Interim Report of the Working Group on Ecosystem Assessment of Western European Shelf Seas

24–28 April 2017

Lisbon, Portugal

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Contents

Executive summary

The ICES Working Group on Ecosystem Assessment of Western European Shelf Seas (WGEAWESS) meeting was held in Lisbon (Portugal), on 24–28 April 2017. The meeting was attended by 8 participants from 4 countries and chaired by Steven Beggs, Northern Ireland (UK). This was the first year of the new 3-year Terms of Reference (ToR) for WGEAWESS. The main activities for the group at the 2017 meeting were to discuss progress and further development of work towards the ToRs a) Continue metadata compilation for all ecosystem components available for IEA development, b) Continue evaluation of data and trends for a regional Integrated Ecosystem Assessment (IEA). Identify ecosystem trends relevant to stock assessment and management.

As an outcome of specific objectives to integrate the activities of WGEAWESS with sister IEA groups, the meeting was held back to back with both the ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea (WGIAB) and the Working Group on Comparative Analyses between European Atlantic and Mediterranean marine ecosystems to move towards an Ecosystem-based Approach to Fisheries (WGCOMEDA). This back to back meeting had many advantages and provided much opportunity for group integration and future collaboration.

During the preceding year much of the work by the members of the group was focused on the completion of ToR e) development and submission of an INTERREG Atlantic Area proposal. The group were successful in reaching stage 2 of the process with a proposal that aimed to make progress towards the implementation of an IEA in the Western European Shelf Seas.

The group continued to work towards ToR a) with a review of current metadata records for subregions represented by the current membership and experience of the meeting participants. The group discussed the continuing shortage of membership from key subregions within the remit of WGEAWESS and how participation from those areas might be encouraged.

Work towards ToR b) involved the generation of a wish list of key biotic and abiotic variables required for an initial ITA of each subregion. Currently the group have completed ITAs for the Irish Sea and Gulf of Cadiz. Further work on the Celtic Seas and Portuguese waters ITAs is planned before the next meeting. Recommendations from WKIDEA were discussed. Group integration with WGCOMEDA led to plans for a joint analysis of IEAs across a number of ecoregions covered by the groups.

The group began to collate and review documented links between stock trends (recruitment, SSB, mortality) and possible biotic and abiotic drivers (SST, windstress, productivity). Work on report cards for individual stocks and areas that could be used by stock assessment groups to inform ecosystem considerations were identified as a key output for this ToR. These report cards would provide background knowledge of ecosystem trends and provide sources for data and illustrated time-series of key trends. It was agreed the group would present a report card to the next meeting of the Working Group on Southern Horse Mackerel, Anchovy and Sardine (WGHANSA).

Progress was made towards ToR d) including the compilation of a list of existing Ecopath models for the area. The group discussed the use of a workshop to explore the practicalities of using the outputs from the many existing Ecopath models across the area, and exploring their utility for IEAs (including ITAs) in the western shelf region.

The location of the next meeting will be Nantes, France, on 5–9 March 2018.

1   Administrative details

Working Group name	
Working Group on Ecosystem Assessment of Western European Shelf Seas (WGEAWESS)	
Year of Appointment within the current cycle	
2016	
Reporting year within the current cycle (1, 2 or 3)	
1	
Chair(s)	
Eider Andonegi, Spain (Basque Country)	
Steven Beggs, UK (Northern Ireland)	
Meeting venue	
Lisbon, Portugal	
Meeting dates	
24–28 April 2017	

2   Terms of Reference a) – e)

ToR Descriptors TOR	Description	Background	Science plan topics addressed	Duration	Expected Deliverables
a	Continue metadata compilation for all eco-system components available for IEA development	Process initiated and completed for specific subregions in previous ToR. Other subregions in draft.	4.3	3 years, progress updated annually	Database linked to ICES for Regional Sea Programmes
b	Continue evaluation of data and trends for a regional Integrated Ecosystem Assessment. Identify ecosystem trends relevant to stock assessment and management	Linked to WKECOVER, WKRISCO, WKDECOVER, and the commitment to provide advice in the context of EBAFM	4.2, 4.1	3 years	Report IEAs and provide advice to fisheries groups as appropriate
c	Review and update the regional Ecosystem overviews	Linked to ACOM-SCICOM advice	4.2	3 years	Ecosystem overviews
d	Develop and apply eco-system models to fill identified gaps in empirical data for use in IEAs	This would be linked to activities conducted under previous ToRs	4.1	3 years	Regional modelling products
e	Development of Interreg Atlantic Area proposal	Funding is being sought to increase the resources and participation of the group		1 year	Successful fund capture

3   Summary of Work plan

Year 1	The main task will be the development of a proposal for Interreg funding. the group will also be involved with providing advice to WKIrish. We will continue to identify and catalogue datasets available that would be potentially valuable in an IEA and EBAFM. Ongoing analysis of important trends in ecosystem indicators. Improve communication with relevant advice groups (fisheries stock assessment).
Year 2	Continue with Year 1 activities while liaising with relevant ICES WG membership. Development of ecosystem models to fill identified gaps in empirical data for use in IEAs. Scope of IEA and model development will be dependent on successful Interreg funding.
Year 3	Continue with Year 2 activities while liaising with relevant ICES WG membership. Development of ecosystem models to fill identified gaps in empirical data for use in IEAs. Scope of IEA and model development will be dependent on successful Interreg funding.

4   List of Outcomes and Achievements of the WG in this delivery period

Poster and Oral presentations ASC 2016:

- Integrated Ecosystem Assessment in support of ecosystem based fisheries management in the Irish sea – case study with cod (*Gadus morhua*) S.E. Beggs and M.G. Lundy;
- Clupeids in the Irish Sea: Evidence of food mediated density-dependent control of an abundant forage species. S.E. Beggs, P J Schön and I. McCausland;
- Andonegi, E. and Prellezo, R. Making the Ecosystem Based Fisheries Management operational for management support in the Bay of Biscay: analysing the effects of the implementation of the Landing Obligation at an ecosystem level.

Publications by group members:

Llope, M. (2016). The ecosystem approach in the Gulf of Cadiz. A perspective from the southernmost European Atlantic regional sea. ICES Journal of Marine Science 74.1 (2016): 382-390.

Ruiz, J., Rincón, M. M., Castilla, D., Ramos, F., & del Hoyo, J. J. G. (2017). Biological and economic vulnerabilities of fixed TACs in small pelagics: An analysis of the European anchovy (*Engraulis encrasicolus*) in the Gulf of Cadiz. Marine Policy, 78, 171–180.

Rincón, M. M., Mumford, J. D., Levontin, P., Leach, A. W., & Ruiz, J. (2016). The economic value of environmental data: a notional insurance scheme for the European anchovy. ICES Journal of Marine Science 73.4 (2016): 1033-1041.

Rincón, M. M., Catalán, I. A., Mäntyniemi, S., Macíaas, D. & Ruiz, J. (2017). Embedding anchovy survival in the environment with a dual time resolution: A Bayesian state-space size-structured population dynamics model. Fish. Bull., submitted.

Project proposals:

- Atlantic Area Interreg AtlantEA;
- Representation at WKIRISH Belfast.

5   Progress report on ToRs and workplan

5.1   ToR a) Continue metadata compilation for all ecosystem components available for IEA development

The group began the meeting with a review of current metadata records currently identified for the geographical region covered by WGEAWESS (Figure 5.1). Particular focus was on the continued identification of time-series for the development of integrated trend analysis (ITAs) in all subregions. To this end a wish list of key biotic and abiotic variables required for an initial ITA of each subregion was generated based on the criteria for variable selection listed in Diekmann *et al*. (2012). In particular, the data required should meet the following criteria:

1. Annual estimates of values need to be available;
2. Key components and parameters of the ecosystem need to be considered;
3. Missing values and data gaps must be minimized;
4. Ecosystem components as well as forcing variables need to be balanced in terms;
5. Cross-correlations between variables representing the same functional group or hydrographic/climatological processes should be low to convincingly describe ecosystem dynamics over time, a length of at least 20 years should be achieved (e.g. 1987 onwards).

Currently the group have constructed ITAs for the Irish Sea and Gulf of Cadiz sub regions, and these were updated. Further work on the collation of time-series and development of a Celtic Sea and Atlantic Iberian waters ITA will be continued. The group also made good progress in identifying and collating time-series of key components and parameters of the remaining subregions. It is planned to have preliminary and comparable ITAs completed for all subregions by the next meeting of WGEAWESS.

For all areas, including those not currently represented by WGEAWESS membership, the use of modelled products as a source of key environmental variables (SST, salinity, Chl *a*) was discussed. While the use of modelled products in lieu of real observations is not encouraged, the increasing use of these products in peer reviewed research and ecosystem management products suggest that outputs are trusted to represent true trends in hydrography and biotic variables such as SST and chlorophyll *a*. These being available for the whole geographical region provide a useful source of key physical and biological data where currently the group have not been able to identify other sources or expert opinion. A number of products were identified and their availability for the various subregions assessed. A key attribute of modelled products was there spatial and temporal resolution. The outputs from the identified modelled products were compared with existing point and modelled sources in the Irish Sea. The comparison here suggested that the general trends in SST were generally comparable. Another useful aspect of these modelled products is spatial resolution providing an opportunity for future spatial analysis methods to be employed (see Dorota Szalaj presentation, Annex 4).

Due to the importance of primary and secondary production for higher trophic levels, specifically fisheries, the inclusion of products to represent these was discussed and the use of CPR (continuous plankton recorder) data investigated. CPR data have been used in the Irish Sea ITA to provide indices of primary production and key copepod species. Its availability and resolution for other subregions is being explored.

Finally, time-series of higher trophic levels, mainly elasmobranch species and key pressures fishing activity indictors were identified for many of the subregions from ICES stock assessment group outputs and annual advice sheets.

Recommendations from WKIDEA were discussed and the group planned to perform a sensitivity analysis of current ITA methods used by WGEAWESS and sister groups. Group integration with WGCOMEDA and WGIAB led to plan for a joint analysis of ITAs across a number of Atlantic and Mediterranean ecoregions covered by the groups. The group discussed the continuing shortage of membership from key subregions within the remit of WGEAWESS and how participation from those areas might be encouraged.
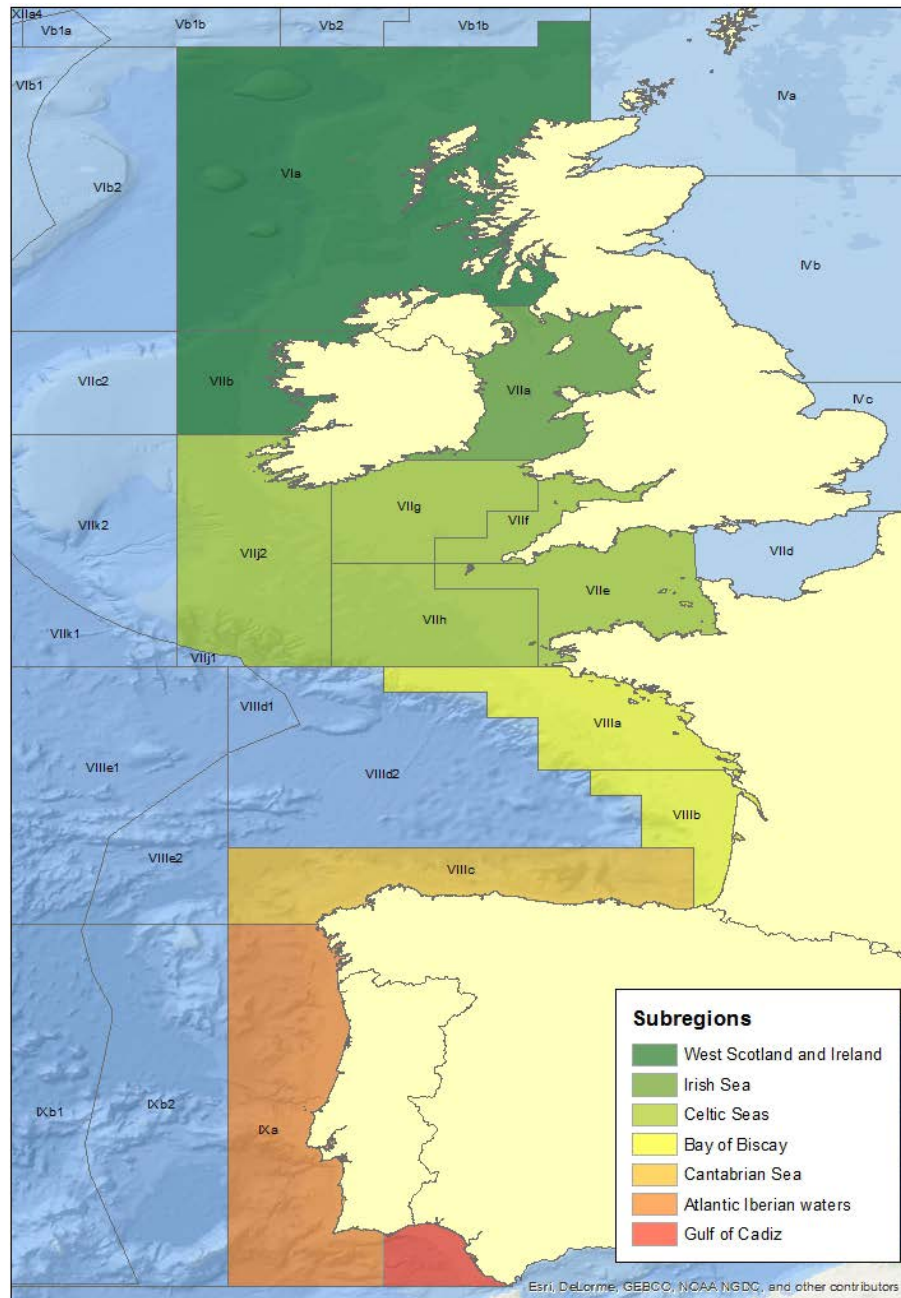

Figure 5.1. WGEAWESS geographical coverage and subregions.

5.2 ToR b) Continue evaluation of data and trends for a regional Integrated Ecosystem Assessment. Identify ecosystem trends relevant to stock assessment and management

The group affirmed its commitment to providing advice and assistance to stock assessment groups through development of ToR b. Initial steps were to compile a list of stocks included within the remit of the ICES advisory process. The number of stocks managed or reported on within the geographical range of the group is extensive. Work building on previous group activity has begun to identify the key fisheries in each subregion and time-series available to describe changes in abundance and key stock parameters (recruitment, weight at age, maturity). Stock assessment group reports and ICES advice sheets being the main sources of this information.

In relation to identifying ecosystem trends relevant to stock assessment and management the group began to collate and review documented links between stock trends (recruitment, SSB, mortality) and possible biotic and abiotic drivers (SST, windstress, productivity). It was agreed the group would be represented at the next meeting of the WGHANSA stock assessment group. It is hoped that a report card format can be devised and provided to other assessment groups in all subregions (Annex 3). Work on report cards for individual stocks and areas that could be used by stock assessment groups to inform ecosystem considerations were identified as a key output from this ToR. These report cards would provide background knowledge of ecosystem trends and provide sources for data and illustrated time-series of key trends.

The group continues to work closely with the sequence of workshops under WKIRISH. Work has been presented in relation to the biotic and abiotic trends in the Irish Sea and key drivers of local commercial fish dynamics, specifically recruitment. Potential indicators of the recruitment environment for Irish Sea cod and haddock where identified from literature and research conducted during the past year.

The group plan to further explore the usefulness of inclusion of these documented environmental drivers in stock recruitment relationships for forecasting etc. The key development here will be at WKIrish4 programmed on 23–27 October 2017 in Dunloughaire, Ireland. WKIrish4 is intended to specify and parameterize an EwE model and an ensemble modelling approach (Thorpe *et al.*, 2016) for the Irish Sea. The aim is to work with stakeholders to build a foodweb picture based on their understandings of the ecosystem (Beaudreau and Levin, 2014), and explore the use of this information in the two modelling systems.

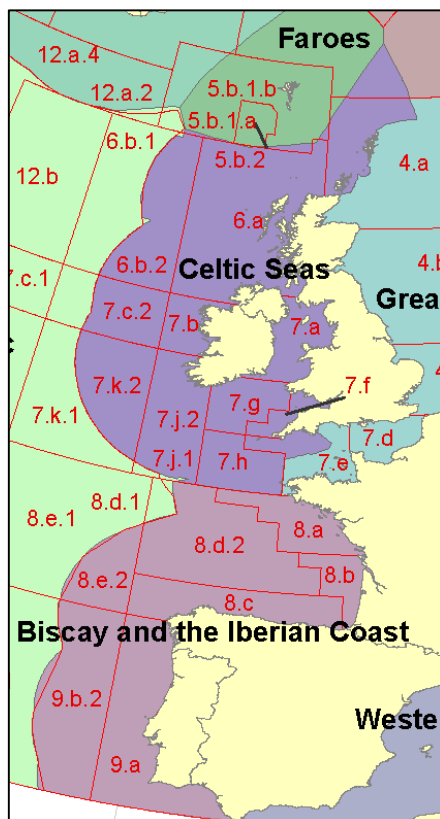## 5.3   ToR c) Review and update the regional Ecosystem overviews

Figure 5.2. ICES Ecoregions Celtic Seas and Biscay and the Iberian Coast covered by the group

The group did not revisit the regional Ecosystem overviews: the Biscay and the Iberian Coast and Celtic Seas (Figure 5.2).

5.4   ToR d) Develop and apply ecosystem models to fill identified gaps in empirical data for use in IEAs

The use of ecosystem models to provide useful products for ecosystem based management is well advanced. While many models of varying complexity and sophistication exist from single species models to end-to end ecosystem models the experience of the group lies with the commonly used Ecopath with Ecosim (EwE) model. The accessibility, relative ease of use and therefore availability of Ecopath models for the geographical range of the group was considered to be sufficient for further investigation. Progress by the group was made towards the ToR through the compilation of a list of 29 documented Ecopath models within the geographical area of the group. It became evident from collating this information that many models had been constructed and if available covered a large proportion of the geographical extent of WGEAWESS. The models however were built for different purposes, encompassed different periods (or none at all if not Ecosim), and had differing functional group descriptions. However, the different models are all attempts to capture the basic dynamics of the foodwebs in these areas and periods. Direct comparison remains difficult, but meta-analysis based on these remain a valuable possibility (Kolding *et al.*, 2015). The group discussed the possibility of a workshop to explore the practicalities of integrating information from these existing Ecopath models and exploring their utility towards informing IEA in the western shelf region. The workshop could be between relevant IEA groups

(WGINOSE, WGEAWESS, WGCOMEDA) and modelling groups (WGSAMS) The workshop would aim to:

a) Document and catalogue current model availability, and specify whether they were Ecopath only, Ecopath with Ecosim (EwE), or included Ecospace;

b) Evaluate models in terms of current state of development and availability of complete details and document key runs;

c) Determine what output information from these models was comparable between different specific formulations and parameterization, and would be useful for IEA;

d) Determine if these outputs, specifically time-series from EwE, could be used as input for ITA along with empirical dataseries;

e) Identify where existing models might be straightforwardly modified to enhance their inter-comparability and utility in IEA and ITA;

f) Determine whether a CRR would be valuable on the use of the Ecopath family of models in ITA and IEA, with worked case study examples.

5.5 ToR e) Development of Interreg Atlantic Area proposal

During the previous year much of the work by the members of the group was focused on the completion of ToR e) development and submission of an INTERREG Atlantic Area proposal. The group were successful in reaching stage 2 of the process with a proposal that aimed to make significant progress towards the implementation of an IEA approach within the Western European Shelf Seas, while working in a common framework with the ambition of harmonizing the development level between the different subareas. The proposal was structured following the goals of WGEAWESS, so that each of the WPs corresponded to one of the ToRs, with additional WPs included to assure the objectives of the INTERREG call (Figure 5.3). The general idea was to use similar techniques/tools used in WGEAWESS (ODEMM, ITAs, EwE-Ecospace), but in a complete stakeholders' integration environment. The core group of the proposal was composed by WGEAWESS members, who were leading different work packages depending on their expertise on the group, but also other partners were added, aiming at keeping them also involved in WGEAWESS for the near future. The proposal was ultimately unsuccessful with members of the group awaiting reviewer feedback before exploring further submissions.
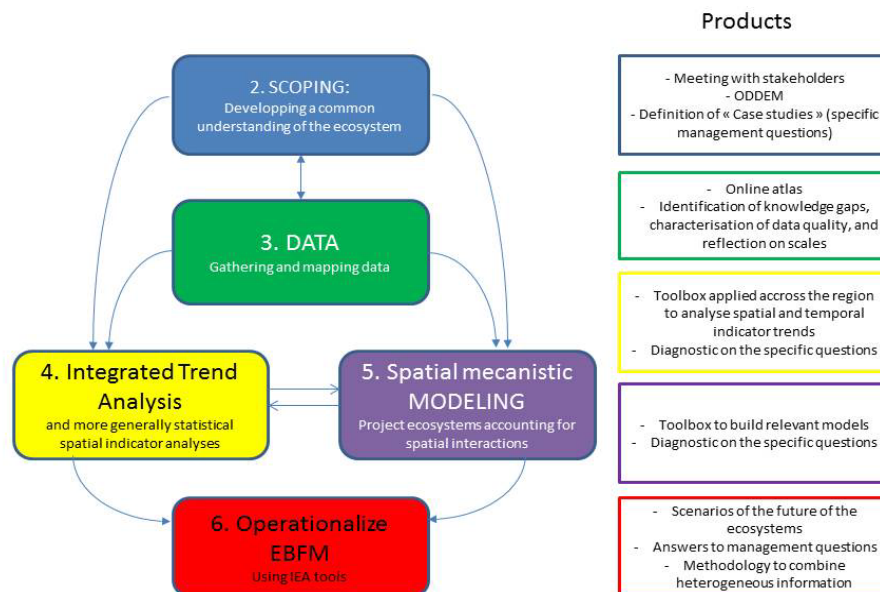
Products

Figure 5.3. Conceptual diagram of AtlantEA proposal showing main work packages and operational outputs (products).

References

Beaudreau, A. H. and P. S. Levin (2014). Advancing the use of local ecological knowledge for assessing data-poor species in coastal ecosystems. Ecological Applications 24:244–256.

Diekmann, R., Otto, S., and Möllmann, C. (2012). Towards Integrated Ecosystem Assessments (IEAs) of the Baltic Sea: Investigating Ecosystem State and Historical Development. *In* Climate Impacts on the Baltic Sea: From Science to Policy, pp. 161-199. Springer.

Kolding, J.; Bundy, A.; Christensen, V.; Steenbeek, J.; Law, R.; Plank, M.; and van Zwieten, P.A.M. Exploitation patterns in fisheries, a global meta-analysis from 151 Ecopath models. In Garcia, S.M. (Ed.) 2015 Balanced Harvest in the Real World. Scientific, Policy and Operational Issues in an Ecosystem Approach to Fisheries. Report of an international scientific workshop of the IUCN Fisheries Expert Group (IUCN/CEM/FEG) organized in close cooperation with the Food and Agriculture Organization of the United Nations (FAO), Rome, 29/09-02/10/2014

Thorpe, R. B., Dolder, P. J., Reeves, S., Robinson, P., and Jennings, S. (2016). Assessing fishery and ecological consequences of alternate management options for multispecies fisheries. ICES Journal of Marine Science 73(6): 1503-1512.

6 Revisions to the work plan and justification

None.

7 Next meetings

The 2018 WGEAWESS meeting will take place in Nantes, France, on 5–9 March 2018 (Year 2).

Annex 1: List of Participants

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Annex 2: Recommendations

Recommendation	Adressed to
1. WGEAWESS recommends a workshop to explore the practicalities of integrating information from existing Ecopath models and exploring their utility towards informing IEA in the western shelf and surrounding regions.	(WGINOSE, WGEAWESS, WGCOMEDA) and modelling groups (WGSAM).

Annex 3: Report Cards

Example of stock report cards providing ecosystem advice, time-series and key varia-
ble state indicators.

ICES WGEAWESS
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European anchovy (*Engraulis encrasicolus*) in Subdivision IX.a South (Gulf of Cádiz)

Enviromentally driven recruitment

Anchovy (*Engraulis encrasicolus*) is the most important fishery in Gulf of Cadiz and it exhibits a particular population dynamics behaviour. Together with natural mortality, fishing pressure exerts a strong control on its population and prevents adults to survive beyond one year. Without sustain of adults, the population mostly relies on recruits to persist between years. On the other hand, recruit survival is highly affected by the environment (Ruiz et al. 2007).
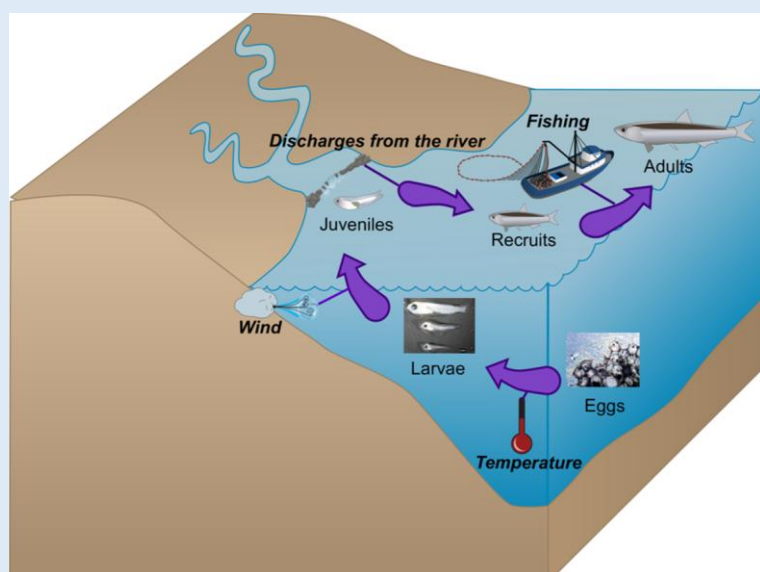

Figure 1: *Diagram of anchovy life cycle in the Gulf of Cádiz*

Sea surface temperature (SST), intense easterlies and discharges from the Guadalquivir River have been identified as the main factors influencing anchovy population dynamics during early life stages (Prieto et al. 2009, Ruiz et al. 2006, see Figure 1). Temperature changes are known to determine the timing of the spawning of this species (García & Palomera 1996, Motos et al. 1996) while the wind regime has been seen to influence recruitment variability in this particular stock (Rincón et al. 2016). Strong easterlies at the time of spawning can disperse eggs and larvae with a negative impact on survival (Ruiz et al., 2006). The level of river discharges has been related to stock oscillations. The 1995 collapse coincided with a severe drought that forced discharges to drop below 100 Hm^3/month that year. The raise of water flow in 1996 and 1997, was followed by an increase of the stock in 1997 (see Figure 2). Currently, due to agriculture demands, discharges have been stabilized around 100 Hm^3/month, inducing a small variability on recruitment (Rincón et al. 2016).
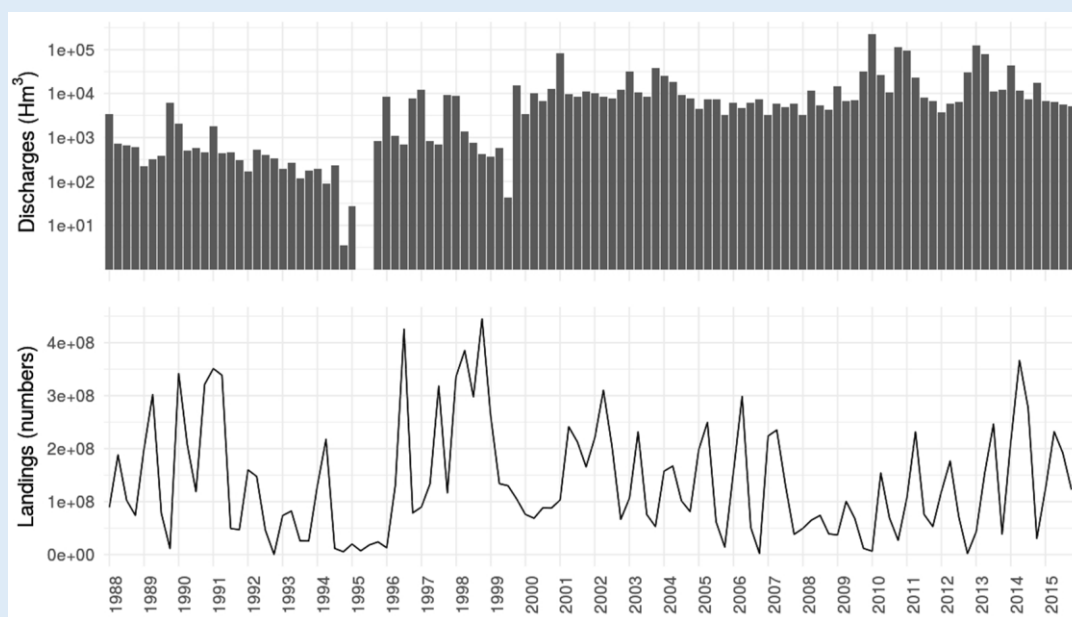
Figure 2: *Discharges from the Guadalquivir River and anchovy landings quarterly time series.*

ECOSYSTEM APPROACH

Much effort is being devoted lately to understand the role of the Guadalquivir estuary as a nursery ground as this may have important implications on the stock dynamics. Since 1997, a long-term monitoring program is being carried out on a monthly basis in the estuary (eg. González-Ortegón et al. 2015). In addition, an exhaustive study of the state and functioning of the estuary was conducted in 2010 (CSIC 2010), which influenced the positioning of governmental agencies regarding crucial long-term management decisions.

In the last years, models including environmental information have been developed by means of Bayesian simulation techniques (Ruiz et al. 2009, 2017, Rincón et al. 2016, 2017) as well as mass-balanced models describing the role of anchovy in the marine food web (Torres et al. 2013). Studies arising from the Guadalquivir monitoring program have described long term changes in anchovy early life stages and other nekton components in relation to salinity and turbidity conditions (Drake et al. 2007, González-Ortegón et al. 2010, 2012). An ecosystem approach perspective is presented in Llope (2017). Ruiz et al. (2015) review the role of the estuary, and its anthropogenic transformation, in the ecosystem services provided by the Guadalquivir River to the Gulf of Cadiz.

REFERENCES
References can be found at https://drive.google.com/open?id=0B0LQHqr-qs_6ZHdHQ1U4Sm94NEk

Cod (*Gadus morhua*) in Division 7.a (Irish Sea)

ECOSYSTEM OVERVIEW

The integrated trend analysis (ITA) conducted by WGEAWESS highlights that the Irish Sea ecosystem has undergone considerable changes over the last 30 years. Pronounced changes in the Atlantic Multi-decadal Oscillation (AMO) and the winter North Atlantic Oscillation (NAOw) suggest changes in atmospheric forcing in the Irish Sea. Hydrographic conditions in the Irish Sea are largely influenced by these environmental drivers with an increasing trend in sea surface temperature (SST) linked to the positive phase of the AMO, and the increasing influence of global climate change. Declines in zooplankton groups important for fish recruitment have also been observed while concurrent increases in phytoplankton have been linked to possible reductions in grazing pressure (Lynam *et al.*, 2011). Meanwhile increases in gelatinous zooplankton may be linked to anthropogenic disturbance and climate.

SPECIES KNOWLEDGE

Figure 1: *Atlantic Cod, Gadus morhua* (picture from msc.org)

Cod in the Irish Sea are at the upper thermal boundary of the species, and their growth and surplus production (*i.e.* including the reproductive component) are among the highest found throughout the range (Brander 2010).

There is evidence that the reduction in cod recruitment observed in the Irish Sea since the 1990s may be a consequence of a combination of small spawning-stock biomass and poor environmental conditions, coinciding with a shift towards above-average sea temperatures (ICES 2006; Beggs *et al.* 2014).

The link between SST and recruitment success may result from a range of processes operating at the individual to ecosystem level (Rijnsdorp *et al.* 2009). Temperature has direct effects on the physiology of larval cod, affecting growth rates and mortality (Campana 1996). At the population level variations in SST result in variable spawning times (Kjesbu 1994; Kjesbu *et al.* 2010), possible mismatch between prey/predators, and/or changes in the suitable hydrodynamic conditions required for successful transport to nursery areas (Brander 2005; Rijnsdorp *et al.* 2009).

KEY ECOSYSTEM TRENDS

Ecosystem considerations	2010	2011	2012	2013	2014	2015
Sea Temperature (SST)	↘	↗	↘	↘	↗	↘
Secondary Production (food)	↘	↗	↗	↘	→	↗

Table 1: *Recent trends in key ecosystem variables.*

• Recruitment variability in Irish Sea cod is significantly negatively correlated with the climatic drivers; NAO index and sea surface temperature (SST) (Planque & Fredou 1999; Brander & Mohn 2004)

• SST has been shown to influence larval cod survival and recruitment in the North Sea through the interaction between early life history growth and planktonic prey availability (qualitative and quantitative), mainly *Calanus finmarchicus* and Euphausiids (Beaugrand *et al.* 2003; Olsen *et al.* 2011)

• Optimal temperatures for cod cover a range between 7 - 15°C, and depend on the criteria used to assess optimality (e.g. growth, metabolic scope) (Righton *et al.* 2010). Cod stocks are not generally observed in locations with a annual mean bottom temperature above 12°C (Dutil & Brander, 2003)
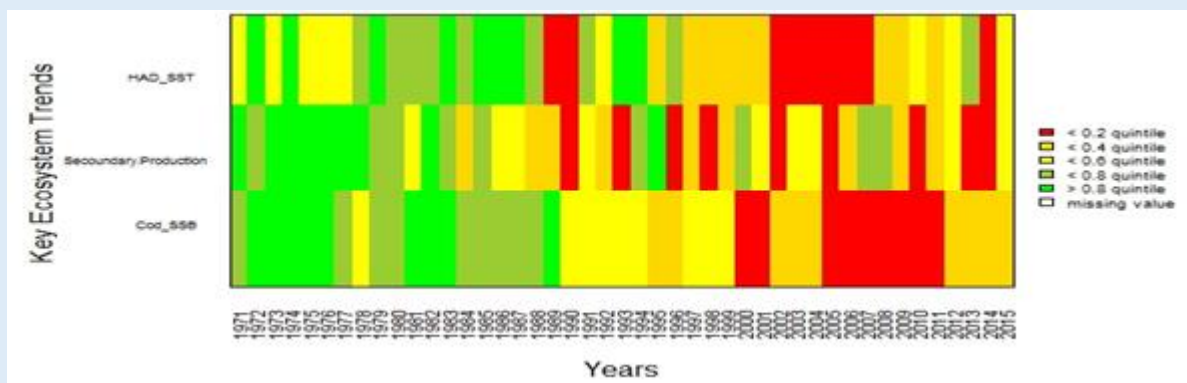

Figure 2: *Trends in key ecosystem variables for Irish Sea cod 1971-2015.* Sea surface temperature (SST), secondary production (*Calanus finmarchicus*, Euphausiids from CPR data), and Cod SSB (ICES advice 2016).
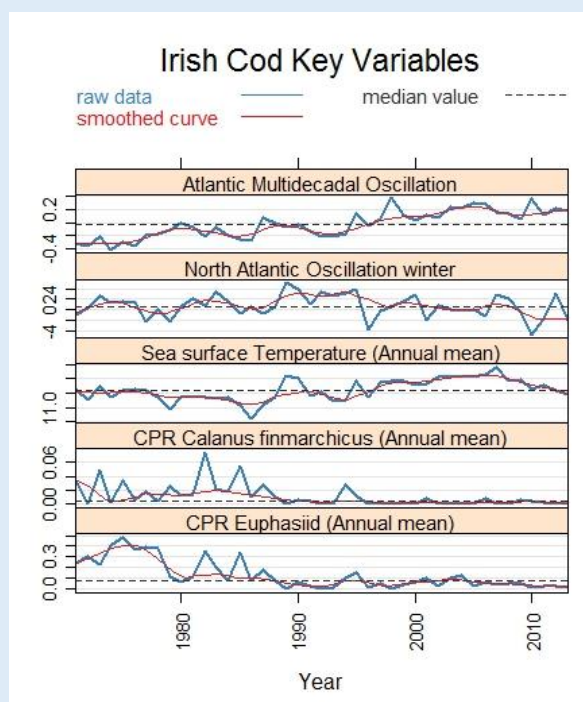

Figure 3: *Time series of Irish Sea variables identified as having potential to influence the habitat and biology (growth, recruitment, mortality) of Irish Sea cod.*

Annex 4: Summary of the WGEAWESS presentations

Impact assessment of minimizing unwanted catches and discarding (MINOUW Project): a case study in Southern Portugal

Maria Angeles Torres

CCMAR- Centre of Marine Sciences, University of the Algarve, Campus de Gambelas, 8005-139 Faro, Portugal

Discards ban is a key issue under the 2013 Reform of the EU Common Fisheries Policy (Landing Obligation, LO). The H2020 MINOUW Project (Science, Technology, and Society Initiative to minimize Unwanted Catches in European Fisheries) was conceived in support to the gradual elimination of discards by adopting fishing technologies and practices aimed at reducing pre-harvest mortality and post-harvest mortality of discards, while avoiding damage to sensitive marine species and habitats. MINOUW aims to find collaboratively practical solutions on a case-by-case analysis of the main types of European fisheries following a multi-actor approach involving all relevant stakeholders in pilot study areas. One of the case study involves the crustacean-trawl fishery in the South and Southwestern coast of Portugal. This fishery targets on the commercial species rose shrimp (*Parapenaeus longirostris*), Norway lobster (*Nephrops norvegicus*) and red shrimp (*Aristeus antennatus*) causing high discard rates. The lack of information on the ecological effects of banning discards on the species and even less at the ecosystem level is particularly troubling and is a cause of concern. The overall objective of our study is to estimate the effects of banning discards on the structure and resilience of the southern Portuguese marine ecosystem, including the effects on the upper and lower trophic levels using Ecopath with Ecosim modelling approach. To this end, further simulations will be compared under alternatives scenarios: a) baseline (i.e. no LO implemented), b) discards-landed (i.e. LO achieved) and c) more selective fishing (i.e. including results from selective devices used in the study area). We expect that the implementation of LO will have ecological consequences in the ecosystem dynamics and therefore they should be considered for marine conservation benefits.

Presentation: An Ecosystem Approach to pelagic fisheries management in Portuguese continental waters – spatial perspective

The study presents an application of spatial method as a tool for an ecosystem approach to pelagic fisheries management in Portuguese continental waters. The objective was to combine geographic information systems (GIS) and Multi-criteria decision method in order to find a set of areas suitable to protect sardine essential habitats and at the same time maintain fisheries socio-economic efficiency.

To perform the analysis, a conceptual suitability model that consisted of 13 criteria was developed (Fig 1). To minimize negative impact on fishing activities and maintain conservation objectives, the criteria were divided into two parts: suitability (conservation related) and non-suitability (socio-economic related).
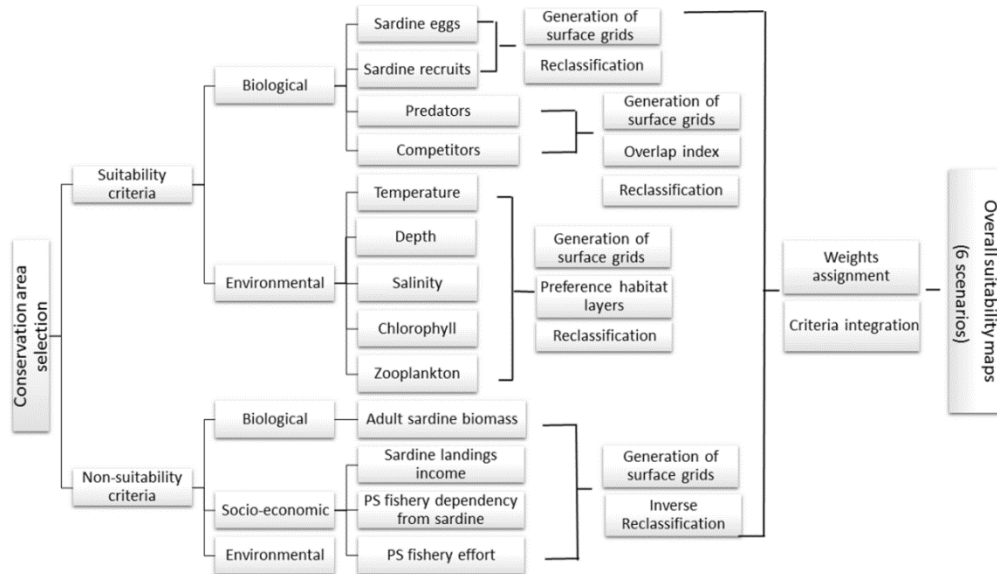
Figure 1. Methodology applied to combine Geographic Information System (GIS) and Multi-criteria Decision Method (MCDM) as a tool for an ecosystem approach to fisheries management.

Additionally, to represent holistic ecosystem approach, the criteria were grouped into three main dimensions: biological, environmental and socio-economic. The variables that represent criteria were standardized to uniform scale ranged from 1 to 5 where a score of 1 represents no suitability for protection and score 5 indicates high suitability. Weighted combination of all criteria resulted in the production of final suitability maps for 6 scenarios. Scenarios varied with magnitude of weight applied to conservation related criteria and socio-economic related criteria.
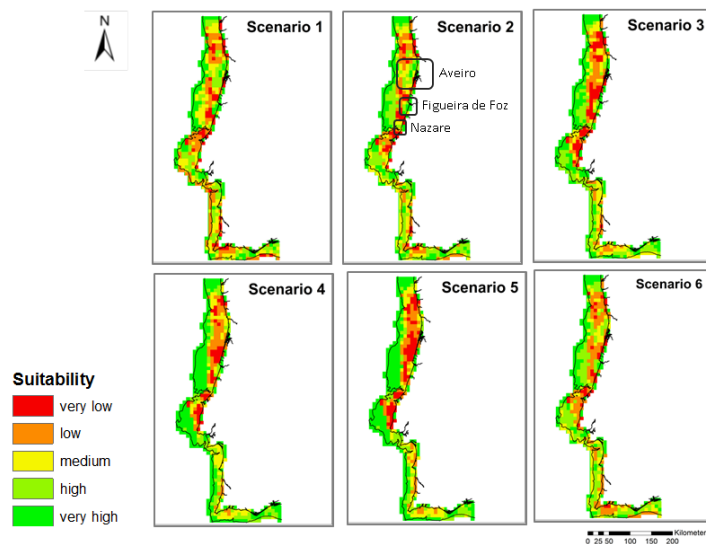

Figure 2. Final suitability maps produced for 6 scenarios that varied depends on weights applied. The areas selected indicate the areas that have the lowest trade-offs between conservation and fisheries.

Final suitability maps indicated three areas (offshore Aveiro, Figueira de Foz and Nazare) that consistently, across all scenarios, have the lowest trade-offs between conservation and fisheries (Figure 2). They might be of special interest as potential candidates

in the process of conservation area selection. The spatial analysis was performed for the year 2009. In future it will be expanded to cover time range of 5 years (2005-2010).

Testing environmental, economic and social criteria in a co-creation process with stakeholders: An example model for European anchovy using shiny R package

Margarita María Rincón Hidalgo, Javier Ruiz Segura, Marta Ballesteros

Population dynamics models and active participation of stakeholders have proven to be very useful in developing successful management regulations for fisheries, but they usually operate separately. The lack of communication seems to be one of the main impediments and the need of a common language emerges in a straightforward way. Models providing comprehensive outputs on the consequences of concrete management actions act as part of that language providing a framework in order to link scientist knowledge with the experience and needs of stakeholders.

In this communication we describe a successful example by using shiny R package. This allowed us to show the outputs of a bioeconomic model for anchovy population dynamics in the Gulf of Cádiz under different management strategies defined by the stakeholders. The interactive tool provides the environmental, social and economic impacts of different management scenarios. Stakeholders give a positive feedback about the relevance of the tool as evaluated in a structured manner and state explicitly trade-offs among different management strategies; furthermore, they suggested future steps to a process that is expected to lead to a reconsideration of the present management strategy.

Keywords: Toy model, stakeholders, management, co-creation, European anchovy.

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Anchovy or rice? Trade-offs in the Gulf of Cadiz

Marcos Llope

The Gulf of Cadiz socio-ecosystem is characterized by a focal ecosystem component – the estuary of the Guadalquivir River– that has an influence on the marine ecosystem –serves as a nursery area– and at the same time concentrates a great number of sectoral human activities. This nursery role particularly affects the anchovy fishery, which is the most economically and culturally important fishery in the region. As a transition zone between terrestrial and marine environments, estuaries are particularly sensitive to human activities, either developed directly at the aquatic environment or its surroundings. A dam 110 km upstream from the river mouth regulates freshwater input (mainly for agriculture purposes) into the estuary with consequences on turbidity and salinity. Using time-series analysis we (1) quantify the effects that natural (plankton, temperature, winds) and anthropogenic-influenced variables (freshwater discharges, turbidity, salinity) have on the abundance of anchovy larvae and juveniles, and (2) relate the abundance of these estuarine-resident early stages to the abundance of adult anchovy in the sea. Water management stands out as a key node where potentially conflicting interests (agriculture, power generation, aquaculture, fisheries) converge. Linking land-based activities to its impact on stock biomass represents the main challenge to ecosystem-based management in this particular regional sea. By focusing on

the effects that these activities ultimately have on the anchovy fishery –via recruitment– our study aims to provide alternative management scenarios by quantifying trade-offs between sectors.

Trophic structure and biomass flows in the western Iberian upwelling ecosystem- an Ecopath mass balance model-

poster presented by Maria de Fátima Borges

EcoFishMan - An Ecosystem Fisheries Management Plan for the Portuguese Crustacean Fishery- lessons learnt

Maria de Fátima Borges

References:

Cristina Silva,Hugo Mendes Mafalda Rangel, Laura Wise, Karim Erzini, Maria de Fátima Borges, Marta Ballesteros, Jose Luis Santiago, Aida Campos, Jonas Viðarsson, Kåre N.Nielsen, 2015. Development of a responsive fisheries management system for the Portuguese crustacean bottom trawl fishery:Lessons learnt. Marine Policy, 52, (2015) 19-25.

Wise, L. and Fonseca, P. and Murta, A. G. and Silva, C. and Mendes, H. and Carvalho, J. P. and Borges, M. F. and Campos, A. (2015). A knowledge-based model for evaluating the impact of gear-based management measures under European new Common Fisheries Policy. ICES Journal of Marine Science, 72(4), 1140-1151pp.

Santiago, J. L. and Ballesteros, M. A. and Chapela, R. and Silva, C. and Nielsen, K. N. and Rangel, M. and Erzini, K. and Wise, L. and Campos, A. and Borges, M. F. and Sala, A. and Virgili, M. and Vioarsson, J. R. and Baudron, A. and Fernandes, P. G. (2015). Is Europe ready for a results-based approach to fisheries management? The voice of stakeholders. Marine Policy, 56, 86-97pp.