

FISHING DISCARDS. TACKLING THE PROBLEM FROM A RESEARCH AND INNOVATION PERSPECTIVE



**REPORT FROM THE WORKSHOP ABOUT
FISHING DISCARDS ORGANISED BY THE
EUROPEAN FISHERIES' TECHNOLOGY
PLATFORM. ACCOMPLISHED IN VIGO, AT
CETMAR HEADQUARTERS ON THE 22ND OF
JUNE 2012.**

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1. BACKGROUND

The European Fisheries Technology Platform aims to identify the key challenges for the future of fisheries and fishing research and technology and to formulate, based on them, the sector's strategy and action plan that will strengthen its capacity to grow smart, sustainable and inclusive in the forthcoming years, thus, keeping a prominent role within the European Marine Economy.

The EFTP, through its Board of Directors and Secretariat, is promoting a number of workshops aimed to discuss and agree on a series of issues that are of paramount relevance in the above mentioned process:

1. Fishing Vessel Technologies
2. Discards.
3. Energy Efficiency.

The aim of the **discards workshop has been to make progress on the above mentioned process by putting together the inputs yield by a panel of stakeholders and experts** from different European regions, developing different activities and representing different particular interests. Discussion addressed the key challenges and on how efforts should be oriented in the forthcoming years with regards to those.

The workshop took place on the 22nd June 2012 at the premises of Fundación CETMAR, in Vigo. Participants from different countries and with different background disciplines and professional profiles, attended and a number of them contributed with presentations and inputs. The event was scheduled as a side activity to the Seminar "Discard management in European fisheries" organised in the framework of the Faros Life + Project www.farosproject.eu.

2. METHODOLOGY

During the morning session, Faros Project Seminar's presentations provided relevant information on the legal framework and about the state of the art, addressing the CFP reform, the Spanish position and the industrial point of view on this matter, as well as a number of recent projects and technological initiatives aimed to yield solutions. This first part of the meeting was open to a wide attendance (more than 60 people could attend and make questions).

The afternoon session was designed for a more restricted number of attendants in order to enhance more direct interaction (35 people max. allowed).

To facilitate this process a discussion document was drafted for introducing the scope of the problem and proposing major challenges and core technologies to tackle. This document was circulated to workshop attendants a few days prior to the meeting accomplishment.

After introducing the importance of this process for the achievement of the EFTP goals and explaining the working method, participants took part in two parallel round table discussions.

The discussion was organised, as proposed in the discussion document, around three main topics:

- i. Improving fisheries management patterns to avoid discards
- ii. Smart (selective, efficient and sustainable) fishing gears and devices
- iii. Secure long-term fisheries sustainability: market, governance and socioeconomic perspectives

The first aspect addressed was to accept or amend the challenges suggested within each topic.

Apart from this, the following questions were proposed for debate:

- Overview of the current status:
 - What has been and has not been done?
 - Which are the critic technologies to overcome the challenges?
- Where to concentrate future efforts and why?
- What are the **necessary activities or mix of activities** to address each challenge?
- What should be **the scope** (national, regional, sea-basin...) of the activities addressed to cope with each challenge in the terms agreed to describe it?
- What are the most relevant **drivers**?
- **Estimate the horizon** (time for the challenge to be achieved)
- Assign **priority** action among topics (This was accomplished remotely after the workshop).

3. BRIEFING OF FAROS PROJECT' SEMINAR¹

After welcome and introductory words provided by the Director of CETMAR, Ms. Paloma Rueda Crespo, the President of Vigo's Port Authority, Mr. Ignacio López Chaves, and the Secretary of the Sea from Galicia's Ministry of Sea and Rural Affairs, Mr. Juan Carlos Maneiro Cadillo, two subsequent sessions about regulatory/policy framework aspects and technological perspectives, respectively were developed.

First session was aimed to introduce the situation and expectancies regarding the Common Fisheries Policy Reform, and the perspectives and positions, under this change of scenario, of the Spanish Fisheries Administration and the Spanish Industry.

The first Key note speech was provided by **Director Ernersto Penas Lado, Head of Directorate A at DG Mare.**

The first assert remarked by Director Penas Lado, was that the discard ban is an irreversible decision. The CFP reform is still under progress, and the co-decision process has to be developed, however there is a wide consensus on the need to eliminate fishing discards on all European fisheries. The dimension of the problem so big that there is no option for further delay; the European Commission will put all its means at the disposal of the fishing sector to help them coping with this regulatory change, so this should be seen by the industry as a window of opportunity rather than as a threat.

Ms. Penas Lado explained that the problem on discards has really been put high in the politic agenda due to the pressure of NGOs and to a strong social sensitization towards discards eradication. This was, from the start of the reform process, one of the key issues to address. Discarding was considered a huge waste of resources, an economic inefficiency and an unacceptable damage to the ecosystem; however it has become the most prominent matter among all those comprised in the Reform thanks to social environmental concerns.

Mr. Penas Lado remarked that a clear regulatory baseline framework is needed to tackle discards elimination. There is a wide consensus on the need to eradicate this practice and this is going to be in the legal framework, thus deadlines and specific related partial objectives needs further development. The

¹ It has to be noticed that FAROS Project' Seminar did not necessarily pursue exactly the same objectives of the EFTP workshop, although the later was planed as a side event to the first. For this reason, the Seminar aimed to provide a wide perspective about discards: regulatory and political framework with particular emphasis in the Spanish case, advances from past projects and technological developments, and other aspects such as sustainability labelling, etc. Despite of all the references to the Spanish perspective it has been considered useful to add this summary to the report as a framework reference to bothe related events.

Council of the European Union reached a general approach on the CPF reform. Specific deadlines comprise a first stage up to the end of 2014 and the second, from the start of 2015, and all fisheries under the TAC and Quota system are comprised.

One of the most difficult challenges in this process has to do with relative stability principle. Spain, for example is in favour to modify this principle to facilitate some of the measures regulating discards (landing all catches). Spanish representatives consider flexibility is one of the key words that should apply to some elements of the process, from the point of view of the Spanish industry.

Mr. Penas Lado explained the different options being analysed to manage discards within the TAC and Quota System. He recognises the difficulties derived from the distant positions of countries such as Germany and France or Spain, for example. However he showed optimism about the possibilities to reach to a solution. One of the crucial elements to elucidate which will be the best solution will consist in gathering all the data to have a clear and detailed picture of the problem dimension. This is one of the issues pursued by the possible obligation to land all the capture. This will significantly help knowing not just the amount but the composition of discards.

The **Deputy Director of Resources Management at the Spanish Fisheries Secretariat, Mr. Borja Velasco Tudury**, focused his presentation on the specific concerns of the Spanish fleet with regard to the treatment of discards on the CPF Reform process. He provided data on how the current system based on TACs and Quotas and on the Relative Stability principle, is not really efficient. He provided some figures that show that Spain is buying quota to other countries, and that in some cases these quotas have been assigned to countries that do not really make more business from them than selling such quota to other countries. Companies have established alliances and real business have in fact found a back door to overcome the constraints of the Relative Stability principle. Mr. Velasco would recommend introducing more flexibility on the new regulation to solve the problem and make the distribution of quota be based on the actual capacity of the states to exploit the quotas assigned. The Spanish government does also propose a more gradual approach to the problem. Among the measures being under discussion on how to manage discards, they would be against the possibility of establishing commercial (so profit-oriented) routes for the catch of immature individuals. He finally claimed that to act efficiently against discards, it is crucial to know well the composition of such discards, so more research work on this aspect should be put into practice.

The third person to give a presentation was **Mr. Juan Manuel Liria, representing CEPESCA**, and thus, the Spanish Confederation of Fishing Industry, supported some of the asserts made by Mr. Velasco, and added some others. He strongly remarked the need to invest more in commercial/real-conditions

experiments. This is also one of the recommendations included in the FAO Guidelines² about discards management. He strongly recommended to uptake FAO recommendations within the agenda of the European Commission; he considered this approach as one of the most rational and well balanced ones, since the debate on discards has gained so much prominence in the politic agenda. In this context, Mr. Liria, highlighted this alternative (FAO's one) as a better approach for a research oriented by the reality of each fishing context.

Mr. Liria expressed his concerns about some of the measures under discussion, he considered Real Time Management, not possible unless some more flexibility is introduced to the system, the decision system is changed, and unless it is approached on a case-by-case (specific fishing context) basis. This perspective is in good part a consequence of the complexity of Spanish Fisheries. There are other countries of course with similar problems, but they're not the majority.

During the debate, at the end of this first session, most of the questions were about managing mechanisms. If MSY is the objective, and if the current TACs and Quota system is failing mainly because of discards. It is also expressed the concerns about the need to know more on what it is happening to implement more effective measures. The EU has invested huge amount of resources during the last years in research and assessment to have data enough as to propose effective management measures to recover the stocks. However it is true that with regards to discards, one of the intentions behind the obligation to land all catches is that it is yet not sufficiently known how much it is discarded and what is the composition of discards in each fishing ground. Measures to incentive transparency are needed, and some successful stories can be used as good examples to benchmark: the Netherlands and UK, for example. Despite of this, the deadlines managed, for example 2020 goals, and the declared intention to recover EU major fishing stocks by 2015, seems to be unrealistic. New experience should build on past success and failure stories, but Northern countries such as Norway, started the process a long time ago, and success took its time.

The second session on projects and results achieved, started with the presentation of **Marine Stewardship Council** representative, **Mr. Carlos Montero**. He explained how MSC certification system is considering discards among its indicators to evaluate the performance of the fleet in a given fishery. For this, he first went through the whole certification process, and made special emphasis in explaining how discards are being considered within the system, second, to illustrate this information he provided examples of certified companies and fisheries. One of the issues he remarked from MSC system is the

² 'International Guidelines On Bycatch Management and Reduction of Discards'. FAO 2011

philosophy of it, to work for introducing continuous improvements. He explains that companies being accepted for certification but scoring low in some aspects, will be required to put improvement measures in practice and to measure their impact.

Another characteristic he remarked about the MSC system is transparency; he proposed that allegations to the process and ideas on how to improve the system are not just welcome but actively pursued by the organisation. The website is the tool where all this participatory processes are implemented.

Mr. José Fernandez, from ARVI (Vigo's cooperative of fishing ship owners), explained his experience in discards projects starting some years ago at IEO (Spanish Oceanographic Institute). He had been involved in the PSE-REDES, BADMINTON and FAROS projects. As a result of these projects there are available a number of new tools/technologies _facilitating discarding estimates, or supporting the process to know more about discards composition_ and a design of a selective gear for Galician demersal-trawling fleet.

To build on those past experiences, and given that some of them were unfinished due to some drastic changes in Spanish R&D funding instruments, ARVI, together with IEO and a gear manufacturer, TECNOPESCA, have been working together in a new project to make field trials of the new gears with the commercial fleet involved in the process. Results achieved by the time of the conference accomplishment were explained and also how the experimental process was designed, it was also provided evidence on how far such process is not evident at all, how far industry involvement is crucial and that many different aspects have to be considered when a new selective gear is to be designed.

Mr. Luis Taboada Antelo, the Coordinator of Life+ FAROS project at IIM-CSIC (Marine Research Institute of the Spanish National Research Council) explained the achievements of the FAROS project and how far those have been built on past results from another projects (like previous Life project Be-FAIR).

The FAROS project was aimed to implement a number of technologies and tools deemed to automate the capture and transfer of information on discards, to define management protocols based on the analysis of this information, and to determine alternatives for feasible uses of discarded biomass.

The approach followed wanted to demonstrate the feasibility of real time decision taking based on the right tools to manage and process information about discards. Further more, besides improving the capacity to decide based on real time information, predictive modelling has also been introduced in order to plan the fishing strategy on a more efficient manner (considering the probability for discarding in one area and determining optimal fishing routes, for example) to avoid discarding and increase profitability.

On the other hand, knowing the composition and amount of discards, strategies to take value from those can also be optimised. Logistics can be organised, on board conservation processes can be effectively implemented, and marketing paths can be efficiently managed by standardising and securing the offer, linking closer offer and demand sides, which is key to build trust/reliability to target markets.

Mr. Ricardo Pérez Martín, Research Professor at IIM CSIC, proposed with his presentation to spread the use of systems and technologies that allow quantifying and determining the composition of discards. For years IIM-CSIC has promoted and got involved in several projects aimed mostly to reduce the potential losses that can derive from a discard ban. It is well known that among the causes of discarding it can be found an inadequate legal framework, economic stimulus, wrong fishing practices, inadequate fishing technologies, etc. Commonly a mix of these factors is in fact present.

One of the areas where IIM-CSIC has invested more efforts in the last years has to do with finding (economically and technically) feasible uses of discarded biomass (unwanted fish species and/or sizes, crustaceans, disposal from fish gutting and processing, etc.).

Among the possible alternative uses for this biomass it can be considered the options of developing commercial routes (which is not always a desirable solution), developing animal and or human food products or foodstuff, and obtaining value added molecules and compounds that can be used in chemistry or pharmaceutical products, in industrial products, as an ingredient to other foods, etc.

After this introduction, Mr. Pérez-Martín went through a number of projects, seven in total, carried out within the last years by IIM-CSIC and other institutions from Spain, like CETMAR or IEO, and other countries like Portugal, France, etc; FAROS project is one of the examples. In some cases of relevant success such as for example the identification of a discarded species of commercial value for direct human consumption, the *Capros aper*, it happened that once invested an important amount of effort by the Spanish sector in guaranteeing the appropriateness of the product and developing a market for it, paradoxically, it happened that other countries were provided with quota for this product and Spain was not.

It was also remarked the good amount of positive results achieved in developing small scale industrial prototypes and processes that had been demonstrated useful to extract value added products from discarded material. Mr. Pérez Martín suggested that support would be needed to close the circle and demonstrated that technologies as those developed in the FAROS project together with those developed for value added compounds and food stuff, could be integrated to improve production logistics by knowing in advance the amounts and qualities of discarded stuff, decide processing based on demand options, and adapt the production means to this information, gaining efficiency in the whole process.

Mr. Vegar Johansen, Director of SINTEF's Fishing Technology Department, made an overall presentation based on discards but also about SINTEF's structure and its funding (industrial involvement in the funding), as one of the issues influencing the success of this organisation in providing solutions for discards.

Mr. Johansen starts assuming that In Norway they have discards although they are prohibited. The first thing he adds to this is that one of the things they have been doing for years to tackle the problem is to invest a lot in research about this problem. Apart from a clear bet for R&D as one of the key elements for progress to a solution, he remarked a number of key facts that can be considered "lessons taken" from their own past experience:

1. There must be a legal mandate.
2. There must be solutions (management, technology...).
3. Fishermen have to be involved.
4. VMS systems have to be of general use and they can offer plenty of the information needed to determine when the closure of fishing grounds (cod juveniles...) is needed.
5. By-catch is allowed in some fleets however all of the by-catch is landed.

There are vessels that assume that they will get some cod if they fish even most is by-catch. There are technologies being developed, and already in use technologies aimed to add value to landed discards. The potential for some of the technologies aimed to add value from landed discard / by-catch is high. An illustrative example is that SINTEF is running a mobile processing plant which is performing pretty well.

Research and development efforts have also been made to avoid wrong catch and catch loss not just for trawlers, also other gears as purse seiners, long-liners...they can also be significantly improved.

SINTEF has also good expectancies on improvements that can be derived from R&D in detection technologies

With reference to long-lining, Mr. Vegar Johansen recognises that although there's been much research on this, however in Norway it has not been much implemented.

A new fishing concept that SINTEF is currently developing is based on the possibility to get fish onboard passing the catch through a moonpool at bottom side of the hull. Fish is kept alive in a pool inside the

vessel and this way implementing discard safe systems can be easier, using grids or mesh size or other devices to allow juveniles leaving or, when feasible, selecting one by one the desired catch. One of the additional advantages of the system is that by avoiding gear management practices, fishing can be made in a safer and more attractive working place.

Mr. Vegar Johansen suggested that, according to SINTEF experience, catches can even increased if new technologies are implemented. He also suggested that more efforts have to be made for the Improvement of gear materials (such as biodegradable materials) and that a reduction of discards has been efficiently achieved in some cases by introducing grids and different mesh shapes and sizes... Efficiency in this case has to be studied on a case by case basis. It is important to remind that not all the solutions perform well under any circumstances.

Another promising research area is to develop technologies that can reduce the costs of development. More sophisticated techniques: simulation, testing and full trial experimental designs, can be optimised with adequate tools and experimental support and infrastructures.

SINTEF is also promoting an initiative to concentrate the efforts of fishing technology scientist (EFTC).

The initiative is under development but it relies on the idea that huge benefit can be achieved from efficient efforts to integrate capacities, exchange good practices, share data and research outcomes, transfer knowledge through interaction among scientists, administration and industry (not just fishermen but fishing technology vendors, etc.). EFTC relies on the idea that solutions exist thus organisations have to coordinate efforts.

www.farosproject.eu/documents.aspx

and at

www.eftp.eu/

4. CONCLUSIONS ACHIEVED

The European fishing industry is facing nowadays a number of constraints which may compromise its future. The consequences of overfishing, the excess of fleet capacity (though decreasing) in some fisheries, the dependence on subsidy policies are some examples of those.

In the CFP reform process it is recognized that *despite the progress since 2002 reform, the objectives to achieve sustainable fisheries in all its dimensions (environmental economic and social) have not been met and the Green Paper identified a series of structural shortcomings for the current CFP*³.

In 2011 the European Commission put high in its agenda the need to find an efficient way to make the discard ban operational. Work on this matter was intensified and among different initiatives promoted by DG Mare it can be remarked the High Level Meeting that was accomplished in 1st March 2011 and on the 3rd of May a stakeholder hearing⁴ that took place with wide participation from industry, NGOs, etc.

In this context, fishing discards have reached a top position in the CFP Reform Agenda. There is a broad public consensus on the fact that unwanted catches should be reduced to almost negligible levels. The proportions of unwanted fish catches are an unacceptable waste of natural resources and a clearly inefficient practice from an economic management perspective. While awareness on accidental fishing has significantly increased during the last years, there is still unreported mortality and a lack of knowledge on the real dimension of the problem, its consequences and the paths to solve it effectively. Indeed unwanted catches and discards, besides constituting a substantial waste themselves, affect negatively the sustainable exploitation of marine biological resources and marine ecosystems, as well as the financial viability of fisheries. Thus, the complexity of the problem, makes the regulatory and policy framework, probably the most relevant driver to tackle discards. It is necessary that this matter is kept high in the politic agenda but also that a wide an open perspective is considered to determine the regulatory changes that can be expected more efficient in achieving the elimination of discards.

The new draft regulation on the Common Fisheries Policy, currently under discussion, states that an ecosystem approach to fisheries management needs to be implemented, environmental impact of fishing activities should be limited and unwanted catches should be minimized and progressively eliminated. The

3 COM (2001) 425 final. PROPOSAL FOR A REGULATION OF THE EUROPEAN PARLIAMENT AND THE COUNCIL ON THE COMMON FISHERIES POLICY.

4 http://ec.europa.eu/fisheries/news_and_events/events/030511/report_en.pdf

new CPF proposes to move towards a gradual elimination of discards on a case-by-case basis, and taking into account the best available scientific advice to reduce unwanted catches and gradually ensure that all catches are landed.

Fishermen are willing to play an active role in designing measures to avoid by-catches and discarding, which would foster industry involvement and self-compliance. As specific measures are foreseen on this regard, cooperation between industry and research agents seems to be the best strategy to tackle this extremely complex but so important problem.

Innovation is key for introducing the means that ensure coexistence of sustainability, social inclusion and economic profitability.

4.1 MAIN TOPICS AND CHALLENGES TO FOCUS RTD& INNOVATION EFFORTS IN THE FORTHCOMING YEARS

Participants in the EFTP workshop “*How to tackle fishing discards from a research and innovation perspective*” agreed on the structure of topics and challenges that were proposed within the previously shared discussion document:

Topic 1: Improving fisheries management patterns to avoid discards.

- 1.1. Increase and improve the availability and quality of data to estimate discards, their effects on the ecosystem (biodiversity, recruitment levels...) and the effects of measures to avoid them, by involving the commercial fishing fleet in this process.
- 1.2. Upgrade in tools and technologies to process the data under an ecosystem approach.
- 1.3. Implement innovative and more appropriate management measures (at metier or specific fisheries scale), to recover the long term fishing potential and monitor their impact: real time management, discard bans, temporary area closures, MPAs, etc.

Topic 2: Smart (selective, efficient and sustainable) fishing gears and devices.

- 2.1. Improve the selection capacity and efficiency⁵ of fishing gears.
- 2.2. Reduce the effects of fishing gears on the seafloor, vulnerable habitats and endangered species.

⁵ Gear efficiency should not involve an increase in catches, so efficiency must come from other properties of the "new" gears (for example if they are lighter they will reduce energy consumption).

Topic 3: Secure long-term fisheries sustainability: market, governance and socioeconomic perspectives.

- 3.1. Foster fishing industry and market resilience.
- 3.2. Profitable and sustainable use of fishing discards⁶.
- 3.3. Socio-bio-economic approach. This must integrate the economic, social and governance perspectives to analyze and foresee the impact of measures implemented.

Before discussing each of the specific topics and challenges proposed, participants agreed on a number of general asserts that can be applied when addressing this matter:

1. The EFTP is reflecting a position of a wide variety of stakeholders but as far as it is an industry led initiative, it must be remarked that the industrial perspective has been specially pursued in the analysis.
2. Whatever the measures that are taken with regard to discards, and specially whatever the recommendations are with regard to RTD and Innovation orientation of the efforts, industry has to find feasible options to contribute to the achievement of the selected challenges. Social and economic perspectives must always encompass environment-driven measures and their assessment.
3. There is an important consensus that regulatory framework is a key driver to address most of the challenges identified. As it is remarked at the end of the report from the stakeholder hearing on discards afore mentioned, *the EU legislator must remove all incentives for discarding from the legislative framework*. Furthermore, participants in the workshop also agree that there must be a commitment from regulatory bodies to enhance more agile adaptation of legislation to research and technology findings.
4. When discussing about funding perspectives and particularly referring to Horizon 2020, participants agree that more flexibility (than in FP6 and FP7) in structuring the size of proposals and consortia depending on the topic description and interpretation by participants, should be introduced.

⁶ The term discards would no more be applicable as far as the catch is kept on board, thus it should be understood in this case as the catch that before was discarded.

Topic 1: Improving fisheries management patterns to avoid discards.

Sustainability has become an indispensable global goal nowadays. In fisheries, among other things, it particularly implies avoiding or reducing as much as possible the catch of unwanted species. In this sense, fisheries management is a key concept and must be based on biological and ethological knowledge of exploited species and taking into account the spatial behaviour of the fleet over years. Appropriate management measures contribute to long term sustainability of fisheries. The effectiveness of such measures should be tested by using different indicators and perspectives.

👉 ***Challenge one: Increase and improve the availability and quality of data to estimate discards, their effects on the ecosystem (biodiversity, recruitment levels...) and the effects of measures to avoid them, by involving the commercial fishing fleet in this process.***

An accurate and actual quantification of discards volume generated by most relevant species is an ambitious but crucial challenge. Biodiversity, recruitment and proper functioning of food webs, among others, depend directly on catch and discard levels. Their effects are not properly described in many cases, so it is not possible to know accurately the environmental performance of communities facing these changes neither predict mid and long term responses. Obtaining long time data series is necessary to estimate the ecosystems' resilience.

There is a wide amount of disciplines that should be integrated in addressing this challenge: study the interaction among species, introduce genetic information in the information to be considered, improve modelling to increase predictive capacity and perform more complex analysis, and integrate modelling with computing and telecommunications to allow real time monitoring, assessment and management.

Having more information available and having it on a real time basis is considered as one of the keys to allow reducing the mortality of discards, which is at the end the real goal of measures aiming to eliminate them. Thus, technologies & processes that can guarantee long term survival of unwanted catches, or avoidance of catching unwanted sizes or species must be promoted.

The increase of availability and quality of data requires a significant industry support and direct involvement of commercial fleets. Data capture systems and devices such as digital cameras on board, special sensors to measure oceanographic and environmental variables, artificial vision systems for measuring discards, etc., are useful technologies that would benefit from further progress, adaptation and integration. However improvements should always be adapted to allow high industrial involvement and guarantee solutions' uptake.

Improving historical data and opening access to databases, statistics by geographic area and type of gear, geo-referenced information, etc. is another aspect about data availability that would reinforce and accelerate knowledge and technological progress in this context, by making data available to a wider spectrum of researchers and facilitating interaction among a larger number of stakeholders.

Participants also remarked as a need the relevance to promote standardization in this field, starting for example, by guaranteeing a common understanding of all discards-related vocabulary altogether with standardised methodologies used to estimate discards.

When the discussion focused on the kind of necessary activities to achieve this challenge, there was a broad consensus that most of the efforts should concentrate in demonstration and technology transfer. There is already a vast amount of knowledge, data and technology with high potential to lead to a change of scenario with regard to the above mentioned challenge. But this all should be made available to speed up technological progress. Involving the fleets in the processes to obtain the data is considered essential, but it is also crucial to demonstrate that this can be efficiently done and yield promising results. Demonstration activities are of paramount importance and assessing potential impacts of measures under commercial conditions is particularly relevant to promote a wider involvement of fleets in the process to eliminate discards.

The scope for this kind of activities should overpass the EU frontiers. International cooperation is very important at this point, not just because many fisheries of interest for EU fleets are beyond their jurisdiction, but also because of the opportunities to learn from experiences in other areas and because promoting standards should be pursued at an international context too.

For the above stated, it can be deduced that promotion of data sharing and standardisation are two of the relevant drivers. The third, but not less relevant, could be a global effort to involve commercial fleets in data acquisition. Would policy and regulatory framework foster progress in this direction, a significant change of scenario in a real short term could be expected, even in less than five years.



Challenge two: Upgrade in tools and technologies to process the data under an ecosystem approach.

Fishery assessment models should evolve to integrate more variables that allow the implementation of an ecosystem approach. This approach is based on the application of scientific methods focused on

biological organization levels that encompass the processes, functions and interactions between organisms and their environment, and recognizes humans as an integral component of the ecosystems.

In the way towards implementing the ecosystem approach to fisheries, the optimization of assessment models is a crucial challenge. There are several types: Whole ecosystem and dynamic system models (for example ECOPATH with ECOSIM); Minimum realistic models (for example, Multi-species statistical models); Individual-based models (for example, OSMOSE); bioenergetic models; predator-prey models, etc... In addition, neural networks have applications in forecasting, classifying, studying distribution and fisheries management. Forecasting in fisheries covers distribution of eggs, recruitment, fish growth/age, biomass and fish catch and collapse of fishery industry.

The potential for excessive and/or selective fishing to act as an evolutionary force⁷ has been recently emphasized. To improve understanding and management of fisheries-induced evolution, it is encouraged a greater application of methods from behavioral ecology, physiological ecology and behavioral genetics.

Technologies aiming to make progress in applying the ecosystem approach need from progress in modelling and all should benefit a lot from the development of the possibilities for real time monitoring. It is expected that in the near future a “network of virtual observers” replace significantly the labour of onboard observers.

Demonstration under pre-industrial scale conditions is a remarkable demand of all the stakeholders to speed the transfer of technologies and realise their yields to market, society and environment.

Participants recognise that demonstration and innovation efforts should increase but there is also a clear need to make progress on research, enhancing the capacity and complexity of data analysis as well as the prediction ability to orientate different decision makers.

When discussing about the scope, the most common position was coherent with the one proposed for the first discussed challenge. There is an agreement that this field of development should be tackled under an international perspective (beyond EU), as many fisheries of interest for EU fleets are beyond their jurisdiction and also some aspects (standardization...) should be set at an international level.

Time frame for this challenge to materialise significant progress is expected to take from 5 to 10 years.

⁷ Factor capable to cause an evolutionary change.

👉 ***Challenge three: Implement innovative and more appropriate management measures (at metier or specific fisheries scale), to recover the long term fishing potential and monitor their impact: real time management of discard bans, temporary area closures, MPAs, etc.***

A number of traditional fisheries are overexploited or above safe exploitation limits causing a decline in catches, together with an effort increase as a compensatory response. Innovative approaches and strategies are crucial to overcome this situation. Specific management based in the implementation of good practices, regulation, marine protected areas, real-time area closures, real-time information capture, etc. are some of the mechanisms that could provide solutions to contribute in this regard, taking into account the specificities of each fisheries or metiers.

Communication technologies, GIS and computing sciences can provide monitoring and decision support systems to execute actions under real time management, discard bans, MPAs, etc. Data from new generation Vessel Monitoring System, for example, could serve to assess areas of stress in fisheries. Therefore, as in a scorecard, a pool of indicators should be selected and implemented in a Decision-Support System (DSS) for sustainable fisheries management, allowing the interaction between the different stakeholders.

One of the new and promising approaches in fisheries management is based on the idea that an effective management can be achieved if time-scheduled and quantifiable objectives are established and the stakeholders elect by their own the strategies and tools to use to achieve such objectives, allowing them a more flexible adaptation according to their preferences and capacities, as stakeholders that organise and interact properly in each area under the condition to achieve the agreed goals.

Whatever the management approach is, research should be aimed to provide solutions to select the most suitable management measures on a case by case basis, however when talking about management it is key that the regulatory framework facilitates and effectively incentives their implementation. Policy support or management-support research could in this case be one of the most effective orientations for research and development activities; and active involvement of all stakeholders in the process is again a core premise.

An acceptable level of development in overcoming this challenge is considered feasible only in a mid to long term timeframe (10 to 15 years).

Topic 2: Smart (selective, efficient and sustainable) fishing gears and devices.

Improving selectivity by directly changing and or modifying the fishing gears is another way towards avoiding accidental fishing. A fishing gear is considered selective when it successfully prevents the

capture of not allowed or unwanted species or sizes. Addressing the problem of unsustainable fishing practices in the short to medium term involves the reinterpretation of catch systems as a priority, since their characteristics significantly determine the type and quantity of discards generated by a fleet.

👉 ***Challenge one: Improve the selection capacity and efficiency of fishing gears (at metier or specific fisheries scale)***

Despite the voting process to determine priority levels among the challenges discussed has not yet been addressed, this challenge was considered by participants in the discussion process if not the most, one of the most relevant priorities.

More effort should be focused in the design, testing and construction of high selectivity and efficiency fishing gears and/or devices, by combining active (separation of target and non target species according to their different habits or behaviour) and passive (mechanical sorting of those individuals who do not reach a preset size) selection systems.

Efforts on mixed fisheries, that represent the most relevant ones regarding discards and also the most complex ones to find a feasible solution, should be prioritised.

On one hand it is stressed the idea that technological developments in other fields than fisheries should be explored to be adapted for an onboard application (for example, solutions based on automatics, robotics, logistics, communications...). Nevertheless, the challenge to reduce discards in the medium term, demands simple and practical solutions, to be quickly and easily implemented on commercial fishing boats. Among other things, it should be pursued more gentle fishing methods that increase the quality and so the value of the capture. Other technologies and knowledge areas that are considered very relevant to achieve the goal of reducing unwanted captures are studying fish behaviour and consider this knowledge as an input to selective gear and devices development. Simulation and modelling are also critical tools to simulate the behaviour of selective gears and devices and make faster and more efficient the progress in this field. Best practices' benchmark from areas that have achieved success in this field and proactive knowledge share, should also be enhanced.

It is important to keep in mind that the real objective is to reduce mortality derived from discards, then, efforts should probably concentrate more in obtaining new technologies that avoid the capture of unwanted species or sizes. That means the need to clearly describe the composition of discards, to clearly define the technological needs on a fishing metier by fishing metier basis.

As said, for a successful yield of the efforts invested, fishermen have to find incentives to use the new technologies. Those could be derived from a reduction of energy costs, an increase in fish prices and in improvements on commercial opportunities, legal incentives, etc.

The industry is specially for the idea that they must take part in all the process; shared responsibility also implies a strong involvement in research and development activities: in integrating their know-how in all the process, from providing practical information about all the elements influencing the discards in every fishery, suggesting improvements in the design stages and, of course, testing every new device or gear under real-operational conditions. The proactive involvement of the fishing industry is crucial to successfully accomplish the technological challenge and assure future compliance.

In the process to develop a new selective fishing gear, as said, fishermen must find clear incentives to use them, thus, one of the relevant constraints for new developments is their efficiency. Environmental benefits from new gears can come not just from a discards' reduction, but also for the reduction of energy consumption and even from the use of environmentally friendly materials. Then a compromise of benefits has to be explored, considering both economic and environmental perspectives.

Although there is a big difference among the progress obtained by different countries, and though in the last years both, industry and research bodies, have intensified their efforts in this field, it is still necessary to make progress from research, to find feasible solutions on a fishing metier-by-fishing metier basis, and to demonstrate their efficiency to the industry. A realistic timeframe to expect a change of general scenario in using selective gears in most of the European fishing grounds, if efforts are effectively oriented, could take from 10 to 15 years. Nevertheless, effective results in reducing discards could be achieved for some metiers in a shorter term.

 ***Challenge two: Reduce the effects of fishing gears on the seafloor, vulnerable habitats and endangered species.***

Fishing gears alter seafloor habitats, but the extent of these alterations, and their effects, have not yet been extensively quantified in the Atlantic. The physical impact of trawling on the sea bottom has been proven in a number of studies. The direct physical effects of this fishing method is mixing and re-suspension of bottom sediment and its biological effects fall primarily on the significant decrease of sessile organisms like sponges, anthozoans and corals. These benthic communities constitute the structural basis of the trophic network, so deterioration of their populations jeopardizes the ecosystem balance.

Technologies such as the development of specific computer-aided gear design and simulation tools; the use of new materials (biodegradable, resistant, light...) in gear manufacturing; the improvement of selective devices and mesh size/shape combinations; the use of different kinds of sensors, etc. would provide different options to reduce discards and the undesirable effects of fishing gears operation (benthic impact, discards, footprint...).

New designs should focus all, gears, doors and other related devices. One of the greatest impacts on the seabed derives from the trawl doors responsible for the horizontal opening of the fishing nets and the traction force generated by the friction on the seabed produced also causes important fuel consumption, so this seems to be one of the key elements to be improved. Footrope of the trawl is also responsible for the seabed alteration, hence, new designs for gentle footrope should also be investigated.

Simulation tools and simulation facilities are also of paramount relevance to make efficient design purposes. With regard to simulation tools, they need to combine with model-testing in flume tank facilities and full scale trials performed with commercial fleets, in order to optimize simulation capacity to more realistic results. Simulation could also benefit from open access data and platforms that allow learning from past experiences and foster modelling tools optimisation.

As said an assumable and feasible compromise between reducing impact, increasing selectivity, gentle and efficient catch and energy efficiency should be pursued. Taking into account the large variety of fishing métiers all around Europe, the horizon for this to be achieved is foreseen in this case longer, estimated at 15 years for a general accomplishment of the challenge in most of the European fleet; however successful results could be achieved in a shorter period for some relevant métiers..

Topic 3: Secure long-term fisheries sustainability: market, governance and socioeconomic perspectives.

Marketing systems are directly related to the sustainability of fisheries and all its social and economic impact. Changes in exploitation and selectivity patterns are expected to have relevant consequences in the profitability of the activity. Expected economic and social impact of the technological and organisational changes should be studied and future scenarios should be forecasted, to find sustainable and prosperous paths for adaptation.

Although mentioned in the third place in this report, it must be remarked that, under the EFTP perspective, this topic must be understood by all the agents as of paramount relevance. Knowing or having the capacity to estimate the economic and social consequences of discards' elimination is probably essential to successfully overcome any of the challenges mentioned in this report.

When developing the discussion about this topic, it gains relevance the need to invest efforts in an accurate and adequate social awareness about discards, citizens should know more about the dimension of the problem, the complexity of it and of finding solutions, its consequences and of course about the means and efforts in place by all stakeholders to eliminate discarding. Only with this it will be feasible to find a public willing to pay more for a more sustainable fishing.

Information to a wide public is also a key driver to be fostered in the case of developing markets for new products derived from discards and fish offal.

👉 **Challenge one: Foster fishing industry and market resilience.**

Expected changes in discards' regulation will have a number of consequences in the placement of fishing products in the market, both in quantity and quality. For example, in the short term, it could be expected a reduction of the availability of target catches, while alternative market strategies will have to be found for alternative species and products. The analysis of current and expected changes in consumer patterns is also of paramount importance, sustainable labelling could be a tool to add commercial value and transfer part of the effort made to the market. Are consumers willing to pay more if they have guarantees of a more sustainable fishing? Are there other tools that could help differentiating sustainable products? Market and societal concerns and understanding of the problem and of the efforts made to tackle it, is crucial to increase the willingness to coherently share the effort by, for example, accepting higher prices for more sustainable practices.

It can be easily assumed that fish-markets will suffer some drastic changes when the new scenario for discards regulation enters in force and efforts to eliminate discards intensify strongly in the short term. Therefore research efforts shall focus in knowing the potential scenarios and suggesting best strategies to adapt to them ensuring the survival of the sector.

Results from research efforts towards the challenge of market resilience could be expected in a mid term horizon, taking from 5 to 10 years.

👉 **Challenge two: Profitable and sustainable use of fishing discards.**

Several attempts have been made in the last years to find and demonstrate different feasible processing techniques and technologies that can yield valuable outcomes from fishing discards. Food and bio technologies have proven the technical feasibility of a number of options. However, despite of some remarkable exceptions (fish meal and oil, animal foodstuff and fish gelatine) it is widely considered that there is still a wide gap for getting the most for the industry from this field of opportunity.

As it was made evident during various of the FAROS' Seminar presentations, there may be still place for improvement in integrating existing technologies for more efficient logistics and real time management; mobile solutions and low scale processing could also require some improvements and could be applicable in more areas than now available; however the real gap is behind an effective clustering of activities. Technology can effectively allow the fishing industry delivering their products for further and science-based

processing. A number of value added compounds can be obtained from discards as from many marine products, but future efforts should involve having the high-tech industry (chemistry, biotechnology, pharmaceutical...) establishing stable alliances with the primary or first processing sector as providers of best quality raw materials. Incentives for clustering these industries' interests in research, development and mainly demonstration activities could provide this new path for getting valuable products under sustainable exploitation patterns.

Would progress be achieved in this field, the fishing industry should prepare for a qualified treatment, preservation, storage and delivery of valuable materials, applying new on board practices and technologies and adapting vessels to this.

Therefore, further than expecting much progress on processing and biotechnologies (finding new molecules, compounds, etc.), important improvements could be expected from technology transfer and innovation applied to logistics, in a smart clustering of activities (i.e. through establishing strategic alliances with the fishing industry integrated in them) and in designing and developing new marketing approaches.

The fishing industry will need to promote or get involved not just in obtaining interesting bio-products from discards and by-catch, but in promoting the study of alternative markets for discarded fish and crustaceans, including, of course, human consumption. Benchmark from other countries' experiences is again a recommendation for an efficient approach to alternatives.

With the available technologies, knowledge and experiences from public and private sectors all around the world, and of course in Europe, significant progress towards this challenge could be achieved in five years or less.

👉 ***Challenge three: Socio-bio-economic approach. This must integrate the economic, social and governance perspectives to analyze and foresee the impact of measures implemented.***

It is necessary to obtain reliable quantified estimations at different levels (economic, bioeconomic and on populations) of the expected effects of the change of scenario for the fishing industry with regard to discards' reduction. Thus, it will be possible to obtain short, mid and long term predictions and plan and act in coherence with foreseeable realistic scenarios, reducing the commonly unmanaged uncertainty.

Successful implementation of ecosystem-based fisheries management policies requires that all stakeholders consider, in their action the multiple ecological and socioeconomic objectives, to a reasonable extent. Management-strategy-evaluation (MSE) methods that rely on simulation testing of the

whole management process from catch to consumer, are only possible with the direct involvement of all parties.

The sector's governance structure should be analysed to adapt to the expected scenarios efficiently and smartly. This might be a specific field for research activities. The governance map is not sufficiently clear and overlapping should be avoided while at the same time, networking is enhanced. An efficient design of the governance map should reinforce the capacity of the stakeholders to interact and the possibilities of implementing successful bottom-up approaches.

An integrated approach to the implications of changes in management and selectivity patterns and practices to more sustainable ones should also yield benefits for an effective policy orientation, to facilitate an efficient and soft adaptation to a new global fisheries paradigm. Research efforts in this field would provide relevant results within the mid term, in less than 10 years.

4.2 RESULTS OF THE VOTING PROCESS.

A total of 8 people voted the list of challenges above described to set up the relation of priorities. As far as there were no challenges added or eliminated, this exercise would simply allow to put them into an order that determines priority instead of thematic affinity (that is represented by the order set out at the discussion document and for this during the discussion at the workshop).

Results obtained:

Results obtained ranked by number of votes	N0. of votes
Increase and improve the availability and quality of data to estimate discards, their effects on the ecosystem (biodiversity, recruitment levels...) and the effects of measures to avoid them, by involving the commercial fishing fleet in this process.	29
Improve the selection capacity and efficiency ⁸ of fishing gears.	28
Socio-bio-economic approach. This must integrate the economic, social and governance perspectives to analyze and foresee the impact of measures implemented.	23
Implement innovative and more appropriate management measures (at metier or specific fisheries scale), to recover the long term fishing potential and monitor their impact: real time management, discard bans, temporary area closures, MPAs, etc.	23
Profitable and sustainable use of fishing discards.	16
Foster fishing industry and market resilience.	14
Reduce the effects of fishing gears on the seafloor, vulnerable habitats and endangered species.	14
Upgrade in tools and technologies to process the data under an ecosystem approach	13

⁸ Gear efficiency should not involve an increase in catches, so efficiency must come from other properties of the "new" gears (for example if they are lighter they will reduce energy consumption).

4.3 PARTICIPANTS' LIST

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