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Report of the Working Group on Mixed Fisheries Advice for the North Sea (WGMIXFISH2): August Meeting

27-31 August 2012

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Contents

Executive summary

The ICES' Working Group on Mixed Fisheries Advice for the North Sea [WGMIXFISH] (Chair: Steven Holmes (UK)) met for a second time at ICES HQ, 27-31 August 2012 to address two issues.

1. To attempt to apply mixed fisheries forecasts to the west of Scotland (WoS) single species advice using the same methodology as the first WGMIXFISH meeting in May which applied mixed fisheries forecasts to the North Sea.
2. To investigate the possibility of producing mixed fisheries forecasts based on the scenario of all stocks fished at Fmsy in 2015. Such a scenario – considering the mean F on each stock two years beyond the TAC year – has not been attempted before and was considered beyond the scope of a purely operational meeting such as the May meeting of WGMIXFISH.

The mixed fisheries runs for WoS followed the approach used by ICES; management plan where it exists and MSY framework otherwise. The species considered as part of the demersal mixed fisheries WoS were cod, haddock, saithe, whiting, anglerfish, megrim and *Nephrops norvegicus*. Only cod is currently subject to a multi-annual management plan.

As for the North Sea five scenarios were considered

1. **max**: The underlying assumption was that fishing stops when all quota species are fully utilised with respect to the upper limit corresponding to single stock exploitation boundary.
2. **min**: The underlying assumption was that fishing stops when the catch for the first quota species meets the upper limit corresponding to single stock exploitation boundary.
3. **cod**: The underlying assumption was that all fleets set their effort at the level corresponding to their cod quota share, regardless of other stocks.
4. **sq_E**: The effort was set as equal to the effort in the most recently recorded year for which there are landings and discard data.
5. **Ef_Mgt**: The effort in métiers that used gear controlled by the EU effort management regime had effort adjusted according to the regime.

The max and min scenarios were included to bracket the space of potential catch and SSB outcomes but for most fleets are considered unrealistic scenarios. Of the remaining scenarios none was picked as a preferred scenario.

Data was supplied by France, Germany, Ireland, Norway (landings only), UK(EWNI), and UK(Scotland). To check for the correct implementation of short term forecast code within the software used (FLR) the working group always reproduces the short term forecasts of the single species assessments. It was unable to reproduce the forecast for WoS haddock. This was traced (after the meeting) to an error in the single species forecast.

Scenario forecasts were completed but the current management measures in place for WoS cod together with the pattern of landings compared to discards for the same stock led to unrealistic results. Further investigations revealed that these were due to both some data issues linking poorly the stock-based assessment data to the fleet-based catches-effort data, as well as to some simplifying assumptions within Fcube that were shown to be invalid for the WoS. The data was re-compiled post meeting

and improvements have been identified for the Fcube methodology, and it is anticipated successful mixed fisheries forecasts for the WoS can be demonstrated in 2013.

To address mixed fisheries issues in the west of Scotland area it was considered necessary to include anglerfish and megrim. The stocks for these species are defined for the west of Scotland and the North Sea combined and landings of these species are shared between the areas. The shared stock issue has already been encountered with respect to saithe. WGMIXFISH therefore considers that long term (once technical issues over WoS forecasts are resolved) it is best to combine the mixed fisheries forecasts of the North Sea and WoS.

The Fmsy ToR was considered for the North Sea area because a quality checked data set used for mixed fisheries projections was already available. The approach adopted for the Fmsy scenario was to produce a stochastic version of Fcube that incorporated the uncertainty in future recruitment. Retaining the scenarios used by the current forecasts, multiple iterations of the forecasts are performed and a confidence interval of outcomes established. The probability of any given scenario achieving Fmsy across all species considered could then be attained. The 50th percentile results for F and SSB can also be compared to their MSY targets and the trajectories of these ratios traced on a 'Kobe plot'.

As expected successive application of the **cod** scenario lead all species to be fished at or below Fmsy (cod continues to be the most limiting, or 'choke', species in terms of effort required to catch available quota).

1 Introduction

1.1 Background

A second meeting of the **Working Group on Mixed Fisheries Advice for the North Sea** [WGMIXFISH] (Chair: Steven Holmes (UK)) was held at ICES HQ, 27-31 August 2012 to address two issues.

3. To attempt to apply mixed fisheries forecasts to the west of Scotland single species advice. As for the first WGMIXFISH meeting in May (ICES 2012a) (which applied mixed fisheries forecasts to the North Sea) the application to the west of Scotland applies the methodology developed by the ICES' Workshop on Mixed Fisheries Advice for the North Sea [WKMIXFISH] (ICES 2009a) and Ad hoc Group on Mixed Fisheries Advice for the North Sea [AGMIXNS] (ICES 2009b) which met in 2009.
4. To investigate the possibility of producing mixed fisheries forecasts based on the scenario of all stocks fished at Fmsy in 2015. Such a scenario – considering the mean F on each stock two years beyond the TAC year – has not been attempted before and was considered beyond the scope of a purely operational meeting such as the May meeting of WGMIXFISH.

The current interest in fleet- and fishery-based approaches has its origins around 2002, when the conflicting states of the various demersal stocks in the North Sea made the limitations of the traditional, single-species approach to advice particularly apparent. The history of the adoption and development of the Fcube approach (after Fleet and Fishery Forecast) used by this WG is detailed in ICES (2009a) and Ulrich et al. (2011). Mixed fisheries projections and advice for North Sea stocks was always envisaged as a first step in developing such advice throughout the ICES regions (ICES 2012b). The successful benchmarking of analytical assessments for two stocks west of Scotland (ICES division VIa) offers the possibility of using the Fcube software in a way similar to in the North Sea. The species considered as part of the demersal mixed fisheries west of Scotland were cod, haddock, saithe, whiting, anglerfish, megrim and *Nephrops norvegicus*.

The mixed fishery advice will be based on the CFP TAC regime and is consistent with relative stability. The circumstances of 2002 have also lead to the introduction of effort restrictions alongside TACs as a management measure within EU fisheries and there has been an increasing use of single-species multi-annual management plans, partly in relation to cod recovery, but also more generally. These developments are of key importance for the general approach to mixed-fisheries advice, which must build on the existing legal and management system.

1.2 Effort limitations

For vessels registered in EU member states, effort restrictions in terms of days at sea were introduced in Annex XVII of Council Regulation 2341/2002 and amended by Council Regulation 671/2003 of 10 April 2003. The days at sea allowances have been revised by subsequent Council Regulations and the documents listing these days at sea limitations are given in Table 1.2.1

In 2008 the system was radically redesigned. For 2009 effort limits were changed to be on the basis of kWdays effort pots assigned per nation per fleet effort category. The baselines assigned in 2009 were based on track record per fleet effort category averaged over 2004-2006 or 2005-2007 depending on national preference. The latest effort

allocations available by nation and gear are given in Appendix 1 of Annex IIa of Council Regulation (EU) 43/2012. Member states are permitted slightly larger allocations of effort in cases where that effort involves low cod catches, e.g. through the implementation of more selective gears or cod avoidance measures. Full details are given in Article 13 of Council Regulation (EC) 1342/2008 and table 1.2.2 summarises effort reductions imposed in the current year. In relation to this, some member states have implemented real-time closure schemes. The closures apply to areas with high cod catch rates with the intention that closing these will lead to an overall reduction in the catchability of cod (Holmes *et al*, 2011).

1.3 Definitions

Two basic concepts are of primary importance when dealing with mixed-fisheries, the Fleet (or fleet segment), and the Métier. Their definition has evolved with time, but the most recent official definitions are those from the CEC's Data Collection Framework (DCF, Reg. (EC) No 949/2008), which we adopt here:

- ***A Fleet segment*** is a group of vessels with the same length class and predominant fishing gear during the year. Vessels may have different fishing activities during the reference period, but might be classified in only one fleet segment.
- ***A Métier*** is a group of fishing operations targeting a similar (assemblage of) species, using similar gear, during the same period of the year and/or within the same area and which are characterized by a similar exploitation pattern.

In 2012 WGMIXFISH requested data according to aggregations based on the definitions of the EU Data Collection Framework (DCF). The data call allowed merging across DCF metiers (see section 3.2 and Annex 2) and as such national data entries were sometimes not by métier in the strict sense. Merging of metiers to reduce to a manageable number going forwards in the forecasts further leads to the formation of combined or 'supra-metiers'.

1.4 Terms of Reference

The terms of reference for WGMIXFISH were as follows

2011/2/ACOM24 The **Working Group on Mixed Fisheries Advice for the North Sea** (WGMIXFISH), chaired by Steven Holmes, UK, will meet at ICES Headquarters, 21–25 May and 27–31 August 2012 to:

21–25 May,

1) Carry out mixed demersal fisheries projections for the North Sea taking into account the single species advice for cod, haddock, whiting, saithe, plaice, sole and *Nephrops norvegicus* that is produced by WGNSSK in April 2012, and the management measures in place for 2013;

2) Update the mixed fisheries annex for the North Sea;

3) Produce a draft mixed-fisheries section for the ICES' advisory report 2012 that includes a dissemination of the fleet and fisheries data and forecasts ;

27–31 August,

4) Compile and review available fleet and fisheries data for fisheries West of Scotland;

5) Where viable carry out mixed fisheries forecasts for fisheries West of Scotland taking into account the advice produced by WGCSE 2012 and the management measures currently in place for 2012;

6) Produce a mixed fisheries annex for the west of Scotland region;

7) Produce a draft mixed-fisheries section for the ICES' advisory report 2012 that includes a dissemination of the fleet and fisheries data and forecasts ;

For the North Sea and West of Scotland regions investigate the possibility of producing mixed fisheries forecasts based on the scenario of all stocks fished at FMSY in 2015.

The August meeting addressed ToRs d) to g) and the FMSY scenario.

1.5 Software

All analyses were conducted using the FLR framework (Kell *et al*. (2007); www.flr-project.org) running with R2.14.1 (R Development Core Team, 2008). All forecasts were projected using the same fwd() function in the Flash Package. The Fcube method is developed as a stand-alone script using FLR objects as inputs and outputs.

The Fcube model has been presented and described in Ulrich *et al.* (2008; 2011).

1.6 Fcube

The basis of the model is to estimate the potential future levels of effort by a fleet corresponding to the fishing opportunities (TACs by stock and/or effort allocations by fleet) available to that fleet, based on fleet effort distribution and catchability by métier. This level of effort was used to estimate landings and catches by fleet and stock, using standard forecasting procedures.

In 2012, single-species ICES advice was given according to a single preferred option; management plan if implemented, MSY framework otherwise. The basis for each single stock advice was retained in the current mixed-fisheries framework.

A complicating factor when incorporating *Nephrops* is the fact that the species is found in a number of distinct areas or functional units (FU), only some of which receive an abundance estimate (necessary to calculate a catchability). This WG followed the approach adopted by ICES (2009b) which is to perform the normal Fcube prediction for those FUs with absolute abundance estimates, then to calculate a ratio (R) of the yields to the ICES' advice for the same FUs. For those FUs without absolute abundance estimates, landings resulting from the Fcube run were simply taken to be the most recently recorded landings multiplied by the same ratio R. To do this, landings for each métier had to be apportioned across the FUs. This was facilitated by the supply of effort and catch data by FU.

2 Application of mixed fisheries forecasts to the west of Scotland: Data and model setup

2.1 Stocks

2.1.1 Data

The assessment data for the different stocks were taken from ICES WGCSE 2012, (ICES, 2012c). Fleet effort and catch data was provided by national institutes in the form of csv files. The specification of the 'metier tags' to be used for data aggregation was as for the joint WGNSSK-WGMIXFISH data call used to collect data for the North Sea mixed fisheries forecasts (see Annex 2). Unlike for the North Sea, data for WGCSE was not uploaded in fleet and metier format to InterCatch, so cross checking of data with InterCatch output was not possible.

For cod and whiting, no modifications were needed to incorporate the assessment and forecast inputs into the mixed fisheries routine. As is the case for the North Sea stock, the single species haddock forecast includes non-standard procedures for projecting mean weight and mean selectivity, and the resulting parameters as used in the single-stock projections were entered manually for the mixed-fisheries projections

2.1.2 General configuration of Fcube

Nephrops stocks were incorporated in the evaluation by functional unit. For the *Nephrops* stocks in FU11, FU12, FU13 and *Nephrops* from areas outside the functional units, the ICES advices were taken for the Fmsy approach.

The functional units with separate stock indices from underwater surveys (FU11, FU12, and FU13) were treated as separate *Nephrops* identities in the projections. *Nephrops* in the Firth of Clyde and Sound of Jura are considered separately within FU13 by ICES because the biologies of the two areas are considered distinct (with much higher densities in the Clyde). Landings from the Sound of Jura do, however, form only a small component of FU13 landings and although abundance estimates for the Sound of Jura have been available recently there are often years with no biological data from market samples (length frequencies from Clyde data are employed). To simplify the mixed fisheries projections *Nephrops* in the Firth of Clyde and Sound of Jura were treated as one stock. Catches outside of the functional units West of Scotland were omitted in the projections, and were less than 1% of total catches in 2011 (for 2003-2010 a mean of 2.4% of total catch (0.8 – 4.6%)).

Anglerfish and Megrim were treated similarly to Nephrops stocks by assuming a constant abundance (biomass estimates are provided within the relevant WGCSE assessments) and applying a catch (and thus implicit harvest ratio) in the intermediate and TAC years. Anglerfish abundance is given for area VIa separately. The TAC for anglerfish in VIa in 2012 was assumed to be in the same ratio to the overall TAC as the ratio of landings in VIa compared to landings over the whole stock area in 2011. The 20% reduction required by the single species advice (see section 2.1.3.1) was applied to a 3 year average of the harvest rate. For megrim the F/Fmsy values are calculated within the model for the single species assessment, which could not be replicated here. WGMIXFISH used the ratio between the current landings and 2013 advice as an F mult.

As for the North Sea projections, the Fcube code made use of total weights of landings and discards and did not consider age-disaggregated data. Also, repeating what

has been standard practice for the North Sea projections the following five options (or scenarios) were explored:

1) **max**: The underlying assumption was that fishing stops when all quota species are fully utilised with respect to the upper limit corresponding to single stock exploitation boundary.

2) **min**: The underlying assumption was that fishing stops when the catch for the first quota species meets the upper limit corresponding to single stock exploitation boundary.

3) **cod**: The underlying assumption was that all fleets set their effort at the level corresponding to their cod quota share, regardless of other stocks.

4) **sq_E**: The effort was set as equal to the effort in the most recently recorded year for which there are landings and discard data.

5) **Ef_Mgt**: The effort in métiers that used gear controlled by the EU effort management regime had effort adjusted according to the effort regime. In 2012, that implies a 25% effort reduction in the TR1 gear categories compared to 2011, and another 25% reduction in 2013 compared to 2012. These reductions are only indicative of what is stipulated in the cod plan, but do not account for the derogations potentially exerted under articles 11 and 13 of the plan.

2.1.3 Stock trends and single species advice

Recent trends are described on a stock-by-stock basis in ICES (2012c), and latest advice by stock is available on the ICES website. In order to give a global overview of all west of Scotland demersal stocks at one time, this information is collected below. It should be noted that although there is only one advice, additional management considerations are also listed.

2.1.3.1 Anglerfish in IIIa – IV – VI

Trends

There has been a decline in abundance and biomass since 2008. The average biomass over this area in the last two years (2010–2011) is 20% lower than the average biomass of the three previous years (2007–2009).

Advice

Based on the ICES approach to data-limited stocks, ICES advises that catches should be reduced by 20% in relation to the average of the last three years. Due to the uncertainty in the landings data, ICES is not able to quantify the resulting catch.

Additional management considerations

1. The stock status is uncertain, and reference points have not been defined for the stock. Because of identified problems with growth estimates and uncertainties in ageing, previous reference points are no longer considered to be valid.
2. There is no specific management plan for this stock.

2.1.3.2 Cod in VIa

Trends

Total mortality is high, and is increasingly the result of mortality due to discarding. The spawning-stock biomass continues to increase from an all-time low in 2006, but remains at a very low level (well below Blim). Recruitment has been estimated to be low over the last decade. The 2005 and 2008 year classes are estimated to be above the recent average.

Advice

ICES advises on the basis of the MSY approach that there should be no directed fisheries and that bycatch and discards should be minimized in 2013 and 2014.

Additional management considerations

1. Cod in Division VIa is subject to the EU cod long-term management plan (EC 1342/2008). ICES has not evaluated if the management plan is in accordance with the precautionary approach.
2. Following the ICES MSY framework implies fishing mortality to be reduced to 0.03 (lower than F_{MSY} because SSB in 2013 is 84% below MSY $B_{trigger}$), resulting in landings of no more than 30 tonnes in 2013. This is expected to lead to an SSB of 6630 tonnes in 2014.
3. Following the transition scheme towards the ICES MSY framework implies fishing mortality to be reduced to 0.34, based on (F_{2010}*0.4)+((F_{MSY}*(SSB_{2013}/MSY $B_{trigger}$))*0.6), resulting in landings of no more than 270 t in 2013. This is expected to lead to an SSB of 5240 tonnes in 2014.
4. ICES have provided two outlook tables with differing assumptions of F in the intermediate year. Outlook A assumes F2012 was consistent with the required reduction in F under the management plan in 2011 (F2011*0.75), with a target F of 0.46 in 2013 and TAC of 460t. Because F has not declined according to the Management Plan in recent years, a second Outlook Table B was provided which assumes F2012 = Fsq(2009-2011) = 0.88. The management plan target in 2013 of F=0.53 results in a TAC of 390t.

2.1.3.3 Haddock in VIa

Trends

The 2009 year class is above the average in the recent period, but is below the long-term average. Nevertheless, this year class is the main contributor to the increase of the SSB in 2012 to above B_{lim}. F has been above F_{pa} in most years since 1987 and has been declining since 1999. F is now below F_{MSY}.

Advice [the advice – and additional management considerations - here is the revised advice subsequent to WGMIXFISH]

ICES advises on the basis of the MSY framework that landings in 2013 should be no more than 3100 t. Effective technical measures should be implemented to reduced high discard rates in the *Nephrops* fleet (TR2).

Additional management considerations

1) An EU management plan proposal was evaluated by ICES and is considered to be precautionary. The aim of this plan is to keep the SSB above 30 000 tonnes with a fishing mortality of no more than 0.3. The main elements

in the plan are a 25% constraint on TAC change between years and lower fishing mortality rates whenever the SSB is lower than 30 000 t.

2) ICES evaluated an EU management plan proposal and considered it to be precautionary. Following the plan would result in a 25% TAC decrease. This would result in removals from the stock of 8100 tonnes and landings of 4500 tonnes in 2013. This is expected to lead to an SSB of 21 700 tonnes in 2014.

3) Since F is below F_{MSY} in 2011, the transition to MSY option is not relevant.

4) Precautionary approach: A fishing mortality of 0.04 is needed to increase SSB to around B_{pa} in 2014. This corresponds to landings no more than 520 tonnes in 2013.

5) EU emergency measures were implemented in 2009 in Division VIa. These measures include *inter alia* quite strict bycatch limits (30% cod, haddock, and whiting combined). The recent improvement in stock condition and has lead to increased catches of haddock for which the current bycatch arrangements are inappropriate. To address this issue an EU Commission Regulation No. 161/2012 has been approved that suspends the catch composition rules as regards haddock.

2.1.3.4 Megrim in IVa and VIa

Trends

Fishing mortality has been below F_{MSY} for almost the full time series and biomass well above MSY $B_{trigger}$

Advice

ICES advises on the basis MSY approach that landings in 2013 should be no more than 4 700 tonnes for both areas.

Additional management considerations

1) There is currently no management plan for this stock.

2.1.3.5 Saithe in IV, IIIa and VI

Trends

The SSB has been above B_{pa} since 1997 but has declined since 2005 towards B_{pa}. Fishing mortality has fluctuated around F_{MSY} since 1997. Recruitment has been below average since 2006.

Advice

ICES advises on the basis of the EU–Norway management plan that landings in 2013 should be no more than 100 684 tonnes for the whole assessment area.

Additional management considerations

Since 1996, the saithe in subarea VI has been assessed together with North Sea/Skagerrak saithe, with allocation of TAC based on historical landings. In 2012 the TAC for subarea VI comprised 9% of the overall TAC.

2.1.3.6 Whiting in VIa

Trends

The spawning-stock biomass has increased slightly since an all-time low in 2005, but remains very low compared to the historical estimates (and well below B_{lim}). Fishing mortality has declined continuously since around 2000 and is now very low. Recruitment is estimated to have been very low over the last decade. The 2009 year class is estimated to be above the recent average.

Advice

ICES advises on the basis of the precautionary approach that catches in 2013 should be reduced to the lowest possible level and that effective technical measures should be implemented to reduce discards in the *Nephrops* (TR2) fleet.

Additional management considerations

1) Precautionary approach: Given the low SSB and low recruitments in recent years, it is not possible to identify any non-zero catch which would be compatible with the precautionary approach. Catches should be reduced to the lowest possible level.

2) There is currently no management plan for this stock.

2.1.3.7 Nephrops in North Minch – (FU11)

Trends

The stock has been above MSY $B_{trigger}$ for more than 10 years. The harvest ratios (removals/UWTV abundance) have fluctuated around the F_{MSY} proxy.

Advice

ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 4200 t.

Additional management considerations

1) There is currently no management plan for this Functional Unit.

2.1.3.8 *Nephrops* in South Minch (FU 12)

Trends

The stock has been above MSY $B_{trigger}$ the full time-series. The harvest ratio (removals/UWTV abundance) has decreased since 2007 and is now below F_{MSY} proxy.

Advice

ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 5800 t.

Additional management considerations

1) There is currently no management plan for this Functional Unit.

2.1.3.9 *Nephrops* in Firth of Clyde & Sound of Jura (FU 13)

Landings from the Sound of Jura form only a small component of FU13 landings and there are often years with no biological data from market samples (length frequencies from Clyde data are employed). To simplify the mixed fisheries projections *Nephrops* in the Firth of Clyde and Sound of Jura were treated as one stock.

Trends

Firth of Clyde: UWTV abundance remains well above the MSY $B_{trigger}$. Harvest rates for *Nephrops* in the Firth of Clyde have declined since 2007 but remain above the proposed F_{MSY} proxy.

Sound of Jura: Harvest rates for *Nephrops* in the Sound of Jura have been well below the proposed F_{MSY} proxy in recent years. UWTV abundance remains higher than observed at the start of the series, but the series is too short and patchy to propose a MSY $B_{trigger}$.

Advice [a single target of 6400 t was used in the mixed fisheries projections; see section 2.1.2)]

ICES advises on the basis of the MSY approach that landings in 2013 should be no more than 6400 t (5600 t for Firth of Clyde and 800 t for Sound of Jura).

Additional management considerations

1) There is currently no management plan for this Functional Unit.

2) Management of *Nephrops* should be implemented at the functional unit level. In this FU the two subareas imply that additional controls may be required to ensure that the landings taken in each subarea are in line with the landings advice.

2.1.3.10 *Nephrops* in Other rectangles (NEPOTH)

Trends

There is no information available on the trends in the stock or exploitation status for the rectangles outside the FUs ('other rectangles') for which ICES provides advice.

Advice

ICES advises that the catches in the other rectangles should not increase.

Additional management considerations

1) There is currently no management plan for this area.

2) There is currently no advice given following the ICES MSY framework for this area.

3) To provide some guidance on appropriate future landings for these areas, ICES advises that the catches in the other rectangles should not increase.

2.1.4 Software

The text table below illustrates the various software used to conduct the stock assessments on the stocks for the west of Scotland.

Species	Assessment	Forecast
Anglerfish IIIa, IV & VI	Consideration of survey trends (no specific package)	none
COD VIa	TSA	WGFRANSW
HADDOCK VIa	TSA	MFDP
MEGRIM IVa & VIa	Surplus production process model after Schaefer (1954)	Risk based approach
Nephrops	Consideration of survey trends (no specific package)	none
WHITING VIa	TSA	WGFRANSW

In the mixed-fisheries runs, all forecasts were done with the FLR framework. The forecasts, when available, were performed with the FLash package (fwd() function).

2.2 Fleets and métiers

2.2.1 Catch and effort Data

Data was requested consistent with the definition of DCF métiers, as specified by the joint WGNSSK/WGMIXFISH data call (see Annex 2). Unlike for North Sea data all data was provided as comma separated files as no InterCatch files consistent with the request were available.

For the MIXFISH projections the categorization following the EU Cod management plan was used. This is consistent with what has been performed for the North Sea area and permits addressing management-oriented scenarios and issues associated with the plan. The WGMIXFISH métiers are thus defined as combinations of gear and mesh size.

The categories used to define métiers in the North Sea and Skagerrak could be used unaltered with one exception. Irish otter trawls with 100-119mm cod end form a significant part of the Irish fleet and so data was submitted for vessels using nets in this mesh range separately.

2.2.2 Definitions of fleets and métiers

The starting point for defining fleets and métiers was to match definitions used in the cod long term management plan (Table 2.2.2.1). Fleets were further split by nation, and sometimes further by vessel length category. The decision to split by vessel length category followed to a large extent the fleet structure decided for the North Sea and considered also the overall importance of the fleet in terms of total effort. The latter consideration was to prevent unbalance in the relative size of fleets in the model. The final choices can be summarized as follows:

- England, Wales and Northern Ireland: Distinction of the <10m vessels; Otter trawlers and seiners pooled together, with separation at <24m, 24-40m and >=40m.
- France: The only category of French vessel west of Scotland was otter trawlers >=40m.

- Germany: The only category of German vessel west of Scotland was those carrying static gear.
- Ireland: Separation of trawlers at <24m and >=24m (but TR1 and TR2 mesh sizes combined within vessel length categories). Pooling of long lines and gill nets into a single static fleet.
- Scotland: Distinction of the <10m vessels (trawlers only). Otter trawlers and seiners pooled together, with separation at <24m and >=24m and FDF vessels in a separate fleet (but TR1 and TR2 mesh sizes combined within vessel length categories). Pooling of long lines, gill nets, trammel nets and pots into a single static fleet.

As a second step, and in order to reduce the number of categories, an aggregation threshold, established through trial and error was used to determine 'small' métiers. A métier failing to catch 1.0% in 2011 of at least one of the stocks considered was classified as small. Within each fleet, all these small métiers are then aggregated by fleet in one "Other" métier (OTH). Further, all small fleets (i.e. containing only the "OTH" métier), were afterwards aggregated into one single "OTH" fleet.

The final data used contained 10 national fleets (plus the OTH fleet) from five countries. These fleets engage in one to three different métiers each, resulting in 18 combinations of country*fleet*métier*area catching cod, haddock, whiting, anglerfish, megrim and *Nephrops* (Table 2.2.2.2)

As a cross check of the data, the total landings and discards across all fleets were compared to the values estimated from the single species stock assessments (Figure 2.2.2.1). Some landings may not be allocated to fleets, due to for example missing countries or areas (e.g. area IV for anglerfish and megrim) or national landings with missing logbook information that cannot be allocated to a fleet. When single-stock catches are higher than fleet-based catches, the differences between them are pooled into the "OTH" fleet (both landings and discards). When fleet-based catches are higher than estimated by ICES, no correction is made, but the mismatch will imply that the corresponding catchability parameters will be poorly estimated.

By the end of the WG meeting the landings coverage for haddock was good with a ratio very close to one between MIXFISH and WGCSE totals. The match between haddock discards was almost as good (with the MIXFISH total slightly larger). Landings coverage for whiting was also good but the discards total supplied to WGMIXFISH was approximately double that supplied to WGCSE. For cod, the landings coverage was poor (40%) and the discards coverage even lower (20%). Anglerfish landings were at 66% of the ICES total and for megrim WGMIXFISH landings represented 34% of the ICES total but discards were more than twice the ICES total.

Post meeting it was realised a correction made to Scottish landings and discards data for cod for area misreporting had not been applied to the data supplied to WGMIXFISH. With the fleet disaggregated data conditioned in the same way as for ICES the overall match between landings and discards data sets for cod became very good (Figure 2.2.2.2). The difference in Anglerfish landings totals was found to be because landings data from one country was missing. Once this data was supplied agreement for Anglerfish was good. It was also discovered an error had occurred in the Irish raising procedure. With the Irish data corrected discards totals for all species were revised. This had minor consequences for cod and haddock but discards totals for whiting and megrim were considerably revised with the new totals across nations

a much closer match to the ICES assessment data totals (Figure 2.2.2.2). The remaining difference in megrim totals is because the ICES total covers both divisions VIa and IVa.

It must be underlined that the corrections to the data described above were performed several weeks after the WGMIXFISH had met. The corrections are explained in the report and an update performed with the new datasets, but it was not possible to deal subsequently with an issue related to the basic nature of the cod data (as opposed to its incorrect supply).

These data issues prevented implementation of WoS mixed-fisheries advice, because the estimated parameters were not considered reliable. However, it is the WGMIXFISH group experience that obtaining a reliable and consistent fleet-based dataset is an unavoidable and major challenge that necessitates repeated checks and several iterations, as was also the case in the North Sea at the early stages. This underlines also the importance of establishing a common data call and processing procedures between the single-stock and mixed-fisheries processes, which must at the same time address unique aspects which apply to particular stocks in single species assessments so that they can be successfully reproduced in the mixed fishery projections.

2.2.3 Trends

A number of overview graphs (using the Lattice package in R) were produced to aid quality checking of the data once compiled into the final fleets object. Some are useful to show the relative importance of the fleets chosen and trends in their effort and catches. Effort share by métier and fleet (Figure 2.2.3.1) and landings by fleet and stock (Figure 2.2.3.2) are included in this report.

3 Application of mixed fisheries forecasts to the west of Scotland: Mixed fisheries forecasts

3.1 Description of scenarios

3.1.1 Baseline Runs

The West of Scotland mixed fisheries forecasts were treated as an exploratory exercise in order to discover limitations in the data and to identify any issues in extending the approach used for the North Sea to the West of Scotland fisheries. As such, the objectives of the single species stock baseline runs were similar as for the North Sea, i.e. to:

1) Reproduce as closely as possible the single species 2012 advice produced by ACOM, and

2) Act as the reference scenario for subsequent mixed fisheries analyses for testing the application of Fcube to the West of Scotland.

There was some discussion on the treatment of two of the 'new' stocks in the model, Anglerfish and Megrim, owing to the fact that they are

1) stocks that straddle both the North Sea and the West of Scotland, and

2) have no analytical assessments which prejudices undertaking a forecast.

In the end, it was decided to treat Anglerfish and Megrim similarly to *Nephrops* stocks by assuming a constant abundance (biomass estimates are provided within the relevant WGCSE assessments) and applying a catch (and thus implicit harvest ratio) in the intermediate and TAC years. It was considered that further thought should be

given to how these stocks are treated in future and that their inclusion on this basis was a preliminary and exploratory step.

For the analytical stocks west of Scotland (cod, haddock and whiting) the various single-stock forecasts presented by WGCSE are undertaken with a Time Series Analysis (TSA) age-based analytical assessment outside of the FLR framework, and the historical assessment results were read into FLR stock objects in order that the forecast could be undertaken in the single unified frame-work necessary for mixed fisheries analysis using the 'fwd()' method in FLR (Flash R add-on package). The same forecast settings as in WGCSE are used for each stock regarding weight-at-age, selectivity and recruitment as well as assumptions on the F in the intermediate year. For the TAC year some different assumptions were necessary when compared to the ICES single species advice for cod and whiting, and problems arose in recreating the haddock intermediate year results and forecast due to an error in the single species assessment; these problems are described in section 3.2.1 below.

The intention of the baseline runs is mainly to act as a check to ensure that the projections were set-up correctly within the Fcube script, but these runs also have the incidental benefit of acting as a quality control check on the WGCSE projections themselves. Some differences can occur in the forecast calculations, (sometimes because of the diversity of single-stock assessment methods used) and the WG always investigates in depth the reasons for potential discrepancies, with adjustments to the Fcube forecasts made if necessary to minimise discrepancies; however this was not possible with the time available for the West of Scotland stocks and it was decided to explore the reasons for these differences before the next WGMIXFISH meeting. The causes of all discrepancies were found between the meeting and completion of the report and are described in section 3.2.1.

There may also be small differences in the catch input to WGCSE assessments and the more disaggregated data provided for WGMIXFISH. If data for WGCSE contained examples where the discard ratio from a sampled fleet was allocated to an unsampled fleet, differences in overall discard levels will occur between the data sets. Provision of data sets for single species stock assessment by metier into InterCatch has not been done for stocks under WGCSE and so an extraction of InterCatch data for comparison with and possible adjustment of WGMIXFISH data was not possible.

3.1.2 Mixed fisheries runs

3.1.2.1 Fcube analyses of the intermediate year (2012)

The single species stock forecast settings and target F for 2012 from the baseline run were used to perform Fcube scenario analyses for 2012 (Run "One Year Fcube" – Single-Stock Target F 2012). The aim of these analyses was to provide alternative sets of plausible levels of F by stock in 2012 accounting for mixed-fisheries interactions. This is similar to the base case run described and analysed in ICES (2008).

The Fcube scenarios **max**, **min, cod**, **sq_E** and **Ef_Mgt** were performed.

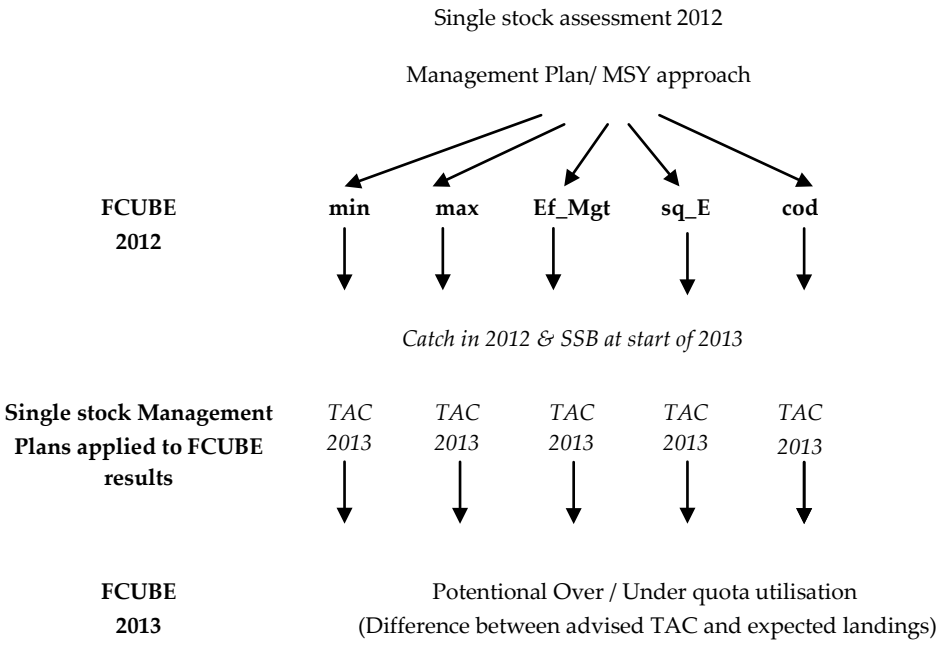
3.1.2.2 Fcube analyses for the TAC year (2013)

The new F2012 values by stock derived from the Fcube scenarios were used as input for the intermediate year in single-species forecasts, instead of the values from WGCSE. The stocks were projected again to 2014, using the same settings (objectives and constraints) for 2013 as in the Baseline Run. The aim was to derive single species stock TAC advice for 2013 following the single species advice approach but as if catch resulting from the assumed mixed-fisheries interactions in 2012 had come about and

the data were available for the intermediate year. Finally, for each Fcube scenario, the same scenario was applied in 2013 to the stock results (numbers-at-age) resulting from applying that scenario for 2012. In this way the following could be calculated:

- • Differences in recommended TACs for 2013 resulting from the single species advice approach being applied to the stock status at the end of the intermediate year of different scenarios and
- • An estimate of the cumulative difference between baseline run (single species advice) intermediate year catch plus TAC and realised catches over two years from each scenario,

In summary, the Fcube runs followed the scheme below:



3.2 Results of Fcube runs

3.2.1 Baseline run

The rationale behind the single species baseline runs is given in Section 3.1.1. [Table 3.2.1.1 contains the outputs from these runs.]

The issues and problems encountered in replicating the single species advice for each species are given below. The results from these baseline runs are compared with the results from the corresponding ICES runs in Tables 3.2.1.2 and 3.2.1.3. and Figure 3.2.1.1.

Cod

In 2012 the EU Council introduced a 0 TAC for Cod VIa with a by-catch rule where cod is allowed to be no more than 1.5% of total catch retained on board in any fishing trip (Council Regulation No 43/2012)[1]. This led to an interesting implementation is-

[1] "By-catch of cod in the area covered by this TAC may be landed provided that it does not comprise more than 1,5 % of the live weight of the total catch retained on board per fishing trip."

sue, both within the single-stock forecast and the mixed fisheries context, as depending on the level of landings of other species this may lead to an increase or a decrease in landings of cod. Potentially Fcube is a suitable and informative model for such an analysis providing an estimate of an expected catch under a range of assumptions of catches for other stocks. However, this is complicated by the fact that;

i) the bycatch TAC on a 'per trip' basis (not over the full year) implies that a different pattern of discarding may be observed (i.e. those with little quota previously may be able to land more each trip, whereas those with a larger amount of quota previously may have reduced landings opportunities due to the 1.5% limit). The result of this management change would need to be monitored in order to understand the effect on landings and discards and to be able to project them for future years;

ii) the bycatch TAC implies that cod may be up to 1.5% of total catch of all species, but at present only a limited number of species are included in the Fcube model. As such the total historic and predicted landings may need to be introduced as a parameter within the Fcube model in order to estimate cod landings.

The approach adopted in WGMIXFISH 2012 was to assume Fsq in the intermediate year matching Outlook Table B from the advice sheet (http://www.ices.dk/committe/acom/comwork/report/2012/2012/cod-scow.pdf). It was then assumed the management plan target F of two successive 25% reductions on F_{2011} was implemented, giving an F target of 0.53 as in the LTMP for 2013. The resultant human consumption catch again matched that in Outlook Table B from the advice sheet.

Haddock

The results of the short term forecast could not be repeated. It was unclear from the WGCSE report what level of recruitment to assume for the intermediate year. If a recruitment value taken from the fitted stock-recruit relationship was used, for a given mean F the SSB values of the forecast could be reproduced but the corresponding TAC values were considerably lower than that from the single species advice table. The problem was traced to an error in the single species forecast and the VIa haddock advice was revised after the WGMIXFISH meeting. After this was corrected for landings for 2013 were still higher in the baseline than the ICES single species forecast and this was traced to the fact that and estimated 8% unallocated removals were not kept separate, but allocated to landings and discards proportionately. By partitioning the catch according to the landings proportion of the total F (56%) the forecast was reproduced successfully. This should be taken account of in the code in future runs.

Saithe

No problems – same as for the North Sea.

Whiting

There were no problems in reproducing the intermediate year forecast. For 2013 single-species advice recommends that catches should be reduced to the lowest possible level based on the precautionary approach. As a F=0 scenario would imply no fishing under the **min** scenario of Fcube, something that was considered unrealistic, it was decided to set the model so that the TAC remained at the 2012 level in 2013. The resultant F under this catch scenario was not available in the single-species forecast table (ICES, 2012c), so it was not possible to check whether it exactly reproduced the single-species forecast results. However, as the resultant TAC and F was within the

range of other forecast options it was considered that the model was likely to have successfully reproduced the forecast results, albeit with a different catch option.

Nephrops

All thee Functional Units West of Scotland (FU11, FU12, FU13) have UWTV surveys and estimated abundance and Fmsy values. As such, the predicted landings (and discards) were replicated based on a harvest ratio as advised in the WGCSE single species advice. In the case of FU13, there are sub-FU stock areas defined in the advice (Firth of Clyde and Sound of Jura). These areas were combined and the Fmsy for the Firth of Clyde (the area from which 95%+ of landings are derived) used. The simplification lead to an overestimate of landings in 2013 of 20 tonnes compared to the ICES advice or < 0.3% difference.

Anglerfish / Megrim

For anglerfish VIa and megrim VIa there is no accepted age-based analytical assessment or forecast, but advice is provided on the abundance (numbers and biomass) as well as the harvest ratio in relation to Fmsy and Bmsy. As these values were available they were used in the forecast in a similar way as for *Nephrops* stocks that had UWTV survey estimates of abundance, i.e. the target corresponded to a desired harvest ratio on the assumption that biomass in the intermediate and TAC years are equal to the biomass in the assessment year, as for the *Nephrops* Functional Units with UWTV surveys.

The degree of success in matching single species forecasts is summarised graphically in Figure 3.2.1.1.

3.2.2 Mixed fisheries analyses

3.2.2.1 Fcube analyses of the intermediate year (2012)

By the end of the Working Group meeting, a computation of the one-year Fcube forecast (i.e. projecting fleets and stocks into 2012, the intermediate year of advice) had been performed. The WG considered the results produced by the end of the meeting to be clearly unrealistic and there were known problems with data and concerns over the single species haddock forecast (see section 3.2.1).

With the kind cooperation of data suppliers the input data was corrected. Also the correct haddock short term forecast was established. The one-year Fcube forecast was re-run and the results can be seen in Figures 3.2.2.1.1 to 3.2.2.1.4. Given the preliminary nature of the results, the group considered that more understanding of the model behaviour and of the implications of results was needed before justifying the extension of the forecast to the TAC year (2013), although no technical issue is foreseen in its actual computation.

A great discrepancy was observed between the status quo effort scenario ("sq_E") and the baseline for cod in terms of the relative balance between landings and discards, and this issue was investigated further.

It was observed that for VIa cod the ratio of landings to catches in tonnage is of the order of 8%, whereas the ratio of landings to catches is of the order of 36% in the Fbar calculated by numbers over the age range 2-5. Indeed, more than 90% of catches are discarded at age 2 and 3, but only 10% at age 5. Ultimately, that deviation creates bias in the model, because the catches by fleet are expressed in tonnage (ratio of landings to catch 8%) whereas the target landings F used in the scenarios **min**, **max** and **cod** is based on the Fbar landings ratio, (landings account for 36% of F). This combination of

low estimated fleet catchability and, by comparison, high target landings translates into a higher number of allowed fishing days for the fleets. In comparison, the **Sq_E** and **Ef_Mgt** scenarios simply set the fleets' effort level manually and make use of only the one landings:catch ratio (catchability ratio). As an additional test, new runs were performed using the ages 2-4 as the Fbar range for cod in VIa, decreasing the Fbar ratio of landings to catches from 36% to around 17%, and this reduced discrepancy significantly (results not shown).

This source of bias hadn't been noticed in the North Sea application because no North Sea stocks currently included in the Fcube projections show such high discrepancies between the two metrics. The group recommends this being investigated further before the next advice year and that actions are taken to make the model more robust.

3.2.2.2 Fcube analyses for the TAC year (2013)

Projections into the TAC year were not conducted as it was considered invalid to do so until believable analyses for the intermediate year could be established.

3.2.2.3 Relative stability

Relative stability was not considered because no believable analyses for the intermediate year could be established.

4 F_{MSY} scenario

4.1 Approach

The F-cube model has traditionally only been used to describe mixed fisheries scenarios based on short term forecasts. Such short term forecasts are expectations of the stock abundance and catches in two years, following the estimates of recruitment and mortality from the stock assessment. Investigating the possibility of producing mixed fisheries forecasts based on the scenario of all stocks fished at FMSY in 2015 takes the mixed fisheries projections beyond the timeframe of single species short term forecasts.

Before detailing the methods used to answer this request, it should be made clear that the assumptions in F-cube prevent all stocks being fished exactly at their estimate single species F_{MSY} value. The reason for this is that F-cube accounts for the fact that in mixed fisheries, the F values for different species are linked within fisheries. This is a very natural assumption, and one of the strengths of F-cube.

However, the types of scenarios made use of in F-cube can be sequentially run until 2015, assuming that the management on these stocks will follow the current management plans. Management Strategies Evaluations (MSE) loops are conditioned for each stock, a full feedback loop is run every year, where a pseudo-assessment is performed, forecasted two years ahead in order to derive a TAC consistent with the single-species management plan, and the TAC defines the level of fishing mortality that applies on the stock the following year. Independent, single-species MSE runs form a baseline. Then Fcube scenarios are applied as in the current short-term forecast implementation, i.e. the Fs corresponding to each TAC that apply on each stock the following year are replaced by the F corresponding to the Fcube estimates, which take into account the full set of fishing opportunities (i.e. the TAC for all stocks). So for example, the "cod" scenario will provide similar developments of the cod stock as in the baseline but this may well not be the case for other stocks as the TACs on these other stocks might be under-utilised in this scenario if cod is the choke species.

A lack of process knowledge (both biological and economic processes) means that the exact response of the indicators (F, SSB, yield) from the different scenarios is uncertain. However, some of the uncertainty that results from the lack of process knowledge can be accounted for in a standard MSE manner. As an example, historic recruitment for all these fish stocks has been highly variable. This variability can only partly be explained by the effect of the spawning stock biomass on the recruitment. The uncertainty about the future recruitment in the Fcube runs is captured by using the feedback loop described by the SSB-R relationship, combined with random draws from a statistical lognormal distribution parameterized by the historic variance. Multiple iterations of the forward loop allow statistical distributions of indicators (such as species SSB or the combined species yield in tonnes and in monetary value) to be determined. To ensure a fair comparison between scenarios it is ensured the same random draw is used for all scenarios for a given time step and iteration.

The resulting statistical distributions of the indicators are plotted, as well as the median Fishing mortality and Spawning Stock Biomass trajectories for individual stocks in Kobe plots (Kell, 2011). In these Kobe plots, horizontal and vertical reference lines depict reference SSB and F values. The fishing mortality reference lines can be based on the deterministic estimate of F_{msy} by ICES (ignoring the accompanying range estimates) or on the fishing mortality targets in the management plans (Fmp). These two F estimates (Fmsy and Fmp) are not the same for all plans. Hence, it was decided to produce Kobe plots for both reference F values.

Multiple iterations performed over multiple years increases the computations required, and therefore the computing time, considerably. Work was therefore also undertaken to write a version of the code that allowed for parallel processing. In this version two scenarios were dealt with at a time (one per processor) and the processing time was approximately halved. A higher degree of parallel operation could be developed but few laptops contain more than two processors currently.

The work was only conducted on the stocks from the North Sea already considered within WGMIXFISH. This was because the FLR stock objects required had already been formed allowing the WG to concentrate on implementing the stochastic Fcube. Much of the work in relation to the west of Scotland ToR involved forming the FLR stock objects for the stocks west of Scotland. The approach does not include *Nephrops* at present because there is no dynamic projection model available (stock recruitment relationship and linkages between exploitation and abundance) and assuming constant abundance over many years is not very relevant, so more reflection should be given on how to include this important species in the future.

An additional scenario was added. Known as the value (**val**) scenario and initially examined in Ulrich et al. (2011) the scenario weights the amount of effort a fleet needs to catch each species in its portfolio of catches by the value of landings for that species - by that fleet - compared to the overall value of landings for that fleet. Because catchability is calculated in Fcube as landings/effort the model has effectively adopted new catchabilities. Using the new catchabilities the effort necessary to land all quotas is calculated.

4.2 Results

With a limited time available the stochastic Fcube used 5 repetitions only. This number would be increased substantially for operational runs, however the results obtained are considered sufficient to demonstrate the concept and give an initial

indication of the prospects of all major commercial stocks being fished at Fmsy in 2015.

Figure 4.2.1 shows an array of box and whisker plots for the North Sea cod stock. If the same results are shown mean standardised (Figure 4.2.2) a greater variability can be seen in the SSB results than for the mean F or landings results. This suggests different recruitment levels for a given stock size, applied across stocks in a mixed fishery, affects SSB more than the mean F or landings metrics. It can also be seen that scenarios display different variability relative to one another in one metric compared to another metric. The cod scenario results are identical with the baseline results (as should be the case for this stock).

Cod is used to illustrate outputs available if the median of the projections is used to compare SSB to the MSY trigger value (Btrig) and F to Fmsy (Figure 4.2.3). The figure shows how the baseline, **min** and **cod** scenarios achieve F < Fmsy and SSB > Btrig by 2015. The **Ef_Mgt** scenario comes close to matching these objectives by 2017. The **val** scenario leads to a positive change in the F and SSB metrics compared to the end point of the historic assessment whereas the **sq_E** and **max** scenarios see an increase in F and decrease in SSB over time.

An alternative to considering the outcome of all scenarios for a chosen stock is to consider the outcome on all stocks of a given scenario. The Kobe plots for all scenarios are shown in Figure 4.2.4.

One further type of Kobe plot was considered. To summarise the effect of each scenario across all stocks in a single plot it makes use of the median results from each stock and scenario combination. Trajectories of summed landings (across all stocks) and total effort summed over all fleets (kWdays) are compared to the value of these metrics at the start of the projections. The resultant plot is shown in Figure 4.2.5. It shows effort and landings (across species) considerably reduced for the **min** and **cod** scenarios but with an upturn in landings at the very end of the time series. By contrast the **max** scenario shows increased effort and landings initially but a decrease in landings and the effort necessary to take those landings later in the time series suggesting that on a species wide basis the max scenario may be unsustainable. The **sq_E** scenario shows no change in effort (that is how the scenario is defined) but indicates that for all the species combined landings will increase by 2017. The **Ef_Mgt** and **val** scenarios show an initial decline in landings and overall effort but significant increases in landings later.

5 Future Developments

5.1 Data Issues

Experience has shown the specification and processing of data to ensure international data sets that are, to the fullest extent possible, error free, consistent across countries and consistent with single species stock assessment data to be critical to the successful production of mixed fisheries forecasts. It is possible the data sets gathered by WGMIXFISH will be of value to outside research interests while WGMIXFISH itself wishes to enhance the data and analysis opportunities at its disposal, e.g. through the inclusion of economic data.

Consequently the WG devoted time to an informal data workshop and was joined by two additional scientists concerned with supply of economic data under the DCF and the VECTORS EU research programme.

5.1.1 InterCatch and the Regional Database

Ultimately the use of InterCatch in accepting metier level data before raising to an internationally aggregated total was successful. The raising process for the WGNSSK is fully documented and the final data safely and permanently stored. However, depending on the stock involved the raising and allocation process ranged from cumbersome to traumatic. The problem stemmed from the increase in categories for which allocations had to be made for data with no discard and/or age information. A manual process that is convenient for making 10 to 30 allocations proved almost unfit for purpose when the number of allocations rose to the region of 300.

It is planned to address the problem in two ways. The first is to allow grouping of metiers. The same allocation is then applied to all metiers within a group in one operation. Secondly, automatic allocations will be made possible. To retain stock assessor control automatic allocations would only occur between metiers in the first tier of the allocation hierarchy and it will be possible for them to be overwritten manually or disallowed.

As well as speeding the allocation process it was considered important to facilitate an easier means of checking the quality of potential donor data as well as checks on the allocations selected for consistency of approach and to ensure against accidental allocations. Graphical outputs were considered the most efficient means to do this. One suggestion was to make it possible for the user to call up graphs of age distributions of potential donor data, a second is graphical output of discard ratios. In both cases 'outlier' data can be quickly spotted. To check the allocations selected the approach suggested is graphical output as shown in Figure 5.1.1.1. Blocks are coloured according to where in the allocation hierarchy the allocation falls. Blocks representing the top level (categories with the same metier tags but from different countries) suggest where automatic allocations could be made. Vertical stacks of blocks suggest where grouped allocations would be viable. It was considered important to make this graphical output available before the allocation scheme is finalised as this makes correction of unwanted allocations much easier.

The regional database (RDB) is a database used to store biological data at the greatest possible level of disaggregation, e.g. data from a research trip might be queried to the level of an individual length or weight sample for a given species-haul-trip. The 'Fishframe' database developed by DTU aqua has been chosen as the RDB platform and responsibility for its maintenance moved from DTU to ICES in 2012. The RDB Steering Group will have 2 meetings per year and in addition workshops focussing on the Baltic and Atlantic/North Sea areas are planned.

Within WGMIXFISH, whilst there is support for a regional database, there was concern about how it would link with InterCatch, and whether adoption of the RDB would lead to an increase in the time overhead of data input and management. In particular extra burden on stock assessors should be avoided. Given that InterCatch has been shown to meet the needs of the single species stock assessment WGs and WGMIXFISH, the WG considered the best approach would be to develop Fishframe so that it can be used to prepare data to the level currently required by InterCatch before transfer to InterCatch.

Ultimately, it is also recognised that this year's process of letting the stock coordinators take the burden of raising the unsampled strata to the sampled strata is still not optimal, not only due to its time consumption, but also because stock coordinators often do not have the basic information and knowledge regarding the sampled strata, e.g. length distributions. Raising can only be done on the basis of the metier tags in

spite of these being potentially different across countries. The WGMIXFISH is aware of these issues but has taken these choices as intermediate and pragmatic first steps forward. It is however the WG's perception that better progress could also be achieved by reducing the number of unsampled strata being uploaded in InterCatch.

5.1.2 Additional stocks for inclusion in WGMIXFISH

To address mixed fisheries issues in the west of Scotland area it was considered necessary to include anglerfish and megrim. The stocks for these species are defined for the west of Scotland and the North Sea combined. ICES official landings data show landings of megrim to be shared approximately equally between the two areas while less than 20% of anglerfish was landed from area VIa in 2011. Therefore, even without addition of area VIa to the North Sea mixed fisheries forecasts there is an incentive to add megrim and anglerfish to the species analysed by WGMIXFISH.

Reports form stakeholders suggest a recent and large increase in the amounts of hake caught by the mixed gadoid demersal fisheries, both in the North Sea and west of Scotland. Some of these fleets belong to nations with low quotas for hake and it has been speculated that hake might prove to be the most restrictive (or 'choke') species for some fleets if included in the mixed fisheries forecasts for the North Sea. Northern hake is, like megrim and anglerfish, a stock defined across multiple areas; In the case of hake not only west of Scotland and North Sea but also further south in the west to ICES areas VII and VIII with a split in landings of approximately 20% for the North Sea and west of Scotland combined, 46% in area VII and 34% in area VIII. It was noted that the major fisheries for the stock occurred in the southern end of its range (ICES areas VII and VIII) and therefore exogenous factors would need consideration whether WGMIXFISH encompassed the North Sea area only or the North Sea and west of Scotland combined.

5.1.3 Additional stocks for inclusion in metier data call

5.1.3.1 WGNSSK

Supplying data to WGNSSK in metier format to InterCatch had benefits in terms of the transparency and permanent recording of allocation decisions and data held in this format offers the potential for future inclusion in mixed fisheries analyses as well as other fleet and metier based research. The possibility of having further stocks uploaded to InterCatch using the WGMIXFISH data call specification will be investigated by the WGNSSK chair.

5.1.3.2 WGCRAN

It was asked whether North Sea crangon could be added to the list of species specified in the joint WGNSSK-WGMIXFISH data call. This is because a knowledge of the technical interactions present in the fleets that fish North Sea crangon would be of use to the EU framework 7 programme VECTORS (www.marine-vectors.eu). In general WGMIXFISH would not want to add to a data call issued under the DCF if it was not of direct benefit to WGNSSK or WGMIXFISH but in this case no alterations or additions would be needed to the data call specification (metier definitions, areas, nations etc) other than the inclusion of the crangon species. WGMIXFISH therefore agreed to the addition of crangon to the species list pending consultation with the chair of the Working Group on Crangon Fisheries and Life History WGCRAN.

5.1.4 Compatibility of WGMIXFISH metiers and economic data collected under the DCF

The guest economists explained how fisheries vessel cost data was collected on an annual basis according to fleet segments. The data considered was composed of

- Crew costs
- Fuel costs
- Repair costs

Critical to the linking of cost data to the metiers used in mixed fisheries projections are the data termed "transversal" data (because of their interest to both biologists and economists), namely

- Weight of fish caught or landed
- Value of landings in Euros per unit weight
- Effort (e.g. hours fishing)

One would expect crew costs to scale with revenue, fuel costs with energy use (which itself would be a function of hours fishing and gear type), and repairs with gross tonnage times days at sea. This relationship is visualised in Figure 5.1.4.1.

If vessels effectively conduct all their fishing activity within a single metier (or metier-tag category) then the cost data for the vessel can simply be attached to the WGMIXFISH category unaltered. The WGMIXFISH data call was specified so that vessel length categories are consistent with the DCF economic data. However, vessels are capable of changing gear type and operating in more than one metier. It is hoped an analysis of the steps needed to assign cost data to the existing WGMIXFISH metier-tag categories for French vessels operating in the North Sea can be completed by the end of 2012.

5.2 Future mixed fisheries methodology meetings

5.2.1 Mixed fisheries forecasts for Iberian waters

The 2012 Working Group on the Assessment of Southern Shelf Stocks of Hake, Monk and Megrim, (WGHMM) made the following recommendation to WGMIXFISH

> *Compilation and analysis of stock data from Iberian waters (ICES Div. VIIIc&IXa) for Fcube provisional application. Identification of following steps needed to accomplish with mixed-fisheries approach in Iberian waters.*

Prior to the August WGMIXFISH meeting it was confirmed that the ambition of WGHMM members is to conduct trial Fcube based mixed fisheries forecasts for stocks in Iberian waters in 2013 in a similar manner to those performed for west of Scotland stocks at this meeting. Iberian waters are outside the interest of the national institutes of current WGMIXFISH participants. Therefore, WGHMM needs to identify individuals among its participants who will lead on

- Identifying the metiers by which catch and effort data should be gathered and writing a data call specification.
- Ensuring the required data is delivered.
- Adapting and running the Fcube package code for the Iberian stocks.

Current WGMIXFISH members can of course provide technical assistance. With respect to the data call WGHMM needs to decide if it wishes to make it a requirement to load the metier based data to InterCatch.

5.2.2 Mixed fishery forecasts for west of Scotland

During the meeting there was discussion as to whether a single North Sea – West of Scotland mixed fishery projection may be a preferred approach given the overlap in stocks and fleets across the areas. This would have the advantage that it could

- Take account of all fleets and fisheries exploiting saithe, megrim and anglerfish which are distributed across areas IV and VIa.
- Be more readily adaptable for consideration of the movement of effort from one management area to another (under the restrictions of TACs and effort limits for each area, but recognising that some fleets are more transient, whilst some remain resident).
- Allow for consideration of fleet behavioural models to explore longer term changes to resource availability.

In 2012 the EU Council introduced a 0 TAC for Cod VIa with a by-catch rule where cod is allowed to be no more than 1.5% of total catch retained on board in any fishing trip (Council Regulation No 43/2012)[2]. This led to an interesting implementation issue within Fcube as depending on the level of landings of other species this may lead to an increase or a decrease in landings of cod. Further consideration may need to be given as to whether a bycatch TAC such as that introduced in 2012 can be implemented in Fcube. Potentially Fcube is a suitable and informative model for such an analysis providing an estimate of an expected catch under a range of assumptions of catches for other stocks. However, this is complicated by the fact that;

- the bycatch TAC on a 'per trip' basis (not over the full year) implies that a different pattern of discarding may be observed (i.e. those with little quota previously may be able to land more each trip, whereas those with a larger amount of quota previously may have reduced landings opportunities due to the 1.5% limit). The result of this management change would need to be monitored in order to understand the effect on landings and discards and to be able to project them for future years.
- the bycatch TAC implies that cod may be up to 1.5% of total catch of all species, but at present only a limited number of species are included in the Fcube model. As such the total historic and predicted landings may need to be introduced as a parameter within the Fcube model in order to estimate cod landings.

5.2.3 Further developments of stochastic Fcube

The current implementation of F-cube for the evaluation of scenarios by 2015 has incorporated the uncertainty in future recruitment (see section 4.1). However, there are several other sources of uncertainty that have been dealt with in previous studies (Ulrich et al. 2011, Iriondo et al. 2012). These uncertainties should be incorporated in F-cube to avoid unrealistically high expectations of detecting differences between the scenarios. Also, adding uncertainty in the model may improve the estimate of the probabilities of the stocks falling outside of safe biological levels.

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[2] "By-catch of cod in the area covered by this TAC may be landed provided that it does not comprise more than 1,5 % of the live weight of the total catch retained on board per fishing trip."

The first possible extension of the F-cube model is therefore to incorporate the statistical distribution of the outcomes of the existing stock assessment models that are used to define the starting values. Previous Management Strategy Evaluations have proven to be especially sensitive to these starting values. By taking the deterministic or median outcome of the existing assessment, the assumption is made that the state of the stock and the mortality are known without error. Using the statistical distribution of the historic assessment (including the starting values and the estimates of stock recruit relationship parameters) would appropriately reflect our uncertainty of the model outcome given the uncertainty about the stock.

Another possible extension of the F-cube model could be a conceptual description of the changes in catchability for the different species within fleets and metiers in response to the imposed management constraints and the economic situation of the fleets. Currently, Fcube utilises a 'what-if' approach, where changes in the basic assumptions and parameters are performed through scenario testing. The catchability in F-cube is assumed constant within metiers, or the mean catchability is assumed constant, with a random variability. In reality, individual vessels within metiers will adapt their fishing behaviour in order to maximize their utility in response to changes in the quota that result from the management plans. Similarly, individuals within fleets can shift among metiers in response to the amount of quota that they get for different species. The adaptation of individuals to quotas for different species can be modelled using Dynamic State Variable Models. This has been done for the Dutch beam trawl fleet under quota constraints for sole and plaice (van Oostenbrugge et al. 2008). A second modelling approach for quantifying the response of individuals within fleets or metiers is the 'Fishrent' model. This model also optimizes the economic return of fleets in response to quota.

Finally, the calculation of the long term outcomes of all scenarios accounting for the different uncertainties can be time consuming. This could be reduced by calculating scenarios in parallel. During WGMIXFISH2 2012 scripts for computation of the scenarios was parallelized, reducing computation time by 50%. If a multi processor platform could be identified for hosting stochastic Fcube runs further degrees of parallel computation could be developed, speeding the completion of a given combination of scenarios, forecast years and repetitions. Similarly, for a given time available a greater number of scenarios, years, or perhaps most significantly repetitions can be dealt with. More repetitions should improve the confidence limits of the results.

6 Conclusions and Recommendations

The August meeting of WGMIXFISH has produced a first attempt at mixed fisheries projections for the west of Scotland region (ICES area VIa). It has also produced the first stochastic version of Fcube similar in concept to management strategy evaluation projections in order to consider the issue of all species evaluated being fished at Fmsy.

Application of Fcube to the west of Scotland stocks did not prove straightforward. Firstly data was supplied in a way similar to that for the North Sea stocks prior to 2012 and this possibly contributed to inconsistencies between data supplied to WGMIXFISH and the single species assessment working group (WGCSE). For example, Scottish data for cod had been corrected for area misreporting before use at WGCSE but this was not done for the STECF data. The same correction needed to be applied to landings and discards totals submitted to Fcube for the catchabilities calculated to be meaningful. If data had been supplied in a way similar to the joint data

call used for WGNSSK and the May WGMIXFISH this inconsistency in the data could have been avoided. It is understood a data call allowing data supplied to WGCSE for west of Scotland stocks to be used by Fcube is to be made in 2013.

To increase trust in the results from alternative scenarios it is considered important for the Fcube code to reproduce as exactly as possible the single species projections in the first instance. Reproducing this year's single-stock advice led to the discovery of a mistake in the computation of the VIa haddock advice, which has since led to a re-issue of the VIa haddock advice. As also shown in previous years, running mixed fisheries projections can provide a valuable quality assurance for the single species forecasts. Unfortunately the cause of the differences between the FLR and single species forecasts could not be resolved during the meeting making it impossible to know whether the Fcube scenarios were bug free.

After resolution of the correct haddock short term forecast and corrections to the data supplied to the WG, Fcube projections into the first year were re-visited. It was found the very high discard ratio observed in ICES VIa cod catches and the difference in landings to catch ratio between calculation by number of fish and total weight made the algorithm used in Fcube to date unsuitable for the west of Scotland projections. It is hoped Fcube can be adapted to accommodate stocks with the characteristics of VIa cod by the next MIXFISH methodological meeting.

Another issue thrown up by VIa cod is the fact this stock is now subject to a bycatch rule instead of a TAC. A pragmatic solution at this WG was to compare projections to a TAC that would have occurred if the cod management plan was applied to the 2011 TAC. Further work is needed to establish scenarios that properly address the bycatch nature of cod landings.

The trial of Fcube on stocks west of Scotland (ICES area VIa) made use of the same scenarios as used for the North Sea in 2012. The **max** and **min** scenarios were included to bracket the space of potential catch and SSB outcomes but for most fleets are considered unrealistic scenarios.

The effect of fleet behaviours on

- The TAC set for 2013 (assuming perfect knowledge of catches in the intermediate year),
- The amount caught compared to single species TAC recommendations,
- The SSB remaining at the start of 2014,

all need to be considered when reviewing the results of mixed fisheries analysis.

The data/methodological problems encountered did not allow conclusions to be drawn on the compatibility of the single species TACs.

As a proof of concept, work on the stochastic version of Fcube was successfully concluded. The approach allows the issue of all species of interest being fished at Fmsy to be investigated while maintaining the 'what if' scenarios so far employed by Fcube, that is scenarios that avoid ad-hoc alteration of catchabilities on individual fleets. The partial exception to this is the **Ef_Mgt** scenario that applies effort cuts as dictated by current EU policy. Further scenarios that address specific fleets would require input from managers. As stated by the workshop on North Sea and Baltic Sea Multispecies Trade-offs (WKM-Trade) (ICES 2012d)

> *Any multispecies advice involves policy choices and thus requires direction from stakeholders and managers. These can be called trade-offs in catching opportunities.*

The approach makes no attempt to ensure stocks are fished at Fmsy. Using the median result from the projections the **cod** and **min** scenarios were found to take all species considered to below Fmsy. The **Ef_Mgt** scenario just failed to do so for cod and sole, the **val** scenario left cod mortality significantly too high, while the **sq_E** and **max** scenarios failed to allow any of the stocks to be fished at or below Fmsy.

Application of the method would require a greater number of iterations. It would then be possible to consider the probabilities of stocks being fished at or below Fmsy by 2015. For the North Sea fisheries this would be possible for 2013. Future work can consider further sources of uncertainty and alternative ways of presenting the results. It should be remembered, however, that the approach does not include Nephrops.

The 'August meeting' was made a second meeting of WGMIXFISH for reasons of ease of administration. There is a clear need for ongoing methodological development and for testing the ability to perform mixed fisheries forecasts in further areas. It is hoped a regular ICES WG meeting can be established in its own right – and using its own name - to consider future developments.

7 References

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Table 1.2.1, Council regulations introducing and modifying fishing effort (days at sea) allowances in EU fisheries.

Year of application	Regulation
2003	(EC) No 2341/2002–Annex XVII
2004	(EC) No 2287/2003–Annex V
2005	(EC) No 27/2005–Annex IVa
2006	(EC) No 51/2006–Annex IIa
2007	(EC) No 41/2007–Annex IIa
2008	(EC) No 40/2008–Annex IIa
2009	(EC) No 43/2009–Annex IIa
2010	(EU) No 23/2010–Annex IIa
2011	(EU) No 57/2011_Annex IIa
2012	(EU) No 43/2012_Annex IIa

Table 1.2.2, Effort reductions in 2012 compared to 2011 and 2013 compared to 2012 by EU regulated fleet segment.

Gear Description	Code	% effort reduction in 2012 compared to 2011	% effort reduction in 2013 compared to 2012
Bottom trawls and seines >= 100mm	TR1	18.2%	22.2%
Bottom trawls and seines >= 70mm & < 100mm	TR2	18.2%	22.2%
Bottom trawls and seines >= 16mm & < 32mm	TR3		0%
Beam trawls >= 120mm	BT1		0%
Beam trawls >= 80mm & < 120mm	BT2	Between 0% and 9,85% for some countries	0%
Gill nets and entangling nets, excluding trammel nets	GN1		0%
Trammel nets	TN1		0%
Longlines	LL1		0%
Not regulated gear	None		0%

Table 2.1.1.1: Summary of the 2013 landings and target Fs/harvest ratios, resulting from the Advice Approaches considered by ICES. Target Fs are left justified; harvest ratios are right justified. Where a stock/Functional Unit does not have a management plan the landings follow ICES advice.

Species	Management Plan / MSY approach for 2013			
	TAC	F / %Harvest ratio	SSB 2014	Rational
Cod VIa	0 t	0	6 790 t	MSY/precautionary approach
Haddock VIa	< 3 130 t (HC)*	0.25	24 500 t	MSY approach
Whiting VIa	0 t	0	14 400 t	MSY/precautionary approach
Anglerfish VI, IV& IIIa	< 9785 t**	n/a	n/a	MP
Megrim VIa-IVa	< 4 700 t	0.29	~ 24 000 t	MSY approach
Nephrops in North Minch (FU 11)	< 4 200 t	12.5	n/a	MSY approach
Nephrops in South Minch (FU 12)	< 5 800 t	12.3	n/a	MSY approach
Nephrops in Firth of Clyde & Sound of Jura (FU 13)	< 5 600 t FoC < 800 t SoJ	16.4 14.5	n/a	MSY approach
Nephrops in Other rectangles (NEPOTH)	< 111 t***	n/a	n/a	

*Value after revision of VIa haddock short term forecast.

** Applying 20% reduction to official landings from IIIa, IV and VI. 20% reduction on landings from VI = 2 856 t

***Value adopted from no change in landings NEPOTH for 2011

Table 2.2.2.1: Métiers consistent with the cod long term management plan and AER database.

Gear	Mesh Size	fleet	Métier
Gillnet		Static	GN1
Pots			OTH
Longlines			LL1
Trammel			GT1
Pelagic Trawl		Pelagic	OTH
Pelagic Seine			OTH
Demersale Seine	>=120	Dseine	TR1
	110-119		
	90-99		TR2
	80_89		
	70-79		
	16-31		TR3
Otter	>=120	Otter	TR1
	110-119		
	90-99		TR2
	80_89		
	70-79		
	16-31		TR3
Beam	>=120	Beam	BT1
	110-119		BT2
	90-99		
	80_89		
Dredge		Dredge	OTH

Table 2.2.2.2: Final fleet and métier categories used in the mixed fishery analysis.

fleet	métier
EN_Otter>=40	TR1.6A
FR_Otter>=40	TR1.6A
GE_Static	GN1.6A
IR_Otter10-24	OTH
	otter.6A
	TR1.6A
IR_Otter24-40	otter.6A
	TR1.6A
SC_FDF	TR1.6A
SC_Otter<24	TR1.6A
	TR2.6A
SC_Otter>=24	OTH
	TR1.6A
SC_Static	OTH
	pots.6A
SC_U10_OTB	OTH
	TR2.6A
OTH_OTH	OTH

Table 3.2.1.1: Baseline run outputs from the Fcube FLR package.

Management plan		COD	HAD	WHG	ANF	LEZ
2012	Fbar	0.88	0.27	0.07	0.30	0.24
	FmultVsF11	0.92	1.25	1	1.17	1.88
	landings	512	3378	357	2789	5232
	ssb	3676	23616	9978		
2013	Fbar	0.53	0.25	0.05	0.24	0.21
	FmultVsF11	0.56	1.15	0.68	0.94	1.69
	landings	387	3729	357	2243	4700
	ssb	3603	25099	14162		
2014	ssb	4522	24540	13823		

Management plan		NEP11	NEP12	NEP13	NEPOTH
2012	Harvest rate				
	FmultVsF11				
	landings				
2013	Harvest rate	0.125	0.123	0.16	
	FmultVsF11	1.54	2.07	1.28	
	landings	4159	5819	6346	106

Table 3.2.1.2: Comparison between baseline run and ICES advice for finfish. Figures for 2012 compare results from the baseline run - that use the same assumptions for F in the intermediate year as the forecasts leading to ICES advice – to the ICES intermediate year results.

Management plan		COD	HAD	WHG	ANF	LEZ
2012	landings					
	Baseline	512	3378	357		
	ICES	520[1]	3416	360		
	% difference	1.6 %	1.0 %	<1.0 %		
2013	landings					
	Baseline	387	3729[2]	357	2243	4700
	ICES	390	3130	n/a	2292	4700
	% difference	<1.0%	-19.0 %[2]	[3]	2.0 %	0.0 %

1 Cod is subject to a 1.5% bycatch rule in 2012. 520 t is the predicted human consumption landings in 2012 from 'Table B' of the catch options tables from the VIa cod advice sheet.

2 The baseline landings for haddock are higher than the single-species landings for 2013 because unallocated removals are not taken into account. Calculating the landings proportion of the catch (56%) gives 3128 t, the same as the single species forecast.

3 There was no comparable unchanged TAC scenario in the single species forecast, therefore the 2013 result cannot be compared to the single species assessment forecast value for 2013.

Table 3.2.1.3: Comparison between baseline run and ICES advice for *Nephrops*. No 'ICES advice' values are given for Nephrops in the intermediate year because the baseline run uses values based on recorded landings in the previous year which can vary significantly from the advice for each FU

Management plan		NEP11	NEP12	NEP13	NEPOTH
2013	landings				
	Baseline	4159	5819	6346	106
	ICES	4160	5821	6326	111
	% difference	0.0 %	0.0 %	-0.3 %	4.5 %

Table 3.2.2.1: Results of running Fcube scenarios on intermediate year (2012). Comparison of the actual TAC, baseline landings according to the single-stock projection, and potential landings in the various scenarios.

	COD	HAD	WHG	ANF	LEZ
TAC2012	5201	60152	307	2789	3387
baseline	512	3378	357	2789	3387
max	512	7651	1811	11159	4823
min	125	1892	376	2184	922
cod	512	7650	1811	11159	4823
sq_E	158	2219	440	2558	1084
Ef_Mgt	116	1594	323	1823	750
	NEP11	NEP12	NEP13	NEPOTH	
TAC2012	3065	4210	6698	111	
baseline	3065	4210	6698	106	
max	11299	14920	31704	n/a	
min	2314	3157	5511	n/a	
cod	11161	14764	31366		
sq_E	3031	3984	7619		
Ef_Mgt	2327	3020	5583		

1 Cod is subject to a 1.5% bycatch rule in 2012. 520 t is the predicted human consumption landings in 2012 from 'Table B' of the catch options tables from the VIa cod advice sheet.

2 The 2012 haddock TAC was set at 6015 t. After WGMIXFISH it was realised this should have been the value used for total removals. After correction of the short term forecast the anticipated HC landings in 2012 are 3416 t.

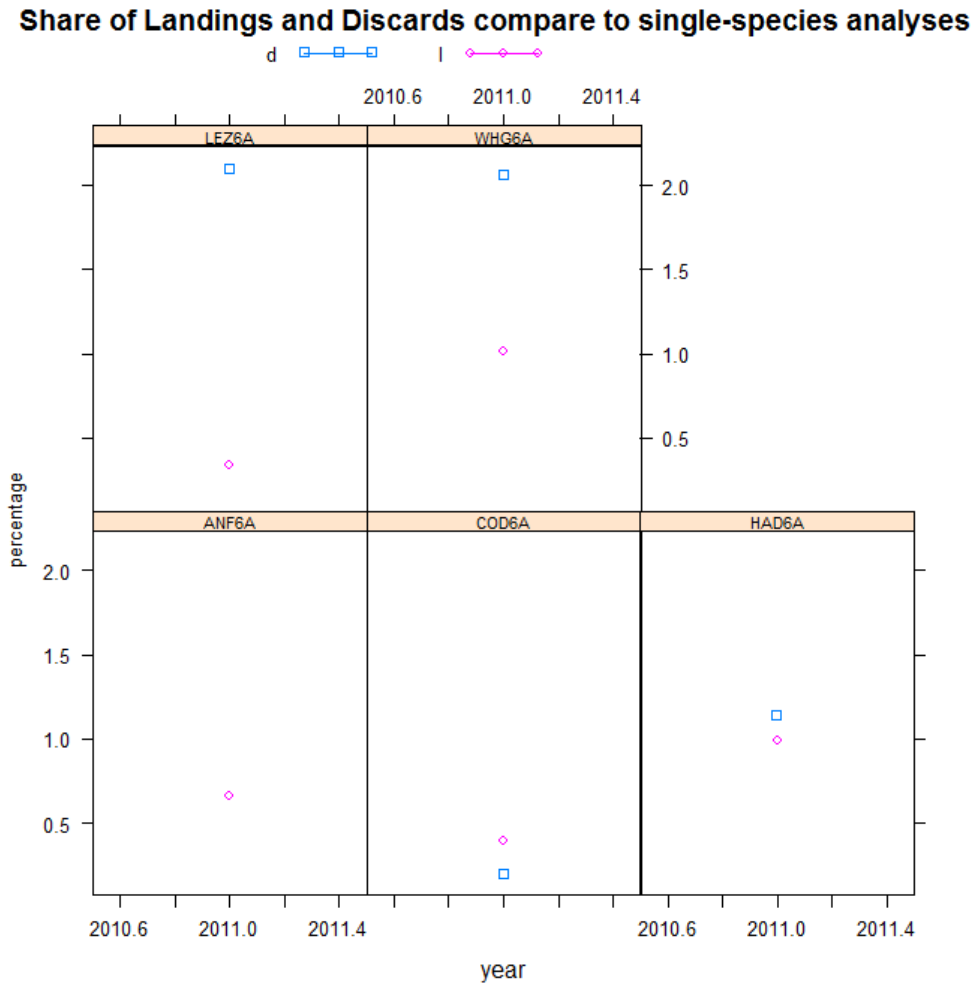

Figure 2.2.2.1. Ratio between the sum of landings and discards across fleets used in the MIXFISH analysis and the landings and discards estimated by the WGCSE stock assessments. Landings only are compared for anglerfish as discards are not considered in the anglerfish assessment and advice.

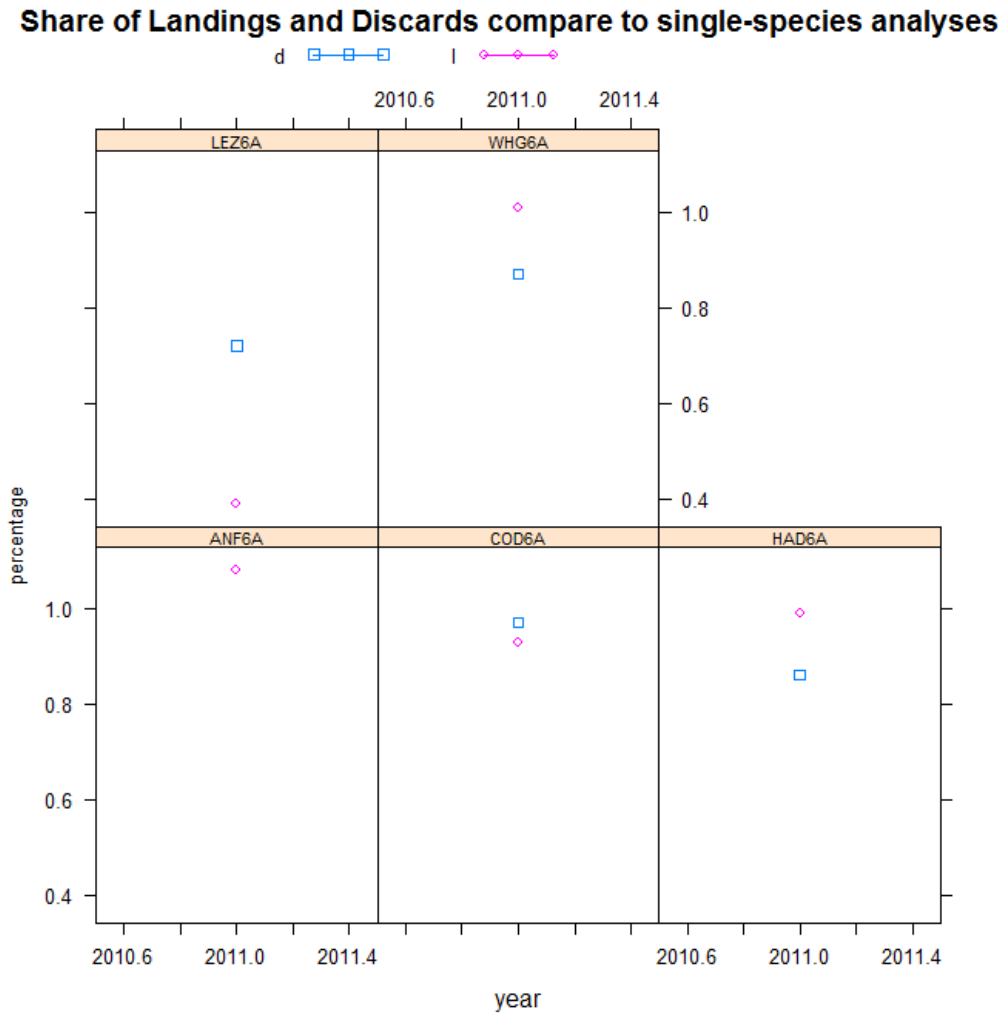

Figure 2.2.2.2. Ratio between the sum of landings and discards across fleets available in the corrected MIXFISH data set (post meeting) and the landings and discards estimated by the WGCSE stock assessments. Landings only are compared for anglerfish as discards are not considered in the anglerfish assessment and advice.

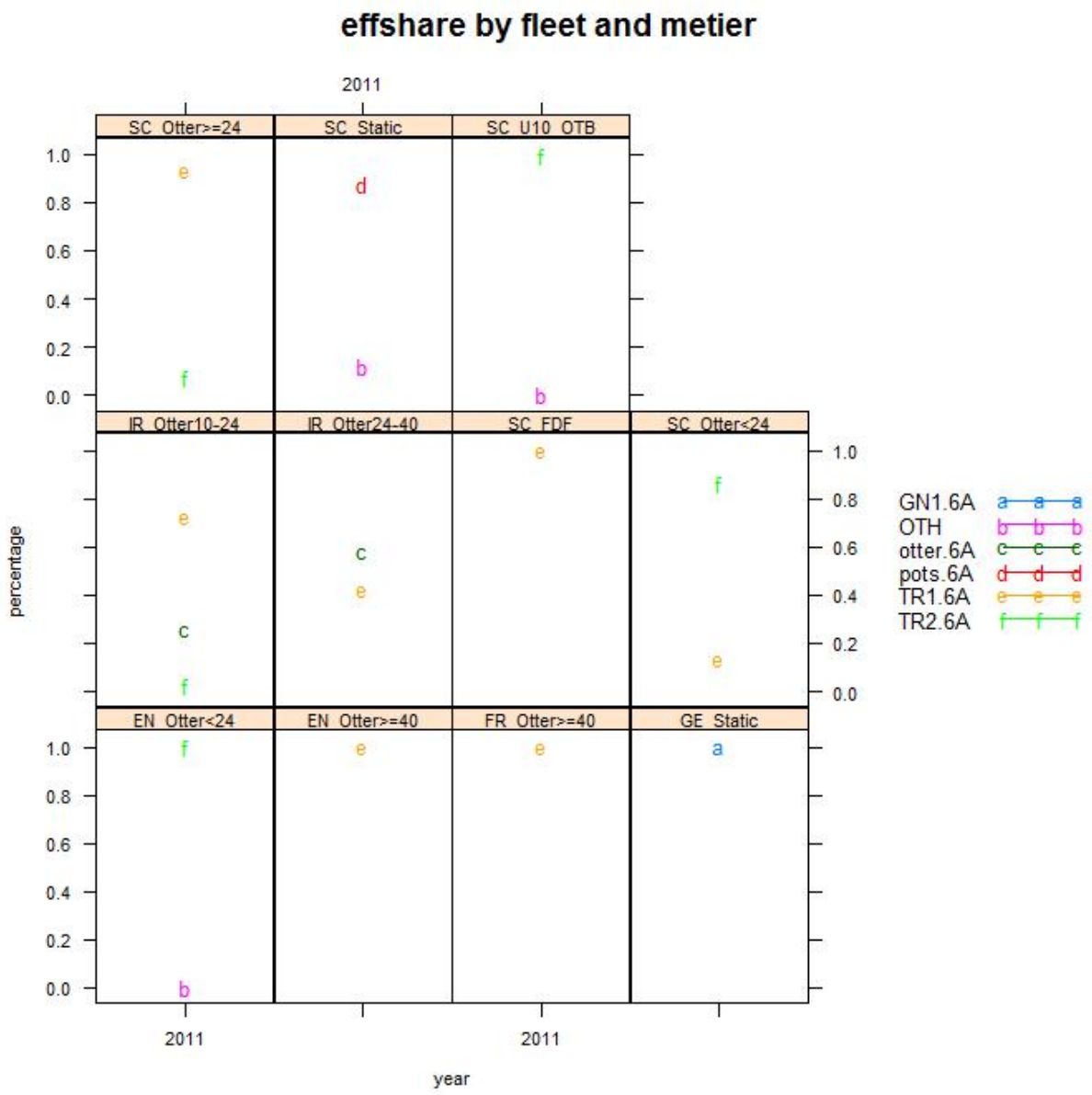

Figure 2.2.3.1 – Effort share (in proportion) by métier for each fleet.

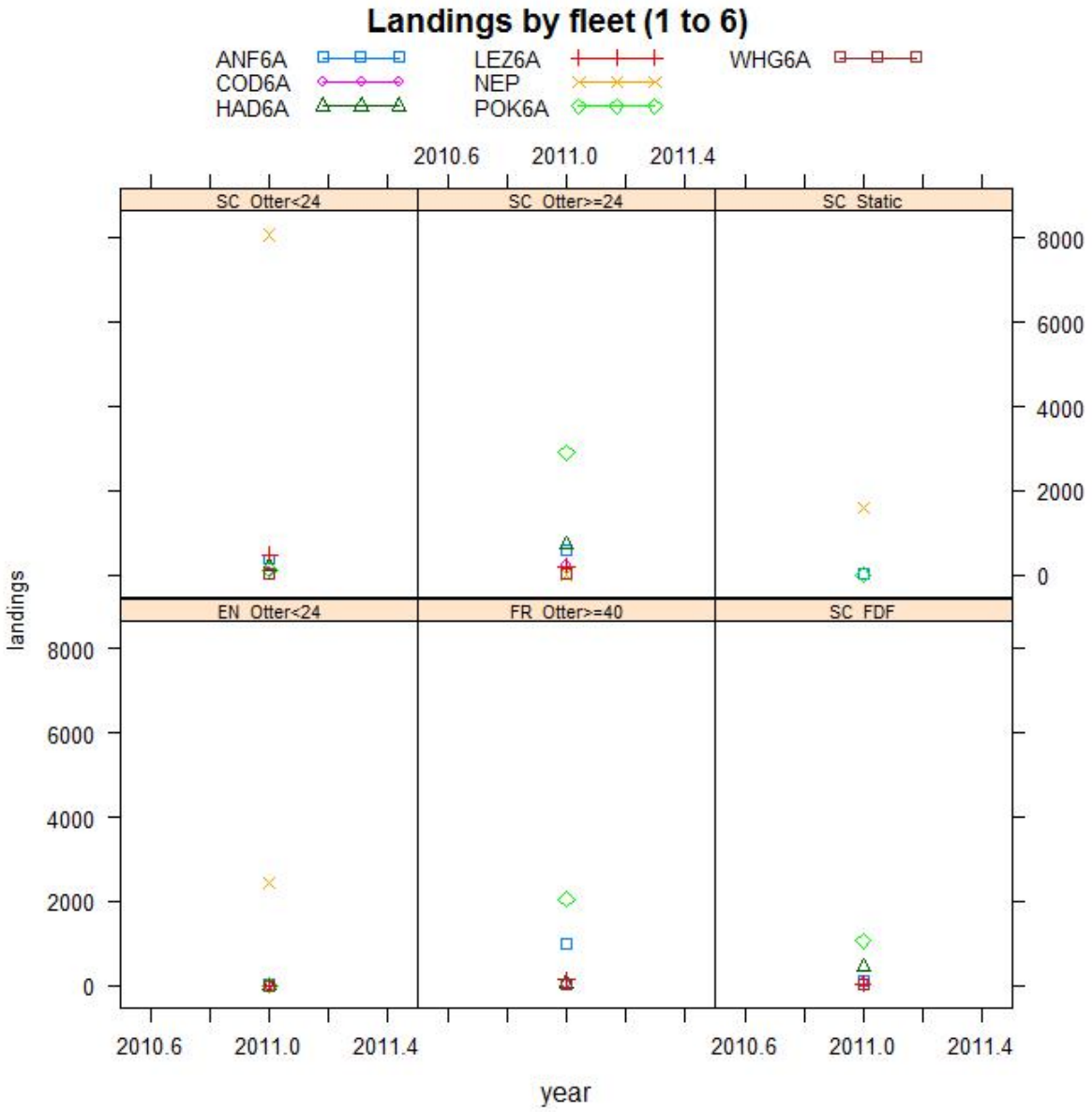

Figure 2.2.3.2. Landings by fleet, stock and year. Fleets are shown in decreasing groups of total landings and with different scales.

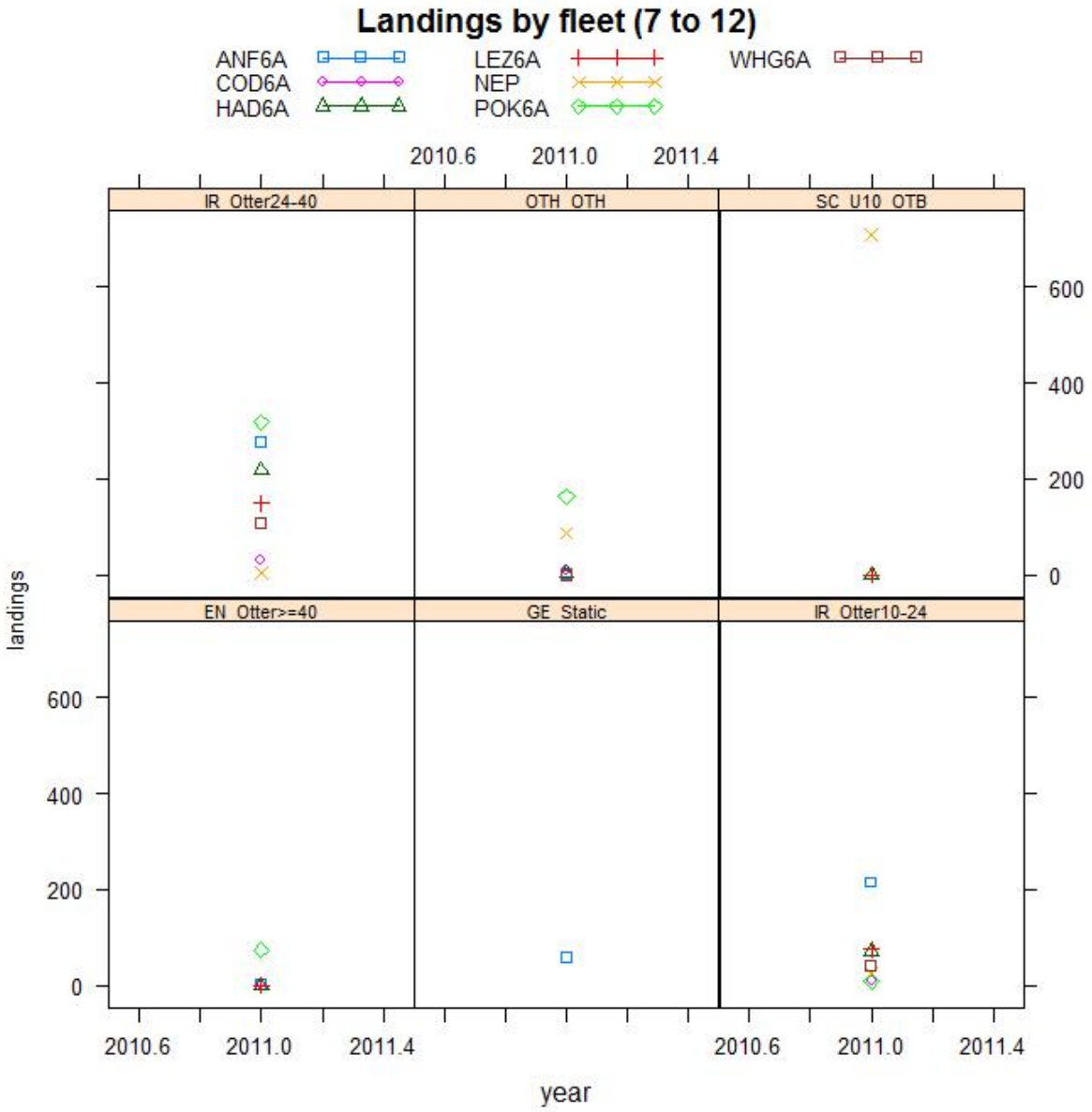

Figure 2.2.3.2 (cont). Landings by fleet, stock and year. Fleets are shown in decreasing groups of total landings and with different scales.

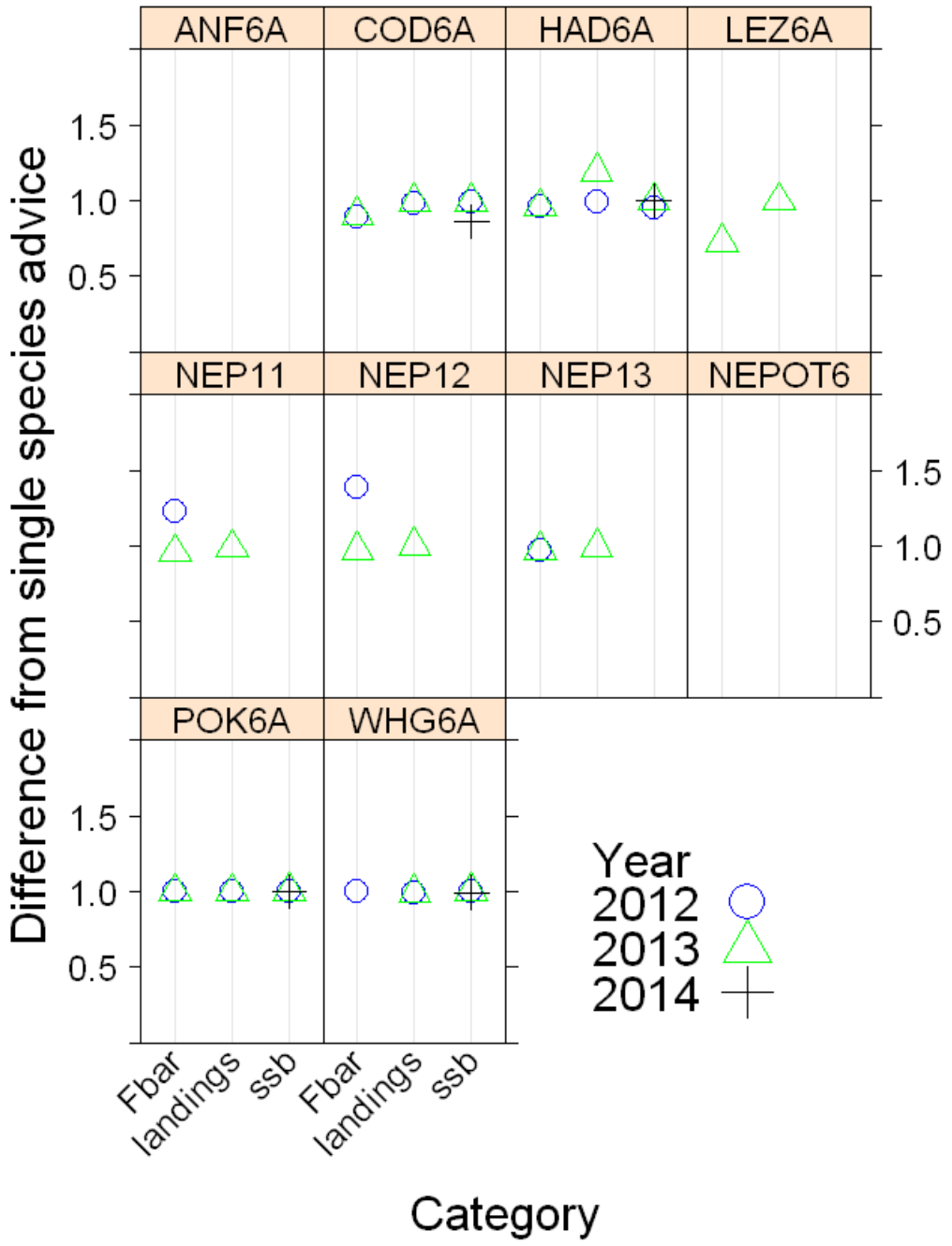

Figure 3.2.1.1. Difference in Fcube outcome from Single Species advice for Fbar (2012-2013), landings (2012-2013) and SSB (2012-2014).

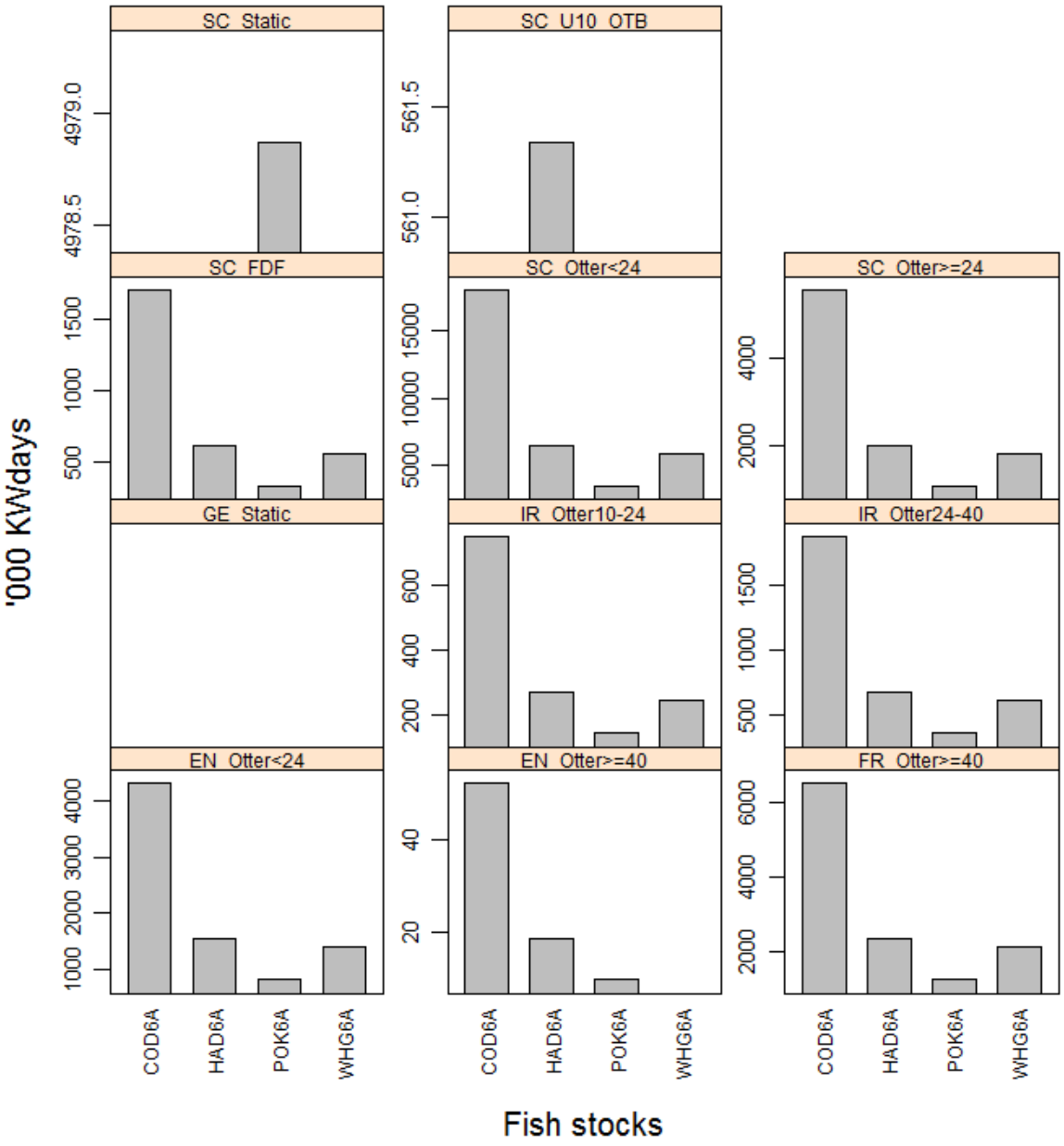

Figure 3.2.2.1.1. Intermediate year results. Single-Stock Target F in 2012; Fcube estimates of effort by fleet corresponding to the individual "quota share" (or partial target F) by stock in 2012. Finfish species.

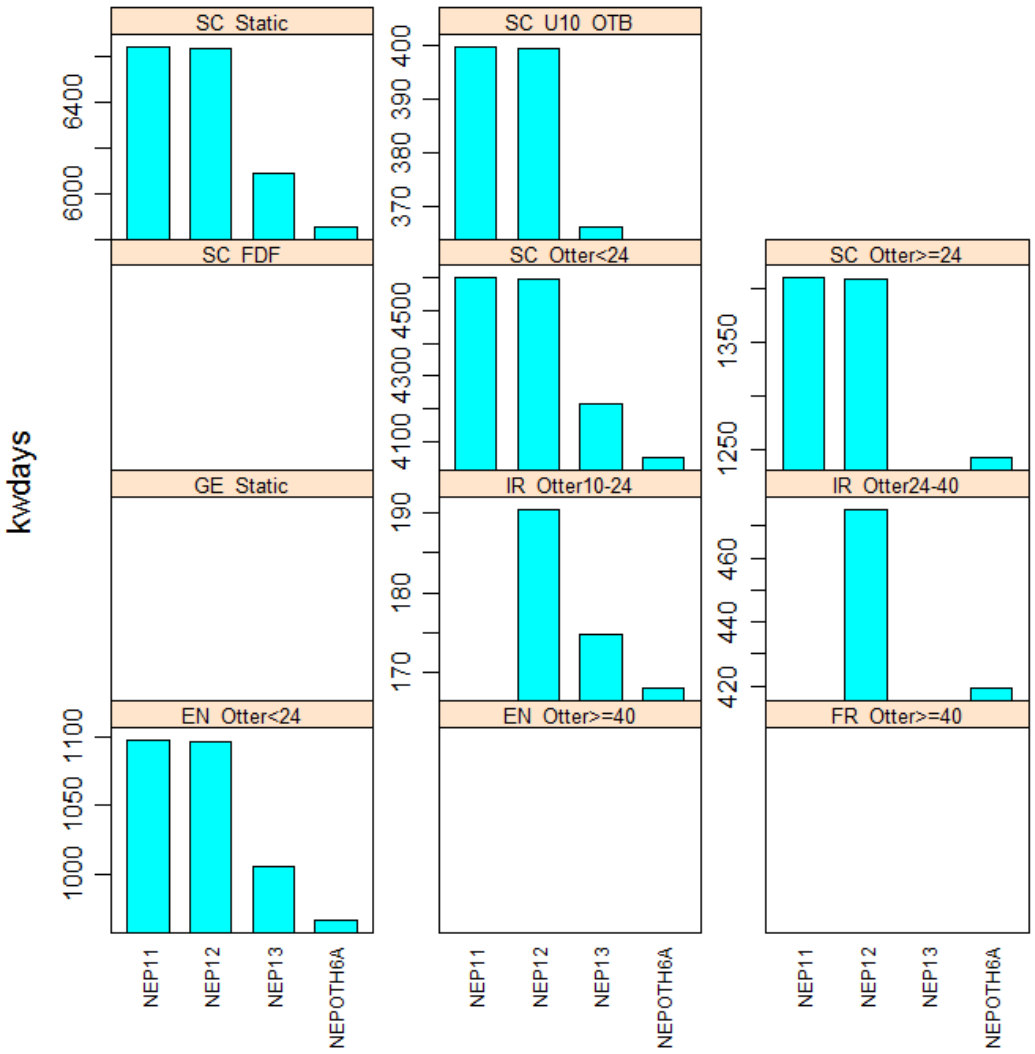

Figure 3.2.2.1.2. Intermediate year results. Single-Stock Target F in 2012; Fcube estimates of effort by fleet corresponding to the individual "quota share" (or partial target F) by stock in 2012 when applying the five scenarios. Nephrops FUs.

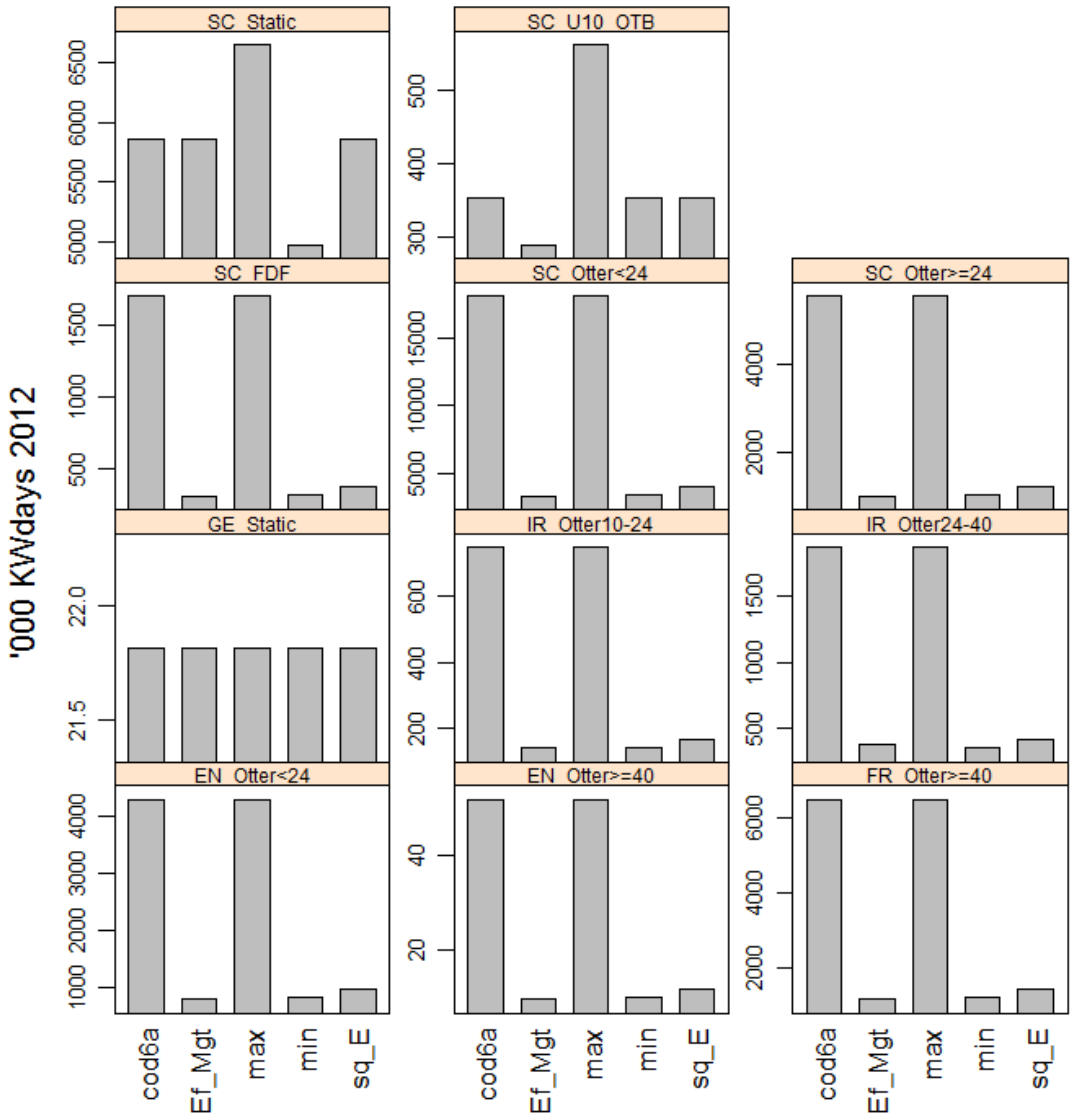

Figure 3.2.2.1.3. Intermediate year results. Fcube estimates of effort by fleet implied by the Fcube scenarios in the intermediate year (2012).

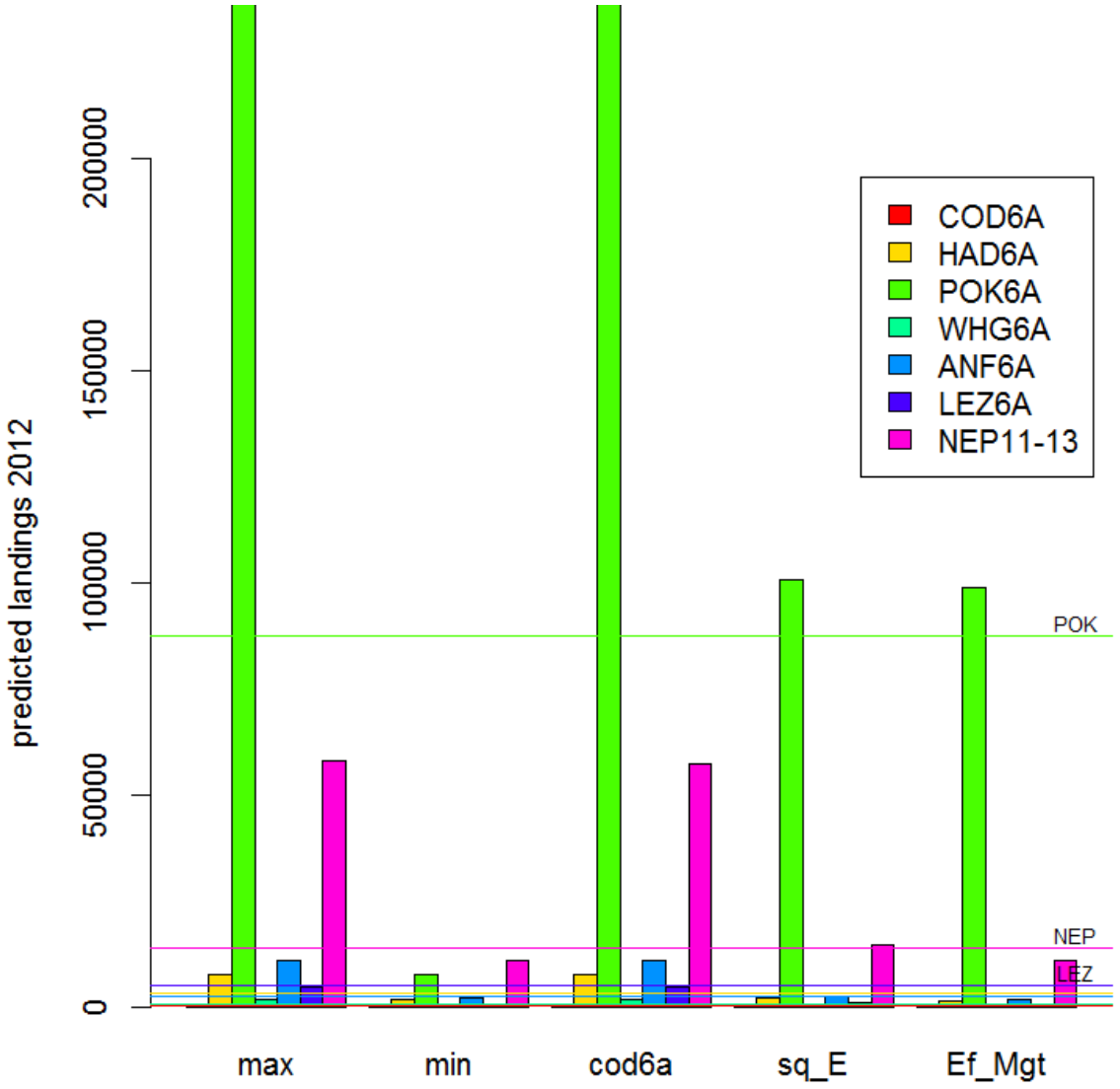

Figure 3.2.2.1.4. Intermediate year results. Fcube estimates of potential landings by stock for the Fcube scenarios in the intermediate year (2012). Horizontal lines correspond to the intermediate year assumptions for landings from the single species stock assessments (as reproduced by the 'baseline run').

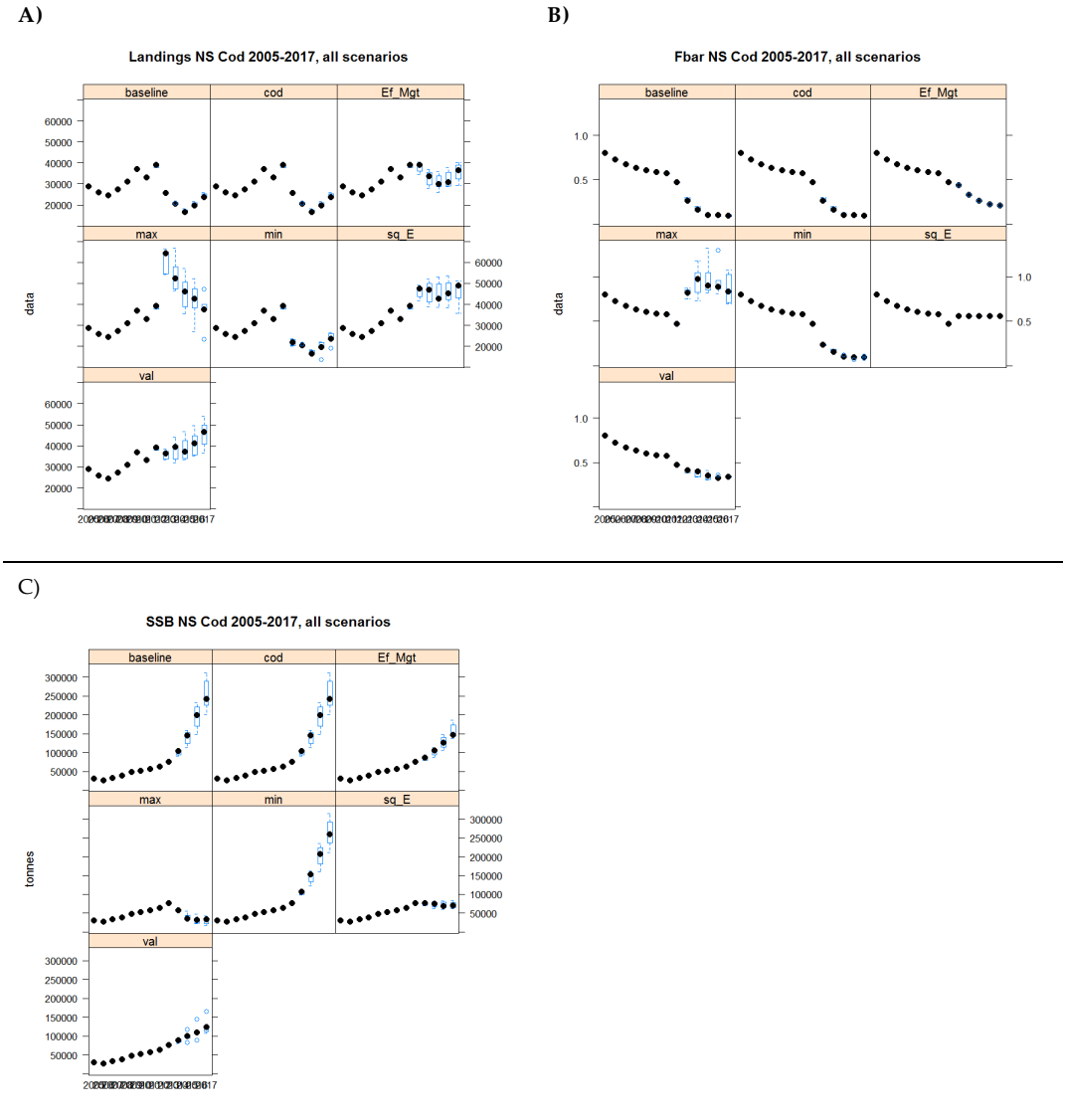

Figure 4.2.1: Stochastic Fcube. Projections to 2017 of North Sea cod stock using the assumptions of the cod LTMP (baseline run) and the mixed fisheries scenarios. Results are deterministic up to 2011. From 2012 the black dot represents the median result. The boxes represent 25-75% confidence intervals and the whiskers the minimum and maximum. Variability results from the uncertainty associated with the stock's stock recruit relationship.

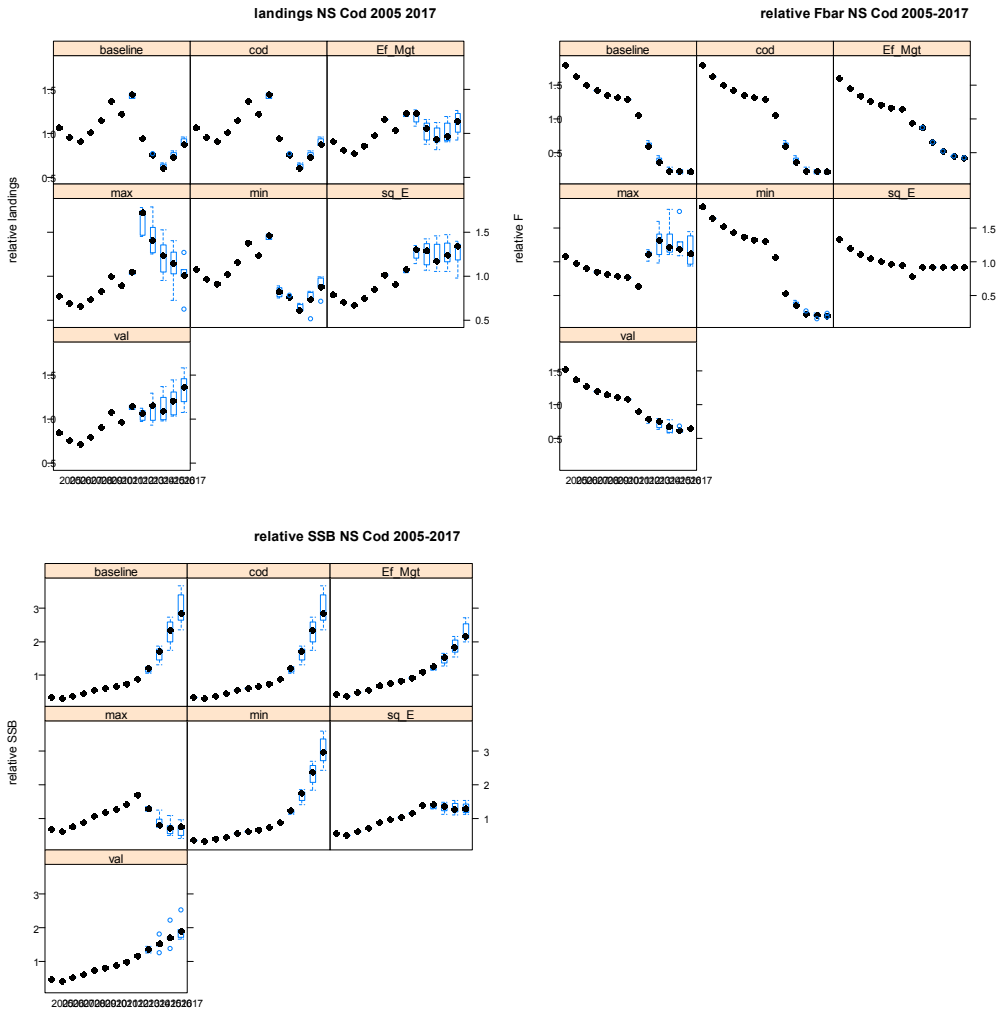

Figure 4.2.2: Stochastic Fcube. Projections to 2017 of North Sea cod stock using the assumptions of the cod LTMP (baseline run) and the mixed fisheries scenarios. Values mean standardised over the period 2006-2017. Results are deterministic up to 2011. From 2012 the black dot represents the median result. The boxes represent 25-75% confidence intervals and the whiskers the minimum and maximum. Variability results from the uncertainty associated with the stock's stock recruit relationship.

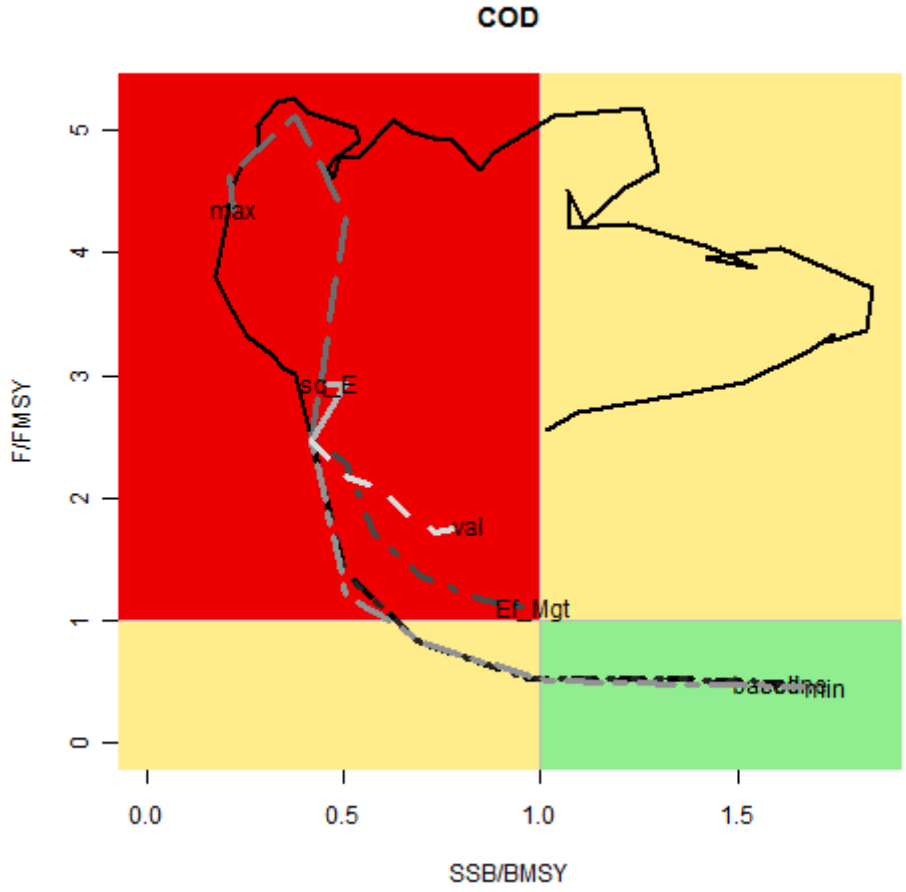

Figure 4.2.3: Stochastic Fcube. Kobe plot of the median result with respect to F/Fmsy and SSB/Btrigger. Results from the scenarios on a given stock. Solid black line represents the historical stock development according to the single species stock assessment. Broken lines show the stock development according to the baseline run and the mixed fisheries scenarios. Scenario labels mark the end point (2017) for each scenario.

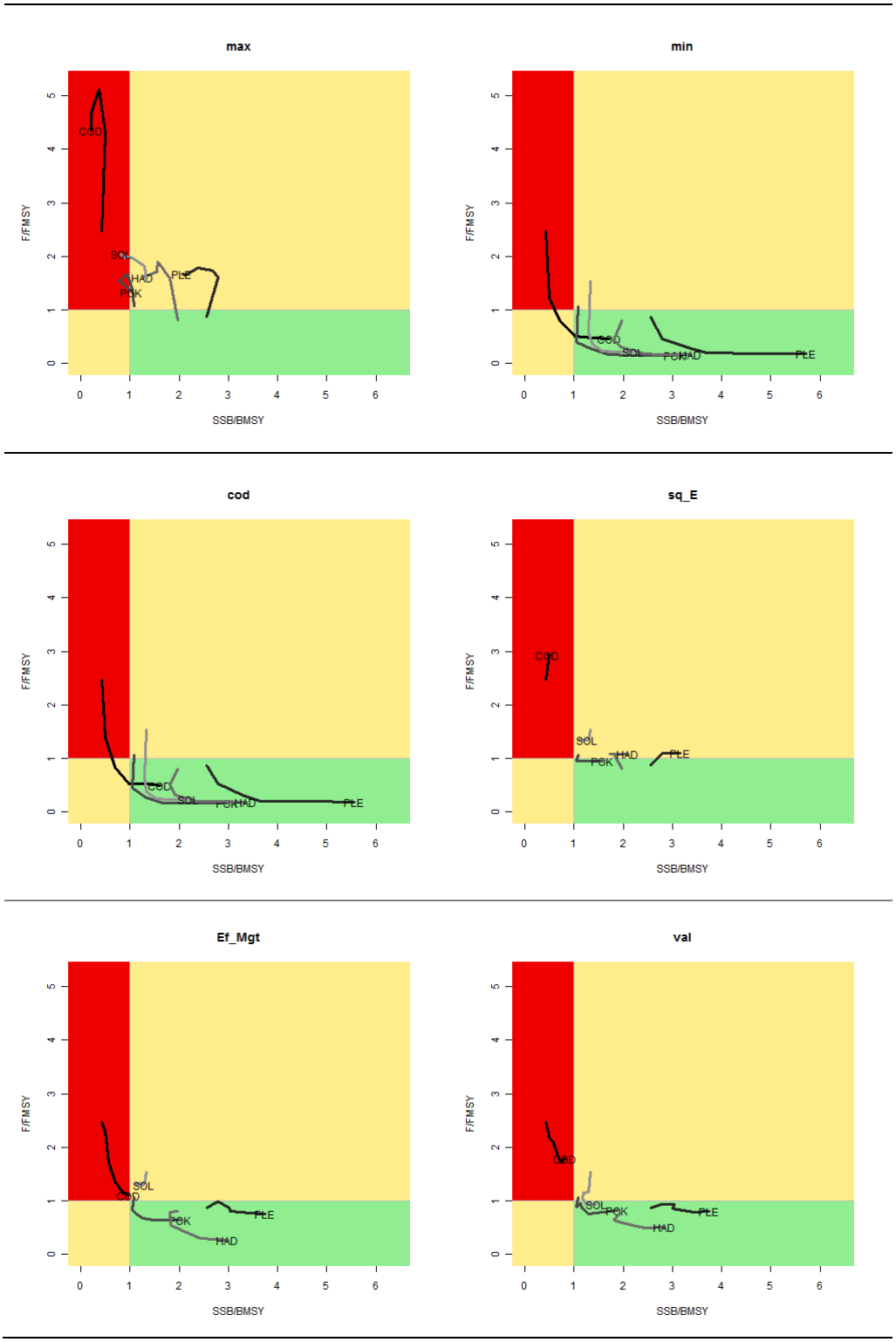

Figure 4.2.4: Stochastic Fcube. Kobe plot of the median result with respect to F/Fmsy and SSB/Btrigger. Results from a given scenario on all stocks. Lines run from the start of the projection and are marked at their end point (2017) by the name of the stock.

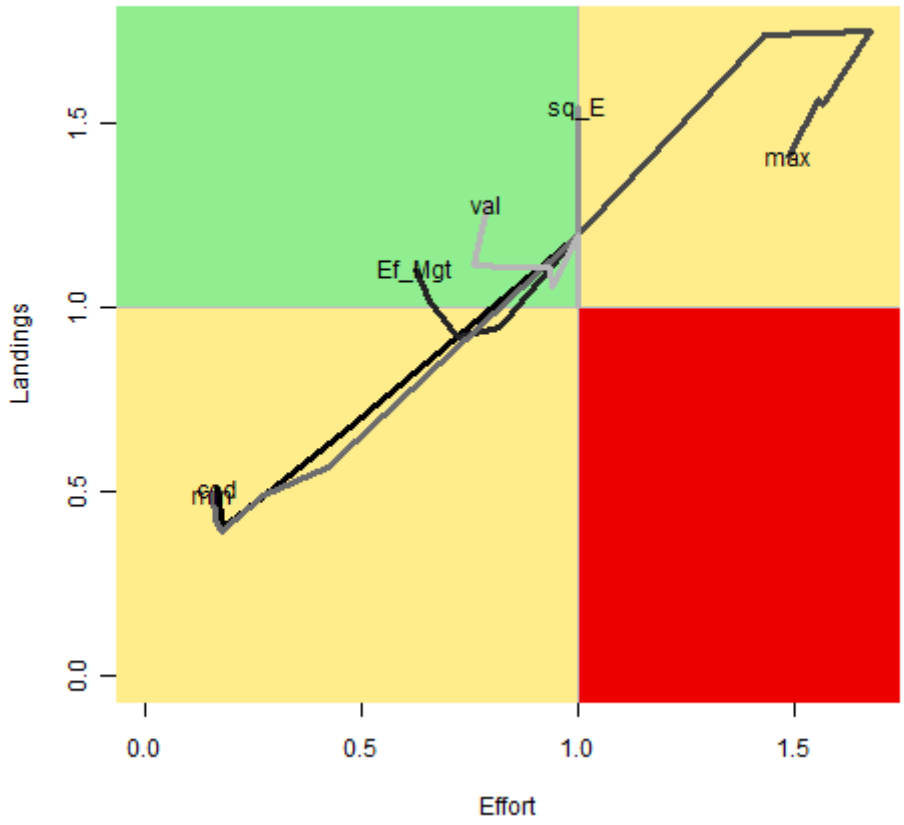

Figure 4.2.5: Stochastic Fcube. Kobe plot using the median results from each stock and scenario combination. Summed landings (across species) compared to value at the start of the projections and total effort (kWdays) expended compared to value at the start of the projections. Lines run from the start of the projection and are marked at their end point (2017) by the name of the scenario.

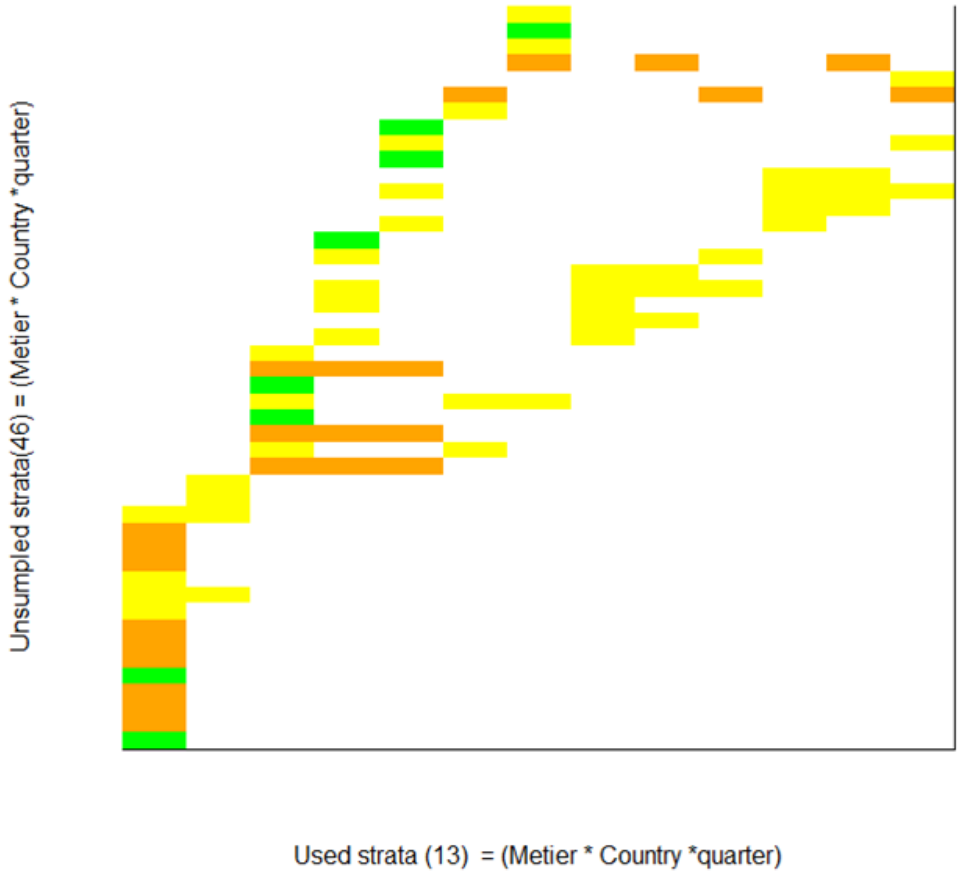

Figure 5.1.1.1. Suggested graphical output for use within InterCatch. Coloured blocks indicate where 'used' strata have supplied discard ratios to the unsampled strata. More than one stratum can be used to supply data to an unsampled stratum. Block colours signify: Green: same season and metier; yellow: same season but only similar metier; orange: similar metier only and a different season.

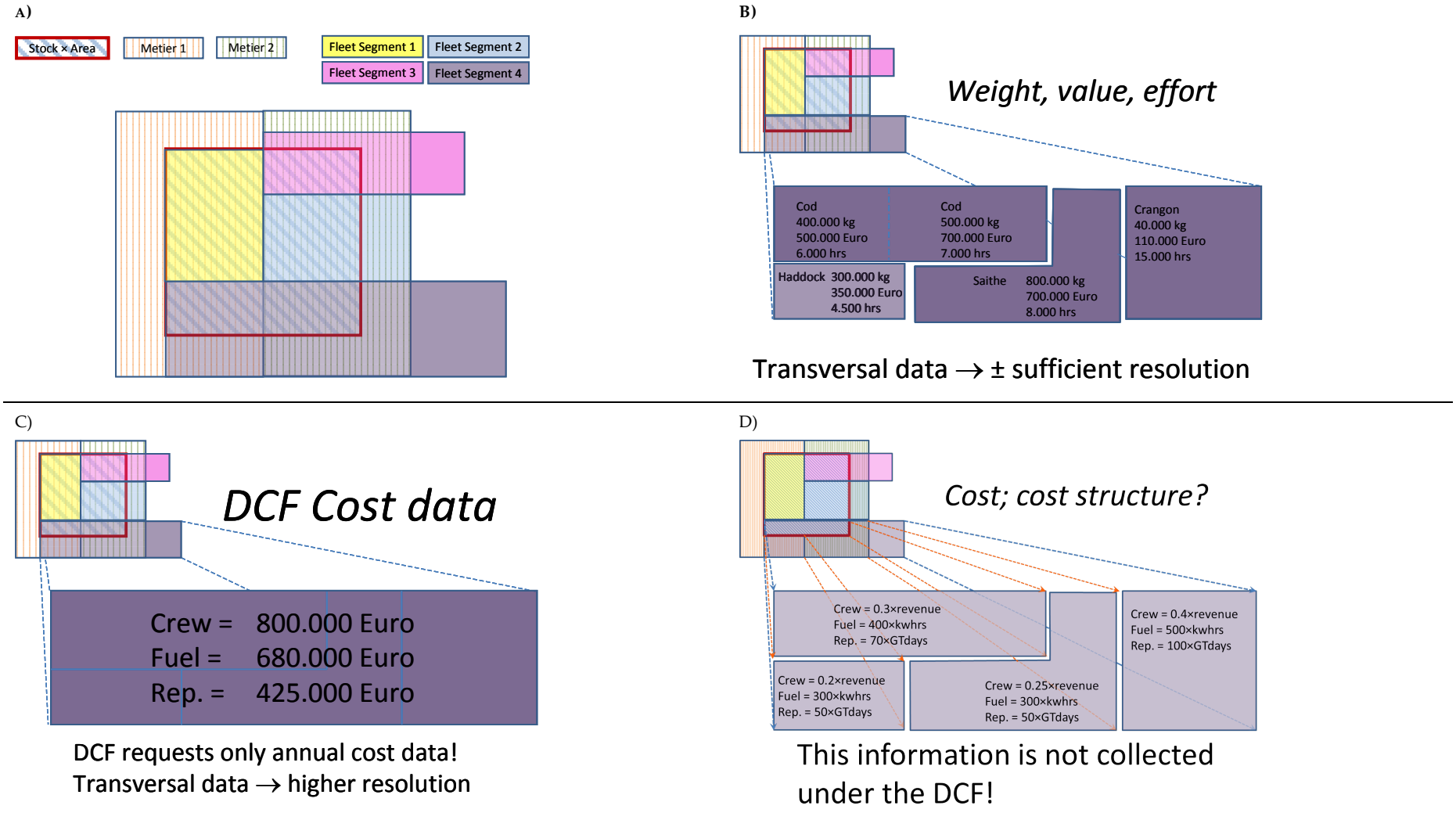

Figure 5.1.4.1: Pictorial representation of the relationship between stocks, metiers, fleet segments, DCF economic cost data and transversal data. Supplied by Jörg Berkenhagen

Annex 1: List of participants

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Annex 2: Specification of the ICES' data call

Following intercessional debate and a workshop held at WGMIXFISH 2011 data for WGMIXFISH 2012 was requested as part of a joint WGNSSK-WGMIXFISH data call issued formally under the EU data collection framework (DCF) regulations. This annex contains a summary of the considerations that influenced the design of the data call followed by a copy of the data call document issued by ICES.

It was briefly considered to try and harmonise the ICES data call with the STECF 'effort regime' data calls but it quickly became clear that this could not be done because

- The STECF data are at the discretion of the EU commission
- As such STECF data calls could be subject to change
- The practicalities of data collection means that the sampling frames used by different member states do not necessarily match up directly with the DCF format.

Attention then switched to the DCF framework. The DCF currently requires the collection of biological data at level 6 of the metier structure given in Appendix IV of Commission Decision 2008/949/EC. The Level 6 metiers are defined by gear type, target assemblage, mesh size and physical characteristics of any selectivity devices fitted. The metier represents a principal domain of interest for which sampling data are required. Table 4 of the RCM (2010) report gave a list of 18 broader levels based on those comprising 90% of either landings, effort or value (of which only 8 have any real significance to the demersal stocks of the North Sea) and was proposed as a starting point for a more practical data call. Three problems with this list were identified

1) The mesh size categories at level 6 are based on the Council Reg. 850/1998 and are not necessarily consistent with the current effort regime therefore making the link between biological data and fisheries management difficult, e.g. the current gear regulation in the Skagerrak uses a different mesh size range for the *Nephrops* fishery than in the North Sea, and the DCF level 6 have been defined accordingly, however they are managed under the same category (TR2) in the current cod long term management plan.
2) Fleet/metiers important to one or more member state are not listed in the 18 broader RCM levels mentioned above, e.g. the large mesh size beam trawl metier (corresponding to BT1).
3) Species specific fleets/metiers (i.e. fleets/metiers exclusively targeting Saithe) could not be distinguished.

Following these considerations two different starting positions became clear, one being that data should be provided at the DCF metier level, the other that data should only be disaggregated to the level of the sampling scheme employed in order to retain the statistical integrity of the data. It became clear that sampling schemes may not necessarily be the same as the DCF metier matrix. Ignoring the sampling design when raising catch data can lead to significant bias and error in the final estimates of numbers at age/length. In turn this implies that data calls should simply request raised catch data, and landings only for those metiers not sampled (effort data would simply match these categories).

It was concluded that data submission would follow the statistically robust route and that age disaggregated data would be provided at the level of the sampling frame. The data was to be submitted to InterCatch for safe storage and to allow allocations

of discards and age distributions to unsampled metiers. To reduce the number of metiers forming the stock data a description of sampling designs along with a map of metiers to samples and likely categorisation (raised or unsampled) was requested from contributing nations. After consideration of those metiers important to the North Sea demersal stocks a reduced set of 'metier-tags', using the DCF level 6 naming convention but often merging over metiers was defined in the data call.

During the data call design process it was realised national sampling schemes rarely distinguished between vessel length categories. Age specific raised data entered to InterCatch was therefore not disaggregated by vessel length category. WGMIXFISH, however, considers more realistic scenario results can be generated by taking account of vessel lengths, e.g. larger vessels using trawl gear may operate in a relatively clean saithe fishery further offshore while smaller vessels operate in a more mixed demersal fishery closer to home ports. As the mixed fishery projections currently base catchabilities on total weight of catch compared to fleet effort, vessel length specific data was requested specifically for WGMIXFISH (because of the way discards are raised in most countries this does mean that discards are allocated pro-rata across vessel length categories, i.e. discard proportions can only be assumed the same across vessel length categories).

Revisions needed to accommodate west of Scotland data

- Addition of anglerfish (ANF) and megrim (LEZ).
- New area code for finfish VIa.
- New Nephrops FU area codes VIa11, VIa12, VIa13, VianotFU.
- Data needed to be requested from one new nation (Ireland) compared to the North Sea data call.

ICES Statistical rectangle definitions for the west of Scotland *Nephrops* FUs are:-

FU number	FU name	Statistical rectangles
11	North Minch VIa	44 46 E3-E4
12	South Minch VIa	41 43 E2-E4
13	Firth of Clyde + Sound of Jura VIa	39 40 E4-E5

DCF. 2010. Report of the Regional Coordination Meeting for the North Sea and Eastern Arctic (RCM NS&EA). Charlottenlund, Denmark, 17-21 May 2010.

Data call: Data submission for ICES working Groups WGNSSK & WGMIXFISH

Rationale

The mix fisheries advice to the EU and Norway regarding the species in the North Sea is elaborated on the basis of the best available survey and commercial data.

Scope of call

ICES Countries are requested to supply landings, discards, biological sample and effort data from 2011. This information should be according to one or more of the metiers listed in Annex 1. The minimum list of species for which data should be pre-

pared according to Annex 1 is given below and in Appendix 8. The species should be reported for the areas in the area list below.

	Common species name	*Code*	*Scientific species name*
1	*Cod*	*COD*	*Gadus morhua*
2	*Common sole*	*SOL*	*Solea solea*
3	*Haddock*	*HAD*	*Melanogrammus aeglefinus*
4	*Plaice*	*PLE*	*Pleuronectes platessa*
5	*Saithe*	*POK*	*Pollachius virens*
6	*Whiting*	*WHG*	*Merlangius merlangus*
7	*Norway lobster*	*NEP*	*Nephrops norvegicus*

Area list

Area	*Area code*
North Sea (IV)	*IV*
Skagerrak (IIIaN)	*IIIaN*
Eastern Channel (VIId)	*VIId*

Deadline

30 March 2012.

Data to be reported

Landings, discards, sample and effort data from 2011 according to one or more of the metiers listed in Annex 1.

Additionally information by vessel length categories are also requested, please see section 'Aggregation vs. WGMIXFISH Requirements'.

Format to report

The InterCatch format should be used.

Additionally information by vessel length categories should be in comma separated (CSV) file, please see section 'Aggregation vs. WGMIXFISH Requirements'

How to report

The InterCatch formatted national data should be imported into InterCatch. Please use the following link: http://intercatch.ices.dk

Additionally information by vessel length categories should be electronically sent to:

Clara Ulrich [clu@aqua.dtu.dk] -- Chair of WGNSSK

Steven Holmes [s.holmes@marlab.ac.uk] -- Chair of WGMIXFISH

The entries in Annex 1 follow closely the naming convention used for the EU Data Collection Framework (DCF). An explanation of the elements of these metier tags follows:

1) *GEAR TYPE (gear types available under the DCF are shown in Appendix 1. Data can be aggregated over more than one category but in this case the most signifi-*

cant gear type is entered. The aggregations assumed in forming Annex 1 are also shown in Appendix 1)

2) *METIER CODE (code conforming to target assemblage code of DCF, see Appendix 2. Data can be aggregated over more than one category but in this case the most significant metier code is entered)*

3) *MESH SIZE RANGE (mesh size ranges available under the DCF, see Appendix 3. Data can be aggregated over more than one category but in this case the most significant mesh size range is entered. If for that gear type data has been aggregated over all ranges used by a nation an additional (to the DCF) entry "all" can be used.)*

4) *SELECTIVITY DEVICE (types of selectivity device available under the DCF are shown in Appendix 4.)*

5) *SELECTIVITY DEVICE MESH SIZE (the actual mesh size of any selectivity device is entered.)*

6) *VESSEL LENGTH CLASS (Member states have indicated national sampling scheme designs do not take account of vessel lengths. Therefore only the non-standard entry of "all" is currently provided for in InterCatch.)*

7) *FULLY DOCUMENTED FISHERIES (If the metier tag defines a fully documented fishery add "_FDF" after length class – but see note below).*

An underscore separates these elements.

Note: Country and area are supplied to InterCatch separately. Country codes are as shown in Appendix 6. Area codes are as shown in Appendix 7. It is stressed that to reduce the number of entries required in InterCatch data is requested according to the areas shown in Appendix 7 and **not** according to finer spatial resolutions.

IMPORTANT:

- When uploading to InterCatch the year is the data year, which must be entered as **2011.**
- If discard data is unavailable there should be no entry for discards. A value of zero should only be entered when zero discards have been observed.

Effort Data

Effort is required in kWdays. Effort is recorded in position 11 of the InterCatch header information.

Fully Documented Fisheries

To prevent a requirement for large numbers of metier tags to be held within InterCatch metier tags for fully documented fisheries will be added on a case by case basis. If national data submitters have a fully documented fishery for which there is landings and discard data and which they wish to submit as a unique metier they should contact Henrik Kjems-Nielsen [henrikkn@ices.dk], the contact point for InterCatch.

Aggregations

If national data are aggregated over several DCF level 6 categories, the metier tag corresponding to the most significant category is chosen e.g. a mobile gear with mesh sizes covering 70-119 mm (combining 70-99 and 100-119) but 70-99mm is most significant – code 70-99.

Exceptions to this general rule are cases where data has been aggregated over all

- mesh size ranges

within the national fleet. In these instances the tag "all" can be entered.

In addition Member states have indicated national sampling scheme designs do not take account of vessel lengths and therefore only the non-standard entry of "all" is currently provided for in InterCatch against vessel length. The option has been left open for length category specific metier tags to be added in future years if nations begin to sample and raise data independently for different length categories.

Aggregations vs. WGMIXFISH Requirements

Age specific data is best raised and entered to InterCatch using metiers / groups of vessels that match national sampling schemes. For 2011 data this means that the vessel length categories will be omitted in the data submitted to InterCatch (e.g. metier tag TBB_DEF_>=120_0_0_all). This is sufficient to address the data needs for WGNSSK. However, - for otter and beamtrawl gears only - these aggregations may be too broad for WGMIXFISH needs (leading to overly large fleet entries in the mixed fisheries projections). To fulfil the additional WGMIXFISH specific need for information by vessel length categories[3], we kindly request estimates of catch weight totals and effort in a format similar to previous WGMIXFISH data calls (albeit using the Metier Tags as used to supply InterCatch) i.e. :

A comma separated (CSV) 'effort' file containing the following entries :

> ID, Country, Year, Quarter, Length disaggregated Metier Tag, Area, KW_Days, Days At Sea, No Vessels

A CSV 'catch' file containing the following entries :

> ID, Country, Year, Quarter, Length disaggregated Metier Tag, Area, Species, Landings (tonnes), Discards (tonnes), Value (average price*landings at first sale, expressed in Euros).

[3] Also, in order to insure consistency and continuity with the data time series previously collected by WGMIXFISH.

- Length categories are <10m; 10<24m; 24<40m and >=40m.
- Vessel length splits are only required for metier tags starting OTB or TBB.

Sums of effort and catch across metier tags disaggregated by vessel length should equal the corresponding totals submitted to Intercatch.

Example:

If a nation submitted data to InterCatch according to TBB_DEF_>=120_0_0_all but this data comes from vessels of 24<40m and >=40m WGMIXFISH requests CSV files for entries of

TBB_DEF_>=120_0_0_24<40 and

TBB_DEF_>=120_0_0_>=40

The CSV files should be submitted electronically to

Clara Ulrich [clu@aqua.dtu.dk] -- Chair of WGNSSK

Steven Holmes [s.holmes@marlab.ac.uk] -- Chair of WGMIXFISH

Supporting Documentation and work to be undertaken after the data upload

Once data has been submitted to InterCatch a process of fill-ins will be undertaken by the respective stock coordinators for entries containing only bulk weight of landings and/or discards. **To aid this process countries are requested to complete a documentation file (EXCEL spreadsheet) in a format like that shown in Annex 2.**

The documentation spreadsheet should be submitted electronically to

Clara Ulrich [clu@aqua.dtu.dk] -- Chair of WGNSSK

Steven Holmes [s.holmes@marlab.ac.uk] -- Chair of WGMIXFISH

For InterCatch related questions contact: Henrik Kjems-Nielsen [henrikkn@ices.dk]

Conversions to InterCatch Format

A description of the InterCatch Exchange format can be downloaded at the InterCatch information webpage under 'Manuals':

http://www.ices.dk/datacentre/InterCatch/InterCatch.asp

A two page overview of the fields in the InterCatch commercial catch format can be found at the same page, again under 'Manuals' (just below the InterCatch Exchange format manual). From this page the valid codes can be seen.

To ease the process of converting the national data into the InterCatch format Andrew Campbell from Ireland has made a conversion tool 'InterCatchFileMaker', which converts data manually entered in the 'Exchange format spreadsheet' into a file in the InterCatch format. The conversion tool 'InterCatchFileMaker' can be downloaded at the InterCatch information page (the one above) under 'Program to convert to InterCatch file format'. The download includes a spreadsheet in which the landings and sampling data can be placed; the converter then converts the data in the spreadsheet into the InterCatch format.

Annex 1

Area	Gear type	Available metier tags For fully documented fisheries add "_FDF" after length class.
IIIaN (Skagerrak) Area Type = SubDiv		TBB_DEF_90-99_0_0_all
		TBB_DEF_>=120_0_0_all
	Otter trawl	OTB_CRU_13-31_0_0_all
		OTB_CRU_32-69_0_0_all
		OTB_CRU_32-69_2_22_all
		OTB_CRU_70-89_2_35_all
		OTB_CRU_90-119_0_0_all
		OTB_ DEF _>=120_0_0_all
	Seines	SDN_DEF_>=120_0_0_all
		SSC_DEF_>=120_0_0_all
	Gill, trammel, drift nets	GNS_DEF_100-119_0_0_all
		GNS_DEF_120-219_0_0_all
		GNS_DEF_>=220_0_0_all
		GNS_DEF_all_0_0_all
		GTR_DEF_all_0_0_all
	Lines	LLS_FIF_0_0_0_all
	Others (Human consumption)	DemHC
	Others (Industrial bycatch)	DemIBC
IV – (North Sea) Area type = SubArea & VIId (Eastern Channel) Area Type = SubDiv		TBB_DEF_70-99_0_0_all
		TBB_DEF_>=120_0_0_all
	Otter trawl	OTB_CRU_13-31_0_0_all
		OTB_CRU_32-69_0_0_all
		OTB_SPF_32-69_0_0_all
		OTB_CRU_70-99_0_0_all
		OTB_ DEF _>=120_0_0_all
	Seines	SDN_DEF_>=120_0_0_all
		SSC_DEF_>=120_0_0_all
	Gill, trammel, drift nets	GNS_DEF_100-119_0_0_all
		GNS_DEF_120-219_0_0_all
		GNS_DEF_>=220_0_0_all
		GNS_DEF_all_0_0_all
		GTR_DEF_all_0_0_all
	Lines	LLS_FIF_0_0_0_all
	Pots and Traps	FPO_CRU_0_0_0_all
	Others (Human consumption)	DemHC
	Others (Industrial bycatch)	DemIBC

Appendix 1 Gear coding (as defined under the DCF). Codes made available in the WGNSSK-WGMIXFISH data call are shown in the left hand column and are based on information from countries fishing in areas IIIaN, IV and VIId about significant fishing gears.

Code available in WGNSSK-WGMIXFISH data call	DCF code	Type of gear
TBB	TBB	Beam trawl
OTB	OTB	Bottom otter trawl
	OTT	Multi-rig otter trawl
	PTB	Bottom pair trawl
	OTM	Midwater otter trawl
	PTM	Midwater pair trawl
SSC	SSC	Fly shooting (Scottish) seine
	SPR	Pair seine
	PS	Purse seine
SDN	SDN	Anchored seine
	SB, SV	Beach and boat seine
GNS	GNS	Set gillnet
	GND	Driftnet
GTR	GTR	Trammel net
LLS	LHP	Pole lines
	LHM	Hand lines
	LLS	Set longlines
FPO	FPO	Pots and Traps
DemHC	FYK	Fyke nets
	FPN	Stationary uncovered pound nets
	DRB	Boat dredge
	HMD	Mechanised/ Suction dredge
	OTH	Other

Appendix 2 Target assemblage (metier code)

The codes in the table below are those permitted under the DCF. Those highlighted in yellow are not yet implemented but can be used.

Code	Definition
DEF	Demersal fish
CRU	Crustaceans
SPF	Small pelagic fish
LPF	Large pelagic fish
MOL	Molluscs
DWS	Deep-water species
FIF	Finfish
CEP	Cephalopods
CAT	Catadromous
GLE	Glass eel
MPD	Mixed pelagic and demersal fish
MDD	Mixed demersal and deepwater species
MCD	Mixed crustaceans and demersal fish
MCF	Mixed cephalopods and demersal fish

Appendix 3 Mesh size coding

Mesh size categories below are those permitted under the DCF. Data should be provided according to the categories below or aggregations of the categories below.

If data is aggregated over categories the most significant category is entered e.g. a mobile gear with mesh sizes covering 70-119 mm (combining 70-99, and 100-119) but 70-99mm is most significant receives code 70-99.

Gear type	Area	Code
Mobile gears	IIIaN (Skagerrak)	<16
		16-31
		32-69
		70-89
		90-119
		>=120
	IV & VIId (North Sea and Eastern Channel)	<16
		16-31
		32-69
		70-99
		100-119
		>=120
Passive gears	Whole of IIIaN, IV and VIId	10-30
		50-70
		90-99
		100-119
		120-219
		>=220

Appendix 4 Selectivity device

Selectivity devices are defined under the DCF as follows

Description	Code
None mounted	0
Exit window/selection panel	1
Grid	2
Unknown	3

Appendix 5 Vessel Length

Length categories permitted under the DCF are shown. For 2012 only the non-standard entry of "all" is currently provided for in InterCatch against vessel length. The option has been left open for length category specific metier tags to be added in future years.

DCF categories	
Vessel Length	*Code*
Under 10m	*<10*
10 to 12 m	*10<12*
≥ 12m <18m	*12<18*
≥ 18m < 24m	*18<24*
≥24m < 40m	*24<40*
≥ 40m	*>=40*

Appendix 6 Country coding (as used currently by InterCatch)

BE Belgium

CA Canada

DE Germany

DK Denmark

EE Estonia

ES Spain

FI Finland

FO Faroe Islands

FR France

GG UK (Channel Island Guernsey)

GL Greenland

IE Ireland

IM UK (Isle of Man)

IS Iceland

IT Italy

JE UK (Channel Island Jersey)

LT Lithuania

LV Latvia

NL Netherlands

NO Norway

PL Poland

PT Portugal

RU Russia

SE Sweden

UK United Kingdom

UKE UK (England)

UKN UK(Northern Ireland)

UKS UK(Scotland)

US United States

Appendix 7 Area coding

Codes accepted by InterCatch. Overall the codes are unique to this exercise because of the desire to receive data on Nephrops by Functional Unit (FU).

Finfish (or Nephrops if not possible to raise by Nephrops Functional Units)		Nephrops only		
		Functional Unit	InterCatch Code	Area Type Code
IIIaN	(Skagerrak)	FU5[1]	IV5	Div
IV	(ICES sub-area IV)	FU6	IVb6	SubDiv
VIId	(ICES division VIId)	FU7	IVa7	SubDiv
		FU8	IVb8	SubDiv
		FU9	IVa9	SubDiv
		FU10	IVa10	SubDiv
		FU32[1]	IV32	Div
		FU33	IVb33	SubDiv
		FU34	IVb34	SubDiv

1: FU5 is found in both ICES divisions IVb and IVc and FU32 is found in both ICES divisions IVa and IVb.

Nephrops Functional Units and descriptions by statistical rectangle follow

Functional Unit	Stock	ICES Rectangles	Division
5	Botney Gut	36-37 F1-F4; 35F2-F3	IV
6	Farn Deep	38-40 E8-E9; 37E9	IV
7	Fladen	44-49 E9-F1; 45-46E8	IV
8	Firth of Forth	40-41E7; 41E6	IV
9	Moray Firth	44-45 E6-E7; 44E8	IV
10	Noup	47E6	IV
32	Norwegian Deep	44-52 F2-F6; 43F5-F7	IV
33	Off Horn Reef	39-41F4; 39-41F5	IV
34	Devil's Hole	41-43 F0-F1	IV

Appendix 8.

Species for inclusion in WGNSSK-WGMIXFISH joint data call.

Whitefish species coding according to Council Regulation (EC) No. 2298/2003 and as used in InterCatch.

	Common name	***Code***	***Scientific name***
1	*Cod*	*COD*	*Gadus morhua*
2	*Common sole*	*SOL*	*Solea solea*
3	*Haddock*	*HAD*	*Melanogrammus aeglefinus*
4	*Plaice*	*PLE*	*Pleuronectes platessa*
5	*Saithe*	*POK*	*Pollachius virens*
6	*Whiting*	*WHG*	*Merlangius merlangus*
7	*Norway lobster*	*NEP*	*Nephrops norvegicus*

Annex 2

The documentation spreadsheet

Example of how to describe specific DCF categories contributing to supra-metiers uploaded to InterCatch

Metier code WGMIXFISH	Area	Vessel length classes	Gear types	Mesh size range	Description
OTB_CRU_70-99_0_0_all	4	<10 10<12 12<18 18<24 24<40 >=40	OTB OTT PTB SSC	70-99	Bottom trawls with mesh size >=70 & < 100 mm. No distinction between gear with or without selective devices. Notes NEP7 - majority of vessels 18<24 length with use of OTT gear. NEP8 & NEP9 - majority of vessels 12<18 length.
OTB_DEF_>=120_0_0_all	4	<10 10<12 12<18 18<24 24<40 >=40	OTB OTT PTB SSC	100-119 >=120	Bottom trawls with mesh size >=100mm. No distinction between gear with or without selective devices.
FPO_CRU_0_0_0_all	4	<10 10<12 12<18 18<24 24<40 >=40	FPO	na	Creels There are very small amounts of creel landings - no sampling. Mostly <10m vessels

Annex 3: Stock-based management plans relevant to west of Scotland

Cod in VI (EU management plan – EC 1342/2008)

The European Commission has adopted a Council Regulation ((EC) No. 1342/2008) which establishes measures for the recovery and long-term management of cod stocks. The stated objective of the plan is to ensure the sustainable exploitation of the cod stocks on the basis of maximum sustainable yield while maintaining a fishing mortality of 0.4. Articles 7–9, describing aspects of the plan relevant for west of Scotland cod, are reproduced below:

Article 7

Procedure for setting TACs for cod stocks in the Kattegat the west of Scotland and the Irish Sea

1) Each year, the Council shall decide on the TAC for the following year for each of the cod stocks in the Kattegat, the west of Scotland and the Irish Sea. The TAC shall be calculated by deducting the following quantities from the total removals of cod that are forecast by STECF as corresponding to the fishing mortality rates referred to in paragraphs 2 and 3: (a) a quantity of fish equivalent to the expected discards of cod from the stock concerned; (b) as appropriate a quantity corresponding to other sources of cod mortality caused by fishing to be fixed on the basis of a proposal from the Commission.

2) The TAC shall, based on the advice of STECF, satisfy all of the following conditions: (a) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be below the minimum spawning biomass level established in Article 6, the fishing mortality rate shall be reduced by 25 % in the year of application of the TAC as compared with the fishing mortality rate in the previous year; (b) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be below the precautionary spawning biomass level set out in Article 6 and above or equal to the minimum spawning biomass level established in Article 6, the fishing mortality rate shall be reduced by 15 % in the year of application of the TAC as compared with the fishing mortality rate in the previous year; and (c) if the size of the stock on 1 January of the year of application of the TAC is predicted by STECF to be above or equal to the precautionary spawning biomass level set out in Article 6, the fishing mortality rate shall be reduced by 10 % in the year of application of the TAC as compared with the fishing mortality rate in the previous year.

3) If the application of paragraph 2(b) and (c) would, based on the advice of STECF, result in a fishing mortality rate lower than the fishing mortality rate specified in Article 5(2), the Council shall set the TAC at a level resulting in a fishing mortality rate as specified in that Article.

4) When giving its advice in accordance with paragraphs 2 and 3, STECF shall assume that in the year prior to the year of application of the TAC the stock is fished with an adjustment in fishing mortality equal to the reduction in maximum allowable fishing effort that applies in that year.

5) Notwithstanding paragraph 2(a), (b) and (c) and paragraph 3, the Council shall not set the TAC at a level that is more than 20 % below or above the TAC established in the previous year.

Article 9

Procedure for setting TACs in poor data conditions

Where, due to lack of sufficiently accurate and representative information, STECF is not able to give advice allowing the Council to set the TACs in accordance with Articles 7 or 8, the Council shall decide as follows: (a) where STECF advises that the catches of cod should be reduced to the lowest possible level, the TACs shall be set according to a 25 % reduction compared to the TAC in the previous year; (b) in all other cases the TACs shall be set according to a 15 % reduction compared to the TAC in the previous year, unless STECF advises that this is not appropriate.

Article 10

Adaptation of measures

1) When the target fishing mortality rate in Article 5(2) has been reached or in the event that STECF advises that this target, or the minimum and precautionary spawning biomass levels in Article 6 or the levels of fishing mortality rates given in Article 7(2) are no longer appropriate in order to maintain a low risk of stock depletion and a maximum sustainable yield, the Council shall decide on new values for these levels.

2) In the event that STECF advises that any of the cod stocks is failing to recover properly, the Council shall take a decision which: (a) sets the TAC for the relevant stock at a level lower than that provided for in Articles 7, 8 and 9; (b) sets the maximum allowable fishing effort at a level lower than that provided for in Article 12; (c) establishes associated conditions as appropriate.

Annex 4: Recommendations

Recommendation	For follow up by:
1. That an annual meeting be held to consider advances in mixed fisheries forecasts methodology and application of mixed fisheries forecasts in new regions. That this meeting receives a separate name to WGMIXFISH.	ACOM
2. WGHMM to consult with WGMIXFISH on the process of defining metiers for aggregation of catch and effort data for northern hake with a view to including northern hake in future WGMIXFISH forecasts.	WGHMM
3. WGCSE to consult with WGMIXFISH on the possibility of combining mixed fisheries forecasts for the North Sea and west of Scotland with a view to a decision on whether to include the west of Scotland region in WGMIXFISH for 2013 by the WGCHAIRS meeting in January 2013.	WGCSE
4. WGHMM to consult with WGMIXFISH over process of defining metiers for aggregation of catch and effort data for stocks in Iberian waters. Also over identifying people to take responsibility for co-ordinating data collection for and running Fcube code on Iberian waters stocks at a MIXFISH methods meeting in 2013.	WGHMM
5. WGCRAN to consult with WGMIXFISH on inclusion of North Sea crangon in the data call specification used for WGMIXFISH.	WGCRAN

Annex 5: Proposed ToR for 2013 WGMIXFISH Meeting

WGMIXFISH – Working Group on Mixed Fisheries Advice for the North Sea

2012/#/ACOM## The **Working Group on Mixed Fisheries Advice for the North Sea** (WGMIXFISH), chaired by Steven Holmes, UK, will meet at ICES Headquarters, 20–24 May 2013.

a) Carry out mixed demersal fisheries projections for the North Sea taking into account the single species advice for cod, haddock, whiting, saithe, plaice, sole and *Nephrops norvegicus* that is produced by WGNSSK in 2013, and the management measures in place for 2014;

b) Update the mixed fisheries annex for the North Sea;

c) Produce a draft mixed-fisheries section for the ICES' advisory report 2013 that includes a dissemination of the fleet and fisheries data and forecasts ;

WGMIXFISH will report by 31 May 2013 for the attention of ACOM.

August' meeting

a) Compile and review available fleet and fisheries data for fisheries West of Scotland;

b) Where viable carry out mixed demersal fisheries projections for fisheries West of Scotland and fisheries of the North Sea jointly, taking into account the advice produced by WGNSSK 2013 and WGCSE 2013 and the management measures currently in place in each area;

c) Compile and review stock data from Iberian waters (ICES Div. VIIIc and IXa) for Fcube provisional application. Identify further steps needed to accomplish a mixed-fisheries approach in Iberian waters.

Supporting Information

Priority:	The work is essential for ICES to progress in the development of its capacity t provide advice on multi-species fisheries. Such advice is necessary to fulfil the r quirements stipulated in the MoUs between ICES and its client commissions.
Scientific justific tion and relation t action plan:	The issue of providing advice for mixed fisheries remains an important one fo ICES. However, in practice all recent advice in this area has resulted from the wor and analyses done by sub-groups of STECF rather than ICES. The Aframe projec which started on 1 April 2007 and finished on 31 march 2009 developed furth methodologies for mixed fisheries forecasts. The work under this project include the development and testing of the Fcube approach to modelling and forecasts. In 2008, SGMIXMAN produced an outline of a possible advisory format that in cluded mixed fisheries forecasts. Subsequently, WKMIXFISH was tasked with in vestigating the application of this to North Sea advice for 2010. AGMIXNS furth developed the approach when it met in November 2009 and produced a draft tem plate for mixed fisheries advice. WGMIXFISH has continued this work in 2010 an 2011 and in 2012 advice was incorporated into single species advice sheets for th first time.
Resource requir ments:	No specific resource requirements, beyond the need for members to prepare fo and participate in the meeting.
Participants:	Experts with qualifications regarding mixed fisheries aspects, fisheries manag ment and modelling based on limited and uncertain data.

Secretariat facilities	Meeting facilities, production of report.
Financial:	None
Linkages to advisory committee:	ACOM
Linkages to other committees or groups:	SCICOM through the WGMG. Strong link to STECF.
Linkages to other organizations:	This work serves as a mechanism in fulfilment of the MoU with EC and fisheries commissions. It is also linked with STECF work on mixed fisheries.