaluate annual progress on achieving maximum sustainable yield and on the situation of fish stocks in accordance with Article 50 of Regulation (EU) No 1380/2013 appropriate indicators will need to be as stable over time as possible. The need for an appropriate sampling frame of stocks to include in the calculation of indicators for the Mediterranean Sea was thus identified.

The species to include in the sampling frame were identified by considering the following:

1. The commercial importance of species in terms of contributions to EU fleet landings by weight at the spatial scale of the entire Mediterranean;
2. The commercial importance in terms of contributions to EU fleet landings by weight at the spatial scale of individual GSAs;
3. The commercial importance of species in terms of contributions to EU fleet landings by value at the spatial scale of the entire Mediterranean;
4. Species listed on the existing GFCM list of priority species for the Mediterranean Sea;
5. The existing STECF stock assessment priority list.

The focus of the sampling frame is on commercially exploited species rather than on vulnerable and/or threatened species since generally data availability for such species is very poor in the Mediterranean Sea. Species managed by RFMOs such as ICCAT were not included in the sampling frame; additional details on how the species listed in Table 1 below were selected are provided in sections a & b below.

The species sampling frame proposed below could be the basis for calculating indicators for the Mediterranean Sea, and should be considered a bare minimum in order to provide meaningful advice to managers. Overall the species included in the sampling frame account for 75% by weight and 67%[1] by value of landings recorded for EU fishing vessels in the entire Mediterranean in 2012.

Table 4.1. Species sampling frame for the Mediterranean Sea

No	Species Name	Species Code
1	*Aristaeomorpha foliacea*	ARS
2	*Aristeus antennatus*	ARA
3	*Boops boops*	BOG
4	*Chamelea gallina*	SVE
5	*Coryphaena hippurus*	DOL
6	*Eledone cirrosa*	EOI
7	*Eledone moschata*	EDT
8	*Engraulis encrasicolus*	ANE

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[1] High value large pelagic species are not included in the sampling frame since they are managed by ICCAT (see Annex I for rankings).

9	*Lepidopus caudatus*	SFS
10	*Loligo vulgaris*	SQR
11	*Lophius budegassa*	ANK
12	*Lophius piscatorius*	MON
13	*Merlangius merlangus*	WHG
14	*Merluccius merluccius*	HKE
15	*Micromesistius poutassou*	WHB
16	*Mullus barbatus*	MUT
17	*Mullus surmuletus*	MUR
18	*Nephrops norvegicus*	NEP
19	*Octopus vulgaris*	OCC
20	*Pagellus erythrinus*	PAC
21	*Palinurus elephas*	SLO
22	*Parapenaeus longirostris*	DPS
23	*Penaeus kerathurus*	TGS
24	*Phycis blennoides*	GFB
25	*Raja clavata*	RJC
26	*Sardina pilchardus*	PIL
27	*Sardinella aurita*	SAA
28	*Scomber scombrus*	MAC
29	*Scomber japonicus*	MAS
30	*Sepia officinalis*	CTC
31	*Solea solea*	SOL
32	*Sparus aurata*	SGB
33	*Spicara smaris*	SPC
34	*Squilla mantis*	MTS
35	*Trachurus mediterraneus*	HMM
36	*Trachurus trachurus*	HOM

a. Species

The most important species targeted by fisheries in the Mediterranean Sea were identified in terms of (i) landings weight and (ii) landings commercial value. Species were ranked according to their contribution to the total landings reported by Mediterranean EU Member States in response to the call for fleet economic scientific data concerning 2008-2014[2], using 2012 as a reference year. Declared landings of the following countries were included: CYP, ESP, FRA, HRV, ITA, MLT, SVN. No data was available for Greece.

28 species / species complexes contributed 80% of total landings in terms of value; 25 species / species complexes contributed 80% of total landings in terms of weight. The remaining 20% were composed of over 1200 additional species / species complexes (Tables 1 and 2, Annex I).

This list of important target species harvested in the Mediterranean Sea was then complemented by adding species of significant commercial importance[3] to the EU fishing fleet from the GFCM (General Fisheries Commission for the Mediterranean) priority species table[4].

b. Stocks

Whilst the species identified by the initial ranking exercise at the spatial level of the entire Mediterranean basin represent the most important marine biological resources exploited by the EU fleet in the Mediterranean Sea, meaningful reporting on the progress of the CFP will of course be required at stock level.

Unfortunately the knowledge available on stock boundaries in the Mediterranean Sea is extremely limited. Instead of biological units defined according to information on fisheries or in aspects such as spatial distribution and degree of reproductive isolation of population sub-units, stocks in the Mediterranean are primarily oriented by the most of the times arbitrary divisions in Geographical Sub-Areas (GSAs) in the Mediterranean Sea; the division of stocks according to GSAs is currently used for stock assessment and management purposes. STECF has in the past highlighted the need for a more refined and updated view on the different stock units, as well as the need to verify whether the current classification of GSAs matches with advisable assessment and management units of the main resources and fisheries of the Mediterranean Sea[5].

In order to nevertheless ensure the suggested sampling frame includes all the most relevant stocks targeted by EU fishing fleets in the Mediterranean Sea, the contribution of individual stocks to total landings in terms of weight and value at the level of Geographic Sub-Areas (GSAs) should be analysed. Such data was not available since the annual Mediterranean and Black Sea data call requests only data on weights of landed species, and is moreover limited to a sub-set of species. Similarly, the capture fisheries dataset publicly available on the GFCM website only provides information at the spatial level of fishing areas (e.g. Ionian Sea, Aegean Sea, Adriatic etc.)[6].

A specific data call requesting the following data from Mediterranean EU Member States would be required to accurately identify the most important stocks at GSA level:

1. Weight of landings per species, year, GSA, fleet segment and gear type;
2. Value of landings per species, year, GSA, fleet segment and gear type.

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[2] Ref. Ares(2014)130188-21/01/2014

[3] Either at the level of the entire Mediterranean basin or in individual GSAs.

[4] http://www.gfcm.org/gfcm/topic/166221/en

[5] Report of the SGMED-08-02 Working Group on the Mediterranean Part II; 21-25 April 2008, Athens, Greece; JRC49329

[6] http://www.fao.org/fishery/statistics/GFCM-capture-production/query/en

In the absence of such data the list of commercially important species was compared to the STECF stock assessment priority list7 (Table 3, Annex I), which identified major stocks in the Mediterranean based on the following considerations:

- Stock contribution to catch and prominence in landings for each GSA;
- Commercial value to prioritize the commercially important species by area;
- Conservation status including threatened species;
- Availability of fisheries data;
- Classification according to life span (short / long living species).

In addition a preliminary analysis of regional differences in landings was carried out based on data available from the Mediterranean and Black Sea data call by identifying cumulative percentage contributions of species to landings weights at GSA level based on 2010 data (Table 4, Annex I). Species with stocks of high importance in certain GSAs (again using the top 80% of landings by weight as the cut-off point) which were had not already been picked up by the ranking exercise carried out at the spatial scale of the entire EU Mediterranean basin were added the sampling frame (e.g. *Raja clavata* in GSA 15 and *Spicara smaris* in GSA 25).

2. Data availability

The data required to report on the progress of achieving maximum sustainable yield and on the situation of fish stocks is not currently available for all the species/stocks identified based on the considerations listed above. Even when relevant data collection systems are in place, the information being collected may not be sufficient to carry out an analytical stock assessment if species are not very common in an area. An overview of data available for stock assessments based on the current sampling regimes in place in the various Mediterranean GSAs is provided in the report of STECF EWG 12-19.

Moreover a concern when calculating indicators based on the available stock assessment data is also the temporal patchiness of the available stock assessments; stock assessments in the Mediterranean Sea are currently not carried out on an annual basis. Figure 1 illustrates the frequency of stock assessments carried out by STECF EWGs since 2008.

STECF will be focussing stock assessment work on the STECF assessment priority list of stocks; new information to compute indicators on the progress on achieving maximum sustainable yield and on the situation of fish stocks will thus first become available for these species/GSAs. Additional assessments will also become available as the result of the GFCM stock assessment working groups.

An overview of the species selected in the sampling frame in relation to current DCF data collection regimes (DCF Group 1 / Group 2 species[8]), species for which information is routinely requested from Mediterranean Member States through the Med & Black Sea data call and whether stocks of the species have been included in the STECF stock assessment priority list is provided in Table 2.

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[7] See Section 10.2; Scientific, Technical and Economic Committee for Fisheries (STECF) – 2012 Assessment of Mediterranean Sea stocks part II (STECF 13-05). 2013. Publications Office of the European Union, Luxembourg, EUR 25309 EN, JRC 81592, 618 pp.

[8] Appendix VII, Commission Decision 949/2008

Figure 4.1. Stock assessments by species and GSA carried out by the STECF Mediterranean stock assessment EWGs in 2008-2014.

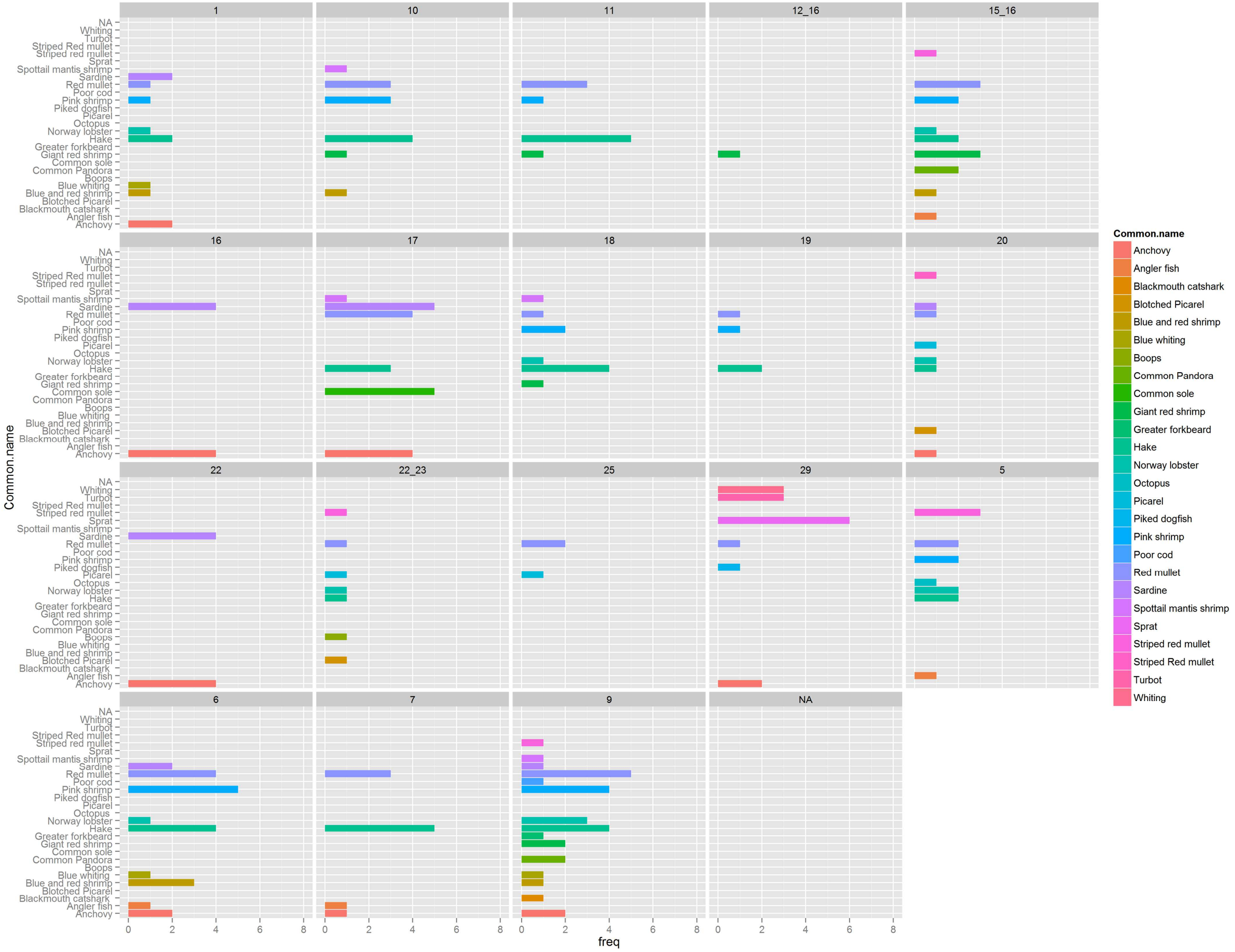

Table 4.2. Data coverage for species selected in the sampling frame.

No	Species Name	Species Code	Med & BS Datacall	DCF Group	STECF stock assessment priority list
1	*Aristaeomorpha foliacea*	ARS	X	1	X
2	*Aristeus antennatus*	ARA	X	1	X
3	*Boops boops*	BOG	X	2	
4	*Chamelea gallina*	SVE			
5	*Coryphaena hippurus*	DOL	X	2	X
6	*Eledone cirrosa*	EOI	X	2	
7	*Eledone moschata*	EDT	X	2	
8	*Engraulis encrasicolus*	ANE	X	1	X
9	*Lepidopus caudatus*	SFS			
10	*Loligo vulgaris*	SQR	X	2	
11	*Lophius budegassa*	ANK	X	2	X
12	*Lophius piscatorius*	MON	X	2	
13	*Merlangius merlangus*	WHG	X		
14	*Merluccius merluccius*	HKE	X	1	X
15	*Micromesistius poutassou*	WHB	X	2	
16	*Mullus barbatus*	MUT	X	1	X
17	*Mullus surmuletus*	MUR	X	1	X
18	*Nephrops norvegicus*	NEP	X	1	X
19	*Octopus vulgaris*	OCC	X	2	X
20	*Pagellus erythrinus*	PAC	X	2	X
21	*Palinurus elephas*	SLO		1	
22	*Parapenaeus longirostris*	DPS	X	1	X
23	*Penaeus kerathurus*	TGS	X	2	
24	*Phycis blennoides*	GFB	X	2	
25	*Raja clavata*	RJC	X	1	
26	*Sardina pilchardus*	PIL	X	1	X
27	*Sardinella aurita*	SAA			

28	*Scomber japonicus*	MAS	X*	2	
29	*Scomber scombrus*	MAC	X*	2	
30	*Sepia officinalis*	CTC	X	2	
31	*Solea solea*	SOL	X	1	X
32	*Sparus aurata*	SBG	X	2	
33	*Spicara smaris*	SPC	X	2	
34	*Squilla mantis*	MTS	X	2	X
35	*Trachurus mediterraneus*	HMM	X	2	
36	*Trachurus trachurus*	HOM	X	2	

* Data call is for *Scomber* spp.

Despite these shortcomings and concerns it is important to note that considerable progress has been made with regards to the number of available stock assessments in the Mediterranean basin over the last decade; an overview of stock status based on analytically assessed and reviewed stock assessments done by either GFCM or STECF expert working groups is shown in Table 3.

Table 4.3. Overview of analytically assessed and reviewed stocks in the Mediterranean. Source: STECF EWG 13-26[9]

		Coomon name	Scientific name	GSA																										
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Small pelagic	1	Anchovy	*Engraulis encrasicolus*						🟥	🟩		🟥							🟥	🟩										
	2	Sardine	*Sardina pilchardus*																🟩	🟥										
	3	Spanish mackerel	*Scomber japonicus*																											
	4	Sprat	*Sprattus sprattus*																											
	5	Horse mackerel	*Trachurus trachurus*																											
Demersal	6	Giant red shrimp	*Aristeomorpha foliacea*									🟥	🟥	🟥	🟥	🟥	🟥	🟥	🟥		🟥									
	7	Blue and red Shrimp	*Aristeus antennatus*					🟥	🟥			🟥	🟥					🟥	🟥											
	8	Bogue	*Boops boops*																											
	9	Common dentex	*Dentex dentex*																											
	10	Greater forkbeard	*Phycis blennoides*									🟥																		
	11	Monkfish	*Lophius budegassa*					🟥	🟥	🟥																				
	12	European hake	*Merluccius merluccius*	🟥				🟥	🟥	🟥		🟥	🟥					🟥	🟥	🟥	🟥	🟥								
	13	Blue whitihing	*Micromesistus potassou*	🟥					🟥			🟥																		
	14	Red mullet	*Mullus barbatus*							🟥		🟥		🟥				🟥	🟥		🟥									
	15	Striped mullet	*Mullus surmuletus*					🟥				🟥																		
	16	Norway lobster	*Nephrops norvegicus*	🟥				🟥	🟥			🟥						🟩	🟩											
	17	Octopus	*Octopus vulgaris*																											
	18	Black spot seabream	*Pagellus bogaraveo*																											
	19	Common pandora	*Pagellus erythrinus*									🟥						🟥	🟥											
	20	Pink shrimp	*Parapenaeus longirostris*	🟥		🟥	🟥	🟥	🟥				🟥	🟥	🟥	🟥	🟥	🟥	🟥		🟥	🟥								
	21	Spottail mantis shrimp	*Squilla mantis*										🟥							🟥	🟥									
	22	Common sole	*Solea solea*																	🟥										
	23	Picarel	*Spicara smaris*																									🟩		
	24	Barracuda	*Sphyraena sphyraena*																											
	26	Poor cod	*Trisopterus minutus capelanus*									🟥																		
Elasmobranches	27	Thresher shark	*Alopias vulpinus*																											
	28	Carcharhinidae	*Carcharinus* spp.																											
	29	Basking shark	*Cethorinus maximus*																											
	30	Tope shark	*Galeorinus galeus*																											
	31	Blackmouth catshark	*Galeus melastomus*																											
	32	Blackchin guitarfish	*Glaucostegus cemiculus*																											
	33	Sixgill shark	*Hexanchus griseus*																											
	34	Pelagic stingray	*Pteroplatytrygon violacea*																											
	35	Starry skate	*Raja asterias*																											
	36	Thornback ray	*Raja clavata*																											
	37	Small-spotted catshark	*Scyliorinus canicula*																											
	38	Smoth hammerhead	*Sphyrna zygaena*																											
	39	Spurdog	*Squalus acanthias*																											

Status unknown: assessemtn done but still preliminary and/or not updated	☐
Status: in overfishing according to Fmsy of the most up to date assessment available	🟥
Status: sustainable fished according to Fmsy of the most up to date assessment available	🟩
No information presented	☐

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[9] Scientific, Technical and Economic Committee for Fisheries (STECF) – Review of scientific advice for 2014 – part 3 (STECF-13-26). 2013. Publications Office of the European Union, Luxembourg, EUR 26324 EN, JRC 86110, 297 pp.

4.2 Indicators for the Mediterranean Sea

In the Mediterranean Sea, stock assessments are carried out both by the working groups of the GFCM and the EU Scientific, Technical and Economic Committee for Fisheries (STECF). The second has recently established a priority list of stocks in EU Geographical Subareas (GSAs) to be assessed in the next years (STECF, 2012). In the past the lack of a more systematic data collection hindered the assessment and management of many fisheries resources in several Mediterranean areas until the early 2000s when the EU Data Collection Regulation (DCR, EU reg. 1543/2000) was implemented in all EU Member States.

The Expert Group recognises that because of the differing management arrangements in the Mediterranean compared to the ICES area and the type and availability of stock assessments, many of the indicators proposed for the ICES area are not relevant. For example, with the exception of tunas, there are no agreed annual TACs set, and where catch limits are in place, these are set for only specific fisheries and under the jurisdiction of Member States.

The following indicators were considered by the Expert group:

1. **Trend of F/FMSY**

The Expert group notes that for the vast majority of stocks in the Mediterranean, reliable estimates of F_{MSY} are not available. To overcome this and in order to derive an appropriate alternative MSY-based reference point, a F_{MSY} proxy ($F_{0.1}$) has been adopted. This indicator is however sensitive to stock-specific age at maturity and age of recruitment to the fishery of each stock. The ratio of estimated $F_{current}$ to $F_{0.1}$ is usually used to evaluate stock status. Projections of this ratio are used to assess the expected evolution towards MSY as a result of new management measures.

$F_{0.1}$ has been estimated for a number of species in several GSAs. Several species are important target species throughout the Mediterranean, but there are notable regional differences in catch compositions recorded in different GSAs, in particular between the western and eastern basins of Mediterranean Sea. (see Table 4, Annex I) A number of factors are decisive to the selection of stocks to be assessed and included in the calculation of indicators, such as the availability of an adequate data-series, the contribution of the particular species to overall landings at GSA level, the economic economic importance of a stock etc. Moreover, computing an average status of all assessed stocks does not necessarily result in valid conclusions which are representative of the status of all the exploited stocks in mixed fisheries.

It is thus advised that this indicator (the evolution of $F/F_{0.1}$ on average) is defined as described in section on Model-based indicator for F/FMSY but also separately for different functional or taxonomic groups (e.g. high level predators, plankton eaters, finfish, molluscs and crustaceans). Special attention should also be given to vulnerable species (e.g. elasmobranchs) due to their life history characteristics (i.e. their slow growth rates and reproductive strategies). Performance of the enforced measures aimed at reaching MSY should be defined by groups and by area, because fisheries in different areas may have different targets likely exploiting different trophic levels of the marine community and may have different responses to fishing pressure. Moreover, it is necessary to enlarge the list of species to be assessed. It is difficult to identify a reduced number of stocks for which performance can be considered representative for all the stocks.

For the cases for which $F/F_{0.1}$ cannot be estimated alternative assessment methods that allows the definition (even though less precise) of their exploitation status and the assessment of the progresses regarding the goal of fishing at MSY might be used. Such alternative methods are discussed under “Other alternative data limited methods” below.

2. Safe Biological Limits (SBL)

In the Mediterranean Sea the limited availability of biomass time series restricts the definition of safe biomass-based limits such as B_{MSY} or any other limit reference points (LRPs) for biomass.

LRPs based on biomass have however been defined for some small pelagics and for some sole and hake stocks, by analysing scatter plots of stock biomass and recruitment estimates. Time series of B/B_{lim} can thus be defined only for a limited number of stocks. Hence this indicator cannot be considered to be representative of the overall trends for all the exploited stocks in the Mediterranean since different species have different life history characteristics and hence resilience to fishing pressure.

3. Selection/exploitation pattern – average L50 - Discard ratio.

One of the aims of implementing fisheries management measures is to minimise the catch of small fish or juveniles giving them a chance to grow before being removed and ensuring appropriate levels of spawning stock biomass. The size/age composition of catches and their evolution with time can thus be informative for the evaluation of progress towards MSY. Potential metrics to use could be the weighted average size of the catch (L_{50}), the proportion of individuals over the age of maturity in the catch, the maximum size in the catch, the mean length in the catch etc. The short data time series combined with the lack of contrast regarding fishing pressure and stock size along the time series in the Mediterranean however reduces the descriptive power of such indicators.

A reduction in discards may mean, among other things, a better utilisation of resources or some improvement in exploitation patterns or changes in fishing pressure with a shift in the catch towards bigger sized individuals. However since catch quotas are not defined in the Mediterranean, discards comprise species with no commercial value or/and of undersized individuals of commercial species.

The proportion of individuals over the age of maturity in the catch may constitute a signal of changes in the biomass of the spawning stock, provided that the spatial and temporal distribution of fishing effort remain relatively constant.

Under the landing obligation rules (Article 15 of Reg. 1380/2013) catches in the Mediterranean will be subject to minimum conservation reference sizes (MCRS). The goal is to reduce unwanted catches. Landings of fish under the MCRS can be monitored and proportions related to total landings (or absolute values?) can be used as a metrics for evaluation.

4. Number and proportion of stocks above/below BMSY?

With the exemption of a limited number of stocks (e.g. sardine, anchovy, red mullet) in specific GSA areas, B_{MSY} has not been defined for most of the Mediterranean stocks. The Expert croup concludes that at present, an indicator based on B_{MSY} would not be representative of the overall status of all stocks. However the current lack of time series of B and of Bmsy should not rule out the possibility of deriving such an index if time series become available.

The evolution in time of the average normalized SSB can be also a useful indicator on the direction of progress in response to management. The Expert group considers that evolution of biomass could be an informative alternative to a model-based indicator for B/B_{MSY} especially if it can be established that the main driver of the changes in biomass over time series can be attributed to changes in fishing pressure.

5. Catch Biomass ratios, trend in mean C/B.

C/B is considered an index of fishing mortality. As F/F_{MSY} rates cannot be estimated for an appropriate number of stocks and stock assessments are not repeated on an annual basis in the Mediterranean, the ratio between catch and biomass index (hereinafter ‘C/B’) can be used as an additional informative indicator. Analysis of C/B trends is included among the MSFD descriptors (Indicator 3.1.2). Catch and biomass data are available for a quite high number of stocks in the Mediterranean because such variables are regularly collected in the DCF. The indicator can be interpreted as a signal of changes in the level of fishing pressure on the stock, although it is necessary to consider that changes in biomass may depend on several causes other than the removals by the fisheries. Environmental factors can also be important drivers of the changes in biomass, for example producing important changes in mortality and in recruitment success.

6. Other alternative data limited methods

In data limited situations such as in the Mediterranean is necessary to explore alternative assessment methods capable of revealing stock status and progress towards the CFP objectives. An example of such methods, which has been frequently used in other countries with the policy objective of achieving MSY is the depletion-corrected average catch (DCAC) model. It needs only of catch time-series data, supplemented by educated guesses of a few supplementary parameters. The method identifies sustainable yields from simple data input and its use can be recommended especially as a first-step estimate for an allowable catch level and/or to complement other data-poor methods. Other variants based on the same ideas have been recently developed. The so-called An Index Method (AIM) allows the fitting of a relationship between a time series of catch data and a relative stock abundance index, and is used to estimate the level of relative fishing mortality at which the population is likely to be stable. The approach allows to construct reference points based on relative abundance indices and catches, and to perform projections to achieve a target stock size. The Catch-MSY method allows for the estimation of MSY from catch data, resilience of the respective species, and some assumptions on the relative stock size at the first and final year of the data time series.

Proposed indicators for the Mediterranean and Black Seas

The Expert group proposes that at present, the most appropriate indicators for assessing progress towards achieving CFP objectives for the Mediterranean and Black Seas are as follows:

- Trends in F/F_{MSY}
- Trends in B/B_{MSY} (although not achievable on the short term)
- Trends in SSB
- Trends in Catch/Biomass ratios (C/B ratio)
- L_{50} as a weighted average size indicator of the catch.

The rationale and methodology to calculate the indicators to monitor trends in F/F_{MSY} and SSB are those described in Section 3.1 above.

In addition the Expert Group proposes that where possible, the values for those indicators proposed for the ICES area in Section 4 above should also be reported for the Mediterranean and Black Seas.

5 BIO-ECONOMIC MODELS AND THEIR POTENTIAL FOR AN ECONOMIC ASSESSMENT OF THE MSY

In addition to the objectives relating to the precautionary approach to fisheries management and MSY, the CFP (Regulation (EU) No 1380/2013) also has stated social, economic and employment objectives viz; Article 2(1) of the CFP states:

The CFP shall ensure that fishing and aquaculture activities are environmentally sustainable in the long-term and are managed in a way that is consistent with the objectives of achieving economic, social and employment benefits, and of contributing to the availability of food supplies.

Furthermore, economic viability is also an objective as stated in the following Articles:

Article 2 (Para. 5,c) [The CFP shall, in particular:] provide conditions for economically viable and competitive fishing capture and processing industry and land-based fishing related activity;

- Article 2 (Para. 5,d) *[The CFP shall, in particular:] provide for measures to adjust the fishing capacity of the fleets to levels of fishing opportunities consistent with paragraph 2, with a view to having economically viable fleets without overexploiting marine biological resources;*
- Article 28 (2,c) *[In particular, the Union shall:] contribute to sustainable fishing activities that are economically viable and promote employment within the Union;*

The fundamental difference between the assessment of the performance of the CFP with respect to social and economic objectives on one side and biological objectives on the other is that the specific objectives for social and economic sustainability are unclear. Consequently it is not possible to estimate and report on progress towards achieving such objectives. While there is some uncertainty associated with assessing performance against MSY objectives or safe biological limits, attaining a ‘viable fishing sector’ is a much more nebulous concept which is currently not quantified. Therefore, assessment of social and economic performance under the CFP can only be monitored through the reporting of developments and trends in certain indicators such as Net profit, GVA or Employment.

There are a large number of bio-economic models[10] currently available which reflects the need to adapt the modelling approach to answer different questions (See for instance Prellezo et al., 2012).

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[10] The large number of available bio-economic models, the capacity of some of these models to change or incorporate functionalities, the relatively low number of bio-economic models specified in peer-review journals, and the extended habitude that these models are only employed by their programmers lead to a general level of ignorance about what most of the specific bio-economic models can do. This way, EWG members have tried to be general in their statements, and just citing examples on the bio-economic models they have expertise on.

The Expert group considers that it is important to distinguish between 3 different types of models: bio-economic optimization models, only bio-economic simulation models and “economic” simulation models[11]. In general, different types of bio-economic models will be required, depending on the issues to be addressed..

Most, if not all, bio-economic (and economic) models provide outputs on revenues, profits, GVA, employment, etc. This should allow the production of most common indicators, the potential comparison with MSY or MEY levels (if they can be estimated) and the Net Present Value of economic flows over time (i.e. transition periods). So, the choice of model will depend on the analysis required.

Assessing potential economic effects of management measures

If we want to analyse the effects of certain management measures (policies) it is necessary to use bio-economic simulation models. This way, for example, it is possible to carry out impact assessments of fishery management plans or to forecast the effects of policies aiming at MSY in general. In this sense, several publications have assessed possible economic consequences of stock rebuilding, without assuming certain biomass levels (e.g. Döring and Egelkraut 2008) or using pre-defined levels of biomass for a group of stocks for which estimates of B_{MSY} are available (from advisory bodies, Quaas et al. 2012; using their own B_{MSY} estimates Froese and Quaas 2012). Maynou (2014) using MEFISTO bio-economic model (Maynou et al., 2006) makes a coviability analysis of MSY scenarios for 2020 in Western Mediterranean fisheries. Such analyses would inform managers on costs and benefits of alternative harvest control rules (e.g. the 15% limit of fluctuations of the TAC in many long term management plans). Major disadvantages of these approaches are that agreed B_{MSY} estimates are not available for many stocks and such estimates, together with a clear indication of the management approaches that are likely to be implemented in an attempt to achieve B_{MSY} will be required, in order to undertake informative economic assessments especially for mixed fisheries. Thus, bio-economic simulation models are useful to investigate the impacts of certain policy measures, such as in long term management plans (i.e. FISHRENT: Simons et al., 2014a; IAM: Raveau et al., 2012; MEFISTO: Maravelias et al., 2014).

Assessing the best way to achieve a management objective

To investigate and compare the which of a variety of different measures is likely to be the optimal means to achieve a policy objective (under certain restrictions), bio-economic optimisation models are needed. For example, such optimisation models could be used to determine the optimum management options to achieve MSY within a specified time frame and other implementation constraints such as a restriction on the inter-annual variation in fishing opportunities or fishing effort. Guillen et al., (2013) estimated the economic effects of fishing at MSY and MEY for multi-species and multi-fleet demersal fisheries in the Bay of Biscay using IAM (Macher et al., 2008; Macher and Boncoeur, 2010), a bio-economic optimisation model. Similarly, Simons et al., (2014a) compared different management measures to manage the North Sea saithe fishery to maximise the net present value of profits (a valid

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[11] This division, even if useful for clarification purposes, is an oversimplification of the reality. In fact, some models can belong to different categories (or may need just slight adjustments); for example, IAM or FISHRENT are optimisation and simulation bio-economic models.

proxy for MEY) using the FISHRENT model (Salz et al. 2011)[12]. In all these cases we may speak of medium or longer term perspective.

Assessing short-term economic effects of management

If we just want to know the economic effects of a quota change to assess short term economic effects (one year) it may be relatively straightforward and less time demanding. Such an approach may be used to predict the economic performance of a fleet in response to future changes in quotas or to estimate the potential difference in rents at current exploitation rates compared to exploitation rates capable of delivering MSY. For example, the EIAA model (Frost et al., 2009) has been used to estimate the economic effects of proposed quotas at EU level. Hence, in order to choose the type of bio-economic model required it is necessary to know what analysis is required, and consequently, in the context of the performance of the CFP, it is important to specifically define what is required for "an economic assessment of the MSY policy". The specification of what is required will determine the modelling approach to be, as well as data needs and time required.

Resource requirements to undertake economic assessments

Assessing the potential impacts of management plans or forecasting the potential effects of policies aiming to achieve MSY e.g. an annual 10% reduction of fishing effort or mortality) will be quite demanding in terms of data needs and time. Some rough estimates are presented in Table 6.1 under case A. A prerequisite to such analyses is that stock assessments are available and the relevant economic data for the stocks and fleets involved[13] have been assembled. Similar needs in data and time are required to estimate the best policy to achieve MSY or MEY by a certain year (case B). If the requirement is simply to provide MSY and MEY estimates the resource requirements may be much less.

Some economic assessment of quota changes can be provided by most bio-economic models, but some of them may require more time or adjustments (case C). Some "Economic" simulation models (i.e. EIAA, BEMEF, FISHRENT if adjusted) are aimed to produce such advice, and are relatively straightforward to run and demand less time to do so. Nevertheless, they still require quotas as input parameters (e.g. quotas corresponding to the MSY exploitation rate) in order to carry out the projections.

The simplest task is to estimate the economic impact on 1 or more fleets of a change in the TAC (at MSY level) for one species. TACs are distributed among Member States with the Relative Stability Principle. How TACs are distributed between several fleets within Member States is a confounding issue. Different criteria (e.g. historical catches, profit, GVA or employment maximisation) can be followed to distribute TACs. Some models (e.g. BEMEF) can show the outputs for different TAC

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[12] The FISHRENT model was specifically developed to analyse rents in TAC fisheries (Salz et al. 2011). It consists of several modules and is in an ongoing process of improvement. Over the last years a stochastic age structured biological population model was integrated (Simons et al., 2014a) and later further spatially extended. The model additionally can include now seasonal movements in terms of migrations to feeding and spawning grounds as well as dispersal of individuals to adjacent areas (Simons et al., 2014b).

The advantage of a model which consists of different modules like the FISHRENT model lies in the possibility to not use every module every time. In case of an assessment of proposed quota changes the biological module to assess the stock(s) is not necessary as the TACs are given.

[13] Assembling these data can be time consuming.

allocations between fleets and consequently show the trade-offs of the allocation using different criteria inside a Member State (case D).

However, it is seldom that a fleet fishes only one stock/species. If the economic effects of several quota changes are to be investigated (e.g. in line with MSY objectives) the task becomes more demanding. Firstly, from a theoretical point of view there is a need to specify: (i) how MSY objectives for multispecies fisheries are to be defined (e.g. maximum production from all stocks or maximum total production for a given effort level), and (ii) whether effort and fishing mortality by fleet change proportionally or independently by fleet in multi-fleet fisheries. The Expert Group is not fully aware if currently available economic simulation models are able to address the problematic issue of MSY and MEY estimation in a multispecies and multi-fleet context. Indeed, while most fisheries are multi-species and multi-fleet, only the multi-species consequences have so far been considered in such analyses (Mace 2001; Walters et al., 2005; Matsuda and Abrams 2006). Given the large biological and technical interactions associated with most fisheries worldwide, an adequate management system based on single-species and single- fleet reference points would appear to be unattainable.

Changes in effort allocation among fleets will inevitable affect the overall selectivity patterns on the stocks they exploit which in turn will give rise to changes in MSY and MEY reference point estimates (Guillen et al., 2013 using IAM model). Hence, the potential for such changes in the overall fleet composition has implications on whether to consider technical and economic efficiency in the definition of MSY and MEY (i.e. by choosing the overall fleet composition, as explained above). Moreover, changes in the overall fleet composition has to do also with political decisions on favouring certain fleets, and consequently rent transfers among fleets and the potential social impacts.

The estimation of the economic effects of fishing at the MEY exploitation rate (F_{MEY}) is likely to be more difficult than at exploitation rates consistent with MSY (F_{MSY}), because the TACs corresponding to F_{MEY} is not routinely provided by advisory bodies (e.g. ICES). Most bio-economic models should be able to estimate the TACs corresponding to F_{MEY}. In this case, simulation “economic” models cannot be used to directly identify the MEY level, unless some trial and error process can be done. In this case, the best option would be to use an optimization bio-economic model that estimates MEY (landings, fishing mortality, revenues, costs, profits, etc.). However optimisation models are inevitable more complex and time demanding than simple “simulation models”. Hence at present, the Expert group considers that multi-fleet and multi-species optimisation model analyses could be carried out although there may be scope to undertake such analyses for a limited number of fleets and stocks.

For single species and single fleet assessments, MEY will generally correspond to a lower (more precautionary) exploitation rate than MSY. However, for multi-fleet fisheries, this is not necessarily the case, because although overall effort may be lower, the effort directed to particular species can be higher than the effort that would be directed to such species if each stock could be managed independently at MSY. Thus, there is the need to set limit reference points in multi-species fisheries, according to the knowledge of the different stocks exploited in the fishery in order to ensure that certain stocks are not overexploited to dangerous levels.

The MEY level is however likely to fluctuate as a consequence of the changes in the variables of the reference economic framework and can vary between fleets. As MEY is an economic objective, the variables are influenced by factors which can be fluctuating independently of the fishing activity (e.g. fuel and fish prices). Therefore, MEY is a moving target..

The analyses done at the optimal situation in equilibrium can provide results by comparing current situation to optimal one (i.e. MSY, MEY), a step forward would be to analyze scenarios with e.g. varying HCR in long term management plans (MSE analysis) to reach these points by taking into account transition periods, discount rate and preferences for present.

Finally, the economic optimizations referred to above are solely based on the profits that can be directly extracted from the fishery, and do not consider rents that can be further obtained through processing, distribution and marketing (Sumaila and Hannesson, 2010; Norman-Lopez and Pascoe, 2011; Guillen et al., 2013). If an evaluation of progress towards MEY taking into account these other economic sectors is required, such a study would be particularly demanding in terms of time and effort and it remains to be seen whether it would be feasible in practice.

Table 5.1: Summary of tasks, models needed and estimate of time to implement them

Tasks	Models needed	Rough estimate of the (minimum) time needed[14]
Running impact assessments for management plans or evaluate policies to achieve MSY (case A)	Bio-economic simulation models (e.g. FISHRENT, IAM, MEFISTO)	From 1-2 days on the easiest case (1 fleet and 1 stock) to 5 days for (2-4) fleets and (2-4) stocks.[15]
Find a (the best) policy to achieve MSY (case B)	Bio-economic optimisation models (e.g. FISHRENT, IAM)	From 1-2 days on the easiest case (1 fleet and 1 stock) to 5 days for (2-4) fleets and (2-4) stocks.
Provide economic indicators for a given TAC (i.e. MSY) and 1 fleet (or several	Economic simulation models (e.g.	All or most of the biological assessed stocks could be

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[14] Considering that TACs and economic parameters from the AER are provided in advance under adequate format (i.e. Excel).

[15] However, be aware that this can only be a limited exercise compared to a full impact assessment of a management plan which consists of two meetings (scoping and impact assessment meeting) and where the simulations are made in between the two meetings (STECF 2010).

fleets with fix proportions) (case C)	BEMEF, EIAA, FISHRENT)	“economically” assessed in 1 or 2 weeks max.
Provide economic indicators for a given TAC (i.e. MSY) and different TAC distributions among fleets (case D)	Economic simulation models (e.g. BEMEF, FISHRENT)	2 to 5 stocks per person per day, depending on the distributions explored.
Provide economic indicators for a fleet fishing few stocks at MSY (2-4)	Optimisation bio-economic models (e.g. FISHRENT, IAM)	Full stock assessments may be need. MSY needs to be detailed. 1 fleet in 2 days?
Provide economic indicators for a fishery: few fleets (2-4) fishing few stocks (2-4) at MSY	Optimisation bio-economic models (e.g. FISHRENT, IAM)	Full stock assessments may be need. MSY needs to be detailed. 1 fishery in 5 days?
Provide economic indicators for 1 stock at MEY and 1 fleet	Optimisation bio-economic models (e.g. FISHRENT, IAM)	Full stock assessments may be need. MSY needs to be detailed. 1 fleet in 1-2 days?
Provide economic indicators for 1 stock at MEY and different TAC distributions among fleets	Optimisation bio-economic models (e.g. FISHRENT, IAM)	Full stock assessments may be need. MSY needs to be detailed. 1 fleet in 2-3 days?
Provide economic indicators for 1 fleet fishing few stocks at MEY (2-4)	Optimisation bio-economic models (e.g. FISHRENT, IAM)	Full stock assessments may be need. MSY needs to be detailed. 1 fleet in 2-3 days?

Provide economic indicators for a fishery: few fleets (2-4) fishing few stocks (2-4) at MEY	Optimisation bio-economic models (e.g. FISHRENT, IAM)	Full stock assessments may be need. MSY needs to be detailed. 1 fishery in 5 days?
Provide the effects to the economy (all sectors) of setting some stocks at MSY	None	Need to make a project

Therefore, the models to be used and the associated expertise required will depend on the specific objectives. However, it is clear that only a superficial analysis could be routinely carried out for a large number of stocks, and that an in depth analysis would need to be limited to a few stocks and fleets.

Potential indicators to report stock status from an economic perspective

Proposed new indicators

The Expert Group proposes the following two indicators, both of which would provide an indication of the economic losses or gains associated with fishing at current exploitation rates compared to the MSY exploitation rate

a) ***Relative Landings Value (RLV)***

The RLV indicator relates value of landings (marketable catch weight (kg) x price per kg) at current exploitation rates ($LV_{current}$) to the estimated potential value of landings at F_{MSY}.(LV_{MSY})

Potential value of landings at F_{MSY} could be estimated from the predicted marketable catch weight at F_{MSY} * average price per kg

The RLV can be estimated separately by stock:

$$RLV = \frac{LVcurrent}{LVMSY} \approx \frac{Current\ TAC}{MSY\ (TAC\ at\ MSY)}$$

Or it can be estimated for all stocks (s) or a group of them (i.e. small pelagics):

$$Exploitation\ rate = \frac{\sum(Current\ landings_s \times Price_s)}{\sum(MSY_s \times Price_s)} \approx \frac{\sum(Current\ TAC_s \times Price_s)}{\sum(MSY_s \times Price_s)}$$

While the RLV may be useful economic metric for single stocks, it is important to consider that a combined-stock indicator may not entirely reflect potential gains or losses that would accrue by moving to F_{MSY} as F_{MSY} and hence MSY may not be achievable simultaneously for multiple stocks.

If price data are not available, the relative landings (marketable catch weight at $F_{current}$ / estimated marketable catch weight at F_{MSY}) can be used to indicate progress towards MSY. However such a measure ignores the economic effects entirely implying that all stocks are equally valuable.

Potential economic gain (PEG)

The PEG indicator provides information on the potential economic performance when fishing at F_{MSY}. It could be expressed as profits (measured as net profits or Earnings Before Interest and Taxes - EBIT) or Gross Value Added (GVA). The choice between reporting profits or GVA can be based on availability of relevant costs data.

PEG could be used to relate the value of landings for a given year (t) with the RLV indicator of that year taking into account the costs of fishing for a given year (y, since there is no need to strictly be the same as the one used of the value of landings) with the fishing effort in year (y) compared to the estimated costs of fishing at F_{MSY}. i.e.

$$\begin{aligned} &Potential\ economic\ gain \\ &\qquad = \left(Value\ of\ landings_t \times \frac{1}{Exploitation\ rate_t}\right) - \left(Fishing\ costs_y \times \frac{E_{MSY}}{E_y}\right) \end{aligned}$$

If fishing effort data are not available, fishing mortality could be used as a proxy for effort.

If fishing effort and fishing mortality data are not available, then a simpler proxy could be estimated:

$$Potential\ economic\ gain = Profits\ (or\ GVA)_t \times \frac{1}{Exploitation\ rate_t}$$

Potential indicators on the status of the fishing fleets reported in the AER

The Expert working group considers that a number of the indicators that are currently reported by the Annual Economic Report on the performance of selected EU fishing fleets (AER) are potentially useful for giving an indication of the economic status of a fleet.

Gross Value Added (GVA)

For society GVA is probably the most interesting indicator as it shows the contribution of the fishing fleet to the local economy.

Profits

Profits indicate whether the activity is profitable and is primarily of interest) to vessel owners. If profits are negative for a long period, fishermen may take a decision to leave the fishery.

Income or Value of landings

The value of landings corresponds to the revenues obtained from selling the catches. While total income or total revenues measures how much money the vessel owners received in total over the year. Thus, total income includes the value of landings but can also include revenues from selling the fishing rights and received subsidies. If fishing is not the only activity of the company it could also include revenues from other activities like tourism. With the total income, vessel owners try to cover all their costs; if total income is higher than total costs they obtain profits, while if lower they obtain losses.

Employment

A major social parameter provided in the AER is employment. However, the employment data in the AER is also two years old, but it may be possibly to report more recent data if MS are asked to provide the most recent numbers. Employment may be expressed as total employed and total full-time equivalent employed. Trends in both employment indicators may be indicative of success or failure of fisheries policies depending on the objectives for employment in the fishing industry.

Data sources to estimate indicators depending on the time-frame

The AER reports economic data and indicators that are almost 2 years old (e.g. at the end of 2014, economic data are reported up to 2012) and there is no possibility to obtain comprehensive economic data from Member States on a shorter time- as fishing companies can only report their data after finalizing their tax statements.

As a consequence economic indicators for periods more recent than 2 years in the past will need to be derived through predictions using simulation modelling. Assumptions regarding the input parameters e.g. fuel prices, fish prices will need to be made for such predictions although for stocks in the ICES area, advised TACs can be used as a basis for future catches. The Expert group recognises that in some circumstances an indication of the likely direction of future economic indicators (profits, GVA etc.) may be possible even if the magnitude of the direction is not sufficiently reliable for management purposes.

Conclusions

There are a large number of existing bio-economic models which can be adapted to assess economic consequences of the MSY policy. Each model is designed to be used for different purposes and therefore a clear specification of the needs and the aims of any analysis are required as a pre-requisite to choosing the most appropriate model.. The Expert group notes however, that models to assess social and economic consequences of policies generally compare a baseline with different scenarios and use the results to report on the development of certain indicators rather than assessing how far of the sector is from achieving the objectives. The Expert group also concludes that without clearly specifying which social and economic objectives are to be achieved under the CFP, it will not be possible to report on the progress towards achieving such objectives.

A further conclusion is that there is scope to forecast the likely economic consequences of setting TACs in line with ICES advice (as previously undertaken using the EIAA model) using more recently developed “models such as BEMEF or FISHRENT. However, before such forecasts can be undertaken on a regular basis there is a need to establish the following:

- which of the potential models is likely to be most appropriate,
- specification of the different input assumptions required and
- the potential sources of divergence in the results derived from the different modelling approaches (which is the most appropriate).

It is also important to ensure that appropriate expertise will be available to carry out such forecasts on a regular basis and that a procedure to ensure provision of the relevant stock assessment parameters is put in place.

The EWG proposes that the following indicators be reported annually as a means to inform on progress of the CFP in achieving its social and economic objectives:

Relative Landings Value (RLV)

Potential Economic Gain (PEG)

Income or Value of Landings

Gross Value Added (GVA)

Profits

Employment

The Expert Group also notes that in principle, and if required, one or more of the bioeconomic models that have already been developed may be appropriate to undertake short-term forecasts (over 1-3 years) for a number of economic indicators for years for which Member States' economic data are unavailable.

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Annex I

Table A1 – Target species / species complexes which contributed 80% in value of landings made by EU fishing vessels in the Mediterranean Sea in 2012; light grey colour = species complex; dark grey = ICCAT species. The total value of 100% of landings = 1,350,186,254 Euros.

No	**Species Name**	**Species Code**	**Landings Value**	**% of Grand Total**
1	*Engraulis encrasicolus*	ANE	115565484	8.6
2	*Merluccius merluccius*	HKE	101075170	7.5
3	*Xiphias gladius*	SWO	70616558	5.2
4	*Osteichthyes*	MZZ	66405714	4.9
5	*Parapenaeus longirostris*	DPS	60204803	4.5
6	*Sardina pilchardus*	PIL	59892854	4.4
7	*Thunnus thynnus*	BFT	57649950	4.3
8	*Nephrops norvegicus*	NEP	53081548	3.9
9	*Sepia officinalis*	CTC	48112904	3.6
10	*Aristaeomorpha foliacea*	ARS	43341604	3.2
11	*Aristeus antennatus*	ARA	43146773	3.2
12	*Chamelea gallina*	SVE	42647011	3.2
13	*Octopus vulgaris*	OCC	42279643	3.1
14	*Mullus barbatus*	MUT	37915461	2.8
15	*Solea solea*	SOL	36385172	2.7
16	*Squilla mantis*	MTS	31103257	2.3
17	*Mullus surmuletus*	MUR	23150123	1.7
18	*Osteichthyes*	FIN	16670952	1.2
19	*Loligo vulgaris*	SQR	16650345	1.2
20	*Ommastrephidae*	OMZ	16288259	1.2
21	*Lophius piscatorius*	MON	15985798	1.2
22	*Sparus aurata*	SBG	15485954	1.1
23	*Penaeus kerathurus*	TGS	14973623	1.1
24	*Eledone cirrhosa*	EOI	12706658	0.9
25	*Eledone moschata*	EDT	11554932	0.9

26	*Gastropoda*	GAS	10797867	0.8
27	*Scorpaenidae*	SCO	10239243	0.8
28	*Lepidopus caudatus*	SFS	10228035	0.8

Table A2 – Target species / species complexes which contributed 80% in weight of landings made by EU fishing vessels in the Mediterranean Sea in 2012; light grey colour = species complex; dark grey = ICCAT species. The total weight of 100% of landings = 364235982 kg

No	**Species Name**	**Species Code**	**Landings Weight**	**% of Grand Total**
1	*Sardina pilchardus*	PIL	80498900	22.1
2	*Engraulis encrasicolus*	ANE	66675181	18.3
3	*Chamelea gallina*	SVE	20073006	5.5
4	*Merluccius merluccius*	HKE	14190410	3.9
5	*Osteichthyes*	MZZ	10728417	2.9
6	*Parapenaeus longirostris*	DPS	8735252	2.4
7	*Mullus barbatus*	MUT	8035080	2.2
8	*Xiphias gladius*	SWO	7730537	2.1
9	*Osteichthyes - Finfish*	FIN	7411601	2.0
10	*Octopus vulgaris*	OCC	7083220	1.9
11	*Sardinella aurita*	SAA	6537473	1.8
12	*Sepia officinalis*	CTC	6048455	1.7
13	*Trachurus trachurus*	HOM	5789961	1.6
14	*Squilla mantis*	MTS	5180883	1.4
15	*Mugilidae*	MUL	5174137	1.4
16	*Thunnus thynnus*	BFT	4709395	1.3
17	*Gastropoda*	GAS	3757988	1.0
18	*Scomber japonicus*	MAS	3714319	1.0
19	*Scomber scombrus*	MAC	3347309	0.9
20	*Trachurus mediterraneus*	HMM	2900476	0.8
21	*Osteichthyes - pelagic*	PEL	2842460	0.8
22	*Nephrops norvegicus*	NEP	2839099	0.8
23	*Ommastrephidae*	OMZ	2834297	0.8

24	*Boops boops*	BOG	2792613	0.8
25	*Lepidopus caudatus*	SFS	2756373	0.8

Table A3 – STECF stock assessment priority list as presented in the report of STECF EWG 12-19.

GSA	Species Code	Common name	Species
1	PIL	Sardine	*Sardina pilchardus*
1	ARA	Blue and red shrimp	*Aristeus antennatus*
1	HKE	Hake	*Merluccius merluccius*
1	DPS	Pink shrimp	*Parapenaeus longirostris*
1	MUT	Red mullet	*Mullus barbatus*
5	ARA	Blue and red shrimp	*Aristeus antennatus*
5	MUR	Striped red mullet	*Mullus surmuletus*
5	HKE	Hake	*Merluccius merluccius*
5	NEP	Norway lobster	*Nephrops norvegicus*
5	DPS	Pink shrimp	*Parapenaeus longirostris*
5	MUT	Red mullet	*Mullus barbatus*
6	PIL	Sardine	*Sardina pilchardus*
6	HKE	Hake	*Merluccius merluccius*
6	ANK	Black-bellied angler	*Lophius budegassa*
6	DPS	Pink shrimp	*Parapenaeus longirostris*
6	MUT	Red mullet	*Mullus barbatus*
6	ARA	Blue and red shrimp	*Aristeus antennatus*
7	PIL	Sardine	*Sardina pilchardus*
7	ANE	Anchovy	*Engraulis encrasicolus*
7	HKE	Hake	*Merluccius merluccius*
7	ANK	Black-bellied angler	*Lophius budegassa*
7	MUT	Red mullet	*Mullus barbatus*
9	PIL	Sardine	*Sardina pilchardus*

9	HKE	Hake	*Merluccius merluccius*
9	MUT	Red mullet	*Mullus barbatus*
9	DPS	Pink shrimp	*Parapenaeus longirostris*
9	NEP	Norway lobster	*Nephrops norvegicus*
9	ARS	Giant red shrimp	*Aristaeomorpha foliacea*
10	HKE	Hake	*Merluccius merluccius*
10	DPS	Pink shrimp	*Parapenaeus longirostris*
10	MTS	Spottail mantis	*Squilla mantis*
10	MUT	Red mullet	*Mullus barbatus*
11	HKE	Hake	*Merluccius merluccius*
11	MUR	Striped red mullet	*Mullus surmuletus*
11	MUT	Red mullet	*Mullus barbatus*
11	ARS	Giant red shrimp	*Aristaeomorpha foliacea*
11	DPS	Pink shrimp	*Parapenaeus longirostris*
15&16	ANE	Anchovy	*Engraulis encrasicolus*
15&16	PIL	Sardine	*Sardina pilchardus*
15&16	ARS	Giant red shrimp	*Aristaeomorpha foliacea*
Dec-16	DPS	Pink shrimp	*Parapenaeus longirostris*
12-16?	NEP	Norway lobster	*Nephrops norvegicus*
15&16	ARA	Blue and red shrimp	*Aristeus antennatus*
15&16	PAC	Common Pandora	*Pagellus erythrinus*
Dec-16	HKE	Hake	*Merluccius merluccius*
15&16	MUT	Red mullet	*Mullus barbatus*
15&16	MUR	Striped red mullet	*Mullus surmuletus*
15&16	OCC	Common octopus	*Octopus vulgaris*
4,5,11-16	DOL	Common dolphinfish	*Coryphaena hippurus*
17	ANE	Anchovy	*Engraulis encrasicolus*
17	PIL	Sardine	*Sardina pilchardus*

17	HKE	Hake	*Merluccius merluccius*
17	MUT	Red mullet	*Mullus barbatus*
17	MTS	Spottail mantis	*Squilla mantis*
17	SOL	Common sole	*Solea solea*
18	ANE	Anchovy	*Engraulis encrasicolus*
18	HKE	Hake	*Merluccius merluccius*
18	MUT	Red mullet	*Mullus barbatus*
18	MTS	Spottail mantis	*Squilla mantis*
18	DPS	Pink shrimp	*Parapenaeus longirostris*
19	DPS	Pink shrimp	*Parapenaeus longirostris*
19	ANE	Anchovy	*Engraulis encrasicolus*
19	HKE	Hake	*Merluccius merluccius*
22+23	ANE	Anchovy	*Engraulis encrasicolus*
22+23	PIL	Sardine	*Sardina pilchardus*
22+23	HKE	Hake	*Merluccius merluccius*
22+23	MUT	Red mullet	*Mullus barbatus*
25	MUR	Striped red mullet	*Mullus surmuletus*
25	MUT	Red mullet	*Mullus barbatus*

Table A4 – Top 25 species ranked in terms of contributions to total landings by weight in 2010 at Mediterranean GSA level.

Species	GSA 1	Species	GSA 2	Species	GSA 5	Species	GSA 6	Species	GSA 7	Species	GSA 9	Species	GSA 10
PIL	47.3%	ARA	81.7%	SPC	16.9%	ANE	29.3%	ANE	42.8%	PIL	37.1%	ANE	57.6%
HOM	15.8%	GFB	18.3%	ARA	16.2%	PIL	26.0%	HKE	18.3%	ANE	24.0%	PIL	22.8%
MAZ	6.8%	BOG	0.0%	DOL	14.4%	HKE	9.6%	PIL	16.9%	HKE	12.1%	HKE	12.2%
WHB	6.7%	SPC	0.0%	HKE	10.5%	HOM	5.2%	SBG	7.0%	MUT	6.2%	DPS	3.5%
ANE	5.6%	MUR	0.0%	MUR	9.9%	WHB	4.5%	ANK	4.6%	DPS	3.8%	ARS	1.8%
HKE	3.8%	MUT	0.0%	WHB	6.9%	MAZ	4.1%	BSS	3.0%	MTS	3.1%	MUT	1.7%
SBA	1.9%	PAC	0.0%	PIL	4.5%	ANK	2.6%	MUT	2.3%	MUR	2.3%	NEP	0.2%
HMM	1.8%	HKE	0.0%	GFB	3.3%	HMM	2.3%	SOL	1.0%	ARA	1.5%	ARA	0.2%
GFB	1.3%	DPS	0.0%	HMM	2.8%	MTS	2.0%	WHB	0.7%	PAC	1.3%	MTS	0.0%
MUT	1.3%	ANE	0.0%	MON	2.1%	MUT	1.8%	MON	0.7%	NEP	1.3%	MUR	0.0%
SBR	1.2%	ARS	0.0%	ANK	1.8%	ARA	1.7%	HOM	0.5%	SOL	1.3%	PAC	0.0%
MUR	1.0%	MTS	0.0%	PAC	1.7%	SBG	1.6%	NEP	0.4%	HOM	1.3%	SOL	0.0%
ARA	1.0%	NEP	0.0%	NEP	1.7%	MUR	1.5%	POD	0.4%	TGS	1.2%	HOM	0.0%
ANK	0.8%	PIL	0.0%	MUT	1.7%	NEP	1.4%	ARA	0.4%	WHB	0.9%	TGS	0.0%
BOG	0.7%	ANK	0.0%	HOM	1.4%	MON	1.4%	GFB	0.3%	BOG	0.9%	WHB	0.0%
DPS	0.6%	SOL	0.0%	SBA	1.2%	PAC	1.2%	SBA	0.2%	HMM	0.5%	BOG	0.0%
SRG	0.5%	WHG	0.0%	SRG	1.0%	GFB	0.7%	MAZ	0.1%	ARS	0.5%	HMM	0.0%
NEP	0.5%	MUL	0.0%	DPS	0.7%	POD	0.6%	BOG	0.1%	GFB	0.3%	GFB	0.0%
PAC	0.5%	SQC	0.0%	ANE	0.6%	MUL	0.6%	MUR	0.1%	GUU	0.3%	GUU	0.0%
MON	0.4%	EDT	0.0%	BOG	0.2%	SRG	0.4%	SBR	0.1%	SPC	0.1%	SPC	0.0%
SBG	0.1%	SPR	0.0%	POD	0.2%	SBR	0.3%	PAC	0.1%	SBG	0.0%	SBG	0.0%
MUL	0.1%	CTC	0.0%	MUL	0.1%	BOG	0.3%	GUU	0.1%	ANK	0.0%	ANK	0.0%
SOL	0.1%	MAZ	0.0%	DGS	0.1%	DPS	0.2%	HMM	0.0%	BSS	0.0%	BSS	0.0%

Species	GSA 11	Species	GSA 15	Species	GSA 16	Species	GSA 17	Species	GSA 18	Species	GSA 19	Species	GSA 25
HKE	40.9%	MUR	22.8%	DPS	39.7%	ANE	62.7%	ANE	54.8%	HKE	22.4%	BOG	48.7%
MUT	20.6%	MAZ	15.4%	ANE	29.6%	PIL	14.6%	HKE	25.5%	DPS	19.1%	SPC	35.7%
ARS	13.8%	BOG	9.9%	ARS	9.4%	MTS	9.4%	NEP	6.5%	ANE	15.4%	MUR	8.3%
ARA	10.7%	CTC	7.3%	HKE	7.8%	HKE	3.8%	DPS	5.6%	MUT	13.8%	MUT	5.5%
DPS	5.1%	SQC	5.5%	MUT	3.7%	MUT	3.7%	MUT	3.8%	ARS	8.1%	PAC	1.8%
NEP	4.7%	MUT	5.2%	MUR	3.3%	SOL	2.9%	MTS	2.8%	MTS	7.5%	HKE	0.0%
SPC	4.2%	DOL	3.6%	PIL	2.9%	NEP	2.5%	ARS	0.8%	ARA	5.5%	DPS	0.0%
ANE	0.0%	WHB	3.4%	NEP	2.7%	WHG	0.1%	ARA	0.1%	NEP	3.4%	ANE	0.0%
PIL	0.0%	ARS	3.2%	PAC	0.5%	MUL	0.1%	PIL	0.0%	PIL	3.2%	ARS	0.0%
MTS	0.0%	RJC	3.1%	ARA	0.4%	SQC	0.0%	SOL	0.0%	ANK	1.5%	MTS	0.0%
MUR	0.0%	SRG	3.0%	MAZ	0.0%	EDT	0.0%	WHG	0.0%	SOL	0.0%	ARA	0.0%
PAC	0.0%	DPS	1.8%	BOG	0.0%	SPR	0.0%	MUL	0.0%	WHG	0.0%	NEP	0.0%
SOL	0.0%	SBA	1.8%	CTC	0.0%	CTC	0.0%	SQC	0.0%	MUL	0.0%	PIL	0.0%
HOM	0.0%	GFB	1.8%	SQC	0.0%	MAZ	0.0%	EDT	0.0%	SQC	0.0%	ANK	0.0%
TGS	0.0%	HKE	1.7%	DOL	0.0%	PAC	0.0%	SPR	0.0%	EDT	0.0%	SOL	0.0%
WHB	0.0%	SPC	1.5%	WHB	0.0%	SRG	0.0%	CTC	0.0%	SPR	0.0%	WHG	0.0%
BOG	0.0%	OCC	1.3%	RJC	0.0%	BPI	0.0%	MAZ	0.0%	CTC	0.0%	MUL	0.0%
HMM	0.0%	ANE	1.1%	SRG	0.0%	SBG	0.0%	PAC	0.0%	MAZ	0.0%	SQC	0.0%
GFB	0.0%	BRF	1.0%	SBA	0.0%	BSS	0.0%	SRG	0.0%	PAC	0.0%	EDT	0.0%
GUU	0.0%	BPI	0.9%	GFB	0.0%	HOM	0.0%	BPI	0.0%	SRG	0.0%	SPR	0.0%
SBG	0.0%	EDT	0.8%	SPC	0.0%	TUR	0.0%	SBG	0.0%	BPI	0.0%	CTC	0.0%
ANK	0.0%	JOD	0.8%	OCC	0.0%	GUU	0.0%	BSS	0.0%	SBG	0.0%	MAZ	0.0%
BSS	0.0%	NEP	0.7%	BRF	0.0%	JOD	0.0%	HOM	0.0%	BSS	0.0%	SRG	0.0%

6 CONTACT DETAILS OF STECF MEMBERS AND EWG 14-20 PARTICIPANTS

1 - Information on STECF members and invited experts' affiliations is displayed for information only. In some instances the details given below for STECF members may differ from that provided in Commission COMMISSION DECISION of 27 October 2010 on the appointment of members of the STECF (2010/C 292/04) as some members' employment details may have changed or have been subject to organisational changes in their main place of employment. In any case, as outlined in Article 13 of the Commission Decision (2005/629/EU and 2010/74/EU) on STECF, Members of the STECF, invited experts, and JRC experts shall act independently of Member States or stakeholders. 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 invited experts make declarations of commitment (yearly for STECF members) to act independently in the public interest of the European Union. 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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7 LIST OF BACKGROUND DOCUMENTS

Background documents are published on the meeting’s web site on:
https://stecf.jrc.ec.europa.eu/web/stecf/ewg1420

List of background documents:

1. EWG-14-20 – Doc 1 - Declarations of invited and JRC experts (see also section 6 of this report – List of participants)
2. Patterson, K. 2014. Indicators for monitoring the CFP: Past practice and alternative choices. Working Paper for STECF EWG 1420: Reporting Needs on Fishery Resources under the new CFP, 29 September 2014.

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Abstract

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*.” To facilitate such a report the Commission requested the STECF to review and give advice on suitable metrics and indicators. Expert Working Group 14-20 was convened to undertake this task and report to the STECF. The STECF reviewed the report by written procedure during December 2014.

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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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