

Deliverable No. D 5.3:

Outcomes from the First Stakeholder Engagement Workshops and Face-to-Face Interviews Conducted in each Case Study Region with Emphasis on PANDORA Scoping and Co-creation



PARadigm for New Dynamic Oceanic Resource Assessments

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The PANDORA Project

The Blue Growth of European fisheries is at risk due to over-exploitation, unforeseen changes in stock productivity, loss of markets for capture fisheries due to aquaculture, future trade agreements opening European markets to external fleets, and fluctuations in the price of oil and other business costs. All of these risks need to be considered when providing advice needed to sustainably maximize profits for the diverse array of fisheries operating in European waters and to help safeguard the benefits this sector provides to the social coherence of local, coastal communities.

PANDORA aims to:

1. Create more realistic assessments and projections of changes in fisheries resources (30 stocks) by utilizing new biological knowledge (spatial patterns, environmental drivers, food-web interactions and density-dependence) including, for the first time, proprietary data sampled by pelagic fishers.

2. Advice on how to secure long-term sustainability of EU fish stocks (maximum sustainable /"pretty good" and economic yields) and elucidate trade-offs between profitability and number of jobs in their (mixed demersal, mixed pelagic and single species) fisheries fleets. Provide recommendations on how to stabilize the long-term profitability of European fisheries.

3. Develop a public, internet-based resource tool box (PANDORAs Box of Tools), including assessment modelling and stock projections code, economic models, and region- and species-specific decision support tools; increase ownership and contribution opportunities of the industry to the fish stock assessment process through involvement in data sampling and training in data collection, processing and ecosystem-based fisheries management.

The project will create new knowledge (via industry-led collection, laboratory and field work, and theoretical simulations), new collaborative networks (industry, scientists and advisory bodies) and new mechanisms (training courses and management tools) to ensure relevance, utility and impact.



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List of Symbols and Abbreviations

CC	Climate Change
CPUE	Catch Per Unit Effort
CS	Case Study
DoA	Description of Action
TAC	Total Allowable Catch
WP	Work Package

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1 Executive Summary

1.1 Introduction

An integral component of PANDORA's methodology is close cooperation with stakeholders from the fishing industry, fisheries management, policy- and decision-makers, and non-governmental organisations (NGOs). On the one hand, this involvement of different stakeholder groups in the research process ensures that problem framing is conducted in cooperation with non-academic actors from the start of the project. On the other hand, the research questions of PANDORA are thus answered not only within the 'ivory tower' of the scientific world, but in close exchange with practitioners from fisheries and fisheries management.

We involve stakeholders in PANDORA to generate new biological data that can complement existing stock assessments, to coframe management scenarios for the simulations run in the project, and to tailor management recommendations to stakeholder needs. As a result of these activities, the final output of this project will be the co-development of PANDORA's Box of Tools, an openly accessible online repository of stock assessment tools, best practice guides, manuals and online training courses from and for fishers and scientists.

Stakeholder engagement in PANDORA occurs in seven Case Study regions across Europe, covering selected fisheries in the EU and Norway. These regions are the North Sea, Northwestern European Shelf, Eastern Baltic Sea, Bay of Biscay, Western Mediterranean Sea, Strait of Sicily, and Aegean Sea. PANDORA thus involves stakeholders from various countries in the EU and beyond, in which fisheries significantly contribute to the economy and to the creation of jobs. To facilitate dialogue with regional stakeholders, a number of engagement methods will be conducted throughout the lifetime of PANDORA; tailor-fitted to the needs and specificities of the different stakeholder groups and Case Study areas of the project (see also Deliverable 5.2: Stakeholder Engagement Strategy).

An important puzzle piece of PANDORA's engagement strategy is a series of regional workshops with those stakeholders that are affected by, or affect, the stock development and fisheries management of the project's target species. The first set of PANDORA stakeholder workshops took place between March and July 2019 in five Case Study areas. The following report outlines the goals, setting, methods and results of every workshop and details how these results contribute to the different work packages of PANDORA.

1.2 Defining the Challenge

Engagement with stakeholders has become common practice in environmental research projects, especially when funded by the European Union. The Responsible Research and Innovation (RRI) paradigm advocates cooperation with non-academic actors to create societally-relevant research and foster good uptake by the potential end users of research results. As already stated in the introduction PANDORA's Communication and Stakeholder Engagement Strategy (D5.2), however, stakeholder engagement is not without challenges. On the theoretical level, it can be demanding to bridge different theoretical schools, ways of thinking and 'worldviews' on the sides of the different stakeholder groups as well as between stakeholders and scientists. In terms of methodological challenges, it is difficult to integrate different kinds of knowledge and data; especially when it comes to integrating the quantitative,

statistical data generated by scientists with narrative, qualitative data from stakeholders and practitioners. Lastly, regarding the practical implementation of stakeholder engagement, the various actors involved in a research project might desire different outcomes of this engagement. There can be challenges of communication and finding a common ‚language‘ (also with respect to terminology and scientific vs. everyday language). Moreover, building trust with stakeholders and fostering productive collaboration and participation have time and again shown to be particularly challenging.

To address these challenges, PANDORA follows a detailed strategy for stakeholder engagement (see D5.2) and employs a trained social scientist to cooperatively manage the potential pitfalls of engagement. Engagement activities within this project are tailored to each specific case and regional context to best address stakeholder needs and craft meaningful exchange. The approach taken to conduct the first series of stakeholder workshops across most of the Case Study areas is outlined in the following section.

1.3 Approach

It is the aim of PANDORA to address important, practical, and region-specific research gaps for European fisheries. Key steps in our methodological approach therefore include the co-framing of management, biological, and future climate and socio-economic scenarios to be explored within the project in dialogue with fisheries, RFMOs, fisheries managers and fellow scientists. PANDORA relies heavily on the process of co-creation through communication with its stakeholders at each stage of the project. Through close cooperation between industry and scientists, regional management gaps will be identified and new biological data generated to inform future stock assessment and management.

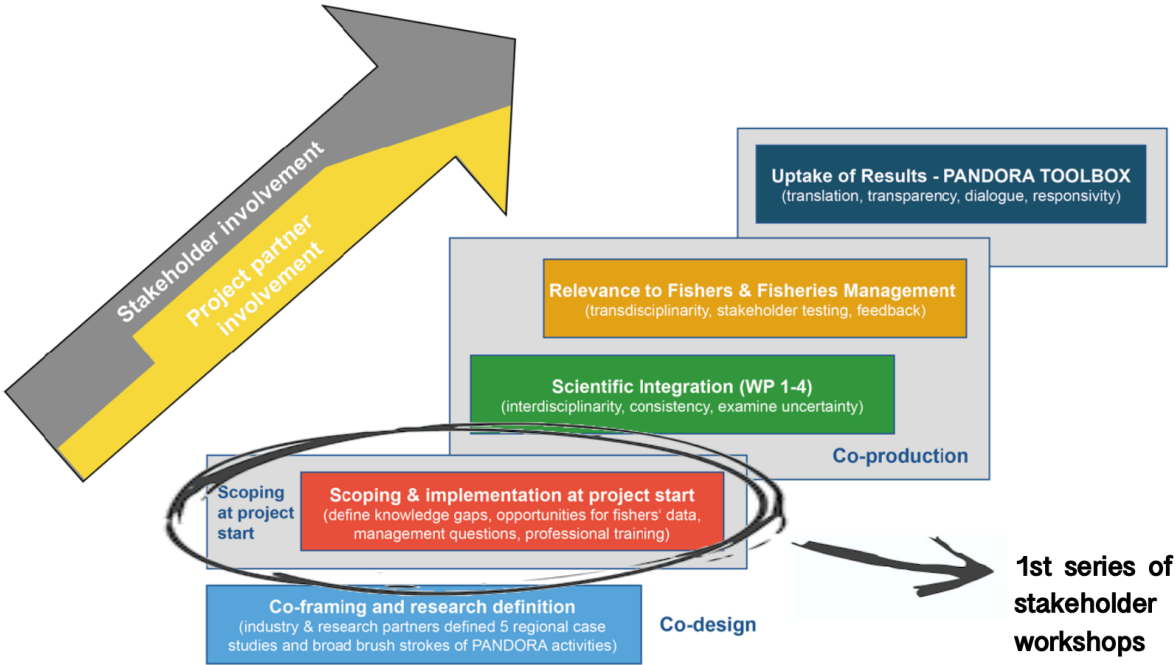


Figure 1: Stakeholder Engagement process in PANDORA from Co-Design to Co-Production (cf. project proposal, p. 34)

This co-creation takes place in form of three series of regional workshops, conducted in each PANDORA Case Study area by the local project partners. This deliverable summarises the results of the first of these workshop series the North Sea, Bay of Biscay, Strait of Sicily and Aegean Sea, as well as face-to-face interviews in the Western Mediterranean Sea (see Figure 2). The overall aim of these workshops was the co-framing of PANDORA’s questions and directions of research together with its key stakeholders. The approaches and methods chosen for each individual workshop differed throughout PANDORA’s Case Study regions depending on the constellation of local stake-holders, thematic focus and workshop goals. Both these thematic foci as well as the methods applied in each stakeholder workshop are outlined in sections 2 to 6 below.

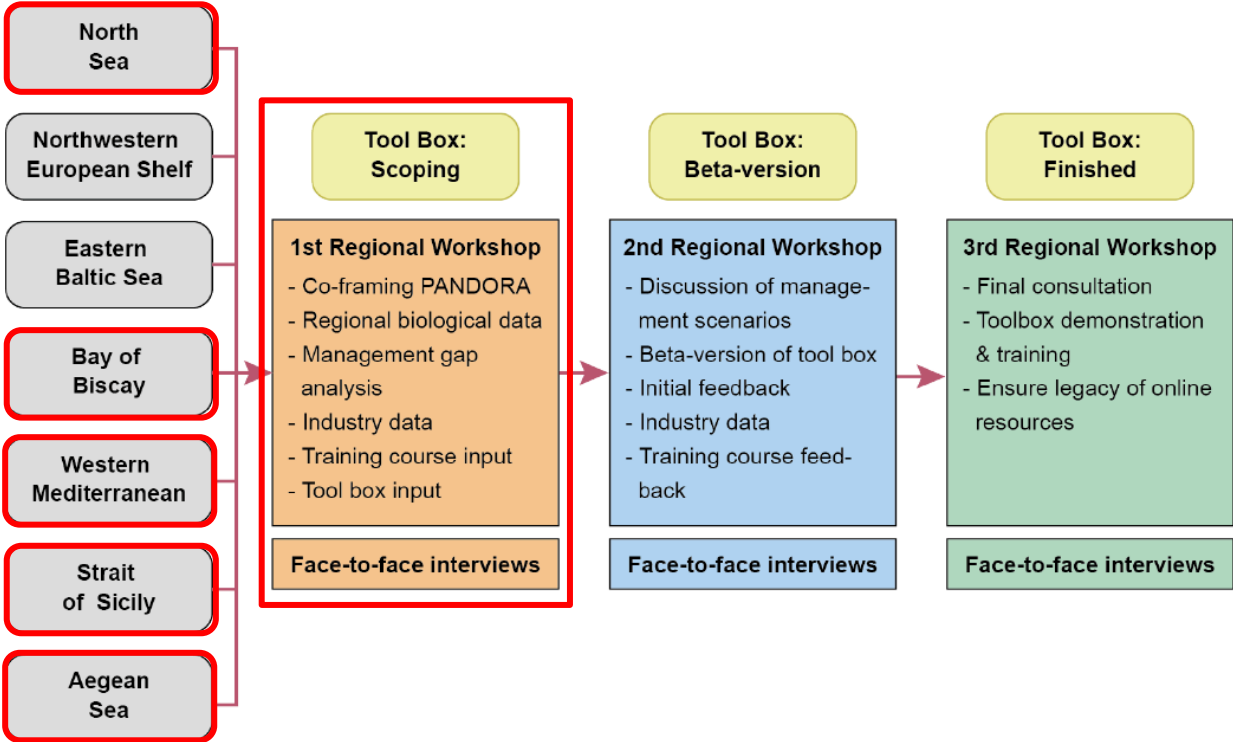


Figure 2: Overview of series of stakeholder workshops throughout PANDORA project lifetime (cf. D5.2, p. 33)

1.4 Contribution to the Project

As the co-framing of PANDORA together with relevant stakeholders is central to its methodology, the contribution of the stakeholder dialogue is essential to reaching the project goals. The first series of stakeholder workshops conducted between March and July 2019 contribute content to WP1, WP2, WP3 and WP4, and they strengthen the relationships with the regional key stakeholders of PANDORA. As a summary of these workshops, the reports within this deliverable will serve as the basis for future work of PANDORA and will inform the project’s outreach and communication activities. A detailed overview of the contributions to PANDORA’s individual work packages is included in each workshop report in the section “Relevance for PANDORA Work Packages”.

In addition to the content created in dialogue with the stakeholders, the cooperation with actors from the fishing industry, fisheries management, NGOs and regional governments during this first phase of workshops will strengthen the ties between PANDORA and its non-academic environment. These ties

are crucial for shaping a societally-relevant project and creating output that will be taken up by all important stakeholders after the end of the project.

1.5 Dissemination and Exploitation

The main aim of the stakeholder workshops and this deliverable is to create consent and direction for PANDORA's different work packages (WP1-WP4). The results from the different regional workshops, as summarised in sections 2 to 6 of this deliverable, will be exploited within PANDORA by WP 1-4 in terms of

- integrating of new biological and ecological information into stock projections (WP1);
- developing new stock development and fisheries management scenarios (WP2 and WP4);
- co-developing of the necessary input to derive 'Economic projections' (WP3);
- and strengthening existing and building of new relationships with PANDORA's key stakeholders in all Case Study regions.

In terms of dissemination, any new research and findings based on the stakeholder workshops, or findings that are relevant to key stakeholders regionally, will be disseminated through

- a) scientific, peer-reviewed publications,
- b) the project website (e.g. news articles),
- c) social media (= PANDORA's Twitter channel),
- d) as well as presentation at future stakeholder meetings, scientific conferences, and other industry- and fisheries-related events.

2 Bay of Biscay

Author: Pierre Calvy, Ifremer (P8)

2.1 Description of the Case Study

The overall Bay of Biscay Case Study concerns both rays (genus *Raja* and *Leucoraja*) and blackspot seabream (*Pagellus bogaraveo*). The workshop reported here took place on March 8, 2019 and focused on questions related to blackspot seabream. Blackspot seabream is a species of commercial interest in particular in Spain, Italy, Portugal and France, where prices at first sale over 15 €/kg are recorded. The exploitation of blackspot seabream in the Bay of Biscay has been restricted by TACs since 2003. The TAC has decreased from year to year from 350 tonnes in 2003 to 117 tonnes in 2019. The stock is at a low level since a collapse in the early 1980s (Lorance 2011).

There is currently no stock assessment for blackspot seabream in the Bay of Biscay. ICES considers one stock unit in ICES subareas 6, 7 and 8 (Celtic Sea and Bay of Biscay) for which the ICES advice is based on the ICES stock category 6 "*negligible landings and stocks caught in minor amounts as bycatch. Includes stocks where landings are negligible in comparison to discards and stocks that are primarily caught as bycatch species in other targeted fisheries*". This results in ICES recommending zero catches as there is no data about stock biomass or trends. Nevertheless, in recent years, fishers have reported an increase in this species' availability especially in the West of Brittany. Although the current stock level is small with respect to historic levels, current TACs may be smaller than unavoidable bycatch, implying that blackspot seabream may become a choke species. To overcome the lack of data, PANDORA aims at collecting data and information including:

- Stakeholder knowledge and information on the species abundance and distribution;
- Quantitative estimates of local biomass from acoustic data collected on fishing vessels;
- Occurrence and abundance of the species, in particular juveniles, in shallow waters along the coast from video observations.

Research Foci and Central Questions

For blackspot seabream, the objective of the Bay of Biscay case study is to collect information on biology and population size. The aim of the workshop was to

1. present PANDORA and the role of stakeholders in the project to fishers and one Producer Organisation from this Case Study involved in bycatch of blackspot seabream,
2. to report on the PANDORA questionnaire distributed to stock assessors of all blackspot seabream stocks in the Atlantic and
3. to organize an acoustic survey of the main area of abundance of the species to the West of Brittany.

The specific objective of the acoustic survey to the West of Brittany is to estimate the biomass of blackspot seabream during summer using echo-integration of acoustic data and associated fishing and underwater visual data from an autonomous underwater vehicle (AUV).

Overview of Main Stakeholders

The study involves fishers of the French Atlantic coast who are likely to catch blackspot seabream, scientists, producer organizations, divers and spear fishers. The fishers involved are mainly small-scale handliners for which blackspot seabream catches can represent an important part of their income. They play a crucial role in the project as they bring empirical knowledge and will participate in the survey. The most involved producer organisation is *Pêcheurs de Bretagne* due to its geographical coverage. They are a key stakeholder that coordinates the dialog between fishers and public administrations. Divers and spear fishers are also stakeholders and were asked to provide data on the locations where they observed blackspot seabream using an online survey.

Issues that Should be Solved with the Workshop

The workshop aimed at increasing the link between PANDORA and the stakeholders and enhancing the collaboration by working together on tools that could facilitate future management. It was important that stakeholders had the possibility to share their problems, needs and wishes for future management. Feedback on the questionnaires was collected to ensure that fishers' needs were well understood and fully addressed. The workshop was also aimed at preparing the acoustic survey in order to accommodate scientific (e.g. space needed for the echo-sounder) and field (e.g. tidal cycle, weather) constraints on-board of the small-sized handliner boats.

2.2 Workshop Setting

The workshop was designed as an opportunity to enhance interaction between stakeholders that are interested in the project at very different geographic scales (from a European scale to a very local scale). After the presentation of the project and a discussion about management needs, the purpose was to choose some areas, dates and modalities that would make the acoustic survey relevant and successful.

The workshop took place in the afternoon of March 8, 2019 in Quimper (Brittany, France) at the headquarters of the producer organisation *Les Pêcheurs de Bretagne*. All invited members were present: five handliners from Audierne, three scientists from IFREMER who guided the discussions, a project member from Hamburg University who communicated about the objectives of the PANDORA project and two members of the producers organisation *Les Pêcheurs de Bretagne*.

Workshop Agenda

1. PANDORAs' framework and benefits for stakeholders
2. Needs of fishermen in terms of management
3. Blackspot sea bream assessment of other European stocks
4. Acoustic survey methods and constraints

Methods

One person presented each of the agenda point in a way open to discussion. Stakeholders were asked to explain their needs. They were invited to speak about their dissatisfaction or suggestions about management methods, to provide ideas of action that would help them in their activities e.g. training workshops. To discuss about the goals and needs of the acoustic survey, maps were used to facilitate the sharing of geographical knowledge on blackspot sea bream spatial distributions (see Figure 3).



Figure 3: Fishers working on survey design for blackspot seabream acoustic survey during first Bay of Biscay workshop.

2.3 Workshop Results

1) *New Biological and Ecological Knowledge*

Blackspot seabream behaviour and abundance: Information about blackspot seabream behaviour emerged from fishers knowledge: seasonality and tidal cycle. Temporal periods during which blackspot seabream is most abundant on Brittany coasts were described. Fishers reported that the species arrives in coastal waters in April or May, is abundant from June to September or October and tends to disappear thereafter, although some fish may be observed occasionally in winter. It was therefore decided to conduct the survey in June and September. Fishers indicated that blackspot seabream is an aggregative species that form dense schools generally homogeneous in size but sometimes mixed with horse mackerel. Their behaviour seems to be more active at the end of the summer than at its beginning.

Location for acoustic survey: Fishers located areas where blackspot seabream occurred with high densities in the previous summers on a map. In terms of behaviour, fishers reported changes according to tidal currents with the species being close to the sea floor at high current speeds and moving up in the water column during weaker currents at which time schools aggregate over rocky features. Moreover, the fishers described their fishing method: after finding a school they anchor or drift over the school for a few minutes. If the first caught individuals are too small they move on and try again a few dozen meters away.

2) *Management Gaps + Needs*

Lack of stock information: The lack of information on the Bay of Biscay stock of blackspot seabream becomes problematic to take management decisions. In commercial fisheries, blackspot seabream is subject to a minimum conservation reference size of 33cm in all Atlantic regions where it occurs (Commission implementing regulation (EU 2017/787). In French recreational fisheries a minimum size of 23cm applies (JORF 2013). The former is presumed close to the mean size at first maturity of females. A strong need for more stability in quotas was expressed as year-to-year variations are problematic to handle by producer organisations.

Protection measures: Protection measures during the winter breeding period were strongly suggested as blackspot seabream are much aggregated at this time and hence highly catchable.

2.4 Relevance for PANDORA Work Packages

WP1: The discussion of the questionnaire results with stakeholders helped in completing the scoping of management needs. A difference of rules in minimum size of capture between recreational and professional fishers was reported. The knowledge that emerged about biological aspects will be useful for acquiring new data during the planned survey.

WP4: The workshop provided an opportunity to clarify the decision process resulting in TACs and quotas and to explain the possible options of fisheries management for the blackspot seabream stock in the Bay of Biscay depending on the survey results. These options include a progressive decrease of the quota until the fishery becomes closed unless the stock biomass is proven to be high enough to sustain the current levels of catches. Alternatively, if the biomass can be estimated, annual catches could be adjusted according to the biomass estimated from an acoustic survey carried out in subsequent years.

WP5: The workshop reinforced the cooperation between stakeholders with different geographical involvement. By being involved in the data acquisition process, fishers and producer organisations become actors in the management decision process. If the survey provides satisfying tools to assess the stock, the protocol will be included in the PANDORA toolbox to enable its implementation by the Producer Organisation and other interested actors, possibly also in other Case Studies and for other species.

2.5 Next Steps

The acoustic survey plan is under revision to take into account fishers' recommendations and indications, in particular for target areas of higher abundance of the species. A number of further meetings with fishers are planned to organize the practical aspects of the survey. First trials of the acoustics equipment on the vessels chosen for the survey will be carried out in April. The survey is scheduled to take place in June in two parts, because tidal conditions do not allow for 10 consecutive days with moderate enough tidal currents. In case of troubles, e.g. bad weather, the survey can be postponed to September.

The issue of a difference of minimum size of capture between recreational and professional fisheries will be reported to ICES, where blackspot seabream stocks are assessed and subject to scientific advice every second year.

Yield per recruit simulations with size varying selectivity and natural mortality will be done to complete WP2 objectives.

3 Aegean Sea

Authors: Paraskevi Karachle & Dimitrios Damalas, HCMR (P11)

3.1 Description of Case Study

The Aegean Sea demersal fishery exploits more than 100 commercial species. However, only four out of them i.e. hake, red mullet, striped red mullet and deep-water rose shrimp, comprise 23% of the landings value and are considered key stocks for the fishery. Demersal species are fished by bottom trawlers and by a small-scale fishery operating mainly near the coast and utilizing a number of different gears, mainly static longlines and gillnets. The fishery is managed through effort control, in a form of spatio-temporal closures, as well as technical measures (minimum conservation reference size, control of gear characteristics, etc.) (cf. STECF 2013). Currently, from the four key stocks, hake is considered to be overfished, while the rest of the stocks are most likely sustainably fished (EU 2018). The majority of the rest of the species are of unknown stock status due to lack of data.

Research Foci and Central Questions

Stakeholder perceptions are important for developing management scenarios within the PANDORA project. Towards that direction a questionnaire was compiled focusing on the management of (mainly demersal) fish stocks in the Aegean Sea. Various stakeholder groups were approached in order to share their views on the current status of fish stocks, major conflicts in the fisheries sector that might induce mismanagement of stocks, probable changes in the status of major stocks, management issues, and finally the impact of climate change on stocks.

Overview of Main Stakeholders

In the frame of the Aegean Sea case-study, effort has been made to retrieve information from various stakeholder groups. Yet, it was not feasible to access all types and effort was restricted to administration (i.e. regional fisheries departments) and fishers (i.e. trawlers and small-scale) that exploit the species that will be further analyzed/assessed in the case study area. Thus, questionnaires were compiled addressing questions relevant to management issues. These questionnaires slightly differentiated between the two groups of stakeholders, as to meet with the needs of the survey and the ability of the different stakeholders to provide relevant information.

Issues that Should be Solved with the Workshop

Collaboration with the stakeholders is a necessity of achieving the aims of the case study. The stakeholder groups approached have, in a way, a complementary perspective of fisheries and the status of the stocks; administrators have policy oriented view, whereas fishers are life-dependent and hence strongly affected by the well-being of stocks.

Questionnaires used in the Greek case study were custom-made in order to gain information of the perceptions on the stakeholders on issues, needs and desired changes on fisheries management currently imposed in the country.

3.2 Workshop Setting

In the case of fishers, two separate workshops were organised:

- May 25th 2019: with seven trawling fishers at the headquarters of the Panhellenic Union of Middle Range Fisheries Ship-owners in Nea Michaniona near Thessaloniki, and
- July 6th 2019: with small-scale fishers in Syros Island at the fishing ports of Ermoupolis and Finikas.

With respect to the fisheries' departments, as it was not feasible to gather colleagues in one place for a proper workshop, questionnaires were dispatched by e-mail. The front page of the questionnaire provided with all the necessary information regarding the project and the use of information. In some cases, additional clarifications were provided, upon request, through phone communications.

The duration of each workshop was approximately 2 hours. In the beginning of the meeting, fishers were welcomed and the scope of the project was described. They were thanked for participating and the questionnaires were distributed. The fishers were given 20 minutes to fill in the questionnaires with the assistance of the scientific personnel. Following, a discussion was conducted, with main topic of the discussions being "How do you perceive management of fisheries in Greece?".

Methods

The questionnaires were structured in a "multiple" choice question type. Overall, the questions were grouped in four (4) general themes: (a) general information (10 questions), (b) policy & legislation (seven questions), (c) socio-economics (five questions), and (d) environment (six questions). This questionnaire was filled out and discussed with the fishers during the workshops.

3.3 Workshop Results

1) New Biological and Ecological Knowledge

Fisheries administrators: Fourteen (14) administrators at regional fisheries departments, from the corresponding offices in the Aegean Sea and Crete, replied to the questionnaire. They see that the major conflict in the fisheries sector are among fishers, fishers-administration and fishers-control authorities. Finally, the vast majority of them see that climate change is an important issue that leads to environmental changes (e.g. temperature), it affects the ecology of species (e.g. re-distribution of fish) and will eventually have negative effects on the fisheries sector.

Fishers: Five (5) fishers that own/operate a trawler and four (4) small scale fishers were interviewed. In general they stated that they do not see many conflicts, except with the recreational fishers (they consider that this constitutes IUU fisheries, and the main issue is the fact that recreational fishers sell their catches). They were very reluctant into sharing their catches (either on an annual basis, or per individual species). For hake *Merluccius merluccius* and deep water rose shrimp *Parapenaeus longirostris* they reported that there seems to be a slight increase in their catch, the Red mullet *Mullus barbatus* catches seem not to have changed, whereas for striped red mullet *Mullus surmuletus* the overall perception is that the catches are decreasing. Fishers are aligned with administrators with respect to climate change, as they also identify environmental changes (e.g. temperature, differences in the weather conditions), re-distribution of fish and expect negative impacts on their profession.

2) Management Gaps + Needs

Fisheries administrators: The current status of fisheries related to the past, according to them is worse and stock dependent, and the main reasons for the current status of fisheries resources are (a) overfishing; (b) bad management; and (c) illegal, unreported and unregulated (IUU) fishing. The majority of the fisheries administrators asked, believe that the status of fisheries in Greece will get worse, and the most expected changes are expected to occur in species fished and in the technology used in the fisheries sector. It was noted by the administrators that fisheries management in the country is not efficient, and they would like to see scientists, along with national and regional bodies, being responsible in fisheries management. The major issues that emerged responsible for the failure of fisheries management were IUU and the lack of proper monitoring, control and surveillance in the sector.

Fishers: The perception of the fishers regarding the current state of the stocks was not clear as some of them consider it better than in the past (mainly from the trawling sector), some that it is worse (small-scale fishers) and some that it is stock depended (both trawling and small-scale). Yet, they see as major drivers for stock status to be, to a large extent, climate change and IUU, followed by pollution, overfishing and bad management practices. Regarding the future of the sector, those engaged in trawling either see it improved or were hesitant on a firm positive/negative reply, whereas the small-scale fishers consider that it will get worse. Fishers would like to see management being a responsibility of national bodies, and then the scientific community.

Fishers consider that the main problems in the current legal frame on fisheries management are lack of funding, spatial and technical restrictions, as well as banned species. An issue that emerged through discussions with small-scale fishers is the engine horse power (HP) restrictions, mainly due to limitations and risks deriving on safety at sea. The trawling industry also agree and fully support the idea of subsidies for engine-replacement, towards increasing safety at sea.

Small-scale fishers consider that alien species, especially *Siganus* spp. that are thriving in the Aegean waters are of major impact in the operations and they consider that management measures should be taken. On the other hand, fishers operating with trawlers consider as of high importance spatial and technical measures deriving from both national and especially EU regulations. For example the 1.5 nm restriction is limiting their fishing grounds to a large extent, and they would like it to be amended. With respect to cod-end mesh size, some of them consider the 40 mm square mesh size (stretched) as a cost effective measure, but some consider it as not effective. Nevertheless, all agree that they would not be keen in seeing it increasing. They also have issues with fleets from neighbouring countries (namely Italy and Turkey) that operate not only in international, but in some cases (illegally) in national waters too. Both acknowledge that the increasing numbers of mammals (especially dolphins) and large tunas in the Aegean Sea waters are also an important factor causing them problems (e.g. acting as predators, damaging gears). Recreational and IUU fishing constitute a problem for them, and would like to see actions to be taken to mitigate those impacts.

3) Management Scenarios Discussion

Fishers: Through discussions with fishers the issue of adaptive management emerged. They would like to see a management scenario that would be flexible and would reflect changes in ecosystems and fish abundances in space and time. In the future they would like to have better access to the markets and they also stated that they would like to see a reduction in the restrictions posed on them by the legislation.

Finally, they consider that management should start from scratch, as they consider that by amending existing legislation instead of progressing and correcting erroneous policies, scattered measures are being taken that in time prove ineffective.

3.4 Relevance for PANDORA Work Packages

Our main goal was to develop management tools which would be both science-driven and in-line with stakeholder needs. The perceptions gathered through the stakeholder engagement workshops will fill in the necessary input to derive 'Economic projections' (under WP3) and conclude to the best 'Management options' (under WP4).

3.5 Next Steps

Based on the workshop results a Management Strategy Evaluation (MSE) framework will be employed so that to allow for comparisons among different management strategies, taking into account the suggestions of the interviewed stakeholders.

4 North Sea

Authors: Alexander Kempf & Bernhard Kühn, TI (P14)

4.1 Description of the Case Study

A wide variety of commercially important species inhabit the North Sea leading to a complex food web structure and mixture of fisheries with strong technical interactions (more than one species are caught simultaneously and one species may be fished by different gears). Both, the biology (e.g., changes in productivity, shifts in distribution) and fisheries management (e.g. relative stability) are influenced by climate change. Together these factors make the management of North Sea stocks extremely challenging and ask for management strategies taking into account these aspects.

The quality of assessments is in general sufficient, however, in recent years assessments of important target stocks have been challenged (e.g., cod, sole, plaice). The reliability of assessments for data limited bycatch stocks are in general under debate and ways how to manage these stocks in mixed fisheries under the landing obligation in a sustainable way is an important question. Management in the North Sea can benefit from improved information on sub-stock definitions (e.g. cod with its different biomass developments in different parts of the North Sea), shifts in spatial distribution, density dependent effects, predator-prey interactions and other factors governing dynamics, while especially data-poor stocks require the development of improved monitoring strategies (together with the fishing industry) to aid in their assessment and management.

Case Study Research Foci and Questions

The ecosystem of the North Sea is changing because of climate change and significantly reduced fishing effort leading to following questions:

- Why are some stocks (i.e. gadoids) not recovering to previous levels despite lower fishing mortalities?
- Density dependent effects: → Can we proof they exist and do we need new tools for reference point determination?
- Can we expect further major shifts in the distribution of stocks under climate change? → Influence on reference points, future catch composition and the economy of fleets
- Stock structure of North Sea cod: Can we do something for cod in the southern North Sea or is the further decrease a result of climate change and cannot be reverted?
- How important are food web interactions? Which interactions do really matter and can we cope with such interactions in management?

The management of the North Sea demersal mixed fisheries under the landing obligation is especially challenging and Brexit further complicates the situation in the North Sea. This leads to following questions:

- Mixed fisheries advice is important under the landing obligation. How can we deal with choke situations?
- Is there a way to optimise the landing obligation in the next CFP reform?
- TACs may not be the right management tool for bycatch stocks. But what else?
- How could zonal attachment scenarios to distribute quotas look like if relative stability has to be replaced because of Brexit and climate change?

Overview of Main Stakeholders

The case study involves representatives of producer organisations from different demersal fisheries as well as scientists. These stakeholders have the best knowledge on stocks, issues with the assessments and how industry data may help to improve the quality of assessments and how fisheries management impacts the economy of fishing fleets. At a later stage case study results will be also discussed with managers and NGOs.

Issues that Should be Solved with the Workshop

The 1st workshop aimed at increasing the link between PANDORA and the fishing industry. It was tried to enhance the collaboration by developing realistic environmental and management scenarios and thinking about how industry could help by providing data to improve the quality of assessments. Stakeholders had the possibility to share their opinions, issues, priorities and wishes for future management to co-frame the work in Pandora. This ensures that the potential of receiving data from the industry is maximised and prevents from running scenarios in WP 2-4 that are either of no interest or are seen as unrealistic by the fishing industry.

4.2 Workshop Setting

Goals of Workshop and Central Questions

The workshop(s) took place 13th and 14th of May 2019 at the University of Hamburg. All invited members were present: 4 fishing industry representatives, three scientists who guided the discussions.

The workshop was designed as an opportunity to enhance the interaction with fishing industry representatives that are interested in the project. After the presentation of the project, the environmental

and management frame for scenarios to be tested in Pandora WP 2-4 were discussed to ensure they are realistic and useful. The frames also define the specifications needed for the tools. Afterwards discussion on the quality of current assessments and the potential for including more biology in assessments and advice was on the agenda. During all agenda points also the possibility to integrate data from the fishing industry was discussed. Finally, ideas for training workshops and the toolbox were collected.

Methods

The scientist running each workshop presented each of the agenda points in a way open to discussion. Guiding questions were prepared beforehand and posed for debate. Stakeholders were asked to explain their opinions. They were also invited to speak about their dissatisfaction or suggestions to get an idea what are the hot topics that need to be addressed by PANDORA. The agenda for both workshops can be found in Annex 1 of this report.

4.3 Workshop Results

1) Environmental Frame for Scenarios and Biological Knowledge

In general, the participants agreed that the topics and central questions (see under point 1) are highly relevant and need to be somehow covered in scenarios carried out in Pandora. The work on multi species interactions was seen as important but also critical given the lack of stomach data after 1991.

Low productivity of gadoids: The main explanation from the stakeholders was a lower productivity of the whole ecosystem, partly caused by less nutrient input via rivers due to programs to reduce eutrophication. However, the assessments used to estimate recruits were also seen critical especially for saithe because according to the opinion of the stakeholders the assessment is biased due to the increase in mesh size and shifts in fishing grounds over the last years. Also the wind direction and wave height has changed considerably impacting the catchability but also the productivity in certain areas and drift patterns of larvae. These factors should be incorporated in assessments and models to explain recruitment dynamics. In general larvae were seen as bottleneck determining year class strength. But there is a lack of data for these early life stages but nobody cares and money is not available to have more cruises and samples. In case of a pronounced lower productivity the stakeholders were undecided whether changing B_{lim} to a lower value is a good option. However, all stakeholders did not want that science is now only running pessimistic recruitment scenarios in forecasts. Too much precaution is not good and just leads to incompletion and loss of potential yield and food. Scientists have to show the full bandwidth of potential outcomes, but need to highlight where the risk becomes high to create damage.

Density dependence: The stakeholders observed density dependent effects for plaice. There seems to be not enough food and this could be also partly caused by less trawling and therefore less available food (e.g., fast growing small worms). Also a shift northward in distribution could be an explanation. However, there is also a good chance that the stock is overestimated in the assessments and plaice density is lower in reality. Another example could be hake that is now entering the North Sea in larger amounts. It was questioned that this has something to do with temperature and maybe more with an expansion of the large stock. Density dependent effects should be included in reference point determination even if this means that F_{MSY} becomes higher and the equilibrium biomass lower. For less vulnerable stocks also a risk of more than 5% (e.g., 10%) to fall below B_{lim} should be acceptable. $MSY B_{trigger}$ as additional reference point (for plaice) was seen very critical and unnecessary. B_{pa} was seen sufficient to ensure that management is precautionary. There is no need to lower F already below $MSY B_{trigger}$.

Climate change and shifts in distribution: Shifts were observed for several stocks (e.g., sole, plaice, cod, cuttlefish). According to the stakeholders the topic is well covered in science but they questioned whether the effects are included sufficiently in the assessments and predictions. This includes also the need to have models with a more detailed spatial resolution. The spatial dimension is also not taken into account enough in management and for example for Nephrops management plans are needed that somehow limit the transfer of fishing pressure between functional units.

Cod in the southern North Sea: The opinion of the stakeholders was that the stock will likely not recover because of climate change (and also less nutrients from the rivers). Cod is moving northward but may come back to spawn for a limited time period. Fishing pressure is already low and hardly any cod is caught. Spatial management to safeguard cod is difficult to implement because of different interests. Real time closures could potentially work if enforced by observers. Wind parks could become a refuge for cod. But there is still not enough information available on the impact of wind parks according to the stakeholders.

Multi Species effects: According to the stakeholders it is important to include multi species effects. However, the data basis is very thin and results are very uncertain. The current models also lack important early life stages (eggs, larvae) and year class strength is often determined already during these stages. It is a general question where to start in the food web (also crangon and other crustaceans may be important). There is hope that with new technology (camera systems and machine learning) also stomach analyses can be carried out much faster and cheaper.

2) Management Frame for Scenarios and Issues with Current Management

Mixed fisheries: The stakeholders agreed that mixed fisheries advice is important. Maximising yield inside the ranges is better than maximising profit because we need food for the people. Profit would need to be maximised for companies separately according to the opinion of the stakeholders. The value chain is also difficult to oversee and market demands can change quickly (also because of substitutes). Therefore, catching less because of profit maximisation may lead to a significant loss later one because substitutes took over the market (plaice example). The focus should be on the big 5-7 stocks and not on all kinds of bycatch as wished by NGOs. It is unrealistic to think that MSY can be achieved for all stocks by 2020.

The stakeholders strongly argued for simpler harvest control rules that could be tested and compared to more complex methods in a mixed fisheries context. One example could be trends based control rules instead of trying to find out the absolute numbers of fish in the sea. A TAC constraint needs to be added to guarantee stability between years.

The “range scenario” in the mixed fisheries advice was seen critical. On the one side the information is valuable, on the other side fishermen would not accept a cut in TAC to harmonize TACs beforehand. It would also “punish” the “good guys” trying to buy and exchange quota beforehand to avoid overshoots in quota. Next to the ranges, flexibility between years could be also achieved by counting a certain amount of bycatch against the quota of the target species (already possible but needs to be allowed more often). Banking and borrowing is also a good idea (but does not always help if you have to pay back one year later). Balanced harvesting is an interesting idea that could be tested for comparison.

Low stock productivity: There is still a lack of process understanding to explain the current low productivity of several North Sea stocks. Climate change, food web effects and other processes determining recruitment strength have to be better understood. Reference points, management strategies and the fishing industry need to adapt to this environmental frame.

Climate change effects and rapid changes in the stocks also challenge current assessments. That assessments seem to lack 2-3 years behind according to the opinion of the stakeholders is a major concern. At the same time some stocks (plaice, hake) recovered to very high stock levels and density dependent effects have been observed. Such effects are currently still ignored in reference point determination. Cod in the southern North Sea is a good example of a stock influenced by climate change that maybe cannot be recovered in this area. This raises serious questions to the management system.

Quotas: A strong need for more stability in quotas was expressed as year-to-year variations are problematic to handle. This also includes to find simpler harvest control rules that do not dependent so much on the absolute numbers from the assessments and more on trends that seem to be more robust according to the stakeholders.

Landing obligation: The current landing obligation was highly criticized by the stakeholders. It is unworkable (also from an economic point of view) and has not been tested beforehand for realism and practicability. Stakeholders therefore were seriously concerned about the implementation of the landing obligation. Compliance can simply not be expected given the current rules. Regulations should thus not be implemented before proper testing. The regulations also differ between areas and are simply too complex to follow. Improvements regarding the landing obligation and compliance could be achieved by allowing marketing of all catches (also the undersized) in combination with minimum mesh sizes. Camera systems are ok for full registration of catches (together with new machine learning) but not for control purposes according to some stakeholders. Therefore, the focus should be on full registration of catches as basis for the assessments at the next CFP instead of focussing on the landing obligation as such. Another way to improve compliance could be to make cameras obligatory when there are indications for non-compliance. Fishermen voluntarily installing cameras etc. also for science should get some benefit. Another suggestion was to allow marketing of undersized fish to have a stronger incentive to bring everything onshore. Balanced harvesting may be tested in this frame. For bycatch stocks alternative management measures instead of TACs are needed in their core areas of distribution.

Bycatch stocks: The management for bycatch stocks should only focus on the core distribution areas of the stocks according to the stakeholders and not on few individuals found at the edge of their area of distribution. This just introduces unnecessary choke effects. The focus should be on the target species. Proper management should also safeguard most bycatch stocks. Alternative management measures apart from TACs are favoured (TACs for the big target stocks only), however, a good knowledge on the biology of the stocks is needed to find the right management measures. Spatial management could be an alternative but difficult to implement and there must be a level playing field. So far we only have choke species identification tools, but no mitigation tools.

Brexit is an important topic and relative stability is under pressure also because of climate change. Politically it is an important instrument that is problematic to replace. To run scenarios dealing with different methods to calculate quota splits (e.g., only distribute fishable biomass or take into account also juveniles?) based on zonal attachment or renegotiated relative stability keys were seen as important by stakeholders to inform the political process. The current pending situation makes the situation for fisheries management more difficult. Different versions of zonal attachment were seen as interesting options by stakeholders.

3) Issues with Assessments and Inclusion of More Biology

In general there was a clear wish that ICES should not give advice if the data basis is simply not good enough to provide assessments with sufficient quality. Especially assessments based on data limited approaches were seen critical. Scientists should not be forced to give advice and misused to transport negative messages.

Assessment of plaice: Concerns were raised for the assessments of plaice (overestimation of stock size), cod (strong decline) and saithe (uncertain/ too low recruitment estimates due to lack of sufficient survey data and increase in mesh size in the commercial fishery). In general, stakeholders had the impression that the trends in the assessments often lack behind 2-3 years. The variability in advice (also caused by errors and benchmarks) is too high and the fishing industry cannot cope with it. Climate change and associated changes in the stocks are a challenge for the assessments, reference point determinations and predictions. It was questioned whether these effects have been already incorporated sufficiently. In general, it was questioned whether the current assessments are flexible enough to incorporate changes in the biology of the stocks fast enough (also because of lacking manpower).

Scientific surveys: The reliability of scientific surveys has been questioned in general. Fishermen often have the impression that scientists miss fish because they fish at wrong times and in wrong areas. Comparative trial hauls between commercial and scientific vessels in the same ICES rectangle were encouraged. Stakeholders had the impression that new survey technology is not used because not enough money is spent for science and monitoring. New ways to monitor fish (e.g., UFO) have been developed but they are not used. The same applies to the potential of using fishing vessels as observation platforms.






Parameter	Change	Why?	Short term forecast	Long term forecast (MSY/PGY)
W		<i>Explain here the reason for changes in the parameters in terms of spatial distributions, foodweb processes, density dependence or environmental drivers,</i>	<i>Any effect on short term forecasts, e.g. on the suitable time range for averaging is listed here</i>	<i>Any effect on long term forecasts e.g. on the assumptions of stability in the relationship between stock size and reproductive potential, is listed here.</i>
Mat				
M2				
R				
D				

Figure 4: Example for a table summarizing existing knowledge on trends in biological parameters for single species advice sheets.

Seabass assessment: Knowledge on seabass could become more important in the future because of climate change. Data from recreational fisheries are needed. For “EU” functional Nephrops units TV surveys are often not available. Knowledge on brown shrimp would be beneficial. I.e. ways to manage the fishery have to be found according to some stakeholders. It was also questioned whether scientists overinterpret the outcomes of the assessment. Just looking at trends instead of absolute numbers may be a more robust approach.

ICES Assessments and Ecosystem Overviews: It was welcomed by all stakeholders to include the table proposed by the PANDORA project to summarise biological information for the advice (see Figure 4)

and work towards getting the knowledge needed to fill these tables was encouraged. Ideas to improve the ICES ecosystem overviews were discussed and the ideas gathered so far were seen promising.

Ideas for information to include in the ecosystem overviews were:

- Trends in the condition and productivity (e.g., mean weight, recruitment) common for certain stocks (e.g., flatfish, pelagics, gadoids)?
- Distribution of stocks and changes over time (common trends, new species coming into the ecosystem?)
- Density dependent and competition effects (Which stocks show currently density dependent effects?)
- Impact of closed areas (including windfarms) on stocks/communities
- Information on spawning areas, spawning times, nursery areas and shifts over time
- Table showing which métiers are mainly responsible for the catch of a certain sensitive species
- Who eats whom in the North Sea food web?

4) Data from the Industry

There was great support from the stakeholders at the workshop to help scientists to get more data from the industry. It was the general feeling of stakeholders that the quality of assessments can be improved by including more industry data. There is willingness to help science with getting enough data. The offers ranged from sampling length and weight of catches (self-sampling), over installing hydroacoustic equipment (or other sensors) on the vessels up to using a room on the vessel as laboratory. Also stomach sampling is possible, however, the analysis needs to be done in the labs. Cameras on board are often possible for catch registration if the data are not used for control purposes. However, for all this new technology (machine learning) is a prerequisite to analyse all the data fast and efficiently. Fishermen helping science should be rewarded somehow according to their opinion. Subventions for new vessels could be also made dependent on the level of support for science. Next to this also the stakeholders felt that more biology should be included in the assessments but also in the advice to better explain observed stock trends and changes in the ecosystem.

There was a general attitude that scientists do not use the potential of industry data. Commercial vessels are always at sea and they should be used as sampling platforms. This could improve the reliability of the assessments to a large extent according to the opinion of the stakeholders. The data basis needs to be improved to guarantee a better quality of the assessments. To be able to utilize data from the industry in an efficient way, new technologies (i.e. machine learning) have to be used to better use the potential of data from sensors and cameras.

There is already more data available than currently used. For example, the information on weight classes of landings is often not used. Also logbooks and VMS data could be analysed more to better understand fishing patterns. Data from auctions (e.g., average price) can give also a good indication on catch rates and how the stocks are developing.

5) PANDORA Toolbox

In general the stakeholders at the workshop had not much experience with tool boxes and have not used online tools. However, there was a strong wish for visualization tools to be able to present available data in an easy and user friendly way (also their own data, e.g., VMS data, catches by haul etc...). Such tools could be also used to identify vessels that have different fishing patterns and catch compositions

compared to other vessels in the same area (also for control issues). The toolbox should be transparent regarding the data quality used as input for models according to the stakeholders. Online training courses should be made available via the tool box.

6) Training Courses

A training course on new advances in hydroacoustics could be interesting for scientists and the fishing industry. Awareness courses for fishermen could be an idea. Some POs already do this for “clever young fishermen”.

4.4 Relevance for PANDORA Work Packages

WP1: The intensive discussions helped completing the scoping of knowledge gaps and management needs in the Case Study.

WP2-4: The workshop provided a great opportunity to get input on the biological and management frame for scenarios to be developed in WP2 to WP4. This ensures that the test cases for Pandora tools are relevant for stakeholders and not just the scientific community. It also ensures that the right tools are developed that are able to address questions relevant for the key stakeholders.

WP5: The workshop reinforced the cooperation between stakeholders and scientists. By being involved in the framing of scenarios and giving feedback on assessments and ideas to improve advice, fishing industry becomes an active actor in the PANDORA project. If data sampling from the industry and the usage in the scientific community could be enhanced over the course of the project, another important aim would be fulfilled.

4.5 Next Steps

The information from this workshop will be used to frame the scenarios tested in WP2-4. The contacts with the industry will help to establish data sampling programs to be used in future assessments. The ideas for the training courses and the toolbox will be directly taken into account for further planning of the project. After results from the scenarios are available, they will be discussed with stakeholders again in a follow-up workshop.

5 Strait of Sicily

Author: Matteo Sinerchia, CNR (P3)

5.1 Description of Case Study

The case study area corresponds to the North sector of the Strait of Sicily and includes the FAO-GFCM geographical sub-areas (GSAs) 15 (Malta Island) and 16 (South of Sicily). Prominent features include deep coral assemblages, cold seep communities, coralligenous habitats, rare or endemic species (such as Maltese ray), high habitat heterogeneity, spawning and nursery grounds for large pelagic fish (i.e. bluefin tuna and swordfish), persistent hotspots of diversity of demersal species, and large fluxes of Atlantic and Indo-Pacific exotic species. Most important human uses of the area are fishing, aquaculture, conservation, shipping and tourism. The area includes the south coasts of Sicily and the Maltese waters within the FAO 37.2.2 statistical. From a biogeographic point of view the Strait of Sicily is traditionally considered as the boundary between western and eastern Mediterranean basins.

Mediterranean fisheries show clear signs of overexploitation of the main fish stocks (Colloca et al. 2017), important modifications to marine ecosystems (Ramírez et al. 2018) and low economic performance (Franquesa et al. 2008; Sabatella et al. 2017). In particular, current and future management needs, identified as part of D.4.1, are reported in Table 1.

As in other areas of the Mediterranean, the Italian fleet is managed through the control of capacity (number of fishing licenses), fishing effort (days at sea, number of trawls), and technical measures (cod-end mesh size, area closures and fish-size limits). A national multiannual management plan (NMAP) for trawl fisheries in GSA 16 was adopted by Italy in January 2018. The new NMAP is based on progressive reduction of fishing effort (days at sea) toward the effort predicted to produce F_{msy} for the main stocks.

In addition, the Mediterranean Regulation EC 1967 of 21 December 2006 fixed a minimum harvest size of 20 mm CL for DPS and of 11 cm TL for MUT. Trawling is not permitted on fishing ground less than 50m depth or within the three nautical miles from the coastline. In 2015, Malta had 14 trawlers that operated on a full-time basis. A preliminary analysis of the capacity of the fleet in the Sub-regional Committee report for the Central Mediterranean (SRC-CM) showed that there was a 39% reduction from 2011 to 2015 (7 permanent and 2 temporary). Fishing effort and capacity in the 25 nautical miles fisheries management zone are being managed by limiting vessel sizes, as well as total vessel engine powers (EC 813/2004; EC 1967/2006). Trawling is allowed within this designated conservation area, however only by vessels not exceeding an overall length of 24m. Such vessels fishing in the management zone hold a special fishing permit in accordance with Article 7 of Regulation (EC) No 1224/2009, and are included in a list containing their external marking and vessel's Community fleet register number (CFR) to be provided to the Commission annually by the Member States concerned (EC 813/2004).

In Tunisia, no national regulations targeted specifically at the rose shrimp fishery are currently in place. However, trawling is not permitted within 3 nautical miles of the coast and at less than 50m depth in GSAs 12-14. Moreover, in GSA 14 a closed season where trawling is prohibited extending from July-September is in place in order to protect recruits of a large number of species. Although minimum landing sizes exist for a number of crustacean species harvested by the Tunisian fleets, there is no minimum

landing size for *P. longirostris*. The minimum legal mesh size used by demersal trawlers in the region is a minimum 40 mm square mesh codend or a diamond mesh size of at least 50 mm¹

Due to the importance of the deep water rose shrimp fishery for the coastal countries in the area, the CFGM adopted the Recommendation GFCM/40/2016/4 on the establishment of a set of minimum standards for bottom trawling fisheries of demersal stocks in the Strait of Sicily, pending the development and adoption of an international multiannual management plan. In addition, owing to the importance of the deep water rose shrimp fishery for the coastal countries in the area the GFCM adopted a series of recommendations targeting deep water rose shrimp and hake fisheries: i) REC.CM-GFCM/39/2015/2 on the establishment of a set of minimum standards for bottom trawling fisheries of demersal stocks in the Strait of Sicily, pending the development and adoption of a multiannual management plan; ii) REC.CM-GFCM/40/2016/4 establishing a multiannual management plan for the fisheries exploiting European hake and deep-water rose shrimp in the Strait of Sicily (GSA 12 to 16); and iii) REC.CM-GFCM/41/2017/8 on an international joint inspection and surveillance scheme outside the waters under national jurisdiction of the Strait of Sicily (geographical subareas 12 to 16), iv) REC. GFCM/42/2018/5 on a multiannual management plan for bottom trawl fisheries exploiting demersal stocks in the Strait of Sicily².

Table 1: Current and future management needs for the Strait of Sicily fisheries (D4.1)

STRAIT OF SICILY			
Species	Current management needs	Future management needs	What should be changed?
Deep-water rose shrimp, hake, red mullets, giant red shrimp	In the last ten years Sicilian trawlers have suffered a declining in both productivity and economic performance due to several co-occurring factors such as: i) overfishing (i.e. decreasing CPUE); ii) raising costs, iii) poor market condition (e.g. low gross prices of fish products), iv) competition with low-price sea food products; v) increased and unregulated access at the fishing grounds in international waters, vi) lack of common management rules shared between the national fleets exploiting the stocks (Italy, Malta, Tunisia, Libya, Egypt); vii) old age of the trawlers, viii) lack of marketing actions to increase the quality and value of the products.	Competition with other fleets, lack of common management rules and approaches, uncertainty on the evolution of the ecosystem.	Enforcing the management plan adopted by the GFCM in 2016
New fisheries developing in the Strait of Sicily:			
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¹ REC.CM-GFCM/33/2009/2 on the minimum mesh size in the codend of demersal trawl nets

² Recommendation GFCM/42/2018/5 on a multiannual management plan for bottom trawl fisheries exploiting demersal stocks in the Strait of Sicily (geographical subareas 12 to 16), repealing Recommendations GFCM/39/2015/2 and GFCM/40/2016/4

The plan includes the following objectives:

- 1) Ensure that exploitation levels of European hake and deep-water rose shrimp are at the maximum sustainable yield (MSY) by 2020 at the latest;
- 2) Protect nursery areas and essential fish habitats important for the stocks of European hake and deep-water rose shrimp in the Strait of Sicily;
- 3) Gradually eliminate discards, by avoiding and reducing, as far as possible, unwanted catches, and by gradually ensuring that all catches are landed;
- 4) Provide for measures to adjust the fishing capacity of the fleets to levels of fishing mortalities consistent with the MSY, with a view to having economically viable fleets and without overexploiting marine biological resources.

Research Foci and Central Questions

For red mullet and deep water rose shrimp, the objective of the Strait of Sicily case study is to generate of biological knowledge based on ecophysiological experiments and modeling the combined effect of multiple stressors, natural or anthropogenic, on the marine ecosystem. The main aim of the workshop was to present the scope of PANDORA to the stakeholders and to receive their feedback in terms of the perceived changes in the fishing as a result of climate, in terms of relevant scenarios to be incorporated in the models, and the questionnaires that had been distributed to them prior to the meeting.

Overview of Main Stakeholders

The workshop was attended by 38 participants from different backgrounds:

- Officers from the fishery department of Italy (DG-PEsca – MIPAAFT),
- Fisheries scientists,
- Fishers representative from Italy, Tunisia, Libya and Malta,
- Officers from FAO, and WWF.

Issues that Should be Solved with the Workshop

This workshop was designed to enhance the link between PANDORA and the stakeholders involved in the area of the Strait of Sicily, which is one of the most important fishing grounds in the Mediterranean Sea. Stakeholders were given the opportunity to express their opinion on the work to be performed by PANDORA, on the key species chosen as case studies, on the relevant scenarios to be modeled with a particular focus on the issues related to climate change and global warming. It was fundamental to engage stakeholders so that they could express their opinion both in discussions and through feedback in the questionnaires. One important issue that was solved for example was the scope of the questionnaires, which, in line to suggestions by stakeholders was expanded.

5.2 Workshop Setting

The meeting objectives were to:

- i) update all stakeholders on recent advances in management and scientific advice on target species and related fisheries,
- ii) promote discussion among stakeholders toward a common view on fisheries management,

- iii) merge empirical and scientific knowledge to ensure that the best possible advice is provided in support of fisheries management,
- iv) one further session of the meeting was devoted to gather views on the impact of climate change on fisheries in recent years.

The workshop was held on the 20-21 June 2019 in Palermo as part of the FAO- MedSudMed technical meeting in support of fisheries management. The meeting was attended by representatives of trawl fisheries, including: fishers, fisheries administrations, ONG, FAO, and research institutes. The total number of participants was 38, from four different countries (Italy, Tunisia, Lybia, Malta). Please find the meeting agenda in Annex 2.

Methods

The workshop was structured by a series of presentations and the delivery to stakeholders of a questionnaire (prior to the meeting) (see Annex 3) related to climate change perception in the Strait of Sicily. Presentations were aimed to update on the current and future research activities. These presentations provided a starting point for discussion in between each talk and during breaks. The questionnaire (see Annex 3) was tailored in order to focus on the effect of climate change as perceived by stakeholders, and in particular on:

- 1) overall perception
- 2) total catch
- 3) spatial variations
- 4) temporal variation/shift

5.3 Workshop Results

1) New Biological and Ecological Knowledge + Climate Change

A presentation of the work planned in PANDORA with reference to the Strait of Sicily was delivered. The presentation included a description of the background information on climate change trends in the region, and the experimental protocol to be used in order to determine the metabolism and the thermal tolerance of two case study species (red mullet and deep water rose shrimp), as well as the modeling approach (Atlantis model) that will be used in order to test the potential effect of various fisheries scenarios and how these would be affected by climate change. A discussion was initiated as a result of this presentation and the questionnaire given to the stakeholders prior to the meeting (see Annex 3). Below, we report the main comments/issues raised by the stakeholders with respect to fisheries, climate change, and key species.

Effects of climate change: Tunisian fishers note the effect of climate change, the fishing *season for red mullet* has arrived 30 days late. In Tunisia there are no subsidies to support the sector, the fleet is old and obsolete. Algeria requested for water extension to 53 miles. Italy and Tunisia share the same fishing areas as well as a pollution problem within them. The same shift was observed by Italian fishers as an effect of climate change in the area in the last years, especially in the recruitment of juvenile red mullets (*fragaglia*) from late July to September that could as a possible result of a shift in the spawning period. The same shift in red mullet recruitment was observed in Tunisia and is probably the effect of warming.

The main changes in *Tunisian waters* due to **warming** were observed in the last 5-7 years. There are changes in fishing seasons, increased strength of currents, increased fish mortality in coastal lagoons also due to invasive species, such as rabbitfish (*Siganus spp.*), or species that can interact with pink shrimp. Negative impact of new invasive species on the productivity of indigenous species.

Another climate change effect in the area could be an increased instability of **surface and bottom currents**. Such variation in the currents is affecting negatively fishing operations.

Discussion of the questionnaire (Annex 3): With regards to the questionnaire, a representative of DG-PEsca noted that new questions could be added to the questionnaire related to the occurrence of new species in the catch. Furthermore, a Tunisian scientist stated that the questionnaire is only about climate change and does not consider other factors, other questions on trend indicators of abundance of some species and about fishing equipment should be included.

2) Management Gaps and Needs

There are a number of gaps that emerged from the workshop, that need to be taken into account in future work. The ability to predict the effect of fishing and the effect of climate change on fish abundance and distribution is a fundamental issue, that would need the integration of biological responses in the models (D1.3). Modelling should also be aimed at predicting the effect of various management measures on the future abundances of various key species. The following is a summary of the discussion during the meeting:

Compliance with laws and regulations: **Italian fishers** perceived a problem in the request for extension of the exclusive areas by the Mediterranean coastal countries (EEZ). They argued that the overexploitation of resources is also due to the trophic pressure by top predators such as bluefin tuna. The same rules for fishing and management should be applied for all fleets of any nationality. Fishermen with the label, rules should comply for the entire Mediterranean. It was noted that all fishermen are collecting plastic waste, but the disposal is at the expense of the fishing vessels. Moreover, Mazara (Italy) fishing boats are subject to EU rules whilst the other fleet have less restrictive measures applied. Fishermen agree to protect fishing areas if all fleets will adopt the same rules.

Tunisian fishers raised the point that, Tunisian and Mazara fishermen have the same concerns: the decline in stocks as well as profitability and occurs in all areas of the channel. The laws are not applied and the controls are missing. They want to see the laws of the Mediterranean unified in a single law for all fishers to safeguard stocks.

Temporal closures of fisheries: **Italian fishers** argued that trawl for giant red shrimp (*Aristaeomorpha foliacea*) should be closed for 5 months of from 30 September to February to allow juveniles to grow and achieve bigger size. However, the temporal closures represent a cost and should be subsidized.

Tunisian fishers stated that to reach a unified period of closure of fishing of stocks like hake and pink shrimp that are in very clear decline, the same closure areas must apply for all fleets. Profitability of fisheries is seen as very low. A Tunisian researcher added that shared temporal closure should be included in the GFCM management plan. In a recent joint meeting in Tunis between Federpesca and other Tunisian operators it was agreed to adopt a shared temporal closure for trawl fisheries in January and February.

Protection of jobs and cultural heritage: *Tunisian fishers* underlined the importance of protecting jobs. An effort must be planned to preserve the fisheries cultural heritage. Pollution causes a drop in efficiency and often this aspect is not considered and evaluated.

3) Management Scenarios Discussion

A representative of DG-PEsca stated that the Italian national management plan for demersal fisheries in South of Sicily (GSA 16) provides indication on the best management scenarios to achieve a good economic performance of the fleets. Improving the exploitation status of the stocks should be an important goal here. Other than that, specific management scenarios were not proposed directly from stakeholders, however the discussion with stakeholders brought up few main issues that are shared among fishermen of different countries:

- the decline in stocks as well as profitability,
- effect of climate change (e.g. changes in seasonality),
- need for common rules.

In this respect, scenarios explored within this project will consist of different management rules (e.g. harvest control) and alternative future climate scenarios.

More feedback on climate change issue will be gathered from the results of the questionnaire survey.

5.4 Relevance for PANDORA Work Packages

The relevance for each WP can be summarised as follows:

WP1: The workshop was fundamental in receiving feedback on the work planned for acquiring new biological knowledge on key species.

WP2-4: The workshop was fundamental in receiving input on the modelling framework in terms of the needs for scenarios to be developed, particularly in WP2. Relevant questions in terms of the needs of fishers were clarified and will complement the scientific questions at the basis of Pandora.

WP5: In terms of engagement, communication and impact, the workshop strengthened the communication between stakeholders and scientists. As a result of this workshop, the stakeholder involvement, and of the fishermen in particular, is an important asset that can lead to a higher relevance of the work being carried out in Pandora for local fisheries.

5.5 Next Steps

The next steps to be carried out in Pandora, in line with the discussion that arose during the workshop, include:

- Laboratory experiment to determine the relationship between aerobic metabolic scope and water temperature for deep water rose shrimp and red mullet as well as their thermal tolerances (D1.3);
- from the modelling perspectives, the first phase of the activity will focus on modifying the structure of the end-to-end ecosystem model Atlantis for the Strait of Sicily to include the thermal relationship derived in D1.3. This will instruct the model on how water temperature shifts out of the thermal preference range affects deep water rose shrimp and red mullet physiological rates and population processes, such as growth and reproduction/recruitment;

- the second phase will consist of gathering climate change scenario data based on RCP projections. Climate change scenario data will provide Atlantis offline the physical forcing variables (temperature, salinity and water currents) that will be used to run the numerical model simulations. In particular modelling outcomes under the current conditions and under the future scenario considered will be compared in terms of ecosystem properties (biomass, size, age composition of the stocks) and economic consequences (catches, profits, etc.).

6 Western Mediterranean Sea (Balearic Sea)

Authors: Diego Alvarez-Berastegui, SOCIB (P18), Patricia Reglero, IEO (P6), Manuel Hidalgo, IEO (P6)

6.1 Description of the Case Study

The study case of the Western Mediterranean (Balearic Sea; for later reference: Baleares) is focused on the potential for improving fisheries assessment processes by integrating environmental variability, spatial structure of populations and spatial connectivity into the fisheries management processes. The fish species targeted in this region involve both demersal species (red mullet, *Mulus surmuletus* and hake, *Merluccius merluccius*) and large pelagic species (albacore tuna, *Thunnus thynnus* and bluefin tuna, *Thunnus alalunga*) with high relevance in relation to social, economic and ecosystem aspects. These resources are managed by different fisheries bodies: ICCAT in the case of the tuna species and the General Fisheries Commission of the Mediterranean GFCM (Geographical Sub Area 5 and 6) in the case of the demersal species, both applying different fisheries assessment and management processes. Regarding the management of fisheries resources by GFCM, fisheries assessment is conducted considering that a population in one GSA is independent from other GSAs. In the case of the tuna species managed by ICCAT, bluefin tuna is considered one stock for the entire Eastern Atlantic, while albacore tuna is considered one stock for the entire Mediterranean.

This study case was selected because the high relevance of environmental variability in driving species distribution and connectivity during the early life history of both the demersal and large pelagic species. Regarding the demersal species, we focus on the analyses of improving fisheries management by considering aspects of spatial structure of populations, spatial connectivity and effect of fish health on survival. In the context of the tuna species, our focus is on issues related to the variability on mesoscale oceanography (as main source of environmental variability). Therefore, the selection of these species allows a wide overview of different perspectives that affect fisheries assessment and management.

Research Foci and Central Questions

In the case of demersal species managed by the GFCM and spatially structured in GSAs, the research focuses on understanding the population sub-structure and connectivity due to the larval dispersal patterns between neighboring subareas, as well as the influence of fish condition on survival, to assess how this information can be included in the population assessment models conducted.

In the case of large pelagic species the main research focuses on how the mesoscale oceanographic processes in the Balearic Sea drive the dynamic location of tuna spawning grounds, the larval dispersal and survival, and how that information can improve estimation of abundance indices of larvae used to assess the spawning stock biomass and the estimation of recruitment.

In both cases (demersal and pelagic), the research questions are approached from a generic perspective, with the aim of developing generic concepts and tools that can be transferred to other species, fisheries and ecosystems

Overview of Main Stakeholders

- Delegates of fisheries management bodies (General Fisheries of the Mediterranean, FAO)
- Representatives of the scientific commission for research and statistics of the International Commission for the Conservation of Atlantic Tunas (ICCAT/SCRS)
- Experts on species biology and ecology
- Experts on fisheries assessment models run in the framework of ICCAT (*Thunnus alalunga* working group)
- Experts on fisheries assessment models from the European Commission
- Researchers conducting fisheries assessments in different GSAs in the framework of GFCM and STECF.

Issues that Should be Solved with the Workshop

Specific issues to be resolved during the workshops conducted in the Balearic Sea Case Study were:

- Identify opportunities, gaps and challenges for advancing the integration of environmental variability into the assessment models.
- Identify specific techniques from the oceanographic community to advance on the field of operational fisheries oceanography. The activities were directed at linking fisheries ecology and operational oceanography for developing information about environmental processes affecting species dynamics and distribution, and the systematic integration of these products into fisheries assessment and management.
- Identify population assessment methods that facilitate the process of integrating environmental variability into fisheries assessment.
- Evaluate the current engagement of researchers involved in fisheries assessment regarding the potential for improving fish population assessments by integrating environmental variability.

6.2 Workshop Setting

Two different workshops (W1 and W2) were conducted in this Case Studies.

W1: Workshop on Integration of Operational Oceanography and Fisheries Management.

This workshop was integrated as parallel open workshop in the framework of the first 'Fish Forum' for the Mediterranean organized in Rome by the GFCM/FAO. This workshop was organized in collaboration with IEO, SOCIB and OGS and was entitled "Towards operational fisheries oceanography in the Mediterranean Sea: gaps, challenges, opportunities from open access data and integrated tools", the agenda and workshop open call are accessible at

<http://www.fao.org/gfcm/fishforum2018/programme/en/>

The results of the workshops were also presented in the FAO Fish Forum plenary session.



Figure 6: Workshop conducted in Rome (FAO head quarters), stakeholder presentations and discussions



Figure 5: Presentation of results at the FAO Fish Forum Plenary Session.

The workshop was divided in two sections:

During the **first section**, the discussions focused on the integration of environmental variability into fisheries assessment, and participants recognized this integration is still unresolved. Chairs presented the bluefin tuna project, a joint research initiative conducted by SOCIB and IEO in the Balearic Islands, as an example of a success case study. The group discussed how to apply same approaches to other study cases, recognizing the strong potential to improve fisheries assessment conducted in the framework of GFCM, especially for increasing the quality of input parameters such as

- CPUE
- stock-recruitment (SR) relationships (moving from density-dependent SR towards environmentally-dependent SR) in fisheries such hake or small-pelagic fish, and
- for opening new opportunities in assessment methods and scientifically informed spatial dynamic management.

The group agreed that it would be most relevant to focus on linking experts of species ecology, fisheries assessment and operational oceanography to create a multi-disciplinary network to achieve specific challenges: 1) a better identification and understanding of the environmental drivers affecting key species ecological processes, 2) adequate parameterization of the key environmental drivers identified (by definition of appropriate indicators), 3) developing best practices for integrating those indicators in current assessment models, 4) fostering capacity building, and 5) identifying success case studies and promote new ones.

In the **second section** of the workshop the objective was to provide information on the data available through the Copernicus Marine Environment Monitoring Service (CMEMS: <http://marine.copernicus.eu/>) regarding environmental variables useful for fisheries science. Recent efforts for collating, integrating and modeling physical and biogeochemical data resulted in the availability of parameters beyond satellite surface observations. Through advanced, complex models assimilating available data, CMEMS provides 3D characterization of the water masses with increasing accuracy (<http://medeaf.inogs.it/>). This enables resolving at high-resolution, on a daily basis, vertical and horizontal patterns of the whole Mediterranean and Black Sea basin including biogeochemical variables (e.g. nutrient concentration, oxygen, particulate organic carbon and phytoplankton primary production). Such variables might be useful to complement fisheries tools for assessment and for ecological studies, from single to multispecies approaches.

W2: Workshop on integration of environmental variability indices in the population assessment models.

This workshop was organized as a one-week meeting at the European Commission Joint Research Center (JRC) in Ispra (Italy) as a specific activity of the PANDORA project. The specific objective was to analyze the opportunities that new methods developed by the European Commission (the A4A fisheries assessment framework, based on the FLR assessment model) offer to improve the tuna population assessment by including environmental variability indices in the assessment models. For that purpose, experts on FLR from the European Commission, the chair of the ICCAT/SCRS Mediterranean albacore tuna, and experts on albacore species biology and environmental indices, worked for one week on the specific case study of population trends of Mediterranean albacore, evaluated the assessment models, and tested environmental indices. In the end, a workshop summary session was conducted to identify gaps, challenges and design a roadmap to advance the integration of environmental variability into the fisheries assessment of tunas.

6.3 Workshop Results

W1: Workshop on integration of operational oceanography and fisheries management

The discussion demonstrated that fisheries data in the Mediterranean region can be limited. Although this is viewed as hampering the integration of environmental variables into the assessments, it is also true that including environmental drivers has a potential for improving assessments. Rich fisheries data cases can be used to test eventual improvement and to identify relationships between environmental conditions and marine resources. A challenge might be represented by the time span of CMEMS products that might be extended to the past for considering as much as possible of fisheries historical dynamics and data. Seasonal forecast and climate projections products (<https://climate.copernicus.eu>) are required for future management scenarios. An important challenge might regard the design, development and implementation of Ocean Monitoring Indicators (OMIs) derived from CMEMS and other observing systems that might be useful to improve representation of processes regarding juvenile/larval stages (dispersion, mortality, recruitment).

The group also discussed a way forward to advance the implementation of “operational fisheries oceanography” and agreed to develop a specific network on operational fisheries oceanography to resolve links between environmental variability and fisheries assessment. The specific objectives of this network will be:

1. To identify and disseminate successful case studies where integration of environmental variability has improved fisheries assessment and management, and to promote new ones (small pelagic, demersal and littoral species). Other case studies will be included regarding conservation of threatened species (e.g. marine mammals and turtles, among others).
2. To design common working schemes and best practices from success case studies in order to maximize knowledge transfer to other fisheries.
3. To align strategic plans in fisheries, conservation and operational oceanography. This should ensure that advances in both fields benefit the most from each other.
4. To provide an evaluation of how operational fisheries oceanography improves advice quality, advancing from a qualitative to a quantitative approach.

Results of the network will be transferred to GFCM in 2020, and the possibility of requesting for a working group on “Operational Fisheries Oceanography” will be considered together with those responsible at the GFCM at that time.

W2: Workshop on integration of environmental variability indices in the population assessment models

The second workshop resulted in the design of a specific assessment model for the Mediterranean albacore, improved with environmental variability indices for larval survival and recruitment. As main result of the workshop, the group identified which are the main data needs, models and research activities to improve the fisheries assessment of the Mediterranean albacore, and designed a roadmap to propose to the working groups in ICCAT the following activities:

- Develop recovery data plans
 - Resolving species assignment issues (species identification confusions)
 - Recovering data on catch and effort, lengths and total effort
- Conduct studies for fisheries description
 - Historical use of gears
 - Define relation between catchability at length of different fishing methods
- Advance existing research of species biology
 - Identify adequate growth curves
 - Resolve interannual variability of length-weight relationships
 - Develop a maturity ogive
 - Identify spatial distribution of immature individuals
- Resolve connectivity and movements of the albacore within the Mediterranean
- Develop species habitat distribution models

6.4 Relevance for PANDORA Work Packages

WP1: Knowledge gaps such as adequate identification of key environmental processes and the parameterization of key environmental drivers will serve as a solid basis to improve the management needs in PANDORA’s Western Mediterranean Sea Case Study.

WP2-4: The workshops help to clarify how the models can be improved, establishing a roadmap towards this end. The selected case studies represent the species in most critical situations (in both demersal and large pelagic) and with clear and identified avenues for improvement.

WP5: The workshop reinforced the cooperation between stakeholders and scientists. On the one hand, the first workshop established a fruitful platform of collaboration linking experts of species ecology, fisheries assessment and operational oceanography to achieve specific challenges. The second workshop helped to improve the communication and collaboration between fisheries scientist and modelers conducting the assessment, ensuring that new developments will be tested and potentially finally implemented in the structural and regular assessment.

6.5 Next steps

The information from these workshops will be used to design the next steps towards a new generation of fish stock assessments that are more biologically and ecologically realistic, particularly regarding their main elements: accounting for the complexity of the spatial structure of assessed populations, designing the best options towards the implementation of environmental variability in the stock assessment, and natural mortality information used in the current assessment models. The contacts with the fisheries modelers developing the assessment in the Mediterranean (considered our key stakeholders) will help to establish effective exchange of knowledge and improve future assessments. Future improvements and simulations developed will be discussed further and continuous feedback considered to improve current assessment.

7 Western Mediterranean Sea (Girona)

Authors: Sílvia Gomez & Francesc Maynou, CSIC (P13)

7.1 Description of the Case Study

The case study concerns demersal fisheries in the province of Girona (NE Spain) as a representative case study of NW Mediterranean fisheries (see Figure 7). The great diversity of fisheries in the province of Girona coast is studied in different fishing ports (notably Port de la Selva, Cadaqués, Roses, L'Escalà-L'Estartit, Palamós, and Blanes). Over time, different types of fisheries have been traditionally developed in each port, according to the spatial, ecological and socio-cultural specificities. In the last few decades, fisheries have been directly impacted by the state of fish resources and the traditional marketing strategies for catches. This situation has determined the present-day fleet landscape: decreasing number of units, fewer crew per unit and low economic profitability.

The main fishery resources in the study area are small pelagic fish, as elsewhere in south European waters (see Table 2). The two small pelagics exploited in the Western Mediterranean are sardine (*Sardina pilchardus*) and anchovy (*Engraulis encrasicolus*) and are exploited with purse seine. The two species account for ca. 6000 t annually in recent decades and comprised 50% of the landings in 2000, but 70% in 2015 due to the strong decrease in the landings of demersal resources (see Table 2). Small pelagic fisheries depend to a large extent on the two target species (over 90% of the landings), and secondary

species such as horse mackerels (*Trachurus* spp.) or mackerels (*Scomber* spp.) are occasionally commercialized.

Table 2 shows that demersal fisheries are exploited mainly by bottom trawl (ca. 80% of demersal landings), but the contribution of small scale fishing is relevant due to the high prices fetched by the variety of species caught by set nets, longlines and traps. The landings of bottom trawl between 2000 and 2015 have decreased significantly (from 5635.2 t to 2387.5 t) due particularly to the decrease in blue whiting (*Micromesistius poutassou*), but also all other target species with the exception of the red shrimp (*Aristeus antennatus*) that has practically doubled its production, from 158 to 369 t. It is important to highlight that this deep-water species is by far the most valuable fisheries resource in the area, with ex-vessel prices around 30 € on average. The landings of small scale fishing gears has also decreased for all target species, except red mullets (*Mullus* spp.) and anglerfish (*Lophius* spp.)

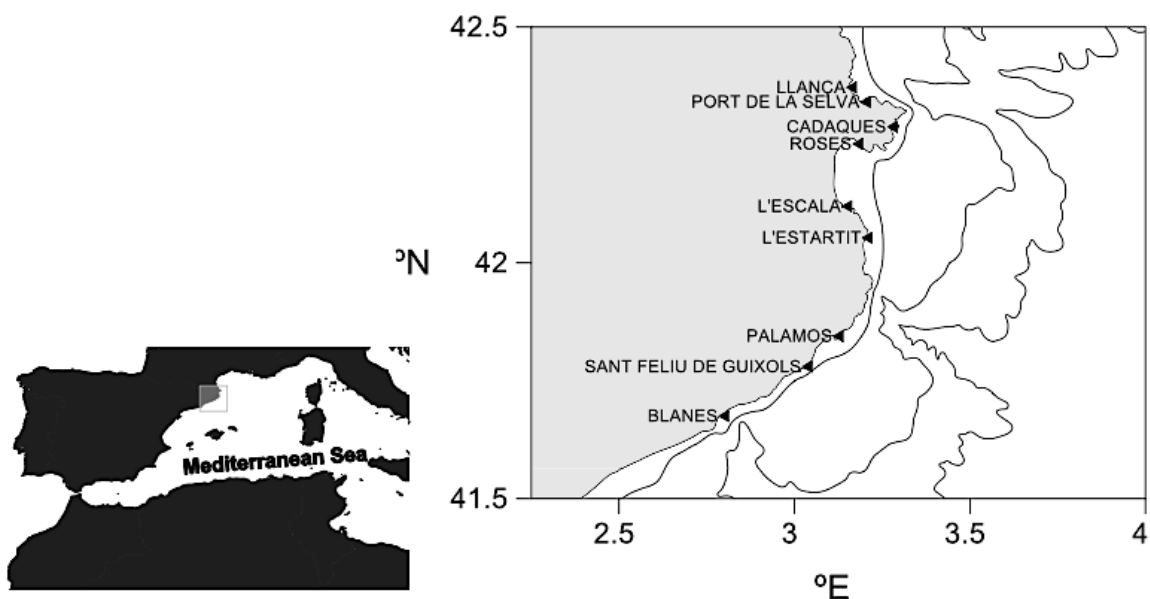


Figure 7: Map of the study area in the context of the Mediterranean Sea (top). The bottom map shows the 9 commercial fishing ports in the study area. Depth contours shown are 50, 200 and 1000 m depth.

Bottom trawlers depend on the target species shown by 71%, while small scale vessels exploit a wider variety of fisheries resources and depend only around 50% on the target species.

Some species interact technically in two or the three fleet types: mackerels and horse mackerels are caught by purse seiners and bottom trawlers, and in smaller quantities by the small scale fleet, while 6 main species are caught by trawlers and small scale vessels (hake, red mullets, cuttlefish, anglerfish, octopus and conger eel). When bottom trawlers and small scale vessels interact technically, trawlers usually catch larger quantities of smaller sizes, while small scale vessels catch larger and better quality fish in smaller quantities.

Certain species that are (or were) important in the landings, such as the blue whiting, horse mackerels and mackerels, fetch very low ex-vessel prices (1 €/kg or less) and it is known that they are discarded in large quantities (50 to 70% of the catch of these low value species is discarded). This by-catch could be subject to valorisation programmes and this aspect will be explored in Pandora WP3.

Table 2: Landings of the 15 main species in the 9 ports of the study area (Figure 7) by fleet type. Fleet types are defined by the main license issued by the fisheries administration and correspond to PS (Purse seine), OTB (Bottom trawl) and a polyvalent license including "artisanal" passive and mobile fishing gears (GTR, GNS, LLO, FPO, SV, PGP, PGM: small scale coastal fishing; here coded SSCF).

Species	2000				2015			
	Purse seine	Bottom Trawl	SSCF	all	Purse seine	Bottom Trawl	SSCF	all
<i>Sardina pilchardus</i>	3119.9			3119.9	2038.4			2038.4
<i>Engraulis encrasicolus</i>	2406.7			2406.7	3626.6			3626.6
<i>Merluccius merluccius</i>		379.9	116.4	496.4		298.8	24.2	323.1
<i>Micromesistius poutassou</i>		1460.9		1460.9		162.3		162.3
<i>Aristeus antennatus</i>		158.1		158.1		368.9		368.9
<i>Nephrops norvegicus</i>		186.0		186.0		84.0		84.0
<i>Mullus spp.</i> ⁽¹⁾		125.7	7.9	133.6		156.5	14.0	170.5
<i>Sepia officinalis</i>		21.6	17.2	38.9		5.7	12.4	18.1
<i>Lophius spp.</i>		244.3	5.3	249.6		171.9	8.2	180.1
<i>Trachurus spp.</i>	312.5	380.5	7.6	700.5	76.8	200.3	5.1	282.3
<i>Scomber spp.</i>	412.0	329.9	9.4	751.4	61.2	21.3	4.1	86.7
<i>Octopus vulgaris</i>		307.2	51.8	359.0		37.4	31.8	69.3
<i>Eledone cirrhosa</i>		343.5		343.5		161.4		161.4
<i>Conger conger</i>		40.4	43.6	84.0		16.1	13.0	29.0
<i>Gymnammodytes spp.</i>			167.9	167.9			41.5	41.5
OTHER species	442.8	1657.0	416.9	2516.8	513.1	702.6	164.3	1379.9
TOTAL LANDINGS	6693.9	5635.2	844.1	13173.2	6316.0	2387.5	318.6	9022.1
% target species	93%	71%	51%	81%	92%	71%	48%	85%

⁽¹⁾ Taxa with spp. represent pairs of species that are not differentiated at market level in the statistics: *Mullus barbatus* and *M. surmuletus*, *Lophius budegassa* and *L. piscatorius*, *Trachurus trachurus* and *T. mediterraneus*, *Scomber scombrus* and *S. colias*, *Gymnammodytes cicerelus* and *G. semisquamatus*.

The evolution of the three main fleets in the study area is shown in Table 3. The fleet size has decreased considerably between 2000 and 2015, ca. 30% for bottom trawl and purse seine and by half for small scale fishing. The bottom trawl and purse seine fleets show similar age and sizes at present (2015) and are composed mainly of vessels in the VL1824 class. The small scale fleet is the largest, in number of units, but comprise smaller vessels usually in the VL0612 class. An important difference of the small scale fleet with respect to the other two is that the small scale fleet can adopt different fishing gears to exploit a wide variety of resources and is more opportunistic. This means that recovering consumption patterns of traditional species (e.g. sea urchins, glass eels) commercially little exploited at present, coupled with a progressive specialization in cephalopods (octopus and cuttlefish) and crustaceans (spiny lobster) that can be currently more profitable according to new consumption patterns, inasmuch that classical species, such as common sole, have been depleted or have decreased (several species of finfish). Moreover, small scale units can change legally the primary fishing gear at short term notice and can switch from set nets or set longlines to other more specialized fishing gear, such as pots for octopus or boat seine for sandeel.

Table 3: Evolution of the fleet size (NV=number of vessels) and technical characteristics of the fleets in the province of Girona. LOA: length-overall (m), GT: gross tonnage, kW: engine power. OTB: bottom trawl, SSCF: small scale fleet, PS: purse seine.

		2000	2005	2010	2015	Reduction (2015- 2000)
OTB	NV	104	100	90	74	29%
	age	30.57	26.83	24.28	27.36	
	LOA	19.11	19.63	19.97	19.08	
	GT	50.84	53.59	55.38	53.52	
	kW	222.97	217.18	206.57	192.68	
SSCF	NV	397	361	247	182	54%
	age	27.28	28.23	28.62	31.31	
	LOA	8.21	8.57	8.93	9.09	
	GT	3.72	4.02	4.46	4.60	
	kW	36.06	38.07	41.15	42.19	
PS	NV	38	36	29	26	32%
	age	19.00	21.92	22.14	26.80	
	LOA	17.58	18.16	19.04	19.08	
	GT	36.61	27.45	39.50	39.45	
	kW	208.88	206.89	215.72	215.62	
Fleet	NV	539	497	366	282	48%

Research Foci and Central Questions

Mediterranean fisheries show clear signs of overexploitation of the main fish stocks (Colloca et al. 2017), important modifications to marine ecosystems (Ramírez et al. 2018) and low economic performance (Franquesa et al. 2008; Sabatella et al. 2017). All these considerations threaten the viability of the fisheries. Results of stock assessments for the period 2002-2014 show that 90% of Mediterranean fish stocks are fished at biologically unsustainable levels (Colloca et al. 2017). The overall level of overfishing is around 2-3 times F_{MSY} (European Commission 2016; Libralato et al. 2018), although in some species such as hake or blue whiting the ratio of current fishing mortality to F_{MSY} is between 5 and 10 (depending on the geographical subarea: Cardinale et al. 2017). Conversely, ongoing stock assessments in WP2 of Pandora show that certain stocks, such as horse mackerels, mackerels and cephalopods are underexploited in the NW Mediterranean.

The strong fleet reduction reported in the previous section is general to other European Mediterranean member states, where the size of the fleet has decreased by 45% over the last decade: from 56,705 units in 2005 to 31,077 units in 2018³, explained by the poor productivity of Mediterranean fish stocks in recent decades and the availability of funds to decommission fishing vessels. Poor productivity of fish stocks, related to the chronic overexploitation of fisheries resources, in combination with externalities such as increased production costs and poor marketing strategies (DG MARE 2017) result in low profitability.

Economic indicators (such as profits or RoFTA) show in general very poor performance, with low productivity of capital and labour, as well as low wages and low economic impact on the local economy

³ combining data in Franquesa et al. (2008) with data in SOMFI (2018).

(Sabatella et al. 2017). However, the new challenges fishers have to face have fostered emerging local initiatives and strategies to improve the commercialization of fisheries products.

On the other hand, in order to redress the overexploitation of fisheries resources, the 2013 reform of the Common Fisheries Policy (EU Reg. 1380/2013) includes the concept of regionalisation in its article 18 and articles 9 and 10 on multiannual plans, to promote regional cooperation on conservation measures. The case study area is included in the multi-annual plan (MAP) for demersal fisheries in the Western Mediterranean (Spain, France, Italy), recently adopted by the European Parliament (February 2019, the regulation is awaiting the Council's final adoption, expected for June 2019). Among other things, the MAP establishes an important reduction of fishing effort (of 40% over the period 2020-2024), the seasonal prohibition of trawling between 50 and 100 m depth, establishing permanent fisheries restricted areas and promoting more selective fishing gear.

Issues to be addressed in PANDORA

The objectives of our research in Pandora is to help address the needs of stakeholders (local fisheries managers, fishers) in transposing the demersal Western Mediterranean MAP into concrete management measures by providing scientific based knowledge on the bioeconomic consequences of specific management measures, as well as to gather industry's initiatives to establish an implementation plan of the MAP that is effective and agreeable to all parties.

To achieve this objective two types of actions are being carried out:

(1) Face-to-face interviews with stakeholders to obtain primary data on the resources exploited, costs of exploitation, distribution channels and scope for diversification. In accordance with the conventional production, distribution and consumption process, two kind of questionnaires have been elaborated. The data collected from the first questionnaire have to help to identify those variables in the fisheries enterprise which explain costs and profitability differences. The questions have been organized in thematic clusters in order to gather that data to reflect, on the one hand, the main **social- and cultural aspects** that can influence in the fisheries enterprise profile. We have focused on understanding the role of fisheries work and workers, composition of the crew, the family aspect of labor force, intergenerational replacement, tasks distribution and fishing hours invested. The fisheries experience in and knowledge of the fishery (usually transmitted from generation to generation) has been considered as an aspect that influence on fisheries strategy decisions. On the other hand, data on the **means of production** attempt as a portray to identify processes of adaptation and changes of this fisheries strategy and the efficiency of production system. The second Questionnaire aims at reflecting the different existing **options of seafood distribution and marketing**, the pricing system, as well as social discourses accompanying the presentation of these initiatives and/or serving as certification schemes to consumers whose final goal is to produce added value to the product and promote it. Furthermore, all those activities that try to foster seafood products through giving value to cultural aspects of fisheries will be considered. This is, activities usually linked to certification schemes and guarantee of the product (eco)labelling.

The analysis of the socioeconomic data on fisheries cost and profitability will take into account all these social, cultural, economic variables to characterize the trajectories of different types of enterprises considering strategies and initiatives to capitalize fisheries sector, their weak and strong points in relation to the European multiannual plan for the Western Mediterranean and the knowledge of new biological data.

(2) a multi-actor workshop to collate the opinion of stakeholders on specific management measures to apply the MAP in the study area. These two actions will help parameterise and define the scenarios for the bio economic assessment in WP3.

Overview on the Main Stakeholders

The stakeholders' groups have been identified for the Province of Girona in the main fisheries ports (Port de la Selva, Cadaqués, Roses, L'Escala-L'Estartit, Palamós, and Blanes). Traditionally, small-scale fisheries and trawl fisheries have been developed in Port de la Selva and Roses where there was the possibility of building a fishing harbour, whereas the reduced space of Cadaqués has only been able to host small-scale vessels. Roses also host a small purse-seiner fleet. The origin of the L'Escala village is historically linked to the pelagic fisheries (purse-seiner) beside the small-scale fisheries, whereas L'Estartit combines the small-scale fisheries with boat seine fisheries (Mediterranean sandeel). Nevertheless, both locations share a strong presence of small-scale fisheries. Palamós port is known by the trawl red shrimp fisheries. Finally, Blanes host different kind of fisheries accounting for a diversity of fleets with small and big trawl vessels, boat seiners, a small pelagic fleet and small-scale fisheries (trammel and gillnet, bottom and surface long-line fleet).

7.2 Workshop Setting

The stakeholder interaction in PANDORA's Western Mediterranean Sea Case Study was so far conducted via qualitative, face-to-face interviews as well as quantitative survey questionnaires. Workshops involving a range of stakeholders together will take place in mid-September 2019 in Almería, South Spain.

Considering the abovementioned fisheries/fleet features, interviews have been collected to different demersal fisheries stakeholder's groups in each of the ports for a total of 34 production units. The sampling has used the snow ball system and the selection of sample units answer to flexible, pragmatic and emergent criteria according to the research goals requirements as well as each fishers' profile availability and accessibility. The sample is being established as the research moves further after the initial introduction to the fieldwork. The gathering of data and their analysis is produced simultaneously, and the sample will be closed as the level of theoretical saturation will be reached.

Apart from these interviews it has been performed eight in depth and informal interviews to different key social actors in managing fisheries in Catalonia (presidents of fishers' cooperatives, presidents from fisheries associations and key actors in the fisheries industrial sector). Whereas the second questionnaire referring to the initiatives of distribution and marketing process have been only performed to three stakeholders and it is expected to collect some other more. Likewise, we are planning to collect some surveys by phone to different initiatives of distribution and marketing that use of online platforms among other systems of selling.

Table 4: Number of interviews collected in each fishing port by fleet segment (SSF, OTB and PS) differentiating by fishing gear in the case of SSCF (GTR, LLS, SV)

		El Port de la Selva	Cadaqués	Roses	L'Escala	L'Estartit	Palamós	Blanes	Barcelona
SSCF	GTR	3	2	3	2	4	2	2	
	LLS								
	SV					1		1	
OTB				2			2	7	
PS				1				1	1

7.3 Workshop Results

The first preliminary results of the interviews ongoing analysis point out towards new fisheries trends. Overall, the trawl fisheries tend to specialize in catching crustacean species of high or medium-high market value. The level of specialization of fleets depends on the historicity of this fisheries in each harbour, the establishment of a co-management plan into force, and the possibilities of its local marketing and promotion as product culturally rooted at the fisheries activity from the coastal village. Whereas some of these specialized vessels yield a profit only with this type of fisheries, other combine them with fisheries aiming to fish multispecies. In contrast to traditional fisheries, present-day small-scale fishers show greater flexibility in fisheries strategies according to marine resource stocks and economic opportunities. Due to the difficulty to forecast the availability of species the trend is to specialise progressively in a few high valued species of high consumer demand. Sometimes such species are supported by co-management plans. The reduction of fish in consumer demand which is more and more centred on few species has driven fishers to focus on fish of quality, cephalopods and crustaceans and some specific species. By fish of quality it is understood: large size, freshness and good presentation that usually guarantees catch welfare. Some few cases have specialised in specific species fostered by regulation policies, co-management plans and quotas system. It is the case of Bluefin tuna (*Thunnus thynnus*), swordfish (*Xiphias gladius*), and Mediterranean sandeel (*Gymnammodytes spp.*). The restriction of fleet enabled to go fishing these species have produced a greater specialization in detriment of fisheries polyvalence system. Furthermore, the more specialised it is a fishery, the more produces of alienation from the product which is expressed as a feeling of lack of interaction with nature that fishers experience in their daily activity.

7.4 Relevance for PANDORA Work Packages

The case study concerns demersal fisheries in the province of Girona (NE Spain) as a representative case study of NW Mediterranean demersal fisheries, a fishery whose landings has decreased significantly in the last 5 years due to chronic overexploitation, therefore contributing to the poor productivity of stocks.

The case study area is included in the multi-annual plan (MAP) for demersal fisheries in the Western Mediterranean (Spain, France, Italy), recently adopted by the European Parliament (Council's final adoption in June 2019) in order to redress the overexploitation of fisheries resources.

The plan expects to reduce the fishing effort by 40% between 2019-2024 among other provisions, which may drive towards an important reduction of the fishing fleet producing important socioeconomic impacts. The fishers' perception on the impacts that measure may produce on demersal fisheries sector

and fishing communities from NW Mediterranean will be gathered in the frame of the multi-actor participatory workshop organized in the annual meeting of Spanish Mediterranean fisheries stakeholders (planned for 17-18 September 2019, Almeria, Spain). The purpose of this workshop is to engage stakeholders in the decision-making for the application this plan will be carry out by Member States.

The face-to-face interviews provide us the socioeconomic information to assess the sustainability of fishing communities to understand how the MAP can affect them accounting for the levels of productivity of demersal fisheries, the profitability and the employment opportunities – three main aspects that PANDORA have the purpose to address through identifying the needs of fisheries management. The results from these interviews will primarily inform the economic projections made in WP3.2.

7.5 Next steps

During the annual meeting of Spanish Mediterranean fisheries stakeholders (planned for 17-18 September 2019, Almeria, Spain) an afternoon session will be dedicated to a multi-actor participatory workshop. The objectives of the workshop will be to gather feedback on stakeholders' preferences on management options for applying the Western Mediterranean MAP and, in general, for working towards the long-term viability of demersal fishing in the Western Mediterranean. The results of the semi-structured workshop will be analysed following preference modelling framework (Lembo et al. 2017).

8 Summary and Implications for Co-Creation

The first series of PANDORA stakeholder workshops took place between early March and mid-July 2019. It consisted of a variety of co-development activities with regional key stakeholders in the North Sea, Bay of Biscay, Western Mediterranean Sea (*upcoming workshop in mid-September*), Strait of Sicily, and Aegean Sea with the aim of co-steering the project's research focus and co-developing its contents. It is the aim of stakeholder engagement within PANDORA to cater to the regional needs in the project's Case Studies and to craft engagement activities that are tailor-fitted to these needs. The stakeholder composition therefore naturally differs between the Case Study regions, and so do the goals of the workshops. Whilst the engagement in the North Sea Case Study centres on cooperation with industry representatives, for example, the main stakeholders of PANDORA in the Aegean Sea are trawler and small-scale fishers, mostly on owner-run vessels (cf. Sections 3.1 and 4.1). What all these engagement efforts have in common, however, is the co-creation of content for PANDORA's work packages together with the societal actors that work in, and manage, regional fisheries across Europe.,

The 2019 stakeholder workshops contribute importantly to the research undertaken in PANDORA by giving it direction, pointing out what is relevant to key stakeholders, and providing experience-based input on biological and ecological stock developments in our focus regions. Table 5 gives a summary of the contributions that the different workshops made to PANDORA's work packages; for details of each topic, please see the indicated sections of the full report.

Table 5: Summary of stakeholder contributions to PANDORA work packages from 1st series of regional workshops

WP	Case Study	Contribution by Stakeholders
1	Bay of Biscay (see section 2.3)	<ul style="list-style-type: none"> - Blackspot seabream behavior and abundance (seasonality, schools) - Recent changes in catches, fish and stock size - Design and implementation of acoustic stock survey for blackspot seabream in cooperation with small-scale handliner fleet of Brittany (locations, dates, technical specifications)
	Aegean Sea (see section 3.3)	<ul style="list-style-type: none"> - Recent changes in catches, fish and stock size for hake, deep water rose shrimp, red mullet, striped red mullet observed - New information about how climate change impacts on fish stocks and fisheries are perceived by stakeholders, e.g. changes in water temperatures, currents, winds and stock distribution - New information about redistribution of species and ecology - Information about alien species in the region
	North Sea (see section 4.3)	<ul style="list-style-type: none"> - Recent changes in catches, fish and stock size of cod, plaice - New information about how climate change impacts on fish stocks and fisheries are perceived by stakeholders, e.g. changes in water temperatures, currents, winds and stock distribution - Low productivity of gadoids: reasons given by stakeholders were low ecosystem productivity caused by lowered nutrient input - Plaice: density dependent effects, lack of available food, and northward shift in distribution observed - Hake is now entering North Sea in larger amounts, possibly due to temperature shifts and expansion of large stock
	Strait of Sicily (see section 5.3)	<ul style="list-style-type: none"> - Stakeholder views on how climate change impacts on fish stocks and fisheries, e.g. changes in water temperatures, arrival of species, spawning period, winds, and fish mortality - Information about invasive species impacts on indigenous species - Feedback on the work planned for acquiring new biological knowledge about red mullet and deep water rose shrimp
	Western Mediterranean (Balears) (see section 6.3)	<ul style="list-style-type: none"> - Identification of key environmental processes - Parameterization of the key environmental drivers
	Western Mediterranean (Girona)	- <i>Covered in upcoming workshop in mid-September</i>
2	Bay of Biscay (see section 2.3)	<ul style="list-style-type: none"> - Blackspot seabream behavior and abundance (seasonality, schools) - Recent changes in catches, fish and stock size for blackspot seabream
	Aegean Sea (see section 3.3)	<ul style="list-style-type: none"> - Climate change impacts on fish stocks and fisheries, e.g. changes in water temperatures, currents, winds and stock distribution - Considered important drivers of stock decline: climate change, IUU, pollution
	North Sea (see section 4.3)	<ul style="list-style-type: none"> - Perceived reasons for low productivity of gadoids should be included - Not only pessimistic stock scenarios should be run in forecasts; too much precaution is not viewed as desirable; rather run the whole bandwidth of potential outcomes - Density dependent effects should be included in reference point determination

		<ul style="list-style-type: none"> - Climate change effects to be included more in assessments and predictions, especially spatial dimension - Multi-species effects should be included in assessments
	Strait of Sicily (see section 5.3)	<ul style="list-style-type: none"> - Stakeholder views on how climate change impacts on fish stocks and fisheries, e.g. changes in water temperatures, arrival of species, spawning period, winds, and fish mortality - Information about invasive species impacts on indigenous species - Trophic pressure by top predators such as bluefin tuna as reason for overexploitation of resources
	Western Mediterranean (Balears) (see section 6.3)	<ul style="list-style-type: none"> - Clarification on how the models can be improved - Knowledge on the species in most critical conditions (demersal and pelagic) - Avenues to improve these conditions
	Western Mediterranean (Girona)	- <i>Covered in upcoming workshop in mid-September</i>
3	Bay of Biscay (see section 2.3)	---
	Aegean Sea (see section 3.3)	<ul style="list-style-type: none"> - Reasons for decline of fisheries: overfishing, bad management, IUU fishing - Information about local conflicts in fisheries management, e.g. between fishers, fisheries administrators and control authorities + between professional and recreational fishers - Lack of spatial and technical restrictions, funding, and banned species - Discussion of mesh size as important factor in management
	North Sea (see section 4.3)	- Mixed fisheries advice seen as important, but rather with maximizing yield within the ranges than maximizing profit
	Strait of Sicily (see section 5.3)	- Temporal closures suggested for hake and pink shrimp fisheries for 5 months (Sept – Feb), but with subsidies in place
	Western Mediterranean (Balears) (see section 6.3)	<ul style="list-style-type: none"> - Clarification on how the models can be improved - Knowledge on the species in most critical conditions (demersal and pelagic) - Avenues to improve these conditions
	Western Mediterranean (Girona) (see section 7.3)	- Sustainability of fishing communities to understand how the MAP can affect them accounting for the levels of productivity of demersal fisheries, the profitability and the employment opportunities
4	Bay of Biscay (see section 2.3)	<ul style="list-style-type: none"> - Discussion of TAC and quota setting process and management options related to this - Discussion of annual catch adjustments according to biomass estimated through acoustic survey
	Aegean Sea (see section 3.3)	<ul style="list-style-type: none"> - Information gathered about local conflicts in fisheries management, e.g. between fishers, fisheries administrators and control authorities + between professional and recreational fishers - Reasons for decline of fisheries: overfishing, bad management, IUU fishing - Lack of spatial and technical restrictions, funding, and banned species - Alien species management is perceived as being an issue - Discussion of mesh size as important factor in management - Wish for management scenario that is flexible, adaptive and reflects changes in ecosystems and fish abundance in space and time

	North Sea (see section 4.3)	<ul style="list-style-type: none"> - Mixed fisheries advice seen as important, but rather with maximizing yield within the ranges than maximizing profit - Focus should be on 5-7 key stocks, not all kinds of bycatch - Simpler harvest control rules are favorable - “Range scenario” in mixed fisheries advice is seen as critical - Climate change, food web effects and other processes determining recruitment strength must be better understood for cod - Current assessments are seen to lack 2-3 years behind, problematically - Landing obligation highly criticized and compliance not possible - Management for bycatch stocks should only focus on the core distribution areas of those stocks
	Strait of Sicily (see section 5.3)	<ul style="list-style-type: none"> - Fishermen agree to a management that protects fishing areas if all fleets will adopt the same rules - Laws should be properly applied and management regulations are missing - Fishing laws should be unified for the Strait of Sicily for all fishers to safeguard the shared stocks - Temporal closures suggested for hake and pink shrimp fisheries for 5 months (Sept – Feb), but with subsidies in place - Scenarios should include decline in stocks, profitability, effects of climate change, and need for common rules
	Western Mediterranean (Balears) (see section 6.3)	<ul style="list-style-type: none"> - Clarification on how the models can be improved - Knowledge on the species in most critical conditions (demersal and pelagic) - Avenues to improve these conditions
	Western Mediterranean (Girona)	- <i>Covered in upcoming workshop in mid-September</i>
5	Bay of Biscay	<ul style="list-style-type: none"> - Strengthening of scientist-stakeholder relations in all Case Study areas - Establishment of relationships with new stakeholders and expansion of existing networks - Creation of a new platform of collaboration between experts of species ecology, fisheries assessment and operational oceanography (Balears) - Introduction of PANDORA project to stakeholders - Reinforced cooperation between local stakeholders - Empowerment of fishers in the assessment process, especially through co-development and joint implementation of stock survey in the Bay of Biscay - Empowerment of industry stakeholders through joint framing of scenarios and giving feedback on assessments and ideas to improve advice - Feeling of contribution to and ownership over PANDORA’s research and results among stakeholders
	Aegean Sea	
	North Sea	
	Strait of Sicily	
	Western Mediterranean	
	Western Mediterranean (Girona)	

Especially in North Sea Case Study, moreover, there was great support from the stakeholders at the workshop to help scientists to get more data from the industry. This self-sampling would have to be restricted to scientific data collection and other requirements (see section 4.3), but willingness to contribute data to scientific research was high among all stakeholders.

The results of the first series of PANDORA workshops summarized in this deliverable will serve as guidance for the work of the different work packages as indicated above. They moreover constitute the

foundation on which any future stakeholder interaction will be based, for example the second phase of workshops taking place in mid-2020. The co-development of the PANDORA together with its stakeholders will thus remain in the center of the project throughout its entire lifetime.

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10 Annexes

Annex 1: North Sea Workshop Agenda - 13./14. May 2019

PANDORA 1st Regional North Sea Workshop - Agenda

Morning

10:00 Introduction

- Who are we?
- What is the main aim of PANDORA?
- What is this workshop seeking to achieve?

10:20 Session I: Discussion on the biological and environmental frame for scenarios

10:20 What we think is most important to cover in scenarios for the North Sea (Presentation)

10:40 What you think is most important to cover in scenarios

Coffee break (15min)

11:30 Session II: Discussion on the political and management frame for scenarios

11:30 Our perspective on how things develop in the next years (Presentation)

11:50 Your perspective on how things develop in the next years and what you would like to change in current fisheries management and policy. What management scenarios would be interesting for you?

12:30 – 13:30

LUNCH BREAK (60min)

Afternoon

13:30 Session III: Biological Data in stock assessments and advice

13:30 Discussion on current assessments and advice. What are the main shortcomings?

14:00 Discussion on additional biological/ecological data products that should be covered in stock assessments and advice.

14:30 Session IV: Training Courses & Tool Box

14:30 What could be an interesting topic for a training course from your side? What is most important to be covered in a tool box for future assessments and predictions?

14:45 Workshop Summary, Closing Remarks, Outlook

15:00 End of Workshop

منظمة
الأغذية والزراعة
للأمم المتحدة

联合国
粮食及
农业组织

Food and Agriculture
Organization of the
United Nations



Organisation des
Nations Unies pour
l'alimentation et
l'agriculture

Продовольственная и
сельскохозяйственная
организация
Объединенных Наций

Organización de las
Naciones Unidas para la
Alimentación y la
Agricultura

MedSudMed technical meeting In support of fisheries management in the south-central Mediterranean Sea Palermo, Italy, 20-21 June 2019

1. Opening of the meeting

- *The Agenda, objectives of the meeting and participants will be introduced.*

2. Deep water rose shrimp and European hake

- *An outline will be provided on the outcomes of the 42th session of the GFCM (FAO General Fisheries Commission for the Mediterranean Sea) for fisheries management in the south-central Mediterranean Sea: Recommendation GFCM/42/2018/5 on a multiannual management plan for bottom trawl fisheries exploiting demersal stocks in the Strait of Sicily (geographical subareas 12 to 16).*

- *The results of the stock assessment for *P. longirostris*, *Merluccius merluccius* and *Mullus barbatus* carried out in 2018 will be outlined and jointly discussed.*

- *The outcomes of recent studies and projects on fishing gear selectivity and on the implementation of spatial based approaches for fisheries management will be illustrated; options to proper disseminate experiences accrued and studies results will be explored.*

- *Options to investigate the impact of climate changes on fisheries and fisheries resources will be explored. Discussion will be held on stakeholders' views on past and ongoing impacts of climate change on fishing activities (e.g. spatial and temporal effects on occurrence of target species, variation in catch species composition and/or species replacement, changes in species abundance).*

3. Deep water red shrimps

- *An outline will be provided on the outcomes of the 42th session of the GFCM on fisheries management: Recommendations GFCM/42/2018/3 and GFCM/42/2018/4 on a multiannual management plan for sustainable trawl fisheries targeting giant red shrimp and blue and red shrimp in the Levant Sea (geographical subareas 24, 25, 26, 27) and in the Ionian Sea (geographical subareas 19, 20 and 21).*

- *The technical work carried out to characterise Deep water red shrimp fisheries will be presented.*

- *Empirical knowledge will be used to integrate information coming from scientific studies. Discussion will be held toward the development of possible options for a common view on the management of Deep water red shrimps fisheries in the south-central Mediterranean Sea.*

4. Other matters

Annex 3: Strait of Sicily – Questionnaire to Fishers about Climate Change

Climate change and Fisheries in the Strait of Sicily

Question 1: Overall Perception

Do you think that climate change (e.g. warming) affected or are affecting fishing activities?	
If yes, positively or negatively?	
In few words, explain why	

Question 2: Total Catch

Have you noticed any change in the catch in the last years due to climate?	
If yes, do these changes regard the total quantity, the type of species or both?	
Could you indicate the species that showed the greatest variation (both increase and decrease) in the catch?	

Question 3: Spatial Variations

Could you say if the catch and/or species variations are generalised or regarded specific areas?	
If yes, did you noticed just a disappearance/appearance of the species or a movement?	

Question 4: Temporal Variation/Shift

Could you indicate if the variations occurred progressively through time?	
Could you indicate when you noticed the main variations?	
Have you noticed any other temporal effect like changes in the seasonality of captures?	
If yes, did you noticed a shift or an anticipation in the fishing season?	