ICES WGMSFDEMO REPORT 2016

Report of the Working Group to Demonstrate a Celtic Seas wide approach to the application of fisheries related science to the implementation of the Marine Strategy Framework Directive (WGMSFDemo)

16–18 February 2016

Glasgow, Scotland

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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Contents

Executive Summary

The Working Group to Demonstrate a Celtic Seas wide approach to the application of fisheries related science to the implementation of the MSFD (WGMSFDemo) met for its third meeting on 16–18 April 2016, in Glasgow, Scotland, to continue work on its ToR.

The WG was updated on developments with regard to developing guidance on operational methods for the evaluation of the MSFD criterion D3.3 in response to a request from the EC.

The EFARO/ICES initiative on preparing an integrated ecosystem survey was discussed and the WG sees that such integration is critical given that many budgets for surveys are being reduced. The work done in WGISUR was supported in terms of process and concept and the importance to progress this in time for the next iteration of the MSFD was recognized.

Significant progress made on the "clean up" of the DATRAS data for use with the OSPAR MSFD indicators was welcomed by the WG. The current situation where there is a DATRAS derived OSPAR MSFD Database, supplemented with data from MSs, but that this supplementary data are not included in the DATRAS database is not satisfactory. For the Celtic Seas, France have provided corrected data and will correct DATRA in due course, there were not that many corrections from the UK but it is intended that these will be uploaded to DATRAS also, Ireland have already updated the corrected data to DATRAS. The submission to DATRAS of supplementary data should be a priority for all MS and the WG recommends that ICES and the Delegates support this wherever possible. The WG considers it essential that the process and data used to calculate indicators should be based on DATRAS and should be repeatable. As custodians of DATRAS, ICES should have a central role in building a permanent process for this.

WGMSFDemo agreed a common stratification scheme for international surveys conducted in the Celtic Seas last year. This year it is investigating a worked example for two different types of surveys in relation to the candidate foodweb indicator 'typical length' for survey suitability to deliver MSFD indicators. Qualitative interpretation of the differences between strata in relation to fishing pressure seems to suggest that the differences are ecologically based rather than altered by fishing effort. Further analysis in respect of the ecological significance of Typical Length (TyL) is required, particularly with regards to possible responses in TyL to changes in fishing pressure.

For the calculation of D3 indicators in the Celtic Seas, the WG agreed to run the code for the Celtic Seas stocks and based on the results to extract and examine in more detail particular stocks and/or particular sub regions such as the Irish Sea or Celtic Sea. Diagrams to present to results in a simple but meaningful manner was agreed.

WGMSFDemo will meet again by early 2017.

1   Introduction

The Working Group to Demonstrate a Celtic Seas wide approach to the application of fisheries related science to the implementation of the MSFD (WGMSFDemo) co-chaired by Jean-Paul Lecomte (France), Eugene Nixon (Ireland) and Carl O'Brien (UK), met for its 2016 meeting on 16–18 April 2016 in Glasgow, Scotland to progress it work under the ToR for WGMSFDemo, which are:

a) To run a Celtic Seas wide MSFD Assessment with a focus on maximizing the use of fisheries related science, infrastructure, data and knowledge acquired under the CFP, in particular but not exclusively D1, 3, 4, 6, 10 and 11.

Based on the experience gained in implementing the first MSFD cycle and a systematic analysis of the Directive (and associated Decisions) and MSFD reports generated by the three Member States to:

i)   Select the elements ICES can progress within the time frame.

ii)   Collate, examine and where appropriate utilize the outputs the relevant research projects on the implementation of the MSFD.

iii) Examine and provide recommendations on the coherence of the GES, Targets (including ranges for targets), Indicators and monitoring programmes established by the 3 Celtic Seas Member States with a focus on accommodating the different approaches into a coordinated Celtic Seas wide implementation process.

iv)   Prepare a concise report with recommendations.

The work of this group coincides with, and supports, the OSPAR Intermediate Assessment in 2017. WGMSFDemo will ensure that, on an ongoing basis, progress will be communicated and feedback considered from the appropriate administrations within each of the three Member States (France, Ireland and the UK), the EC, OSPAR, ICES Member Countries and other relevant organizations.

The WGMSFDemo will report (via SSGIEA) for the attention of SCICOM, ACOM and other relevant groups.

2   Conduct of the meeting

The group worked together as one group over the three days. Colin Moffat joined the WG on the first day, 16 February 2016, on behalf of OSPAR for the discussions relating to the OSPAR Intermediate Assessment (IA) 2017.

3   General Updates

3.1   ICES work on developing guidance on MSFD Criterion 3.3

Carl O' Brien presented information on the process ICES will use in developing guidance on operational methods for the evaluation of the MSFD criterion D3.3 in response to a request from the EC received during 2015. ICES previously advised in 2014 that Criterion 3.3 was the least well developed criterion for Descriptor 3 and that indicators under this criterion should capture three relevant properties:

- Size distribution of the species (state)
- Selectivity pattern of the fishery exploiting the species (pressure)
- Genetic effects of exploitation on the species (state)

ICES is requested by the EC to organize and steer a process for the evaluation, testing and validation of the proposed indicators for criterion 3.3 in support of the MSFD Common Implementation Strategy (CIS). This will develop and test methods using selected stocks (as advice), which will then be rolled out as a broader analysis across the MSFD regions and subregions (as a technical service).

The initial phase will require a dedicated data call (for length and maturity information for 10 stocks), with preparation of draft documents and dissemination of outcomes leading to an advice of the most appropriate indicators to be used in the assessment and evaluation of the GES for the criterion 3.3. This phase will require a workshop (4 days) with invited experts on the 12–14 April 2016 chaired by Carl O'Brien, leading to a formal advice in May 2016. The stocks being considered for Phase 1 are Northern hake, North Sea plaice, Baltic cod, North Sea sandeel, North Sea herring, a Mediterranean stock of red mullet and a Mediterranean stock of anchovy, Black Sea turbot, Bluefin tuna, spurdog in the Northeast Atlantic and roundnose grenadier.

The second phase will use the recommended indicators on 30–40 more stocks from across the region. This will not result in formal advice but show the potential value of the use of the indices. JRC need to be asked to assist with Mediterranean and Black Sea stocks and data calls. This phase will entail a follow-up data call for length and maturity information for a further 40 stocks, a workshop (4 days) with invited experts (10) in November 2016 which will produce an ICES report and briefing note for DGENV which will be agreed by ACOM.

Advice will be released at the end of May 2016, the technical service released November 2016 in time for the OSPAR IA.

In the discussions it was pointed out that MSY may be more precautionary than these criterion, i.e. if a stock is in MSY it is likely that all other criterion will be satisfied. This metric will be based on landings and it not clear what, if any, the discard ban will have on the indicator calculation. It is possible that D 3.3 will be seen as a surveillance indicator and therefore no target will be set.

The WGMSFDemo will keep itself informed of the progress on D3.3 and if it considered it necessary will calculate the indicator value for Celtic Sea as part of the work on D3.

3.2 EFARO/ICES initiative on Integrated Surveys–Proposed Pilots

Dave Reid provided some information on this initative. The background is that at the 2015 General Assembly of EFARO in Bergen in June 2015, ICES and EFARO decided to cooperate to streamline surveys and data collection. It was agreed to setup a joint EFARO–ICES meeting in ICES headquarters to develop two regional pilot studies for developing joint data collection plans using vessel surveys. This approach was approved by the ICES Bureau at its June 2015 meeting. At a meeting in ICES in January it was agreed that there would be three regional pilot studies, North Sea, Bay of Biscay and the Celtic Seas. It is intended that funds, €200k for each study and €50k for overall coordination, would be made available from the EC. What will be delivered will be a description of an integrated surveys for each of the three study areas. Funding to actually carry out the surveys may subsequently become available but no clear sources of funds has been identified.

Essentially, this process is to see how to integrate ecosystem, MSFD and fisheries survey requirements in a cost-effective and efficient manner. This is becoming even more critical as in many cases budgets for surveys are being reduced.

The WG discussed that there are three possible approaches to developing integrating surveys, see Figure 3.1 showing the continuum of ecosystem monitoring, prepared by WGISUR, where there are three entry points.
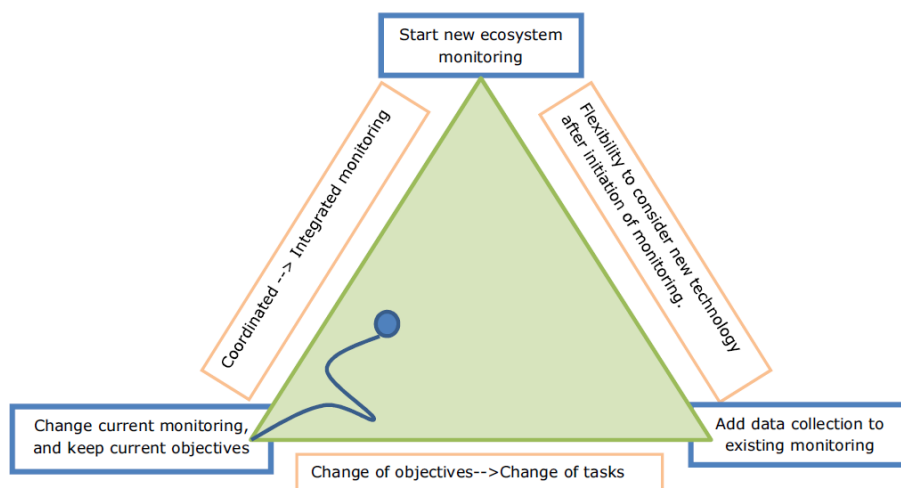
Figure 3.1: The continuum of ecosystem monitoring. Blue boxes: entry points. Example path shows the iterative development of the optimal solution through the considerations of the framework flexibility constraints and technical analytical considerations. (Figure reproduced from wgisur 2016)

It is likely that the Celtic Seas pilot will start from the top of the tringle, the North Sea from the bottom left and the Bay of Biscay bottom right. For the Celtic Sea one of the priorities will be to continue to deliver the time-series and requirements of the Celtic Seas IBTS, although this does not necessarily mean keeping the same sampling stations. This will require some sort of a power analysis of the IBTS monitoring programme. A prioritized list of data requirements for ecosystem understanding such as nutrients, contaminants, litter, birds, mammals will need to be drawn up and the required precision and accuracy of these various elements established. Steps 1 to 4 in the tool developed by WGISUR[1] were discussed and supported as a useful starting point for the pilot design. The work of the TIME project as reported in the MSFDemo 2015 report will be used to inform the pilot study for the Celtic Sea. It is anticipated that any such integrated surveys will be iterative and flexible. Changes, resulting from the transition from DCF to DCMap, will also need to be considered.

The issue of frequency of assessment was discussed and it was agreed that this needs to be considered in terms of monitoring frequency.

WGMSFDemo see this as an important initiative and will fully support and engage with it. As many of the people involved in the initiative are also involved in the WG it was agreed that the WGMSFDemo will:

- Support the development of the Celtic Sea pilot study.
- Initiate discussions with the relevant scientists and administrations within the UK, Fr and Ireland with a view to using the initiative as a focal point to start discussions on the need to move towards integration.
- To identify opportunities to have a trilateral discussion on improving coordination on surveys in the Celtic Seas and moving towards integrated surveys.

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[1] http://www.ices.dk/community/Documents/Expert%20Groups/WGISUR/flow%20diagram_ecosystem%20survey_updated.pdf

It was recognized that it is important to have made progress on integrated surveys in time for the next iteration of MSFD dealing with monitoring programmes, 2020.

3.3   Communications with OSPAR

The WG was updated on the meeting between the OSPAR representatives from UK and Ireland, the OSPAR Secretariat and WG Chairs that took place in London on 27th November 2015. Eugene Nixon outlined that it was a very useful meeting in which it was clarified that there was no overlap between the work of COBAM and of the WGMSFDemo and that the work of DEMO would support the work on the IA.

The issues discussed in the London meeting included the DATRAS clean-up process, the work on indicators that was proposed to be undertaken by WGMSFDemo and how this would relate to work of OSPAR, in particular the Intermediate Assessment 2017.

Colin Moffat informed the WG than Jenifer Godwin is new to the OSPAR Secretariat and will be dealing with many of these MSFD aspects.

3.4   OSPAR 2017 Intermediate Assessment

Colin Moffat outlined the current state of play with regard to the OSPAR Intermediate Assessment (IA). The process is currently running on time and will result in a web-based publication rather than a paper report. For each of the Common Indicators there will be a two page summary reporting sheet infographics. The OSPAR database ODIMS is nearing completion. The IA will be provided to the MSs in July 2017 and it is envisaged that they will use this to prepare their own assessments which will then go to public consultation within MSs. Currently there are 39 common indicators, but all of these do not apply to all the OSPAR regions.

4 Update on progress of the Working Group

4.1 DATRAS – preparation for MSFD assessments

Meadhbh Moriarty updated the WG on progress made on the "clean up" of the DATRAS data for use with the OSPAR MSFD indicators. Gaps and errors identified in this process were identified to the data providers in the Member States which resulted in one of three responses:

1) The data providers corrected the data or made the additional information available and uploaded to DATRAS

2) The data providers provided the corrected/additional information but did not upload to DATRAS yet but their intention is to make these corrections onto DATRAS

3) The data providers provided the corrected/additional data but are not going to upload it to DATRAS.

The number of cases in the final category were limited but nonetheless did exist.

Specifically for the Celtic Seas, France have provided corrected data and will correct DATRA in due course, there were not that many corrections from the UK but it is intended that these will be uploaded to DATRAS also. Ireland have already updated the corrected data to DATRAS. The current situation where there is a DATRAS derived OSPAR MSFD Database, supplemented with data from MSs, but that this supplementary data are not included in the DATRAS database is not satisfactory. Ideally, DATRAS should be updated by the MSs to ensure the information used for the MSFD is uploaded and that DATRAS is the definitive source of information for calculating the MSFD Indicators. The achievement of this should be a priority for all MS and the WG recommends that ICES and the Delegates support this wherever possible.

The script used to identify gaps and errors is well progressed and is being thoroughly documented by Marine Scotland. This documentation will also include a detailed description of the process used and decisions made to make the data MSFD ready. For example, the processes and/or assumption made to calculate sweep length, ground speed, wing spread which are relevant to calculating the swept-areas. Swept-area is needed to calculate some of the parameters necessary to calculate the indicators.

This is a work in progress and will be discussed further with a number of ICES Working Groups during April. An OSPAR Workshop will take place between 18–22 April in Aberdeen and will discuss the script, the processes and assumptions made in transforming the DATRAS data to the MSFD data and examine the calculated indicators generated by the MSFD Data.

There was also a discussion on the start time for the data to be used in calculating the indicators; should all the data from 1983 be used or would it be more appropriate to use the more reliable data in DATRAS collected since the early 2000's. This has implications on what could be used as a baseline for many of the indicators.

It was pointed out that in many cases the indicator is based on a ratios and in some of these situations the influence of start time, swept-area etc. will be less important. This information is needed to undertake a sensitivity analysis of the script and the indicator calculations.

It is the intention that the script and associated documentation will be ready in early April and it was agreed that the documentation will be provided to the WG. It was

pointed out that it would be important to identify clearly in the MSFD Database where data are an estimation produced by the script or is actual data from DATRAS and also where choices were made and if there were alternatives available to the actual choice made.

The intention in OSPAR is to generate one single dataset that will be used for the generation of MSFD indicators for the IA. For the reasons outlined above this will be different data that that contained in DATRAS. Where it will be hosted will be decided by OSPAR. The script and associated documentation will be made generally available, possibly through GitHub. It was pointed out that care is needed in defining the rules and assumptions to be used in the script as there is the potential to have make significant changes to the MSFD dataset compared to DATRAS.

The WG recognized and appreciated the enormous amount of work that has gone into the cleaning of the DATRAS database to make it MSFD ready. It has resulted in some data providers uploaded corrections and new data to DATRAS. There was also a recognition that the work is ongoing and that many of the issues that arose in the WG discussion will need to be addressed at the OSPAR workshop in April in Aberdeen. It is important that the relevant experts with an understanding of the data and the ecosystems are involved in this process.

While the clean-up of the DATRAS data were initiated at WGDemo in 2015, the subsequent involvement of the WGDemo was not at the level originally intended. While there were some discussions in the WG regarding the script and the assumptions and rules it makes, the WG did not review or quality assure the script.

The WG considers it essential that the process and data used to calculate indicators should be based on DATRAS and should be repeatable. As custodians of DATRAS, ICES should have a central role in building a permanent process for this.

4.2   Indicators and Targets Subgroup

Progress in the area of targets and indicators since that last WGDemo is limited as it was considered dependent on the delivery of the MSFD Ready DATRAS Database. Simon Greenstreet informed the WG that Commission Decision on Descriptors 1, 3, 4 and 6 are currently being review, the criterion 1.7 on ecosystem structure is likely to be removed as it was generally not reported by Member States in their Initial Assessments and, where it was, MS reported on Community level indicators. A new 1.4 criterion along the lines of relative proportion of mobile species components is currently being considered. All candidate indicators could be considered by ICES when preparing IEAs for the OSPAR area. It was pointed out that the 4 Regional IEA Groups of ICES use four different methodologies for example ODEMM and Ocean Health. The work of WGBioDiversity and the DEVOTES project were also identified has having made significant progress on integrated ecosystem assessments.

4.3 Monitoring Subgroup

4.3.1 EFARO/ICES initiative on Integrated Surveys

As discussed above, the WG sees the EFARO/ICES initiative on Integrated Surveys as a very important opportunity. It is anticipated that funds will be made available to design the pilot studies in July 2016.

It is important that coordination work is done nationally to ensure the appropriate people are informed of, and involved in, the design of the pilot studies. This included the environmental and fisheries ministries. The OSPAR system may be a useful way to inform the environmental ministries of the EFARO/ICES initiative and of the opportunities and benefits from integrated surveys. In addition, funds for surveys are reducing and the current programme of surveys cannot be maintained. It was pointed out that there is currently three surveys where the UK and Ireland are working collaboratively on, for example Ireland is about to include a beam trawl survey in the Celtic Seas and this is being coordinated with the UK.

Difficulties in getting cooperation between survey organizers were identified and it appears that the IBTS does not seem to be able make the changes without going to the stock assessment WG groups. The members of the WG will assist in making the right connections to facilitate progress on this issue.

4.3.2 Examination of survey suitability to deliver MSFD indicators – a worked example foodweb indicator 'typical length' practical

Consistent with the ToR, the monitoring subgroup to WGMSFDemo is engaged in examining and developing recommendations on how to improve the coherence of monitoring programmes in the Celtic Seas. Having agreed a common stratification scheme for international surveys conducted in the Celtic Seas at last year's meeting, there is a need to independently investigate the efficiency of such a monitoring program in relation to reporting requirements under the MSFD. The planned examination of proposed and accepted common indicators to be evaluated within the Celtic Sea under WGMSFDemo provides an opportunity to assess the efficiency/power of the design to detect changes in these indicators.

In order not to duplicate effort or to derive alternate conclusions WGMSFDemo looked at a candidate indicator for foodwebs (typical length) in relation to a surveys not currently included in the MSFD data product being developed with the help of this working group. The main aim here is to evaluate the utility of the stratification, leaving it to the competent authorities to examine the utility of the metric itself and to interpret the results.

Annex 1 describes the detail of a worked example for two different types of surveys in relation to the candidate foodweb indicator 'typical length' for survey suitability to deliver MSFD indicators. It concludes that the using stratified random or systematic transect designs in conjunction with ecologically meaning full strata developed as part of the TIME project provides significant improvements in temporal detection of change over a regional approach for an independently developed foodweb indicator.

The data suggests that spatial differences are currently much greater than interannual differences with a slight increase in TyL in the western channel over the period

An interactive term between year and stratum is significant suggesting that there are differences in the trends for different strata. However, stratum specific trends are less important than the more general temporal trend.

Qualitative interpretation of the differences between strata in relation to fishing pressure seems to suggest that the differences are ecologically based rather than altered by fishing effort. Further analysis in respect of the ecological significance of TyL is required, particularly with regards to possible responses in TyL to changes in fishing pressure.

4.4   Fish and Shellfish D3.

Cormack Nolan provided information on the Irish Stock Book[2] and suggested that this could be the approach used to assess fish and shellfish (D3) for the Celtic Seas. The Stock Book contains information on all stocks for which Ireland have a quota allocation. It was agreed that the approach proposed was appropriate and will work for both data rich and data poor stocks. It was pointed out that ICES is currently working of Fisheries Overviews and that the data and script was prepared to calculate a number of the indicators. The WG will ensure there is consistence between the work of the WGMSF-Demo and the Fisheries Overviews.

The presentation of the data in the Irish Stock Book and the fisheries overviews was discussed and the three diagrams below were considered as a useful method to present the results.

It was agreed to run the code for the Celtic Seas stocks and based on the results to extract and examine in more detail particular stocks and/or particular sub regions such as the Irish Sea or Celtic Sea.

In terms of Descriptor 3.3 the advice from ICES discussed above will inform the WG on the best approach to take for D3.3 and, where possible, the indicators for D3.3 will be calculated for the Celtic Seas.

2 Available at http://oar.marine.ie/handle/10793/1121
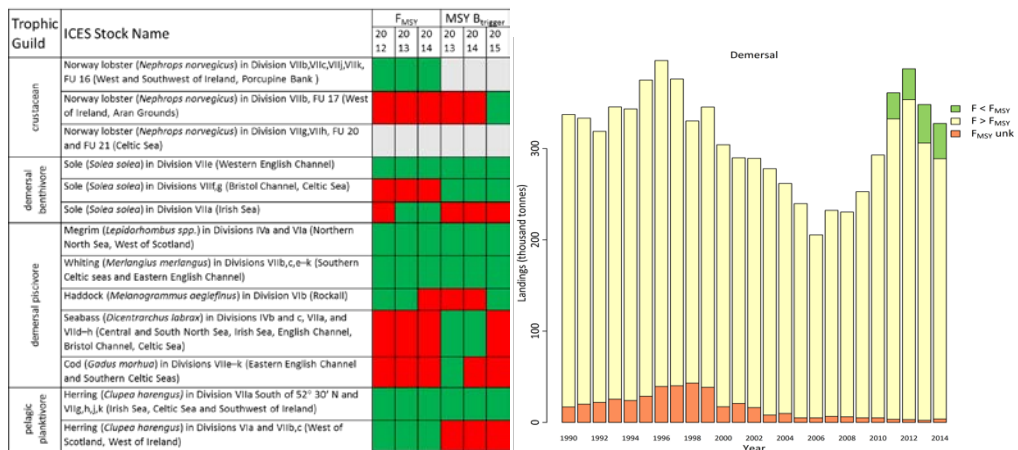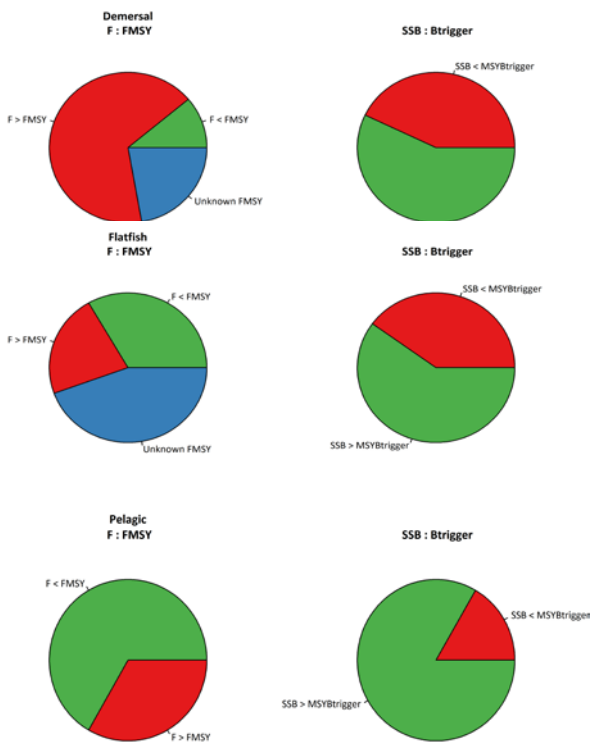
4.5 Date of Next Meeting

WGMSFDemo will await feedback from COBAM, the EFARO/ICES integrated ecosystem survey initiative and the D3 assessments processes before deciding on the date of a next meeting. This will be reviewed in October 2016. In any event, the WG will meet again in spring 2017.

5   List of participants

Name	Address	Phone	E-mail
Simon P.R. Greenstreet	Marine Laboratory 375 Victoria Road Aberdeen AB11 9DB UK	+44 1224 295417	Simon.Greenstreet@scotland.gsi.gov.uk
Sven Kupschus	Cefas Pakefield Road NR33 0HT Lowestoft Suffolk UK	+44 1502 56 2244	Sven.Kupschus@cefas.co.uk
Colin Moffat	Marine Laboratory 375 Victoria Road Aberdeen AB11 9DB UK	+44 1224 295387	c.moffat@marlab.ac.uk
Jean-Paul Lecomte Chair	Ifremer Rue de l'île d'Yeu PO Box 21105 44 311 Nantes Cédex 3 France	+33 (0)2 40 37 42 66	jean.paul.lecomte@ifremer.fr
Meadhbh Moriarty	Marine Laboratory 375 Victoria Road Aberdeen AB11 9DB UK		mmoriar@tcd.ie
Eugene Nixon Chair	Marine Institute, Wilton Place House, Wilton Place, Dublin 3	00 353 1 7753938	eugene.nixon@marine.ie
Carl O'Brien Chair	Cefas Pakefield Road NR33 0HT Lowestoft Suffolk UK	+44 1502 524256 / +44 7786800193	carl.obrien@cefas.co.uk
David Reid	Marine Institute Rinville Oranmore Co. Galway Ireland	+353 91 387431	david.reid@marine.ie
Verena Trenkel by teleconference	Ifremer Rue de l'île d'Yeu PO Box 21105 44 311 Nantes Cédex 3 France	+33 (0)2 40 37 41 57	verena.trenkel@ifremer.fr

Annex 1: WD1 for WGMSFDemo, February 2016

Title: Examination of survey suitability to deliver MSFD indicators, a practical example for two different types of surveys in relation to the candidate foodweb indicator 'typical length'.

Authors: Sven Kupschus, Chris Lynam and Jeroen van der Kooij

Affiliation: Cefas, Centre for environment fisheries and aquaculture sciences, Pakefield Road, Lowestoft, UK

E-mail: sven.kupschus@cefas.co.uk

Introduction:

The aim of the monitoring subgroup to WGMSFDemo is to oversee a more coherent and integrated approach to monitoring in the Celtic Sea. Having agreed a common stratification scheme for international surveys conducted in the Celtic Seas there is a need to independently investigate the efficiency of such a monitoring program in relation to reporting requirements under the MSFD. The planned examination of proposed and accepted common indicators to be evaluated within the Celtic Sea under WGMSF-Demo provides an opportunity to assess the efficiency / power of the design to detect changes in these indicators.

In order not to duplicate effort or to derive alternate conclusions WGMSFDemo looked at a candidate indicator for foodwebs (typical length) in relation to a surveys not currently included in the MSFD data product being developed with the help of this working group. The main aim here is to evaluate the utility of the stratification, leaving it to the competent authorities to examine the utility of the metric itself and to interpret the results.

Surveys

The Q1SWecos survey is a DCF funded beam trawl survey annually conducted in the Western English Channel since 2006 having been extended to wider areas of the Celtic Sea in 2014. Survey design is stratified random in accordance with the agreed strata for the WC. CS data are presented only in the context of a more complete spatial picture while the focus of the WC portion is more on the temporal aspect of the variability of the indicator. Data checks on tow duration, haul location, catch weights and appropriate length weight conversions were performed and correction made to the database.

The Defra funded POSIDON survey is a five year (2012–2016) project conducting a fisheries acoustic survey in the UK waters of the WC and CS. The survey design is transect-based, integrating data from pelagic acoustic backscatter and trawl hauls to derive species and length compositions of pelagic fish species along 1nm distance units along the transect. Because the design is transect-based and not strata based the derived species and length frequency with in an acoustic unit were post stratified to the stratification design.

The geometric mean length weighted by the biomass at length (typical length, TyL, WGECO 2014) was calculated by stratum for demersal and pelagic (anchovy, sardine, sprat, herring, horse mackerel and boarfish) species for the two surveys respectively.

In addition, for the Q1SWecos the metric was also calculated for each haul to develop a better understanding of the spatial variability of typical length. These estimates were

also used to examine the deviance contributions of year and stratum factors in the analyses to evaluate the ability of the design to detect changes in typical length over years.

Results and discussion:

Table 1 provides the mean typical length values by stratum and year. The Q1SWecos survey indicates that fish are generally smaller in the UK inshore strata (2–5) intermediate in the predominantly further offshore strata (6–9, 13 and CS) and largest in the French coastal strata (10–12). The pelagic picture indicates that the purely inshore bay strata (3, 5) contain the smallest communities, while the more exposed bay associated strata (1, 2, 4, and 6) typically have the largest TyL. Offshore strata (7–9, 13) are intermediate. In the CS offshore strata (F, D) exhibit very small TyL values, while the Bristol Channel associated strata are similar to the exclusive bay strata in the WC. A general coherence between TyL and strata is then apparent in both the pelagic and demersal components. Examination at a higher resolution is necessary to see if the strata minimize the variance components in order to maximize the efficiency. From figure 1 it is possible to visually conclude that differences between strata a generally much higher than differences between years within a stratum. Moreover, despite the random stratified sampling design TyL is highly consistent within strata. Confirming that the pattern described in the mean values by stratum is generally reflected in all the samples within a stratum. The visual conclusion is confirmed for the western channel (stratum 1–13) by a two factor GLM. Around 30% of the total deviance is explained by the simple orthogonal model, XX% by the stratum effect. Much smaller though still significant is the year effect, though the pairwise comparisons between years are largely inconclusive. Adding an interactive term to the model to examine differences in temporal trends within strata is significant, but explains an even smaller portion of the deviance than the year effect. Given the lack of separation between years, and the overdispersed nature of the residuals, the model may be over interpreting the importance of the significance of the interaction.

Including the CS strata in the analysis resulted in significant correlation between the year and stratum effects, as the CS strata generally appear to have larger TyL values, but are only sampled in 2014-15. The co-linearity precludes a meaningful interpretation of the results though the magnitude of the stratum effect suggests relative contributions of year and stratum to the deviance are similar in both regions (Figure A2).

It was not possible to conduct a similar analysis of the POSIDON data. Only one year of data were available for analysis at the time of the working group. A spatial analysis using only stratum as a factor was highly significant, but the lack of independence of the transect data caused by the use of common haul data to describe the length distributions is likely to substantially underestimate the true variability. Further examination into the autocorrelation will be necessary to apply this approach to the acoustic data.

Survey		Q1SWecos												POSEIDON
		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015		mean demersal	pelagic 2015
Western Channel	WC_1	41.69267	46.39687	37.55748	28.89842	31.77637	37.09348	44.19925	35.55363	32.05193	38.3041		37.4	16.08289
	WC_2	31.06036	34.0214	29.75785	29.43684	30.69431	31.70582	38.37058	31.52545	28.98771	33.67971		31.9	16.42287
	WC_3	33.3771	28.82129	29.69405	27.04058	34.37462	30.21201	30.55788	32.09789	32.58425	35.30214		31.4	14.22188
	WC_4	31.41554	30.36172	29.82265	26.30088	29.0833	31.25426	30.10992	29.3765	29.18731	30.29233		29.7	16.45904
	WC_5	33.18587	30.12458	29.98653	32.3515	31.26108	31.4846	33.15639	30.79015	31.50544	32.66269		31.7	14.16572
	WC_6	34.47663	29.95716	40.58376	49.83598	37.65651	43.53901	32.83944	36.1088	45.91507	48.23611		39.9	16.21645
	WC_7	36.45055	33.95938	34.89606	34.63313	32.18611	33.31662	34.08927	33.97495	28.71887	31.49894		33.4	15.07677
	WC_8	35.25281	38.79735	49.16663	39.50526	41.29866	37.67215	38.38463	30.55273	40.67725	43.19477		39.5	15.71355
	WC_9	32.58407	38.91759	32.93906	34.27096	38.69273	45.08904	40.5928	46.16215	56.31409	42.60274		40.8	15.70081
	WC_10	35.22167	34.17308	47.66029	31.01385	35.47945	31.84287	43.02605	36.91313	52.28268	36.2852		38.4	NA
	WC_11	42.99592	45.84752	47.20098	43.11854	43.21922	47.98982	41.36113	49.06802	45.5838	46.44725		45.3	NA
	WC_12	34.55557	32.90526	53.81497	44.77794	47.00545	44.94566	48.8998	38.43218	44.1674	37.23178		42.7	NA
	WC_13	34.31487	34.56839	43.55107	31.61763	34.25874	39.58158	39.04093	40.58681	38.49574	37.05019		37.3	15.08794
Celtic Sea	CS_all	NA	NA	NA	NA	NA	NA	NA	NA	36.87991	43.13815		40.0	
	CS_B													14.38644
	CS_C													14.4889
	CS_D													8.555853
	CS_E													NA
	CS_F													8.893102

Table A1: Showing the mean TyL (weighted by biomass of samples) for the time-series of WC strata and aggregated for the CS from the Q1SWEcos survey and acoustically derived TyL equivalents for the POSEIDON survey in 2012

A GLM analysis using year and stratum as factors (for the western channel only) and a gamma error distribution explained around 30% of the deviance. Both effects were highly statistically significant and mean square errors for stratum were around four times as large as those for year. Including an interactive term between strata and year was less significant and explained a further 15% of the deviance (total = 50%), but at the cost of 108 degrees of freedom. The resultant model residuals indicated an over dispersion compared to the assumed distribution so that the model is likely to overestimate the significance of some effects, particularly where there are few data replicates (Figure A3).

This work does not explicitly examine typical length as an indicator of foodwebs, but it investigates the spatial variability of the metric consistent with expected ecological units (strata) suggests that at least is reflects some ecological processes. The smaller TyL values inshore and in the Bristol Channel are consistent with the use of these areas as nursery habitats for commercial species and the home range of a greater number of smaller species. These areas are also some of those most heavily exploited by the beam trawl fleet in the western channel. However, a closer qualitative examination reveals that not all areas with lower TyL values are subject to high fishing pressure (e.g. Stratum 3) and equally not all areas subject to high fishing pressure such as the Celtic Deep (Stratum D) have low values of TyL. It seems likely then that the majority of the variance in TyL is associated with ecosystem processes rather than fishing pressure, while changes within a stratum may be more associated with variations in pressure.

Conclusions:

The using stratified random or systematic transect designs in conjunction with ecologically meaning full strata developed as part of the TIME project provides significant improvements in temporal detection of change over a regional approach for an independently developed foodweb indicator.

The data suggests that spatial differences are currently much greater than interannual differences with a slight increase in TyL in the western channel over the period.

An interactive term between year and stratum is significant suggesting that there are differences in the trends for different strata. However, stratum specific trends are less important than the more general temporal trend.

Qualitative interpretation of the differences between strata in relation to fishing pressure seems to suggest that the differences are ecologically based rather than altered by fishing effort. Further analysis in respect of the ecological significance of TyL is required, particularly with regards to possible responses in TyL to changes in fishing pressure.
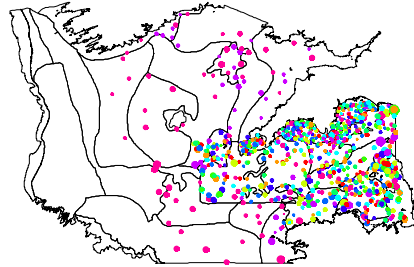

Figure A1: Variation of typical length by haul of the Q1SWEcos survey. Bubble radius is proportional to TYL with colours indicating different sampling years (2006–2015).
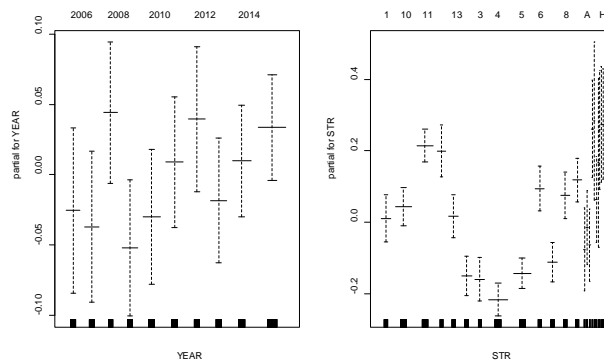

Figure A2: Plots showing stratum and year effects on typical length for the orthogonal model for all data. The large standard errors in the Celtic Sea strata (Letters) are the results of the unbalanced design with the recent survey expansion into the Celtic Sea as indicated by the rug plots. This collinearity is likely to affect the stratum
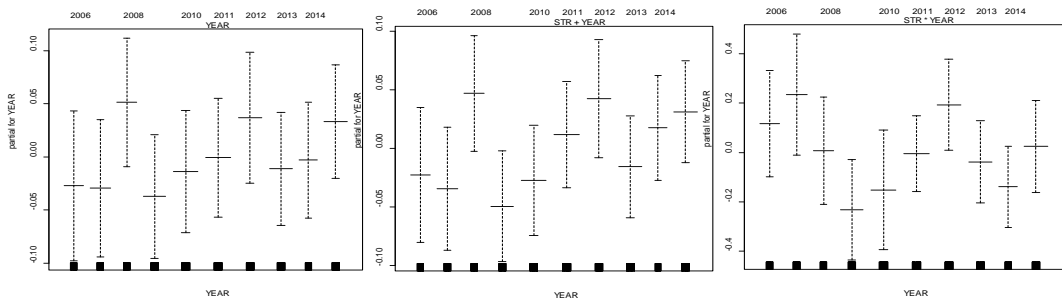

Figure A3: Plot of year effects with standard errors for different models of TyL. The year effect only model (right) indicates larger standard errors for similar mean estimates of the year effect than the stratum and year effects model (centre).