ICES WGCOMEDA REPORT 2016

SCICOM/ACOM STEERING GROUP ON INTEGRATED ECOSYSTEM ASSESSMENTS

ICES CM 2016/SSGIEA:09

REF. ACOM AND SCICOM

Final Report of the Working Group on Comparative Analyses between European Atlantic and Mediterranean marine ecosystems to move towards an Ecosystem-based Approach to Fisheries (WGCOMEDA)

4–6 May 2016

Bilbao, Spain

DRAFT

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Recommended format for purposes of citation:

ICES. 2016. Final Report of the Working Group on Comparative Analyses between European Atlantic and Mediterranean marine ecosystems to move towards an Ecosystem-based Approach to Fisheries (WGCOMEDA), 4-6 May 2016, Bilbao, Spain. ICES CM 2016/SSGIEA:09. 31 pp. https://doi.org/10.17895/ices.pub.8589

Contents

Executive summary

The Working group on comparative analyses between European Atlantic and Mediterranean Ecosystems to move towards an Ecosystem-based Approach to Fisheries (WGCOMEDA) has been consolidated as an active and collaborative platform of research with participation of scientists from the Atlantic and Mediterranean regions working at different ecological levels from population, through community to ecosystem level. The group was established in 2014 and works in cooperation with other groups within the SCICOM/ACOM Steering Group on Integrated Ecosystem Assessments (SSGIEA), such as the ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea (WGIAB) and the ICES Working Group on Ecosystem Assessment of Western European Shelf Seas (WGEAWESS). The group (chaired by Marta Coll, France, Hilmar Hinz and Manuel Hidalgo, Spain) met for the third time in Bilbao, Spain, from 4 to 6 May 2016, with 18 scientists from European Atlantic and Mediterranean countries that attended the meeting (Denmark, France, Germany, Greece, Norway, Spain, and Portugal).

The objective of the third-year meeting was to conclude the work developed by the Working Group (WG) through the main pillars previously established and developed during the last three years. Particularly, the specific objective for this third-year meeting was to discuss the final analyses and to develop a self-assessment of the last three years and establish the step forward and a roadmap for the next WGCOMEDA cycle. The group focused in-deep discussions on sensitive ecological processes (from species and population processes, thorough interspecific relationships, to trophic flows) to climate variability and fishing impact on Atlantic and Mediterranean ecosystems with the following five main topics being specifically tackled:

1) **Global patterns of stability in fish community dynamics:** the group applied a portfolio effect analytical framework across Mediterranean, East Atlantic, West Atlantic, Canary upwelling, and Arctic regions (58 ecosystems in total). The discussion of the group focused on the strength and ecological interpretation of the global patterns found. The group decided to focus on the global patterns rather than region-specific analyses. A new topic starting this year focuses on the non-stationary pattern of stability.
2) **From traits to life-history strategies: deconstructing fish community composition in European Seas.** The group discussion focused on the interpretation of the results shown on life-history strategies that synthesize the life-history traits contribution to fish community structure with marked spatial patterns across Europe. Discussion also focused on how much complexity given by multidimensional information of life-history traits can be avoided, but also what important information was missed (e.g. observation-based length information).
3) **Biodiversity, community and ecosystem traits changes at regional scales**. Under this topic, the group discussed the preliminary results showing a link between marine ecosystem structure and functioning traits and the different estimates of portfolio effect framework. Results were also analysed as a global pattern but differences between ecosystems considered were included, such as community traits, environmental factors or fishing impacts.
4) **Exploring a demographic portfolio using pelagic forage species across Mediterranean and Atlantic ecosystems**. The group investigated patterns

of stability on pelagic ecosystems applying a demographic approach of the portfolio effect to the pelagic fish species. Preliminary results suggest an effect of the mean age and temperature. However, to increase the robustness of this pattern the group will incorporate other systems at a global scale.

5) **Investigating patterns and drivers of functional diversity of benthic ecosystems**. The group discussed the difficulties related with traits diversity calculations for benthic species and the difficulty of comparing index values across regional sea levels. It was discussed if the traits approach used under topic 2, i.e. the idea of using life-history strategies could be used for also for the benthic traits analysis of regional seas. Furthermore, it was discussed if it would be useful to use benthic bycatch data from demersal trawl surveys to attain a larger coverage of data. It was decided to continue perusing this topic with the objective to have fist result ready to be presented at the next meeting.

The group decided to continue the WG three more years and thus discussed how to frame the future scope and terms of reference for the next three-year cycle. This includes a more close collaboration and communication with other SSGIEA groups. Indeed, the next group meeting (pending of the WGCOMEDA approval by the ICES Steering Committee) is planned for May 2017 in Lisbon (Portugal) with a back-to-back meeting with WGIAB and WGEAWESS.

1 Administrative details

Working Group name

WGCOMEDA – Comparative Analyses between European Atlantic and Mediterranean marine ecosystems to move towards an Ecosystem-based Approach to Fisheries.

Year of Appointment within the current three-year cycle

2014

Reporting year concluding the current three-year cycle

3

Chair(s)

Marta Coll, France

Manuel Hidalgo, Spain

Hilmar Hinz, Spain

Meeting venue(s) and dates

1–4 April 2014, Barcelona, Spain (20 participants)

5–8 May 2015, Palma de Mallorca, Spain (20 participants)

4–6 May 2016, Bilbao, Spain (16 participants)

Participants group photo of the third WGCOMEDA meeting in Derio (Bilbao, AZTI). From the left to the right: E. Zanatos, M. Hidalgo, R. Primicerio, M. Coll, J. Otero, B. Merigot, H. Hinz, L. Pécuchet, I. Catalán, S. Henriques, C. Möllmann, H. Fock, J. Claudet, E. Andonegi, R. Frelat, and K. Tsagarakis.

2 Terms of Reference a) – z)

ToR	Description	Background	Science Plan topics addressed	Duration	Expected Deliverables
A	Provide a **comparative synthesis** of current understanding, data and tools available to move towards an ecosystem-based approach in Atlantic and Mediterranean European Seas.	a) The ToR requires an integrated view on what are the drivers and functions shaping marine ecosystems in both seas (Atlantic and Mediterranean), in addition to data available and methodologies used to date. b) This ToR requires a broad knowledge of the topic for all specific regions from the different scientists attending the WG. c) ToR A will benefit from the attendance of scientists from other WGs from SSGIEA such as WGIAB, WGEAWESS or WGINOSE. c) ToR also requires a good coordination with other WGs of other institutions carrying out parallel work on EAF such as SFTEC – EAF, INDESEAS initiatives, CREAM EU FP7 action.	1.1	Year 1	**1.1.** First section of Working Document synthesising available information, highlighting challenges in data and methodological approaches for each sea.
B	Identify key **sensitive ecological processes** (from species and population processes, thorough interspecific relationships, to trophic flows) to climate variability and fishing impact in Atlantic and Mediterranean exploited ecosystems.	a) The ToR requires the participation of experts with a good knowledge of ecological processes in both seas. b) ToR B will benefit from the attendance of scientists from other WGs from SSGIEA such as WGIAB, WGEAWESS or WGINOSE.	1.2	Year 1	**2.1**. Second section of the working document synthesising available information and sensitive ecological processes in each sea. **2.2**. Design the analyses to be performed in the next future (ToR C)
C	Analyse the **role of**	a) The ToR requires	2.1	Year 2	**3.1.** Implementa-

	climate and fishing drivers to explain the potential commonalities and differences in structural and functional ecosystem properties using results from both available indicators and models.	the access to datasets and previously developed analysis and models to perform further analysis and integration of data. b) ToR also requires a good coordination with other WGs of other institutions carrying out parallel work on EAF such as SFTEC – EAF or INDESEAS initiatives.			tion of analyses. **3.2.** Comparative synthesis of results. **3.3.** Paper with both a reviewing and an analytical component.
D	Identify how **knowledge gained in previous and current work at different seas can provide feedback** among regional systems to improve the scientific support for an integrated assessment of the Mediterranean and Atlantic regions for ecosystem approaches to science and management.	a) Outreach of this ToR will be provided in close collaboration with other WGs from SSGIEA such as WGIAB, WGEAWESS or WGINOSE.	3.1	Year 3	4.1. Document to be disseminated to several management and assessment institutions and agencies in Europe.

3 Summary of Work plan

Year 1	1.1 Comparative synthesis of current data and tools available to move towards an ecosystem-based approach in Atlantic and Mediterranean European Seas The first step aimed at providing a review of all the data available and all the methodologies used in regional seas to present an accurate state-of-the-art to advance science for EAF to be used as a white document of the WG. This work needed to be performed in close collaboration with complementary initiatives already in place such as the ones lead by SFTEC – EAF WG, IndiSeas initiative, or CREAM EU FP7 action. 1.2 Identify sensitive ecological processes to climate variability and fishing impact in both Atlantic and Mediterranean exploited ecosystems The success of EAF measures relies on an effective assessment and management of the most sensitive ecological processes to be potentially affected by fishing and/or climate. This work was performed using a comparative platform of research including Atlantic and Mediterranean systems. The group identified key sensitive processes at the species and population level, thorough interspecific relationships, to trophic flows. The outreach of this review complemented the work document to be provided after the first year of WG. During this first year we also planned the analyses to be performed during Year 2 in order to provide the opportunity to the WG participants to prepare before the second meeting in 2015.
Year 2	2.1. Analyse the role of climate and fishing drivers to explain the potential commonalities and differences in structural and functional ecosystem properties using re-

	sults from both available indicators and models, The group used the knowledge obtained during the first year to specifically analyse those sensitive ecological processes previously identified and assess the role that climate and fishing play in driving them. Results should lead to the development of a publication with both a review and an analytical component.
YEAR 3	3.1. Identify how knowledge gained in previous and current work in other seas can provide feedback among regional systems to improve the scientific support for an integrated assessment of the Mediterranean and Atlantic regions for ecosystem approaches to science and management. During the third year the WG participants are aiming at producing an integrative synthesis of all the knowledge gain by the group that can improve the effectiveness of EAF. The group emphasized the feedback of knowledge between regions in the Atlantic and Mediterranean Sea. This work needs to be performed in close collaboration with other WGs from SSGIEA such as WGIAB, WGEAWESS or WGINOSE to avoid work overlapping ('Linkages to other committees or groups' bellow).

4 Summary of Achievements of the WG during 3-year term

- A first cross Atlantic-Mediterranean study that summarizes the fish community composition attending to life-history strategies and traits. This study is under review in Global Ecology and Biogeography: Pecuchet *et al. From traits to life-history strategies: deconstructing fish community composition in European Seas* (Pecuchet *et al.,* 2015. Taxonomic and functional diversity patterns of fish assemblages in the European Seas).
- A first cross Atlantic-Mediterranean comparison of fish community stability as well as its main structural components and affecting drivers (Hidalgo *et al*., In prep., Frelat *et al*., In prep).
- A cross comparison of the resilience capacities of pelagic (forage) fish communities across Atlantic and Mediterranean systems (Catalan *et al.,* In prep).
- A cross comparison of functional diversity and traits of benthic Mediterranean and Atlantic ecosystems.
- A cross comparison of how ecosystem structural and functioning traits are related to fish community resilience and how climate and fishing condition this relationship (Coll *et al*., In prep).
- The **main operational achievement** is the consolidation of a cross-disciplinary network of researchers of European Mediterranean and Atlantic countries that will continue developing new activities in close collaboration with IEA regional ICES WGs.
- During these three years, several communications have been presented to the ICES ASC in 2013, 2014 and 2015:
    - Coll and Hidalgo (2013) Integrating scientific efforts among regional areas of the Atlantic and the Mediterranean towards EBM: the WGCOMEDA initiative. Session G.
    - Hidalgo *et al.* (2014) The ICES Working Group on Comparative Analyses between European Atlantic and Mediterranean marine ecosystems – a new effort towards developing Ecosystem-based Fisheries Management, WG-COMEDA. Session N.

- Pecuchet *et al.* (2015) Taxonomic and functional diversity patterns of fish assemblages in the European Seas. Session D.

- Finally, for the organization of the WG COMEDA meeting in 2015 in Palma, Spain, the chairs received a 5000€ fellow from the European Consortium EUROMARINE (http://www.euromarinenetwork.eu/call2014/) to partially support the attendance of some of the participants. Young scientists were prioritized, but help for travelling (flight) was finally provided to all the participants that requested it.

5 Final report on ToRs, work plan and Science Implementation Plan

The Terms of Reference in this WG are interconnected and articulated in several specific topics, some of them emerged from the beginning of the WG while others appeared along the three years of WG.

After having **identified key sensitive ecological processes ToR B**, the group defined several research topics that articulated the group (see below). With these topics defined, the group focused in investigating the influence of **climate variability and fishing ToR C** at different levels. Final results on **ToR C** were discussed in the third-year meeting, which are developed at different level from preliminary analyses in recently proposed topics to submitted manuscripts to scientific journals (see below). An essential part of the meeting was dedicated **to identifying how knowledge gained in previous and current work at different seas can provide feedback among regional systems ToR D** (see details below). This synthesis exercise was an important element of the third-year meeting that served to design the objectives of the next WG cycle.

Within this context, the five topics defined above have been developed by focusing questions to different compartments (demersal, benthic, and pelagic) and across different hierarchical stage (populations, communities or ecosystems).

5.1 TOPIC 1: Fish community stability: a large- scale analysis of synchrony and portfolio effect across Mediterranean and Atlantic

Lead: M. Hidalgo

Within this topic, the WG aimed at investigating the link between population indicators and life-history traits of species, and characteristics at community level across geographic gradients. To do that, we have investigated the main structural properties and drives affecting emergent properties (e.g. properties of groups that cannot be entirely explained by their individual components) such as the stability of fish communities. We apply the portfolio analytical framework to compare five types of systems across Mediterranean and Atlantic demersal communities: Arctic, Upwelling, Mediterranean, East, and West Atlantic. The Portfolio Effect (PE) is a measure of the stabilizing effect of the diversity that can be also affected for other external (anthropogenic and environmental) drivers.

After the preliminary analyses presented in the previous year meeting, this year we assessed final results at two levels. First, we discussed the main global patterns affecting community synchrony and stability (Figure 5.1.1). The results show that the combination of synchronic dynamics, evenness, fishing impact, and environmental heterogeneity are able to explain a high percentage of variance of fish community stability at global scale. Second, we also discussed the region-specific drivers of the

five aforementioned types of systems. We observed certain recurrence in some of the divers like evenness and fishing impact, while others seemed to be system-specific like sea surface temperature in the upwelling regions or the life-history characteristics like size at maturation or trophic level in the Mediterranean Sea. According to the discussions, system specific responses require further analyses to identify, among other questions, which are the main fish strategies associated with these contrasting responses among regions. Therefore, for the first dissemination of results, we will focus on the large-scale patterns combining information from 58 ecosystems (Hidalgo *et al.*, In prep).

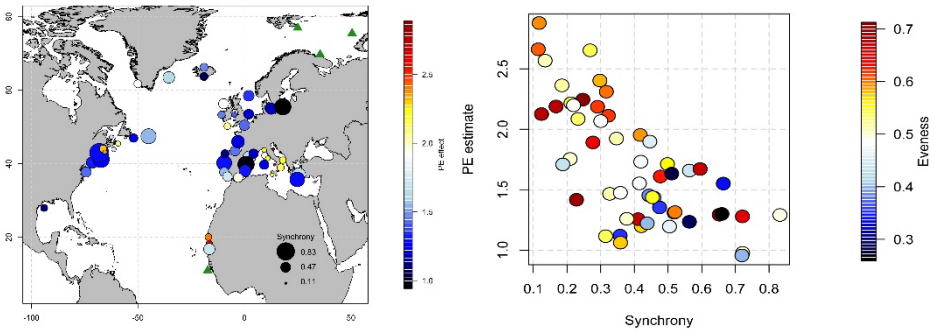

Figure 5.1.1. Large-scale representation of the emergent ecological properties (community synchrony and community stability [Portfolio effect (PE)]) (left). Relationship between synchrony and PE, with the dot colour representing the evenness value (right).

5.2 TOPIC 2: From traits to life-history strategies: deconstructing fish community composition in European Seas.

Lead: L. Pecuchet

This topic aims at calculating and comparing fish demersal communities from the Atlantic and the Mediterranean by studying the traits composition of the communities. Selecting an appropriate set of biological traits to use when characterizing communities can be challenging: traits are often correlated and therefore contain similar information. In this topic, the group investigated whether summarizing traits into life-history strategies (LHS) could be an efficient way of simplifying the analysis of communities' composition. In addition, the study looked at whether the LHS follow specific spatial patterns that can be related to the abiotic environment. Using an extensive set of scientific bottom-trawl surveys conducted in the Northeast Atlantic and Western Mediterranean, we obtained the species composition of the fish communities on a ¼ degree grid. We complemented these data with species-specific information on six life-history traits. We found that three LHS, corresponding to the "Equilibrium-Periodic-Opportunistic" model of Winemiller and Rose (1992)[1] (Figure 5.2.1), sufficiently summarized the information contained in the traits. These three strategies demonstrate marked spatial patterns, with Equilibrium and Opportunistic species dominating at high and low latitudes, respectively. The environmental variables explained up to 70% of the LHS spatial variability. Notably, sea surface temperature and its seasonality were important predictors and had strong and opposite patterns for the Equilibrium and Opportunistic strategies. Due to their tight coupling to the

[1] Winemiller and Rose (1992) Patterns of Life-History Diversification in North American Fishes: implications for Population Regulation. Canadian Journal of Fisheries and Aquatic Sciences, 49(10): 2196-2218.

environment, we argue that LHS can be a suitable tool to monitor community changes in response to natural and anthropogenic stressors, including climate change.

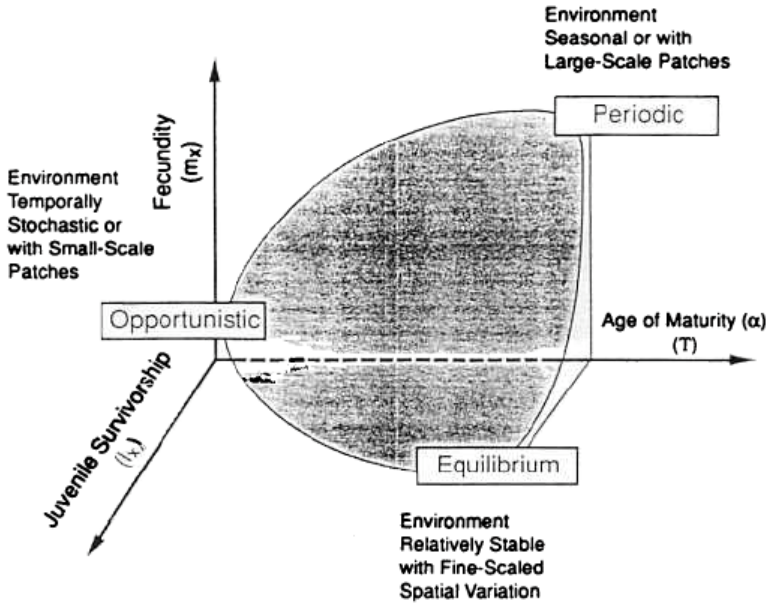

Figure 5.2.1. Life-history strategies framework adapted from "Equilibrium-Periodic-Opportunistic" model of Winemiller and Rose (1992[1]).

5.3 TOPIC 3: Biodiversity, community and ecosystem traits changes at regional scales.

Lead: M. Coll

Under this topic, the group discussed the preliminary results showing a link between marine ecosystems structure and functioning traits, and the different estimates of portfolio effect framework of the fish community developed under topic 1. The main aim of this study was to analyse weather there is a relationship between community stability (here demersal fish community stability) due to the portfolio effect and changes in structure and functioning of marine ecosystems in the Atlantic and Mediterranean regions, and if these changes are common or specific of the regions. Results were analysed as a global pattern, but differences between ecosystems considered were included, such as community traits, environmental factors, and fishing impacts.

The analyses were performed crossing results from topic 1 with structural and functional traits extracted from foodweb models already available from the study regions and formally documented in the scientific literature (Heymans *et al*., 2014)[2]. A series of ecological indicators were extracted from these foodweb models, selecting those models that represented similar areas and years to results obtained from topic 1 analysis. Correlation analyses using Spearman rank statistic and linear models were used for the preliminary analyses.

Preliminary results from 20 case studies (Figure 5.3.1) suggest that synchrony is higher in systems with a higher fishing pressure and that meta-population portfolio effect

[2] Heymans JJ, Coll M, Libralato S, Morissette L, Christensen V (2014) Global Patterns in Ecological Indicators of Marine Food Webs: A Modelling Approach. PLoS ONE 9:e95845

is lower when the maximum proportion of total mortality in the ecosystem due to predation is higher (Figure 5.3.1) and when the secondary production in a system is highly used. The meta-population portfolio effect is also lower when the proportion of exports from an ecosystem is higher (this could be due to fishing) and when the respiration of the ecosystem is lower (thus in Temperate ecosystems). In addition, results suggest that the community portfolio effect is lower when the transfer of energy is higher in an ecosystem, the mean proportion of total mortality due to predation is higher and trophic links are lower. These features are characteristic of temperate, chain-like and highly exploited ecosystems.

The group plans to complement these results with additional areas to include in the comparative analysis, using data-based indicators in addition to model-based, and complementing the analyses with more complex statistical analyses. A second step plans to continue the study using time-dynamic mechanistic models.

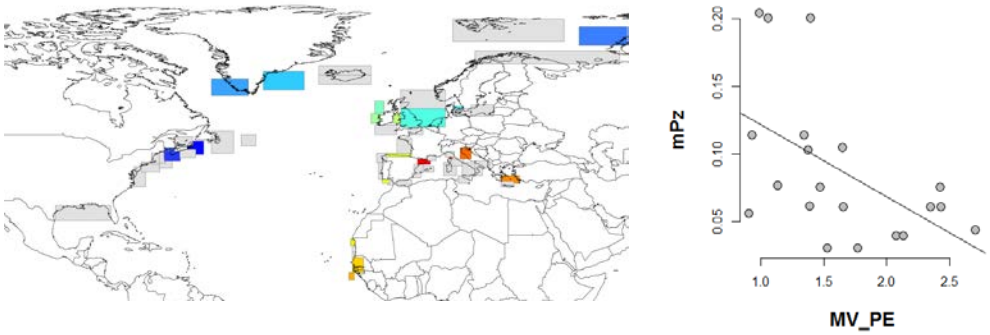

Figure 5.3.1. Overlap between community stability studies [Portfolio effect (PE)]) and ecosystem structural and functional traits database (left). Relationship between maximum proportion of total mortality in an ecosystem due to predation and PE (right).

5.4 TOPIC 4: Exploring a demographic portfolio using pelagic forage species across Mediterranean and Atlantic ecosystems.

Lead: I. Catalán

Advances on the potential usefulness of a demographic portfolio to assess the pelagic system's differences to external drivers in different areas were presented. The specific research questions of this topic include: Do we get stabilizing effects from using a demographic portfolio in small pelagic fish? Does the PE differ between regions? Can we identify potential drivers of PE?

Significant advances with respect to 2015 included i) the addition of two new datasets, which can be potentially disaggregated into five, and 2) a preliminary analysis of external forces in the PE (Figure 5.4.1).

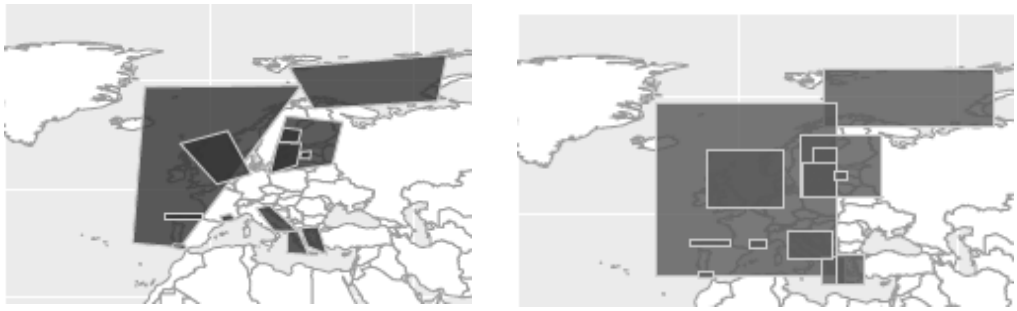

Figure 5.4.1. Areas for which time-series of age-structured data were collected (left). Corresponding areas for which environmental or human-pressure data were collected are shown in the right panel. Time-series were as long as 60 years, but for comparative purposes are tailored down to the mid 1980s until today.

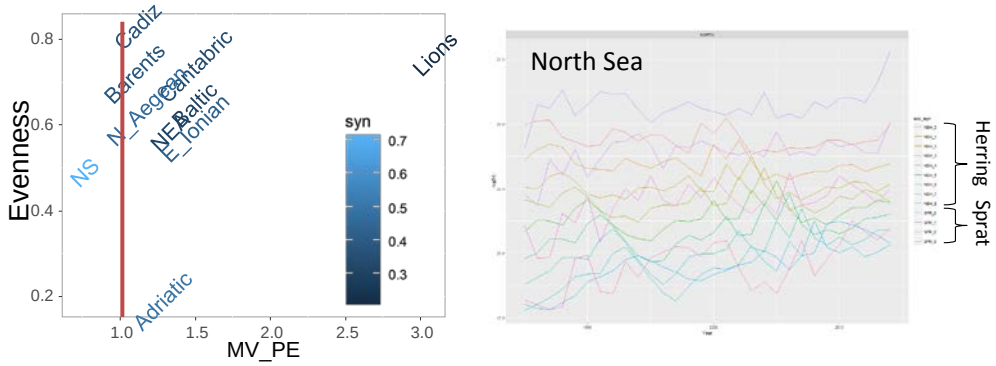

Figure 5.4.2. Left, preliminary relationships between the PE (MV_PE) and both evenness and eynchrony. Right, example of age time-series in two pelagic species in the North Sea

Initial analyses showed relatively large differences in PE among some of the regions (Figure 5.4.2), while being synchrony the best variable describing the portfolio effect. Although other drivers looked promising as drivers of the PE (for example wind or age mass centre), more data points (systems) are needed to have some confidence in the emerging relationships.

Immediate actions for the next meeting include *i)* removing Sprat from the Gulf of Lions GoL time-series, as it is the only Mediterranean case with it, *ii)* Exploring USA/south Africa/Peru anchovy/sardine data, and *iii)* clarifying the properties of PE vs. Z and synchrony case by case.

5.5 TOPIC 5: Investigating patterns and drivers of functional diversity of benthic ecosystems.

Lead: H. Hinz and A. Törnroos

This topic aims to compare benthic communities from both Atlantic and Mediterranean on a functional basis. Functional composition is compared via various indices and related to the idea of resistance and resilience of the two systems. The principle idea is to categorize the fauna of different regional seas according to their vulnerability to physical disturbance from bottom trawling. Morphological properties or traits of the benthic organisms are used to rank species after their vulnerability. After that the complete elimination of vulnerable species or a reduction of abundances are simulated to estimate the effect on functional diversity and ecosystem function properties. The traits composition of regional seas system are compared to inform about

similarities and differences in trait composition and the resilience and resistance of trait diversity to fishing disturbance. Furthermore, this work topic will investigate if ecosystem functionality is affected by the traits loss.

The topic has advanced, however, progress has been slow and has as yet not reached the stage of a full analysis. Traits data have been collated for soft bottom benthic communities (infauna and epifauna) for two areas; the Irish Sea and the Baltic Sea. The data analysis is currently in a preliminary stage as compiling the traits data was time consuming and the lead scientists had limited time to dedicate towards the task. A preliminary analysis has been carried out that have led to adjusting the approach with respect to the types of indicator to be calculated. In particular, common trait diversity calculations were thought less useful and a focus on life strategies as suggested for the fish under topic 2 was seen as a possible future approach. Once a complete analysis has been successfully for the two study areas, it will be applied to other regional sea datasets for the main analysis of benthic systems comparing Atlantic and Mediterranean systems.

5.6 TOPIC 6: Non-stationary behaviour of fish populations stability – a preliminary approach on Northeast Atlantic system

Lead: Romain Frelat – Christian Möllmann

Fish populations are dynamic systems and undergo fast changes due to environmental and anthropogenic drivers. These changes in species abundance and community diversity are expected to have an effect on the ecosystem functions, and especially on its stability. After the first large-scale approach to the main drivers and structural properties to diversity in the topic 1, here the group focuses in the non-stationary dynamics of the stabilizing processes in fish communities.

One of the main assumptions of the Portfolio Effect (PE) as a measure of the stabilizing effect of the diversity is that it is measured on a stable ecosystem. In reality, marine ecosystems are often non-stationary (e.g. some undergoing directional or drastic documented shifts). The preliminary analysis in this topic aimed to answer the following questions: What are the temporal variations of PE computed on dynamic fish communities? What is the effect of the recent changes in demersal fish abundances on the stability of the community?

As a first proof of concept, we used the ICES Datras IBTS data on the North Sea, and computed the PE with moving windows of 10 to 15 years for 9 round fish areas. To help understanding the variation of PE, a sensibility analysis have been produced, looking at the effect of individual species, of the length of the time-series and of the way abundance is measured.

The recent change in fish abundances (increase in Dab, European plaice and Grey gurnard combined with the decrease of Whiting, Cod, and Haddock) is found to decrease the stability of the system (decrease PE from 2.3 in 1985–1999 to 1.3 in 2001–2015) (Figure 5.6.1). This decrease in PE (i.e. decrease in the stabilizing effect of diversity) is found in all the round fish areas, except in area 5, which is less intensively fished (Figure 5.6.2).

The approach is promising and calls for further investigations. The next steps will be to get a better understanding of fish dynamics and their environmental drivers, linking them with changes in PE.

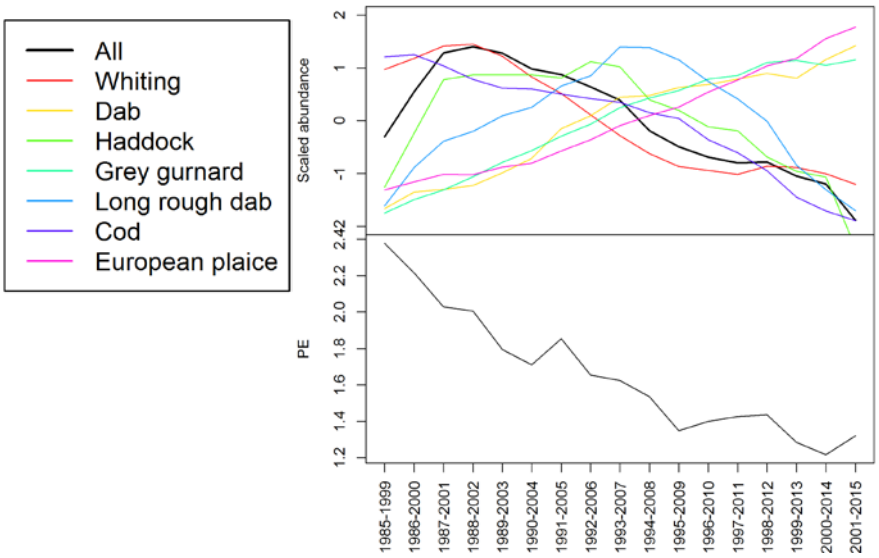

Figure 5.6.1. 15-year moving window calculations of the scaled abundances of the most relevant species and PE.

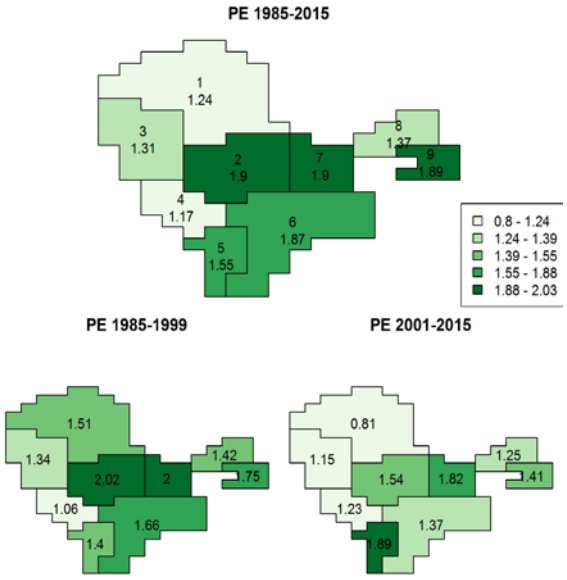

Figure 5.6.2. PE calculations at the main areas for the whole period of study (1985–2015) and two sub-period (1985–1999 and 2001–2015).

5.7 External talks

In all the WG meetings, we save a time slot for external presentations not directly related with the topics associated with the ToRs of the WG. In the 2016 WGCOMEDA meeting, we had four 'external talks':

i) Analysis of functional diversity in Mediterranean multispecies fisheries catches (*Evangelos Tzanatos, University of Patras, Greece*)

As the Ecosystem Approach to Fisheries Management suggests taking into account the ecosystem processes, it is useful to assess the functional traits of fisheries assemblages, especially in the case of multispecies fisheries. An analysis of 21 biological

traits of 86 species was carried out to investigate the relationships between species and trait composition and to rare functional traits at the species and community level. These traits were used in combination with two catch datasets from the eastern Mediterranean (Patraikos Gulf: small-scale fleet, eastern Ionian Sea: entire multispecies fleet), to investigate whether certain fishing tactics or gears tend to remove specific traits, using multivariate methodologies. Rare traits and combinations of traits were revealed for important target or bycatch species. Differences in the traits composition were found both between fishing tactic (*metiers*) as well as gears and areas (eastern Ionian); hierarchical clustering and MDS indicated the distinction of purse-seine catches at gear level. Associations of certain trait categories mainly with purse-seines (at gear level) and longline *métiers* and a trammelnet *métier* (at *métier* level) were found using SIMPER analysis at the trait level. The identification of rare traits/combinations of traits can have significant management implications as overfishing of these traits could result in altering assemblage functioning. It seems that the multispecies character of the benthic fisheries results in a balanced trait removal; the management should regulate the effects of purse-seine fisheries on the functioning of the fisheries assemblage.

Further investigation of the functions that fishing may remove from the ecosystem could contribute to understanding the effects of fishing and reveals overlooked aspects useful for the improvement of fisheries management. Furthermore, it is proposed that future research should be carried out on three scales (at the levels of population, community, and human-induced effects). At population level, the relationships between traits and the identification of major life strategies are a promising prospect. Regarding communities, the distribution of traits across different habitat types and the formulation of niches in the marine environment could provide insights to the organization of assemblages. Regarding anthropogenic effects, an attempt to discern patterns of fishing-induced or climate-induced trait composition shifts could be a useful tool to disentangle the pressures generated by human-induced stressors regarding assemblage functioning. A comparative framework between the Mediterranean and the Atlantic ecosystems would allow the identification of major similarities or critical particularities potentially useful for management.

ii) Drivers of functional diversity of fish assemblages at a global scale (*Sofia Henriques, MARE–Portugal*)

In this study, we explore several hypotheses to explain worldwide patterns of functional traits of fish. To define and assess functional patterns we used the most extensive dataset of fish assemblages of estuarine ecosystems compiled to date (386 estuaries and 2434 species) as well as a large set of functional traits (i.e. linked with salinity preference, body size, maximum depth of distribution, diet, and lifespan). Our findings provide new insights into how two major environmental gradients drive functional traits among estuaries across the globe, through multiple causal processes linked to physiological and metabolic constrains due to temperature and salinity, size-dependent selection from competition, and predation as well as habitat suitability, availability and connectivity.

Globally, conservation efforts have been mostly focused on biodiversity hot spots (shiftily to warmer regions). However, our results showed an unbalanced distribution of functional traits throughout globe with many regions characterized by low species richness supporting unique functional traits. For instance large species increasing towards cooler waters as well as macrocarnivores and planktivores, while small species usually omnivores, herbivores, and detritivores increased at warmer regions.

Therefore, conservation strategies should embrace different ecosystems (e.g. habitat heterogeneity estuary types and area, tidal regime) across the globe (different biogeographic units and temperature gradients) in order to effectively safeguard biodiversity and contribute to ecosystems resilience.

iii) Barents Sea ecosystem vulnerability assessment (*Raúl Primicerio, University of Tromsø*)

In this study, a Barents Sea ecosystem vulnerability assessment was presented. A series of species to community and foodweb analyses based on scientific campaigns were developed and integrated together to assess the historical sensitivity of the Barents Sea to climate change and fishing. In addition, the potential adaptability of the ecosystem to climate and fishing changes in future was included in the analyses. This study presented very interesting approaches on how to link the three levels of ecological complexity that WGCOMEDA is dealing with: populations, communities, and ecosystems.

iv) Exploring Holling's landscapes – what empirical species–abundance relationships may tell us (*Heino Fock, Johann Heinrich von Thünen Institute*)

Inductive macroecological community research has often focused on assembly patterns for communities based on permitted and un-allowed (niche) overlaps, power law relationships with respect to area sizes or fractal dimensions to demonstrate patterns of self- similarity in abundance distributions.

As a theoretical approach, Hubbell's (2001) 'unified neutral theory of biodiversity and biogeography' (UNTB) makes very simple assumptions on processes assembling species into communities, but has to a remarkable degree been able to reproduce patterns in diversity. One of the basic assumptions is that species are ecologically identical, at least as in their contribution to community and regional diversity. Species abundances in local communities reflect the structure of the meta-community.

Species–abundance relationships (SNR) as opposed to species–area relationships (SAR) are analysed for 73 marine faunal assemblages from deep-sea to semi-terrestrial saltmarshes by means of a semi-log model (Gleason model) and a log-log model (power law, Arrhenius model). The semi-log model refers to the log-series distribution of species and resembles patterns predicted by the zero-sum multinomial distribution model of the UNTB.

The linear analysis of the semi-log models in terms of slopes and intercepts together with a downscaling procedure as proxy for ß-diversity reveals patterns that allow interpreting meta-community parameters in terms of Holling's multiple equilibria in natural communities, a key component of resilience theory.

5.8 Implications of the WG COMEDA research topics on assessment, management and ICES scientific policy and strategy (ToR D).

According to several studies (e.g. Rice and Browman, 2014[3], EU Marine Board[4]), the most relevant gaps to develop the scientific basis to implement Ecosystems approaches to management are:

3 Rice, J. and Browman H. (2014) Where has all the recruitment research gone, long time passing? ICES Journal of Marine Science, 71(8), 2293–2299.

i. Understanding the dynamics and resilience of populations, communities, and ecosystems.

ii. Scales of variation in ecosystem state and function—over what time and space scales do ecosystems vary and by how much? What are the critical natural factors and processes, which determine ecosystem function and state?

iii. Processes of ecosystem change—when ecological change is large and difficult to reverse.

iv. Interconnected ecosystems and their dynamics, the importance of complexity and diversity in maintaining healthy seas.

From all those, WG COMEDA has contributed considerable to the three first elements, adopting a cross Atlantic-Mediterranean comparative platform, which is in the essence of the title of this WG. In this sense, an important element of this WG is "*Identify how knowledge gained in previous and current work at different seas can provide feedback among regional systems to improve the scientific support for an integrated assessment of the Mediterranean and Atlantic regions for ecosystem approaches to science and management*"(ToR D). Most of the discussion circulated around of when/how/which type of global ('macro-ecological scale') drivers investigated in the WG main topics contrast/differ with those at regional ('management') scale. The exercise made during the WG contribute to find the main knowledge gained at different areas in close collaboration with other WGs from SSGIEA, such as WGIAB or WGEAWESS has served to structure the new cycle of COMEDA, which will particularly focus on a closer collaboration, communication, feedback and common activities with these groups.

4 EU Marine Board: Science dimensions of an Ecosystem Approach to Management of Biotic Ocean Resources (SEAMBOR) Marine Board-ESF Position Paper 14.

6 Cooperation

Cooperation with other WG

The group was established in 2014 and works in cooperation with other groups within the SCICOM/ACOM Steering Group on Integrated Ecosystem Assessments (SSGIEA) such as the ICES/HELCOM Working Group on Integrated Assessments of the Baltic Sea (WGIAB) and the ICES Working Group on Ecosystem Assessment of Western European Shelf Seas (WGEAWESS).

7 Summary of Working Group self-evaluation and conclusions

1) Working Group name. **COMEDA**- ICES Working Group on Comparative Analyses between European Atlantic and Mediterranean marine ecosystems to move towards an Ecosystem-based Approach to Fisheries.

2) Year of appointment. 2013

3) Current Chairs. Marta Coll, Manuel Hidalgo, Hilmar Hinz

4) Venues, dates and number of participants per meeting.

- Barcelona, Spain, 1–4 April 2014, Institute of Marine Sciences (ICM, CSIC)- participants: 20
- Palma de Mallorca, Spain, 5–8 May 2015 Balearic Oceanographic Centre, Spanish Institute of Oceanography (COB, IEO) – participants 20.
- Derio (Bilbao), Spain, 4–6 May 2016, AZTI – participants 16.

WG Evaluation

5) If applicable, please indicate the research priorities (and sub priorities) of the Science Plan to which the WG make a significant contribution.

The working group is dedicated to the comparison of marine ecosystems in the Atlantic and the Mediterranean. Its main aim is to use ecosystem data at regional sea scale level as replicates from both areas to compare the structure and functioning of the two larger systems. Furthermore, the group particular focus is on understanding how differently structured regional sea ecosystems respond to environmental change and direct anthropogenic pressures with respect to its resistance and resilience. As such the working group is directly working towards the two main strategic science goals set out by the ICES strategic science Plan for 2014-2018:

a) Develop an integrated, interdisciplinary understanding of the structure, dynamics, and the resilience and response of marine ecosystems to change.

b) Understand the relationship between human activities and marine ecosystems, estimate pressures and impacts, and develop science-based, sustainable pathways.

The ICES strategic plan points out to achieving integrated ecosystem understanding requires an interdisciplinary approach including the detailed knowledge of the structure and functioning of marine ecosystems, with appreciation for the connectivity and interdependence of ecosystem components and social and economic activities related to these ecosystems. The WG deals specifically with the Ecosystem Process and Dynamics (EPD) objectives:

a) Quantifying the relationship between habitat condition ecological processes and the provision of ecosystem goods and services.

b) Understand and quantify and mitigate multiple impacts of human activity on populations and ecosystems.

WG COMEDA is primarily investigating the structure and functioning of the ecosystems on a biological basis, but is hoping to also include social and economic activities through the collaboration with other working groups linking both ecological and social indicators such as WG RMES Working Group on Resilience and Marine Ecosystem Services. Contrasting ecosystem units across the Atlantic and the Mediterranean regions should thus help to increase our understanding of processes and structure related to each macro-ecological system, and further our knowledge of their inherent differences and similarities to devise more adaptive management strategies.

6) In bullet form, list the main outcomes and achievements of the WG since their last evaluation. Outcomes including publications, advisory products, modelling outputs, methodological developments, etc. *

Although the working group is relatively young, getting into this third year, several outcomes and achievements have been produced making profit of this collaborative platform:

- A synthesis of fish communities attending to life-history strategies across European seas (Pecuchet et al. Submitted).
- Identification of large-scale drivers of fish community stability (Hidalgo et al. In prep.).
- Empirical relationship between ecosystem traits and fish community resilience (Coll et al. In Prep.).

Although work within these areas has advanced sufficiently, other work is still in progress and may require more time prior to the publication of results. Furthermore, within the working group traits data has been compiled for fish and benthos and the group aims to make available these data to the wider scientific community in the near future.

7) Has the WG contributed to Advisory needs? If so, please list when, to whom, and what was the essence of the advice.

So far the WG has not contributed to any direct Advisory needs.

8) Please list any specific outreach activities of the WG outside the ICES network (unless listed in question 6). For example, EC projects directly emanating from the WG discussions, representation of the WG in meetings of outside organizations, contributions to other agencies' activities.

The WG is collaborating with two operating European projects i.e. DISCARDLESS and MINOUW that are focusing on discards from EU fisheries working both in the Atlantic and in the Mediterranean Fisheries. The WG is assisting towards several deliverables of the projects by providing traits data of demersal fish and benthos. As several group members are part of either project, WG COMEDA also serves as a communication platform between the projects. COMEDA chairs have been granted several EUROMARINE grants, which have served as platforms for a broader dissemination of the outcomes and work produced in the group.

9) Please indicate what difficulties, if any, have been encountered in achieving the workplan.

The main difficulty the WG faces is the lack of proper financing to attract young scientist to the meetings, which may have no official means to finance their trips. So far the group has managed to consolidate funding for one of its meetings but not for the other two. Furthermore, work progress on many of the topics has been slower than expected due to the high workload related to the extraction and compilation of traits data. Furthermore, many WG members while enthusiastic have limited time they can dedicate toward work group topics slowing the progress towards tangible results. Another complication is translating the scientific results into firm management advice since the group is new. As some of the ideas and methods are relatively new we think that they need first to be evaluated by the scientific community before being translated and used in a management context. Next COMEDA cycle will partially focus on establishing and consolidating these communication exchange platforms.

Future plans

10) Does the group think that a continuation of the WG beyond its current term is required? (If yes, please list the reasons)

The group thinks that the working group has **a)** set the basis for a long-term collaboration, **b)** has produced considerable advance investigating transversal properties and drivers of harvested populations, communities and ecosystems from the Atlantic and Mediterranean regions, and **c)** has posed interesting questions and objectives to develop new ToRs in close synergies with other IEA ICES WGs. In addition, some of the scientific topics and ideas dealt within the WG are very recent and need more time to develop its ideas and to reach the stage of tangible outputs.

The ideas and methods developed by the group are novel and need to be completed and reviewed by the scientific community and they will be strengthened with a close collaboration with IEA ICES WGs. Only once this stage is done, results will be of more direct application with respect to a management context (e.g. WG results contribute to improve the understanding about ecological vulnerability as well as ecosystems resilience, which have deeply implications in the development of management strategies). Thus more time is needed to reach our goals in this direction.

11) What additional expertise would improve the ability of the new (or in case of renewal, existing) WG to fulfil its ToR?

So far social and economic aspects are not being covered by the group and expertise in this field would be desirable. Working in collaboration with other existing WG (e.g. WG RMES) or ICES initiatives (SIHD) could be especially fruitful in future.

12) Which conclusions/or knowledge acquired of the WG do you think should be used in the Advisory process, if not already used? (please be specific)

As already mentioned under point (9) and (10) the group has achieved or is in train of achieving interesting scientific results that, when evaluated by the large scientific community can be of interest for management and could be incorporated into an advisory process. Our aim is to continue this work to advance on this direction and to be able to provide insights in the Advisory

processes in the next COMEDA cycle in close collaboration with other ICES WGs.

Annex 1: List of participants

NAME	ADDRESS	E-MAIL
M. Coll	Exploited Marine Ecosystems Unit (UMR EME212), IRD - Universite Montpellier II – Ifremer, Avenue Jean Monnet - CS 30171, 34203 Sète cedex (France).	marta.coll@ird.fr
M. Hidalgo	Balearic Islands Oceanographic Centre (COB). Spanish Institute of Oceanography (IEO). Moll de Ponent, s/n, 07015, Palma (Spain)	jm.hidalgo@ba.ieo.es
H. Hinz	Institut Mediterrani d' Estudis Avançats (IMEDEA) Miquel Marqués 21 07190, Esporles (I. Balears) Spain	hhinz@imedea.uib-csic.es
I. Catalán	Institut Mediterrani d' Estudis Avançats (IMEDEA) Miquel Marqués 21 07190, Esporles (I. Balears) Spain	ignacio@imedea.uib-csic.es
J. Caudet	National Center for Scientific Research (CNRS), CRIOBE, Perpignan, France	joachim.claudet@gmail.com
S. Heriques	MARE - Marine and Environmental Sciences Centre Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal	snpires@fc.ul.pt
C. Möllmann	Institute for Hydrobiology and Fisheries Science, University of Hamburg, Hamburg, Germany.	christian.moellmann@uni-hamburg.de
B. Mérigot	Universite´ de Montpellier 2, UMR 212 Ecosyste`mes Marins Exploite´s (EME), Centre de Recherche halieutique Me´diterrane´enne et Tropicale, Se` te, France.	bastien.merigot@univ-montp2.fr
J. Otero	Institute of Marine Research (CSIC), Eduardo Cabello, 6, 36208 Vigo, Spain	jotero@iim.csic.es
E. Andonegui	AZTI. Funcionamiento de los Ecosistemas Marinos. Marine Ecosystems Functioning. Itsasoko Ekosistemen Funtzionamendua	eandonegi@azti.es
K. Tsagarakis	Institute of Marine Biological Resources, Hellenic Centre for Marine Research, Agios Kosmas, 16610 Elliniko, Athens, Greece	kontsag@gmail.com
L. Pécuchet	Centre for Ocean Life, c/o National Institute of Aquatic Resources, Technical University of Denmark, Charlottenlund Castle, DK-2920 Charlottenlund, Denmark.	laupe@aqua.dtu.dk
R. Frelat	Institute for Hydrobiology and Fisheries Science, University of Hamburg, Hamburg, Germany.	romain.frelat@uni-hamburg.de
E. Tzanatos	Laboratory of Zoology Department of Biology	tzanatos@upatras.gr

	University of Patras GR 26504 Rio, Patras Greece	
R. Primicerio	Faculty of Biosciences, Fisheries and EconomicsUiT – The Arctic University of Norway, Norway.	raul.primicerio@uit.no
H. Fock	Thünen Institute of Sea Fisheries, Germany.	heino.fock@thuenen.de

Annex 2: Recommendations

RECOMMENDATION	ADRESSED TO
1. Under the increasing usefullness of the life-history traits information. The group agreed to suggest to ICES (ICES Data Centre) to consider the developement of a database of life-history information that includes fish, but also other benthic organims.	ICES Data Centre

Annex 3: Agenda

ICES Working Group on Comparative Analyses between European Atlantic and Mediterranean marine ecosystems to move towards an Ecosystem-based Approach to Fisheries

(ICES WG COMEDA)

Third-year meeting

Derio (Bilbao), Spain, 4–6 May 2015

AZTI

– AGENDA–

Wednesday 4/05/16

8.30. A bus will pick up all interested participants form Bilbao downtown, just in front of the Hotel Barceló Bilbao Nervión (see map below).

9.00. Arrival of participants

9.30 – 10.00. **Welcome, practical information, and presentation of participants.**

10.00 – 10.30. **Revision of the agenda, agreements made in the first COMEDA meeting, modifications introduced and objectives for the present year** (Marta Coll, Manuel Hidalgo, Hilmar Hinz).

10.30 – 11.00. **Fast description of old and new specific topics, and presentations of the WG** (Marta Coll, Manuel Hidalgo, Hilmar Hinz).

- ***Topic 1****: Fish community stability - a large- scale comparative analysis of synchrony and portfolio effect across Mediterranean and Atlantic ecosystems* (Manuel Hidalgo).
- ***Topic 2****: Resilience – resistance at different levels through the large-scale patterns and drivers of functional diversity of fish communities* (Lauréne Pécuchet – Martin Lindegren).
- ***Topic 3****: Biodiversity, community and ecosystem traits changes at regional scales* (Marta Coll)
- ***Topic 4****: Exploring a demographic portfolio using pelagic forage species across Mediterranean and Atlantic ecosystems (Ignasi Catalan)*
- ***Topic 5****: Investigating patterns and drivers of functional diversity of benthic ecosystems – preliminary analyses (Hilmar Hinz – Anna Törnroos).*

- *Topic 6: Non-stationary behavior of fish populations stability – a preliminary approach on Northeast Atlantic systems (Romain Frelat – Christian Möllmann).*

11.00 – 11.30. Coffee break

11.30 – 12.00. Introduction to focused discussion on Topic 2 on Functional diversity (Lauréne Pécuchet – Martin Lindegren).

12.00 – 13.00. Discussions on the topic 2: summary of agreements, work to be developed, timing and definition of tasks.

13.00 – 14.30. Group lunch

14.30 – 15.00. Introduction to focused discussion on Topic 5 (Hilmar Hinz – Anna Törnroos).

15.00 – 16.00. Discussions on the topic 5: summary of agreements, work to be developed, timing and definition of tasks.

16.00 – 16.30. Coffee break

16.30 – 17.30. External talks on functional diversity: Evangelos Tzanatos and Sofía Henriques.

17.30 – 18.00. Closing day discussion on functional diversity

Thursday 5/05/15

8.30. A bus will pick up all interested participants form Bilbao downtown (see map below).

09.00 – 09.30. Introduction to focused discussion on Topic 1 on fish community stability (Manuel Hidalgo).

09.30 – 10.30. Discussions on the Topic 1: summary of agreements, work to be developed, timing and definition of tasks.

10.30 – 11.00. Coffee break

11.00 – 11.30. Introduction to focused discussion on Topic 6 on non-stationary stability (Romain Frelat – Christian Möllmann).

11.30 – 13.00. Discussions on the topic 6: summary of agreements, work to be developed, timing and definition of tasks.

13.00 – 14.30. Lunch and group photo

14.30 – 15.00. Introduction to focused discussion on Topic 4 on pelagic and demographic stability (Ignasi Catalan).

15.00 – 16.00. Discussions on the topic 4: summary of agreements, work to be developed, tim-

ing and definition of tasks.

16.00 – 16.30. Coffee break

16.30 – 17.00. External presentation: Raul Primicerio.

17.00 – 18.00. Closing day discussion on fish community stability: conclusions, links across topics future studies.

20.00. Group dinner at Sidreria Arriaga, a typical cider house located in Bilbao downtown (http://asadorarriaga.com/en/)

Friday 7/05/15

8.30. A bus will pick up all interested participants inform Bilbao downtown (see map below).

09.00 – 9.30. Introduction to focused discussion on Topic 3 on ecosystems traits changes (Marta Coll).

09.30 – 10.30. Discussions on the topic 3: summary of agreements, work to be developed, timing and definition of tasks.

10.30 – 11.00. Coffee break

11.00 – 12.30. Implications of the WG COMEDA research topics on assessment, management and ICES scientific policy and strategy (Marta Coll, Manuel Hidalgo, Hilmar Hinz).

12.30 – 13.00. Future of COMEDA group: potential lines of development (Marta Coll, Manuel Hidalgo, Hilmar Hinz).

13.00 – 14.30. Lunch

14.30 – 15.30. Future of COMEDA group: agreement on future focus and main lines for a new 3-years WG (Marta Coll, Manuel Hidalgo, Hilmar Hinz).

15.30 – 16.30. Wrapping-up of the main agreements for each topic and the whole group.

17.00. Meeting closure