Cooperation in Fisheries,
Aquaculture and Seafood Processing

COFASP
ERA-net

STRATEGIC RESEARCH AGENDA

For Fisheries, Aquaculture and Seafood Processing

ABOUT COFASP

COFASP is an ERA-NET. The objective of the ERA-NET scheme is to develop and strengthen the coordination of national and regional research programmes. COFASP was created to directly address actions envisaged within fisheries, aquaculture and seafood. It started in 2013 under the KBBE theme in FP7, and is part of the Europe 2020 strategy, which recognises bioeconomy as an important part of the strategy.

COFASP Partners

- DASTI - Danish Agency for Science, Technology and Innovation, Ministry of Science, Tehcnology and Innovation Denmark
- CNR - National Research Council Italy
- ICES - International Council for the Exploration of the Sea Denmark
- Tecnalia-AZTI Fundacion Azti/Azti Fundazioa Spain
- BMELV - Federal Ministry of Food, Agriculture and Consumer Protection Germany
- BLE - Federal Office for Agriculture and Food Germany
- DLO - Stichting Dienst Landbouwkundig Onderzoek, Wageningen University and Research Center Netherlands
- RANNIS - The icelandic Centre for Research Iceland
- Ifremer - French Research Institute for Exploitation of the Sea France
- UEFISCDI - Executive Agency for Higher Education, Research, Development and Innovation Funding Romania
- RCN - The Research Council of Norway Norway
- ANR - The French National Research Agency France
- DEFRA - The Secretary of State for Environment, Food and Rural Affairs United Kingdom
- Scottish Ministers - The Scottish Ministers Acting Though Marine Scotland United Kingdom
- IEO - Instituto Español de Oceanografia Spain
- HCMR - Hellenic Centre for Marine Research Greece
- GSRT - Geniki Grammatia Erevnas Kai Technologias, Ypourgio Paidias, Dia Viou Mathisis & Thriskevmaton Greece
- FCT - The Foundation for Science and Technology, Ministry of Education and Science Portugal
- Marine Institute - Marine Institute Ireland
- DAFA - Danish AgriFish Agency, Ministry of Food, Agriculture and Fisheries of Denmark Denmark
- EV ILVO - Eigen Vermogen van het Instituut voor Landbouw en Visserijonderzoek Belgium
- DTU Aqua - Technical University of Denmark Denmark
- MATIS - Matís ltd. Iceland
- ISPRA - The Institute for Environmental Protection and Research Italy
- GDAR - General Directorate for Agricultural Research and Policy Turkey
- MMM - MAAELUMINISTEERIUM, Estonia
- Luke - Luonnonvarakeskus, Finland
- IFD - Innovation Fund Denmark, Denmark

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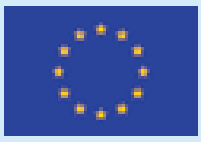
Design: Studio Evers Haarlem BV | www.studio-evers.nl | info@studio-evers.nl



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For Fisheries, Aquaculture and Seafood Processing

This COFASP strategic Research Agenda document is also available at www.COFASP.eu


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EXECUTIVE SUMMARY

The key objectives of COFASP are to strengthen cooperation and synergies between European research programme owners and managers, focusing on the benefits and needs for Fisheries, Aquaculture and Seafood Processing. In WP1 and WP2 COFASP aimed to analyse potential common programme contents and joint calls and produce a final paper on common strategy to address the future research needs and possibilities of research cooperation in fisheries, aquaculture and seafood processing.

This document provides an analysis of elements for a strategic research agenda. The focus is on analysing the topics that from the remit of COFASP, being fisheries, aquaculture and seafood processing, are of prime importance. These topics have been identified in different actions developed within the framework of COFASP; the foresight exercise (WP1), the analysis of the most relevant research projects funded at national and European level (WP1), the analysis of the national priorities (WP2) and the thematic Case Study Workshops (WP4). These topics will then be put in the framework of similar research priorities as defined by JPI Oceans, SEASERA and SCARFish. In the final analysis we will look at how the COFASP priorities are positioned in the institutional landscape and which elements for a future strategic agenda are of importance.

CHALLENGES AND PRIORITIES

For the short run based on the outputs of the COFASP tasks, with specific reference to the definition of call topics, the foresight exercise and results of the several thematic Case Study Workshops, the following list of grand challenges and urgent priorities for research were identified:

AREA	TOPICS
Marine science in general	The focus is on the optimal sustainable use of our seas and oceans. A holistic approach in marine science is needed in light of the marine ecosystem complexity. Management should focus on increased possibilities of using available resources in a novel sustainable way enabling different sectors such as fisheries, aquaculture, tourism and mining to coexist. Marine spatial planning is essential for sound utilization of marine resources. Regional (sea) cooperation is of prime importance (see below).
Environment	Develop a methodology in which impacts of a multitude of activities can be determined at the appropriate ecosystem geographical and time scale. Such as the modelling and risk assessment of disease and pathogen distribution in wild populations and aquaculture systems; develop prevention and treatment systems. Another example can be to devise a methodology that considers species adaptation to ecosystem change and the ecosystem impact considerations of the restoration of certain species.
MSFD and CFP	Both EU policies have a bearing on the management of the oceans, seas and aquatic resources, yet implementation and monitoring are not unified. Research is needed to obtain an optimal regional understanding of implementing and monitoring policies. Novel survey techniques, optimal cooperative and coordinated monitoring at the regional seas level need to be prioritized.

AREA	TOPICS
Fisheries	An urgent priority is addressing the challenges of implementing the revised CFP, i.e. the landing obligation and its mode of operation as well as on-board handling and adequate practices. Management models and monitoring using new technologies to reliably predict the dynamics of ecosystems are needed to improve monitoring, surveillance and data collection. Options of selective fishing gear need to be strengthened. Impact of management operations on the economy of fisheries should be analysed regularly and included in the procedure of management advise.
Aquaculture	Aquaculture growth is currently limited by factors research and innovation could unlock. Sound communication based on facts tracked through marine spatial planning can neutralize hindrances for social acceptance. Thorough biomass estimates and environmental monitoring with incorporation of biological indicators control can improve. Selective breeding and technology innovation can accelerate robustness e.g. with increased juvenile quality.
Seafood Processing	The main research concerns of the Seafood Processing Industry lay in the realm of securing resources and maintaining a stable supply, with increased yield, better utilization and valorisation. The Seafood Processing Industry could learn from the success of the salmon industry in terms of innovation and introduction of new products. Focus on product- and market development for previously discarded species and wasted material is needed, such as better use of oil and proteins in the pelagic industry. Limiting environmental impact of the processing, avoiding post-harvest losses and minimizing food waste is essential for the future of the seafood processing industry. Chilling and packaging technologies as well as better documentation through the value chain can extend shelf-life. The focus must always be on the sustainability in use of natural resources.
Value chain	Standardized information is of high importance for increased sustainability and efficiency in the value chain. The entire value chain will have to adapt to the principle of 'more with less'. New technology/techniques in the processing sector will have to be developed to increase the competitiveness of the European Seafood Sector. Furthermore a focus must be on the health effects of seafood consumption.
Governance	Creation of incentives, backed by facts and science, that facilitate an optimal management of marine resource whereas licence to produce aligns with the public attitudes towards marine production. Communication between producers, consumers and citizens need to be based on reality not image or imagination.
Regionally integrated fisheries and ecosystem management	General marine science require urgently the development of scenarios with multiple objectives (incl. ecosystem and socio-economics), evaluation of trade-offs between multiple objectives, on sectoral and spatial scales, testing the effectiveness of small scale measures (e.g. MPAs) at global population/ecosystem/regional scale and, reciprocally, of large scale measures at small local scale.

RESEARCH ENABLERS

The following priorities for research enablers, identified in tasks on research infrastructures (WP2) and human capacity building (WP4), will assist in implementing the research agenda:

	RESEARCH ENABLERS - MAIN THEMES
	... SUCH AS
Research infrastructure	Sharing and optimising investments in research capacity. Common vision on research facilities that can maximise use of biomass with new innovation and product development.
Mobility	Develop a mobility strategy making use of programmes and schemes available at different level, including the European H2020 MSCAs and the "Blue Careers in Europe" EASME/EMFF action, to increase cross-sectoral mobility of apprentices, students and researchers.
Training	Create training opportunities in all the sectors of COFASP, also covering interdisciplinary needs.

RESEARCH TOPICS

In the light of furthering the implementation of the Blue Growth agenda, the following topics are considered for the period 2018-2020, the main need is to integrate Blue Growth into the Circular Bio-Based Society:

	RESEARCH TOPICS - MAIN THEMES
	... SUCH AS
Exploring resources	• Upscaling of seaweed production • Exploration and development of sustainability concepts • The use of "omics", e.g genomics, metabolomics
Innovation	• Novel technology for efficient monitoring, data collection, -processing, and –analyses • Product development from pelagic species • Multi-use of ocean space • Further development of efficient and reliable aquaculture farming production systems with low environmental impact
Management	• Development of management strategies and evaluation tools sensitive to marine ecosystem resilience • Marine Governance related to societal acceptance of Blue Growth perspectives • Integrated (cross sector) large marine ecosystem based management at regional level • Engaging society to collect scientific information • Coupled social-ecological system modelling

COFASP POSITIONING

If we look at the landscape of research priorities as generated by the several marine actions and institutions such as SEAS-ERA and most recently SCARFish, EFARO, and the JPI Oceans, we note that the different fora have on the one hand different time horizons and perspectives but on the other hand have quite some overlap in the priorities defined, especially on a generic level. There are some common themes being identified in the different research agendas and discussions in Europe. Developing the marine bioeconomy and the environmental impact of activities on the marine ecosystem, and in this the implementation of the Marine Strategy Framework Directive (MSFD) and attaining Good Environmental Status, including Climate Change, is an overarching theme. In addition to this there are three generic themes: 1. Data collection and use of data; 2. Regionalisation and 3. Smart Specialisation[1]. Especially regionalisation and smart specialisation will have quite some influence on both the way data are being collected, managed and used and the way research is going to be organised.

Moving towards a strategy for research it is of prime importance that in the short run the discussions on regionalisation together with smart specialisation and the fundamental set up of data collection, management and use in this constellation is being held. Adjacent to this is a rather fundamental perception of how in the future marine research and research funding is going to be organised. The most practical way forward for the COFASP partnership is to position itself among SCAR-Fish, JPI Oceans and the individual research programmes of the Member States. The priorities as defined in the COFASP foresight exercise are still valid in this landscape. With its more focused scope and well-established network it would be advantageous for the COFASP partnership to continue in a new public-public instrument and develop new targeted joint calls to address specific research needs for the further development of fisheries, aquaculture and seafood processing.

1 The Smart specialisation' approach combines industrial, educational and innovation policies to suggest that countries or regions identify and select a limited number of priority areas for knowledge-based investments, focusing on their strengths and comparative advantages (OECD, 2013). https://ec.europa.eu/jrc/en/research-topic/smart-specialisation

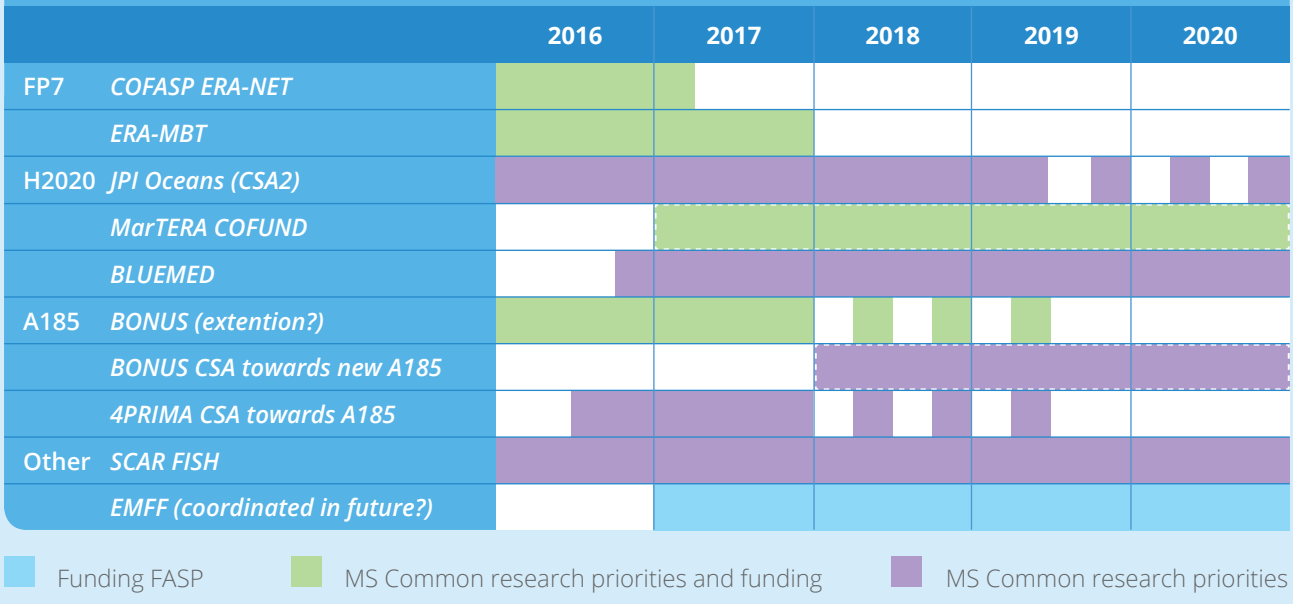
1 INTRODUCTION

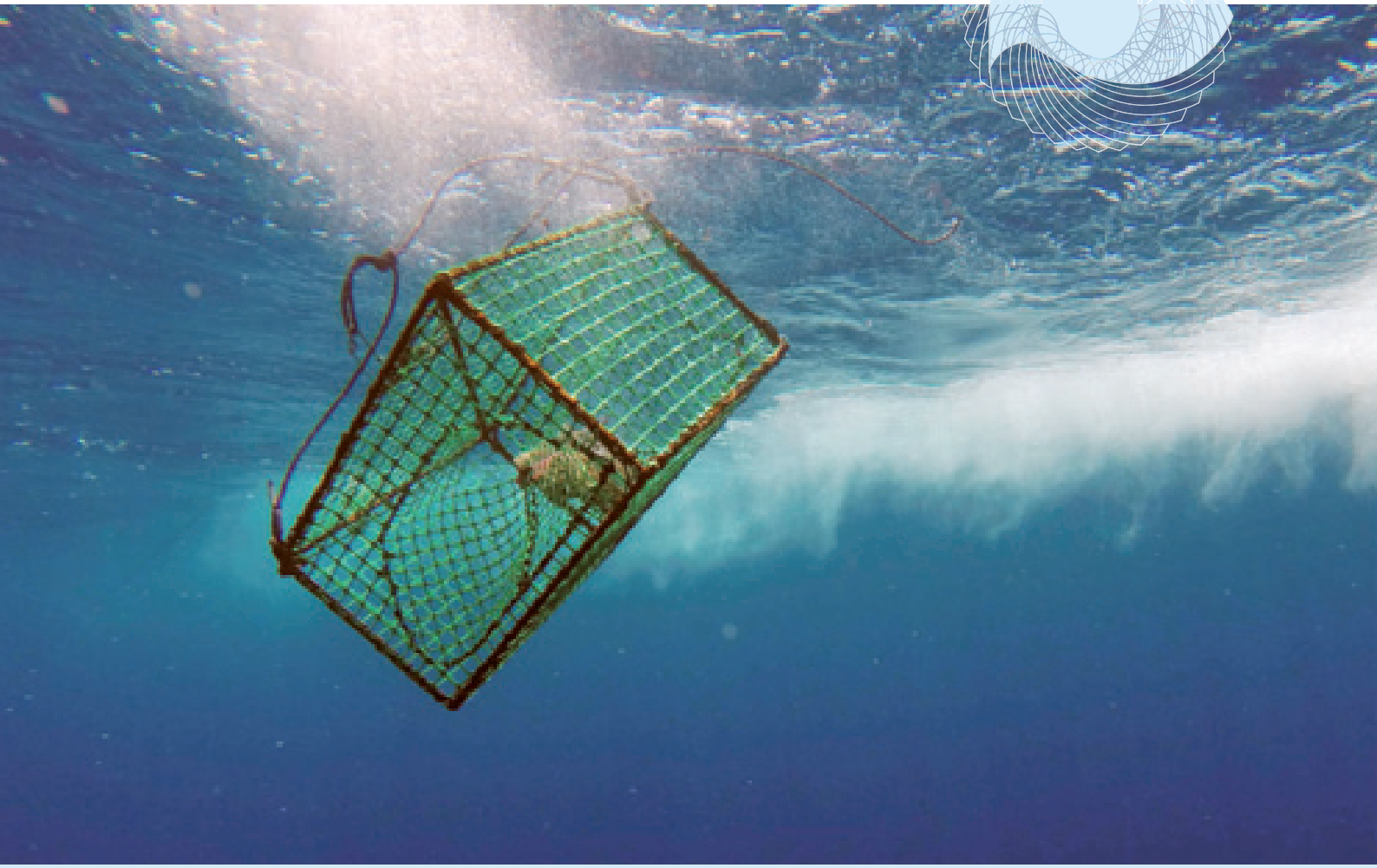
Moving towards 2050 the main challenges we are facing globally is to accommodate the need for food, sustainable energy and fresh water for a world population of almost 10 billion people. As our planet's surface is for 71% covered with water, unlocking its potential through a strategy of Blue Growth is necessary. In addition, adaptation to climate change and mitigation of its negative consequences rate equally high among societies' grand challenges. At the same time technological progress is advancing at tremendous rates; making use of novel technology is a must to turn these challenges into opportunities. This concern is also reflected in the EU Commission's FOOD2030 initiative which seeks to develop Research & Innovation for tomorrow's Nutrition and Food Systems, covering issues such as nutrition, climate robustness, circularity and innovation to transform and future-proof our food systems to be sustainable, resilient, competitive, diverse, responsible and performant in their provision of accessible, healthy and sustainable food and diets for all.

The EU FP7 funded ERA-net COFASP has as main objective to strengthen cooperation and synergies between major European funding agencies that support research on sustainable exploitation of marine renewable resource with the aim of sustainable exploitation of marine living resources and to define the science, information and data necessary to underpin marine policy. In this it is closely related to the EU's agenda of Blue Growth which considers economic growth and employment prospects in the marine and maritime economy as to be of major importance to help Europe's economic recovery.

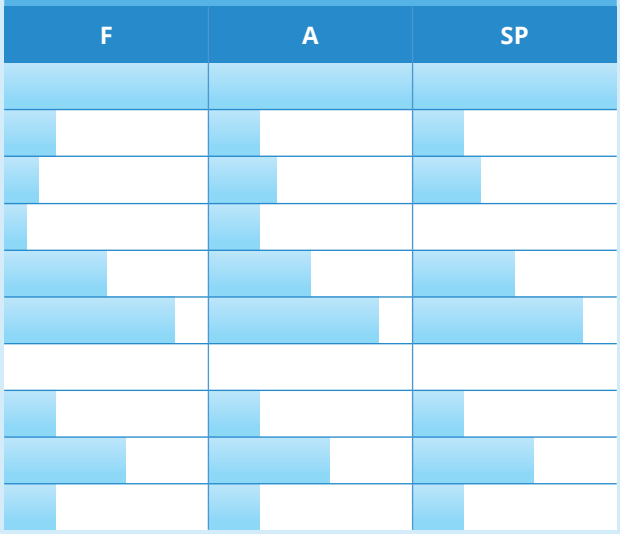
COFASP is not operating in isolation in this, but is closely related and positioned among a number of other initiatives. The figure below depicts the current landscape for pan-European discussion of common research priorities and coordination of funding of research in Fisheries, Aquaculture and Seafood Processing (FASP).

STRUCTURES FUNDING RESEARCH AND INNOVATION - OR INVOLVED IN DEFINING COMMON RESEARCH PRIORITIES IN FISHERIES, AQUACULTURE AND SEAFOOD PROCESSING





COVERAGE OF COFASP SCOPE IN OTHER INITIATIVES



Funding FASP

COFASP builds on the experiences of three earlier ERA-NET initiatives: SEASERA, MARIFISH and MARINERA. **MARINERA** which ran from 2004-2009 aimed at building the confidence to create a favourable climate in which to pursue enhanced cooperation between, and reciprocal opening of, national Marine Research Funding. **MARIFISH** ran from 2007-2011 with main purpose to strengthen the links between European marine fisheries science and fisheries management and, **SEASERA** which ran from 2010-2014 had a focus on establishing an integrated marine research strategy and programmes by constituting a platform for developing a European integrated policy oriented structure to promote knowledge and expertise in any sea related area.

The two existing FP7 ERA-NETs **(COFASP and Marine Biotechnology ERA-NET, ERA-MBT)** are focused on joint calls for the utilization of marine living resources and the technologies around them. They also do other joint activities or addressing specific themes such as foresight analysis, human capacity building or research infrastructure. Both ERA-NETs come to an end in 2017.

The **Joint Programming Initiative "Healthy and Productive Seas and Oceans"** (JPI Oceans) is supported by a new CSA running for 36 months from beginning of 2016. The scope of JPI Oceans is broader than the ERA-NETs and includes research in the marine and maritime sectors. As COFASP has been actively dealing with the fisheries, aqua-culture and fisheries sectors, the SRIA developed by JPI Oceans is focusing broadly on areas such as deep sea resources, marine spatial planning, technology and sensors, and climate change. The strategic areas 9 and 10 are focusing on food security through fisheries and aquaculture (area 9) and use of marine resources, including biotechnology (area 10). There are thus some overlaps between the JPI Oceans SRIA and the common research areas identified in COFASP activities.

Although the COFASP outputs are covering more aspects and describe the challenges and needs in the sectors in greater detail, COFASP to a large extent contributes to objective area 9 of JPI Oceans.

The **MarTERA** ERA-NET COFUND, starting by end of 2016, focuses more on maritime technology rather than on biological resources. However, aquaculture technology has the interest of some of the funding partners. The COFUND seeks to address 1) Environmentally friendly maritime technologies; 2) Development of novel materials and structures; 3) Sensors, automation, monitoring and observations; 4) Advanced manufacturing and production; 5) Safety and security.

The **Joint Baltic Sea Research and Development Programme (BONUS)** is an Article 185 collaboration between research funders running until 2017. The BONUS programme covers many of the research fields that COFASP is also covering. However, the collaboration is geographically restricted to Member States around the Baltic Sea.

The **BLUEMED Initiative** offers a shared strategic framework for working towards a healthy, productive and resilient Mediterranean Sea that is better known and valued. It is designed to tap the full potential of the marine and maritime sectors, structuring transnational cooperation to create new 'blue' jobs and to promote and improve social wellbeing, sustainable prosperity and the environmental status of the region and its surroundings. BLUEMED is the result of joint efforts by Cyprus, Croatia, France, Greece, Italy, Malta, Portugal, Slovenia and Spain, with the support of the European Commission. The BLUEMED Strategic Research and Innovation Agenda (SRIA) published in October 2015 end endorsed through the Venice Declaration will be updated on a yearly basis. A four years lasting Coordination and Support Action funded by the EC provides the operational support to the Initiative, with particular regard to the implementation of the SRIA.

The **Partnership for Research and Innovation in the Mediterranean Area (4PRIMA)** is a CSA to contribute to alignment research and innovation programs on food systems and water use in the Euro-Mediterranean Area in order to develop a A185. The focus is on improving the efficiency and sustainability of food productions and fresh water provision. The work towards research priorities and a detailed implementation plan is ongoing. Fish is playing a large role in the Mediterranean diet, and there is some interest to include marine fisheries products and marine and freshwater products from aquaculture as a component of the food security of the region.

The **Standing Committee on Agricultural Research (SCAR)** was established in 1974. It has several working groups in providing advice on bio-economy research for the EC as well as playing a role for the coordination of national research programmes. The **strategic working group on Fisheries and Aquaculture (SCAR-FISH)** focuses on research policies and research themes in order to better coordinate and direct these activities in support of the Common Fisheries Policy. SCAR-FISH represents fisheries and aquaculture ministries, which may or may not be research funders (depending on the organisation of research funding nationally).

The European Maritime and Fisheries Fund (EMFF) is the fund for the EU's maritime and fisheries policies until 2020. It is one of the five European Structural and Investment (ESI) Funds which complement each other and seek to promote a growth and job based recovery in Europe. As the EMFF is implemented under "shared management", it means that each member state (or region within each member state) sets own priorities for innovation (mainly) and research (limited) that can underpin the fisheries and aquaculture sector. The potential and possible mechanism for coordinating the implementation among member states is currently being explored in a COFASP case study.

1.1 STRATEGIC RESEARCH AGENDA METHODOLOGY

This document presents the Common Strategic Research Agenda as developed over the running period of the COFASP project. It addresses short term, midterm and more long term research issues. These issues were developed using a range of methodologies.

The start of the COFASP project has been the inventory of national research priorities based on which the first COFASP joint call was developed. Next to this very short term inventory a more profound analysis of research implemented in Europe was implemented.

In order to address a specific set of issues, such as for example the sharing of research infrastructure, specific research priorities and mobility of research capacity within Europe, a series of Case Studies has been implemented. During workshops with relevant stakeholders each sector was addressed. Questionnaires were used to gauge opinions.

In addition, an analysis of the most relevant research projects on fisheries, aquaculture and seafood processing funded from 2003 up to 2013 at national and European level has been performed to identify the topics that would need of further research. To derive at a longer term perspective a foresight exercise has been conducted. This activity used a participatory foresight methodology building scenarios involving representatives form relevant stakeholder groups in the fisheries, aquaculture and food processing industry but also from societal organizations. To update the 2014 foresight results an additional revisit workshop was implemented in November 2016. During this workshop also the grand challenges we would be facing towards 2050 were identified.

At first sight it may appear that the different activities result in completely different sets of priorities and research issues. Yet all of the topics raised during all of the activities do fit closely in with one and another. Differences in specific priorities can be attributed to the more specific focus (topical, sectoral) of some of the activities, the time perspective chosen and the technological and funding perspective perceived.

The workplan of projects funded by COFASP are based on a rather short term focus on issues that need immediate attention. The dedicated Case Studies provided a midterm view of priorities. The foresight had a rather long term view and the identification of the grand challenges took a very long term perspective. Running along this time perspective there is also a perception of the technological level of operations and the way related research can and will be funded between private and public funds.

Where the Technology Readiness Level over time moves from lab research via simulations to real world application the application moves closer to market. The more competitive a market the earlier it can be expected that industry will step in for technology development. Yet addressing societal challenges in first instance in the phase of concept development and proof of concept is usually the domain of more public funding.

1.2 IDENTIFICATION OF STRATEGIC RESEARCH PRIORITIES

The identification of strategic research priorities, in terms of topics and partnerships at regional or Pan-European level for the needs of fisheries, aquaculture and sea food processing public and private research activities, was carried out within COFASP workplan in the framework of planned activities of WP1 ("Inventory and strategy (for strengthened cooperation)" and further developed within WP2 ("Towards common programmes"), WP3 ("Joint calls on applied research and on support to advice"), and WP4 ("Dissemination and capacity building").

1.2.1 FORESIGHT ANALYSIS STUDY (WP1)

The foresight study was implemented between September 2013 and June 2014 by the European Fisheries and Aquaculture Research Organization (EFARO) in collaboration with the COFASP partners. The aim of the study was to develop an agenda defining the research required in the medium term (15 years) to enable a sustainable exploitation and farming and retailing of aquatic resources.

1.2.2 ANALYSIS OF RESEARCH PROJECTS (WP1)

A database of relevant research projects funded by the EU member States and the European Commission in the years 2003-2013 was built, collating databases previously developed in the framework of other projects (e.g., MARIFISH ERA-NET, AQUAMED) and through an online questionnaire to the project coordinators. Information has been disseminated through a WebGIS application available on the COFASP website (www.cofasp.eu). The database was updated in 2016 adding the projects funded in 2014 and 2015. The analysis of the collected information allowed to generate a list of research topics that would need to be further investigated in the short-medium period (COFASP deliverable D1.22).

1.2.3 COMMON PROGRAMMES (WP2)

COFASP deliverable D2.13 ("Common research priorities") was the third consecutive report on common priorities. It was built upon two previous reports, providing an overview of the whole process in defining the three joint calls issued by COFASP. In particular, WP2 focused on identifying the national research priorities of all funding partners and on analysing potential common programme contents and joint calls. A total of three reports on common priorities were generated prior to each of the three COFASP calls for applications.

For the first call a questionnaire among partners was used to identify the areas of common interests, gaps and possible duplications with other programmes. The results from the questionnaire were used to extract common priorities to the first COFASP call topics and for future programme activities.

Within WP2, the provision of a Strategic Agenda was also among planned COFASP activities, through Task 2.3. For Marine science in general, an identified research priority was the development of an "overarching system of marine spatial planning".

1.2.4 COFASP CALLS (WP3)

COFASP partners represent a diverse group of stake-holders with different priorities and needs that can be applied to the three COFASP pillars, fisheries, aquaculture and seafood processing. In preparation for the first call a systematic effort was applied to identify the areas of common interests, gaps and possible duplications. The results, based on a questionnaire, were used to extract common priorities to the first COFASP call topics and for future programme activities. The priorities in the first call are in line with the emphasis in 'Marine fisheries science priorities: EFARO's perspective' and 'Key topics for scientific support to the European Aquaculture strategy'.

The first COFASP call was announced in February 2014. In preparations of the second call the previously identified priorities were used along with priorities of related activities such as EFARO and Horizon 2020. The second call was announced in 2015. The third call was launched March 2016 as a joint call with the Marine Biotechnology ERA-Net. The common priorities are based upon a dialogue between these two ERA-NETs.

1.2.5 CASE STUDIES (WP4)

Four topics have been selected for the planned COFASP Case Studies:

- Regional similarities and differences in aquaculture
- Coordination of EMFF implementation
- Regionally-Integrated and Spatially-Explicit Fisheries and Ecosystem Management
- Seafood processing – pan-EU challenges.

The outcome of the first three Case Studies was relevant for COFASP last call and therein incorporated. Five stakeholders workshops were held in 2015 (see also Task 4.2 within WP4). Two for aquaculture, one for fisheries, one for seafood processing and one for EMFF. Four reports were generated from these workshops and collated in a single COFASP Case Studies report.

2 STRATEGIC RESEARCH AGENDA: THE OUTCOME

2.1 SHORT TERM RESEARCH PRIORITIES

COFASP launched three calls during the period of 2014-2016. The final call was a joint call with ERA-NET Marine Biotechnology. The themes and topics selection process for the calls and results are described below. A List of COFASP call topics will be published in a separate document.

First call

For the first call a questionnaire among partners was used to identify the areas of common interests, gaps and possible duplications. The results from the questionnaire were used to extract common priorities to the first COFASP call topics and for future programme activities.

The first call was launched on 1 February 2014 and closed on 15 June 2014, with the thematic focus including all three COFASP sectors. The topics can be considered pillar specific apart from a topic on spatial planning (topic 2) which is cross-sectorial between fisheries and aquaculture.

Second call

Based on the topics and themes identified in the first call a list of topics was assembled and circulated for priority among partners. The feedback provided the basis for a funders meeting for developing a short list of topics for the second call for proposals of COFASP and to ensure avoiding overlap with the H2020 work programme. The funders agreed to have an overarching theme and developed the sector specific topics within this theme.

The second call was launched 15 February 2015 and closed on 17 June 2015. The theme for the second call was an overarching cross-sectorial topic, Resource optimization, mapping and reduction of ecological footprint, environmental sustainability of aqua-culture, fisheries and seafood processing and interaction with other production, with a scope of one or more sub-topics defined for each sectoral area of COFASP.

Third call - Joint call with ERA-NET Marine biotechnology

The third COFASP call was launched on 21 March 2016 and closed on 20 June 2016. The call was a joint effort with ERA-NET Marine Biotechnology (ERA-MBT). The focus of the call was on developing the biotechnology toolbox within COFASP themes. This focus is in harmony with one of the important strategic areas identified by JPI Oceans, "Use of marine biological resources through development and application of biotechnology"[2]. The topics include the MBT scope and the COFASP's common priorities. The topics are in line with the pre-viously identified call priorities and case studies (1.2.5.) which have a strong influence on the selected COFASP priorities.

The European Commission is strongly communicating the need to integrate RTDI in Europe, and a joint call between COFASP and ERA-MBT was an effort to proactively fulfilling this as a short term initiative. There is also a demand to secure continued activities related to what the ERA-NETs build and achieve beyond their project periods. Collaborating on a joint call have brought COFASP and ERA-MBT themes closer and contributed to a better align-ment. This makes the networks better positioned to join forces in future activities within H2020 and other EU-initiatives, such as e. g. Cofund ERA-NETs.

Results from COFASP calls

Table 1 shows the number of eligible proposals received and the number of supported applications in the first and the second call. In the first call 22 applications were received. A total of committed budget from the member states was 5.1 million Euro and five projects received funding, two in fisheries, two in aquaculture and one in seafood processing.

In the second call 36 eligible applications were received. A total of committed budget from the member states was 6.4 million Euro and six were selected for funding, one transsectorial, one within fisheries and four within aquaculture. One application was received in the seafood processing and it did not receive funding.

In the third call 12 eligible applications were received. A total of committed budget of 5.8 million Euro and five were selected for funding, three within aquaculture and two within seafood processing.

As underlined with joint efforts the key to unlock the challenge of feeding future population lies in water based cultivation and food production. For the first two calls aquaculture topics apparently gained most attention by

2 http://www.jpi-oceans.eu/use-marine-biological-resources-through-development-and-application-biotechnology

TABLE 1. SUMMARY OF COFASP CALLS						
	TRANS-SECTORIAL	FISHERIES	AQUACULTURE	SEAFOOD PROCESSING	TOTAL	SUCCESS RATE
Call 1 proposals		4	15	2	21	
Call 1 supported		2	2	1	5	24%
Call 2 proposals	8	5	22	1	36	
Call 2 supported	1	1	4	0	6	17%
Call 3 proposals		2	6	4	12	
Call 3 supported		0	3	2	5	42%

A list of supported projects can be found on the COFASP website: www.COFASP.eu

European researchers as 65% of submitted proposals can be considered from that pillar. The first two calls supported 11 research projects increasing the exposure of the COFASP collaboration throughout Europe. The collective success rate in the two first COFASP calls is approximately 18%. In the third call, with a focus on marine biotech, there were fewer applications with a success rate over 40%. In this call seafood production had more visibility than in the previous calls.

Impact of COPASP calls on research and innovation funding

The concept of cofounding in COFASP showcases the impact that such research and innovation funding can have across borders. As the core of the existence of the COFASP efforts lie in the 2 million EURO grant from the European Commission, the COFASP partners pulled off in the first two calls a budget of 11.5 million EURO (Return on Investment with a factor of 5.75) and with the COFASP´s half of the joint call with the ERA-MBT resulting in research and innovation efforts accumulating to 14.4 million EURO (return on investment with a factor of 7.2). Thus the COFASP calls enabled valuables that were locked in domestic budgets to come together and join efforts through the concept of cofounding to solve the FASP challenges European countries and nations have to deal with.

2.2 MID-TERM RESEARCH PRIORITIES

The purpose of hosting Case Study workshops was to facilitate conversations between stakeholders on common research priorities. Four reports were generated from these workshops. Below is a short list of priorities presented from the Case Study (as reported in the deliverable D2.13 – "Common research priorities").

Fisheries case study

The case study in fisheries "Regionally-Integrated and Spatially-Explicit Fisheries and Ecosystem Management" (RISE-FEM) was held in 23-25 June 2015, Brussels, Belgium. The objective of the RISE-FEM Case Study was to link integrated fisheries and ecosystem management together with spatial planning.

Within the three main topics discussed as priorities was the emphasis on spatial management and mapping and evaluation of functional habitats:

- Develop Management Strategy Evaluation (MSE) and Management Effectiveness Evaluation for multiple-objective and multiple-sector spatial management schemes;
- Improve knowledge on and evaluation of functional habitats;

- Develop spatially-explicit end-to-end models with appropriate complexity for spatial Management Strategy Evaluation.

The spatial management, strategy, modelling, imple-mentation, evaluation is an ongoing theme identified as a priority within the fisheries section. This was part of the COFASP first call topics and the second call (fisheries and trans-sectorial topics). No project related to this topic was supported in the first call, while two projects, PRIME TRADEOFFS and ECOAST were funded in the second call. The habitat mapping was addressed in the first call also. Two projects, GOFORIT and DASTMAP, were supported that have focus on functional habitat (evaluation model).

Aquaculture case study

Two workshops (and visits to farms) were organised for the case study in aquaculture the objective of the aquaculture case study was to identify similarities and differences that are limiting the growth of Mediterranean sea bass/ sea bream industry and Atlantic salmon industry addressing biological life cycle issues, technical and technological issues, market and communication issues and trans-sectorial factors affecting aquaculture development.
Within the aquaculture case studies several common challenges were listed, including description of main research needs.

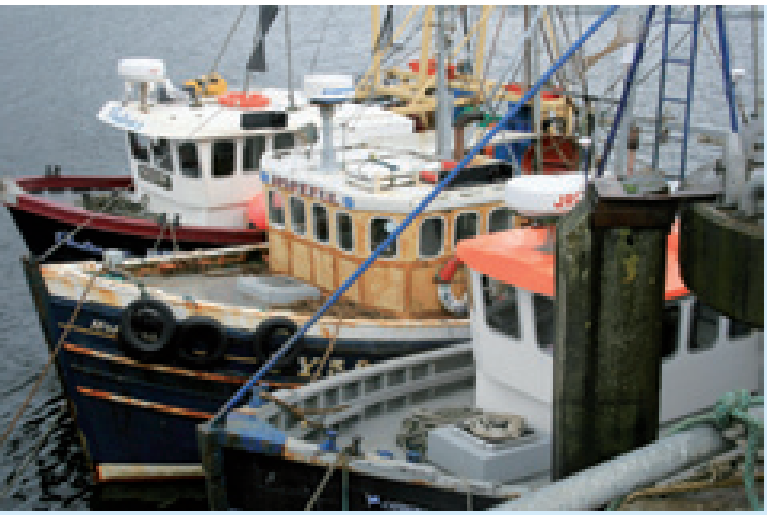
- Social acceptance and communication of aquaculture
- Biomass control
- New grow-out technologies
- Real-time monitoring of environment and biological indicators
- Tools to measure robustness and juvenile quality
- Selective breeding

Some of these issues have been addressed in previous COFASP calls, and two aquaculture projects were supported in the first call (MICROFeed, on feed development, and MicSTATech, on water treatment technology). These topics above were not specifically targeted (or can be regarded as sub-targets) within the second COFASP call. However, four aquaculture projects, IMTA-EFFECT, RAS-ORGMAT, SUSHIFISH and MARINALGAE4aqua, were supported during the second call. The third call was more inclined towards marine biotechnology. Three projects under aquaculture were selected for funding; RobustBass on selective breeding, STURGEoNOMICS on genome-based approach for improvement in aquaculture and AquaCrispr on genetic improvements. These projects will start by end of 2016.

Seafood processing case study

The case study in seafood processing "European Seafood processing challenges – Stakeholder Conversation" was held in 23-24 April 2015, Brussels, Belgium in conjunction with Seafood EXPO. The objective was to identify the European seafood processing industry needs for research. The focus was on sustainability, logistics, optimisation of processes, markets and consumer aspects. A short list of industry needs was identified:

- Securing supply by maintaining stable supply, with increased yield, better utilization and valorisation
- New technology/techniques have to be developed to increase the efficiency and competitiveness
- Better documentation through the value chain can extend shelf-life contributing to product integrity
- Focus on the health effects of seafood consumption to inform the consumer
- Product development, such as better use of oil and proteins in the pelagic industry is important for sustainability
- Limiting environmental impact of the processing, avoiding post-harvest losses and minimizing food waste
- Focus on product- and market development for previously discarded species.
- Chilling and packaging technologies as well can extend shelf-life.



In the first COFASP call the topic for seafood processing was very open. One out of two project within this pillar was supported (SAFEFISHDISH; main objective to improve the microbial and sensory quality and safety of fish from harvest to consumer). The second call topics in Seafood processing was also very wide in scope. However, only one project was submitted within the pillar and none was supported. In the third call, however, two projects were selected for funding. These two projects are CHITOWOUND using biotech tools for implementing novel and improved methods in extracting valuable substances from waste and AntiFoul using novel biotech tools to utilize compounds from red algae. Both projects will start by end of 2016.

2.3 LONG TERM RESEARCH PRIORITIES

A series of workshops was held with relevant stakeholder groups to, using foresight analysis and scenario building, develop a Long Term vision on Research Priorities. Details of the exercise and methodology can be found in several reports on www.COFASP.EU. Below a summary overview of identified priorities is presented. It should be kept in mind that the foresight concentrated on the marine environment rather than on the wider aquatic environment.

Marine Science in General

Optimal use of the seas: what is the optimal sustainable use of our seas and oceans with increased possibilities of using available resources in novel ways and using novel ways to extract and use marine resources? This question has a bearing on the development of an overarching system of marine spatial planning (also see section on Governance).

Value of use of the seas: in order to strive for an optimal sustainable use of the seas it is important to be able to put a value to existing and potential future ecosystem goods and services. Related to this is the question of costing the impact of activities on the marine ecosystem and incorporate these costs into the production costs in the value chain. Together with non-economic values this analysis will provide a basis for a societal cost-benefit analysis of different activities, especially in a world with increased competition for marine resources, especially space. This in turn will provide important input into marine spatial planning.

Environment

Low impact products: a general challenge to all uses of the marine environment is to develop products and production techniques that not only reduce direct impact on the marine resources directly exploited, but are produced with the lowest possible impact on the marine ecosystem, including its associated carbon footprint.

Sustainable use strategies: combined with a strive for low impact products there is a need to devise holistic strategies at the level of Large Marine Ecosystems for sustainable production. This will include a definition of ecosystem and environmental boundaries, setting up strategies for marine resource use and prevention and mitigation measures.

This will require a methodology in which impacts of a multitude of activities can be determined at the appropriate ecosystem geographical and time scale. An example of such a methodology can be the **modelling and risk assessment** of disease and pathogen distribution in wild populations and aquaculture systems; develop prevention and treatment systems. Another example can be to devise a methodology that considers **species adaptation to ecosystem change** and the ecosystem impact considerations of the restoration of certain species.

Fisheries

Monitoring and Management: for the appropriate management of the ecosystem it will remain necessary to develop long term integrated management plans for resource use. Especially in the field of fisheries this will require models that can reliably predict the dynamics of ecosystems and activities undertaken in the ecosystem, including economic aspects (bio-economic modelling). In addition, it will require user-friendly monitoring programs or techniques that result in reliable assessments of exploited marine resources/populations which clearly assess the impact of (alternative) fishery management programs on sustainable use of shared resources. The development and use of technology to improve monitoring and surveillance will be required in addition to continued improvements in monitoring and data collection. Economic impacts of fisheries management operations should also be included in the analysis.

Adaptation strategies: the fisheries sector is confronted with a multitude of challenges that will require an adaptation of prior used (fishing) strategies. As result of ***ecosystem change***, how can fishers adapt vessel types and equipment to make a fit with the new dynamic circumstances? In addition, how can fishing fleets respond to a ***societal call*** to develop low impact fishing methods, such as eco-friendly powered vessels, low impact fishing gears?

And, in the light of ***market demand***, how can the entire harvest of vessels, including by-catch and discards, be appropriately managed and used?

Data use: in order to provide a basis for management of resources and the development of the industry's management and fishing strategy it is necessary to develop technology and methodology that will allow effective and accepted obtaining and using fishery-independent data and commercial data from industry, especially in small-scale fisheries.

Recreational Fisheries: a major challenge is the potential and role of developing recreational fisheries and other recreational uses of the sea, e.g. tourism. How do these activities relate to other commercial uses of marine space and resources and how does competition between alternative uses of resources develop? Also the potential effects of recreational fisheries on fish stocks should be explored.

Aquaculture

Market demand: noting consumer demand and production costs across all modes of aquaculture production, a main challenge remains to be the species that can be cost effectively produced and meet market demand. In this there are several challenges being posed to the sector; which species and production techniques can serve a high-value novel niche market? In case of multiple potential aquaculture species, how could a diversified production scheme look like? And how can aquaculture producers operate in a market characterized by multiple high-value products?

Organic aquaculture: related to market demand is the special case of organic aquaculture. Main questions related to this issue centre on developing the system, using the potentials for herbivore species, sources of feed, plant aquaculture, bivalves (shellfish). The main challenge is to lower the production costs relative to conventional methods.

Technology development: there is a continued demand for improved recirculation facilities and research into multi-trophic aquaculture/agriculture/hydroponics (i.e. both directions: sea-land and land-sea) and off-shore Multi Trophic Aquaculture. In order to devise these systems a better understanding of the potential of Multi Trophic Aquaculture systems is required. In addition, the potential health issues of IMTA components should be addressed as well as the identification of potential species, sources of feed, water treatment technology and increases in water/feed efficiency. New opportunities are foreseen in the symbiosis of aquaculture and other industrial sectors, promoting a circulation economy.

Species enhancement: as for the potential use and enhancement of species, starting point has to be addressing the issue of aquatic animal health and welfare. In addition, research into GM (genetically modified) feed use and fish genetic strains with low environmental risk will be addressed. Species adaptation to ecosystem change will have to be taken into account. Some aspects can be addressed through coordinated breeding programmes.

Seafood Processing

Towards more flexible production units: with a production sector with a more diverse (and more seasonal) production and an European market characterised by multiple market segments (high-value (no-bulk) products, next to bulk ingredients market) there will be a strive away from single-species production plants towards more small-scale and multi-purpose processing units. Research into developing these small-scale and multi-purpose processing units is required.

Maximise processing efficiency: there is an increased strive to fully use all of the harvested fish produce, be it from aquaculture or wild capture fisheries. On the one hand this implies maximisation of the filet yield. But, on the other hand, it also entails optimising the use for fish meal and oil coming from the remains from fish processing (from trimmings) and the use of all co-products for high value products for feed, food, pharmaceuticals and cosmetics.

New products and new production technologies: in addition to optimising the use of the fish harvest there is also the need to develop production technologies for new resources such as seaweed and algae such as the production of biodegradable packaging (from seaweed). In addition, there is a need to overall reduce waste and environmental impacts in processing.

Value Chain

Increased sustainable efficiency: a generic challenge to the fisheries, aquaculture and seafood processing sectors lies in a search to increase efficiency of vessels and gears, of aquaculture production (e.g. feed conversion ratio, time to slaughter) and in seafood processing which at the same time reduces impact on the ecosystem and makes the most efficient use of harvested resources. The entire value chain will have to adapt to this principle of 'more with less', especially new technology/techniques in the processing sector will have to be developed to adjust to changes in raw materials (e.g. species, size).

Setting standards: a major concern is the development of methods to ensure that seafood products meet appropriate standards for health and safety. This includes both setting of health and safety standards as well as devising systems such as labelling, to communicate produce attributes. This will include the identification of threats to food safety along the supply chain, compared to thresholds for safe human consumption, and to develop programme/standards to prevent threats from entering the supply chain.

Information in the value chain: communication of attributes of produce along the value chain across the individual producers towards the final consumer is very important. One of the issues that needs to be addressed is: how can labelling and standardization be organized in the value chain towards a multitude of consumer groups and markets? Steps towards these can be taken by looking into best practice for certification and labelling and into the development of EIDs (electronic identification documents) providing relevant information along the value chain operators and final consumers.

Governance

Control: a main issue is the establishment, in a dynamic world and a permanently changing ecosystem, of a framework for management to ensure resource use (including pollution) to stay within identified and agreed upon limits. This will include the question of which incentives could be used to ensure compliance of the industry and which technology could be further developed to support this (e.g. effort controls, VMS, CCTV).

Licence to produce: increasingly producers need to acquire a licence to produce: a public consent to the industry to exploit the marine environment. Obtaining this licence to produce pertains on the one hand the provisioning of (science based) information on primary production and across all steps in the production chain but, on the other hand, it would require insights in the public attitudes towards marine production and communication between producers, consumers and citizens.

Participation: with a growing complexity of the management challenge at Europe's seas and oceans there is an increased need for Marine Spatial Planning and Monitoring and Evaluation of the use of marine resources. The effective implementation of this calls for the development of a platform for stakeholders to increase participation/input in decision-making and evaluation processes.

Organization of Research and Funding

The financing and organisation of research will over time depend on the relative priority given to (marine) research, the availability of funding from either public or private sources and the level at which science will be organised.

2.4 MID-TERM REVISION: BLUE GROWTH AND THE BLUE ECONOMY

During 2016, nearing the half-way point of H2020 and moving into the final stage of the COFASP ERA NET a reflection specifically on Blue Growth and the Blue Economy was implemented. In the H2020 work programmes 2014-2017, the research and development of Blue Growth has concentrated on new maritime technologies for exploration and exploitation of sea-based resources (food, energy, materials). For the period 2018-2020, the main need is to integrate Blue Growth into the Circular Bio-Based Society.

Crucial to arrive at marine sustainable innovation is planning the optimum use of our marine space and resources. Therefore there is a need for optimising and harmonising Marine Spatial Planning processes, also at the regional level. Noting the scarcity of valuable ocean space, especially competition over the near shore area, the concept of multiple use in a single location needs to be further explored. Examples can be multi-purposing wind farms for seaweed production, aquaculture and tidal energy. Following on this multiple use theme, also the concept of building with nature, operating in harmony between nature, engineering and society needs to be a prevalent theme.

Exploring resources

- Upscaling of seaweed production, development of efficient farming technologies to a higher TRL; optimal use of the marine environmental conditions (sites) for production and processing, including bio-refineries for complete utilization of the biomass (human edible proteins, fine chemicals, energy, bio-based materials, ethanol, methane, low ruminant feed stocks). *Envisaged impacts: unlocking the production of marine algae, increased food security, increased employment in sector, reduction of fresh water use.*

- Exploration and development of sustainability concepts such as the exploitation of large mesoplankton and mesopelagic stocks, exploration and development of systems of retention of nutrients related to aquaculture, optimising usage of marine rest products or "by-catch" from fisheries. *Envisaged impacts: unlocking the production of the mesopelagic, increased food security, improved utilization of resources and generation of new business opportunities for existing and new players, produce high value substances and ingredients, increased employment in sector, enhanced management of the resource.*

■ The use of "omics" in Fisheries and Aquaculture science: the application of OMICS in fisheries and aquaculture research is lagging behind development in other sectors. It is proposed to initiate projects that translate OMICS methods into applications relevant to fisheries and aquaculture. *Envisaged impacts: enhanced stock identification and separation, more accurate description of population dynamics in relation to environmental drivers, improved management and enhanced production.*

Innovation

■ Novel technology for efficient monitoring, data collection, -processing, and –analyses: High Tech Field Observations in Fisheries and Environmental Management (development and application of new sensors and measuring systems incorporating advances from other fields), big data retrieval, handling of data in management support systems, using the potentials of the 'internet of things'. *Envisaged impacts: more effective and efficient monitoring of more aspects of the marine environment and resource use, enhanced advisory capacity, Early Warning Systems anticipating threats.*

■ Multi-use of ocean space, such as the use of windmill parks and offshore production sites, integrating biomass and energy production with focus on multiple-risks, including system design, technology development, site management and legal aspects. For this Novel Building with Nature concepts can be explored, combining food/feed/energy production with coastal protection and water works and ecological engineering to restore/enhance depleted marine habitats and recover fish stocks as well as to support sustainable exploitation of alternative seafood resources. *Envisaged impacts: increased energy, food, feed and ingredient production, efficient and effective use of marine resources, optimal use of geographic/hydrographic features.*

■ Further development of efficient and reliable aquaculture farming production systems with low environmental impact, including pond, Integrated Multi-trophic Aquaculture, RAS, floating closed containment systems and offshore for increased production of biomass for human consumption, including Aqua-breeding: improvement of the growth potential, resilience and robustness of the main aquatic production species using smart genomics based breeding programmes, including ethical aspects. *Envisaged impacts: increased availability of safe and healthy food for consumers, reduction of EU fish imports, job creation in supplier industries.*

Management

■ Development of management strategies and management strategy evaluation tools sensitive to marine ecosystem resilience and regime shifts based on *Reversing the perspective:* from resource-based to product-based management. Closer integration of fisheries and aquaculture into a more holistic seafood production system with attention for seafood safety and perceived benefits of seafood for consumers.

- including the role of climate and habitat change
- while focusing on implementation of MSY and fisheries management plans for mixed fisheries and interacting species in an ecosystem based context,

- with enhanced adaptive management systems including evaluation of social-ecological-system impacts.
  Envisaged impacts: increased availability of safe and healthy food for consumers, reduction of EU fish imports, increased global food security, from a viable capture fisheries being climate change robust, vital coastal communities.

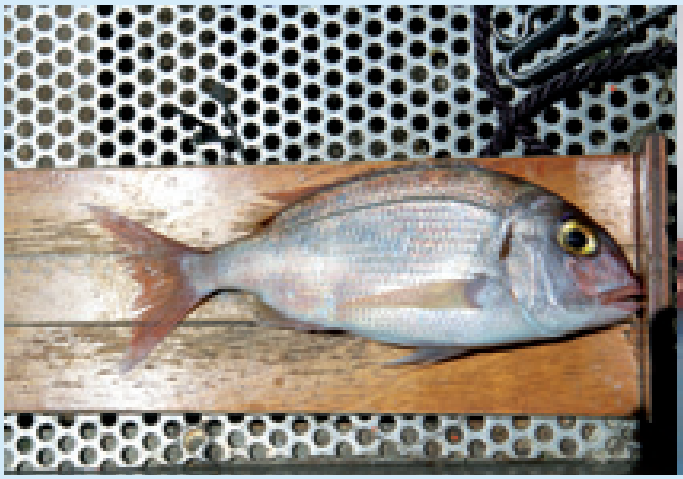
■ Marine Governance related to societal acceptance of Blue Growth perspectives, including animal and environmental friendly (e.g. ecosystem based and organic) production systems based on local and recirculated resources. *Envisaged impacts: growth in Blue Economy in terms of jobs and income, viable coastal communities, acceptance of sustainable exploitation of the Marine Environment.*

■ Integrated (cross sector) large marine ecosystem based management at regional level:

- development of high quality, cost effective, integrated environmental, fisheries and aquaculture monitoring systems for spatially explicit regional implementation of the CFP, MSFD and MSPD;
- develop institutions and best practices at the regional sea level;
- develop specific Regional Programmes, like the Mediterranean focus in earlier calls, with a special emphasize on deep sea, oligotrophic and larger inland water systems.
  Envisaged impacts: more effective resource management, societal acceptance of policies.

■ Citizen science: Engaging society to collect scientific information. Modern media and social networks can help to foster a more systematic engagement of society with marine science issues and promote collecting data for which a systematic scientific monitoring would be too scattered and too costly. Envisaged impacts: more effective and efficient monitoring of more aspects of the marine environment and resource use, enhanced advisory capacity, increased compliance and support for policy.

■ Coupled social-ecological system modelling: Novel natural resource usage modelling approaches to better address the coupling of social, economic and ecological systems and the often non-linear interactions between system components across multiple spatial and temporal scales. *Envisaged impacts: more effective resource management, societal acceptance of policies.*



2.5 RESEARCH ENABLERS

In order to facilitate implementation of the research priorities a number of 'enablers' have been identified: actions that could be undertaken to stimulate more effective and efficient implementation of the identified research priorities.

2.5.1 SHARING INFRASTRUCTURE

Building on previous work in other projects such as SEAS-ERA, Eurocean and the FP7-INFRA AQUAEXCEL project a questionnaire was send out to the COFASP project partners to indicate for their country to update available information and adding Aquaculture and Seafood Processing research facilities.

Operators of listed facilities in Europe were interviewed on different forms of collaboration such as:

- "Shared use of research infrastructures, e.g. through transnational access",
- "Common vision on new needs, optimisation of new investments",
- "Pooling skills for operation & maintenance",
- "Development of innovative technologies".

78 operators shared their opinions and recommendations while bringing updated information on their facilities and on their participation in existing networks. For the full report, including annexes, refer to COFASP website.

Three types of infrastructure were considered:

Research vessels contributing to fisheries

Shared use of RV ranks 1 in the expressed priorities. However, sharing RV is acknowledged not to be easy to implement due to national constraints for the ship time planning. Main recommendation is to develop regional case studies of RV multi-annual programming addressing both scientific, national procedures and logistical issues, including fisheries and biological monitoring.

As for the sharing of research vessels a joint analysis of COFASP, SCARFish and EFARO indicate that there is, in general, a willingness to share vessel time between different types of research and between different users. It is suggested to use the existing EURO Fleets platform to further develop this cooperation.

However, the main issue in sharing research vessel capacity lies in the planning in time of its operations. Understandably sharing capacity currently is subject to fulfilment of other priorities. Although sharing capacity is logical, the reality in practice is that sharing capacity has low priority.

Experimental facilities for aquaculture research

About 70 stand-alone research facilities, operated by 59 operators, are operating in Europe in the aquaculture realm. 85% from these are funded by the public sector and 15% from the private sector. Facilities are mostly land-based tanks, sea-based cages and associated labs for necessary analysis, together able to address new stakes or trends that need a strong support from the research sector. Among the priorities, as identified in aquaculture research, the shared use of research infrastructures through transnational access, and investing in innovative technologies rank 1 ex aequo.

Research and Development (R&D) facilities for seafood processing

45 operators of research facilities for seafood processing responded; 80% from the public sector and 20% from the private sector. Yet country repartition of such research facilities in Europe looks very uneven, 13 countries having no such facilities apparently.

The need to develop a common shared vision on new needs and development of innovative technologies rank 1 ex aequo in the list of identified priorities for the seafood processing industry.

2.5.2 MOBILITY

Fishery, aquaculture, and seafood processing are sectors needing multidisciplinary and multi-sectoral skills, and related curricula, while mobility is playing a fundamental role in this approach, not only with reference to the opportunities offered to study/be trained abroad but also in relation to cross-sectoral job mobility. Mobility as part of Human Capacity Building (HCB) involves in the FASP a very large number of different expertise and qualifications, including scientific and technical personnel from both public and private institutions as well as policy managers, legal officers and employees from the private sector (fishermen, aquaculture and seafood processing operators, etc.).

In the short term, HCB needs can be addressed and fostered in a coordinated way by aligning current national mobility programmes (e.g. within bilateral agreements), provided that a joint effort by funding and research institutions is made for supporting scientific and technical staff in submitting proposals that are in line with identified research priorities. In this framework, dedicated Staff Exchange Schemes shall be put in place, even at Institutional level. At different levels of implementation, mobility can be driven by EU, and in particular H2020 programmes and initiatives, through the funding of actions/projects at EU level most often involving partnerships from many countries and sectors.

Schematically, possible mobility tools by target staff in the fisheries, aquaculture and sea food processing, include:

- Apprentices: “European framework for mobility of apprentices: developing European Citizenship and skills through youth integration in the labour market”
- University students (undergraduates) and trainees (via internships) -> Erasmus+ (Student mobility and traineeships), European Maritime and Fisheries Fund (EMFF) “Blue Careers in Europe” action;
- PhD students : Horizon2020 Marie Sklodowska-Curie Actions (MSCA): Innovative Training Networks (ITN), RISE (Research and Innovation Staff Exchange), COFUND;
- Post-Docs -> Horizon2020 MSCA: Innovative Training Networks (ITN), RISE (Research and Innovation Staff Exchange), COFUND, European Maritime and Fisheries Fund (EMFF) “Blue Careers in Europe” action;
- Junior Researchers: Horizon2020 MSCA-RISE (Research and Innovation Staff Exchange), COST Action;
- Senior Researchers: Horizon2020 MSCA-RISE (Research and Innovation Staff Exchange), COST Action;
- Technicians (Research Institutions) : Horizon2020 MSCA-RISE (Research and Innovation Staff

Exchange), European Maritime and Fisheries Fund (EMFF) "Blue Careers in Europe" action;

- Technicians (Private sector, including fishermen aquaculture employees, seafood services, packaging, fish utilization etc.) -> Horizon2020 MSCA-RISE (Research and Innovation Staff Exchange) in cooperation with academic/research institutions, European Maritime and Fisheries Fund (EMFF) "Blue Careers in Europe" action;
- Policy makers, regulations enforcement, etc.: Erasmus+ Knowledge Alliances, Erasmus+, Sector Skills Alliances, European Maritime and Fisheries Fund (EMFF) "Blue Careers in Europe" action.

Other possible tools are related to training programmes organised by national and international Research institutions in the framework of their planned activities. These include workshops and courses in support of EU marine policies, organized for instance by the International Council for the Exploration of the Sea (ICES) or by the General Fisheries Commission for the Mediterranean (FAO-GFCM) or in the framework of bilateral and regional programmes.

2.5.3 E-LEARNING

In HCB schemes, priority should be given to e-learning and other similar innovative approaches that foster this mind-set. Adults engaging in Lifelong Learning are active learners committed with continued professional development and seek access to appropriate resources, engagement with fellow learners and more expert practitioners. Virtual education should develop a system of harmonized credits (ECTS) similar as far as possible to what exists in conventional education so that students' achievements are reflected in their CVs and recognized by educational institutions. This might not be applicable to some informal learning tools though.

With particular reference to the COFASP sectors, e-learning should envisage both subject-specific training, and non-subject skills such as languages, IT literacy, environmental and regulation issues, soft skills (time management tools, communication, problem solving, entrepreneurship, etc.), among others. Given the gap detected between the industry's necessities and what the traditional education system offers, an e-learning program should focus on a

closer collaboration with the industry, by for example inviting specialists working in the FASP fields to design the contents, be co-lecturers on specific topics, instructors with practical sessions, mentors, appraisers and others alike to provide a practical view apart from the theoretical one.

2.5.4 TRAINING

The conducted study of strategic documents, consultations within the COFASP consortium partners as well as with external key stakeholders allow to list the following most commonly mentioned and most urgent HCB areas of common interest:

Fisheries

- Training in ecosystem assessment, monitoring and management;
- Training in development and use of innovative technologies to improve fisheries monitoring, surveillance and data collection;
- Training in assessing of impact of different fishing gear on protected species, including marine mammals (also in order to reduce by-catch);
- Training in practical application of the ecosystem approach to fisheries management.

Aquaculture

- Training in application of advanced warning systems in mariculture;
- Training in planning, business management and public communications in aquaculture;
- Training in organic aquaculture with the main challenge of lowering production costs relative to conventional methods;
- Training in multi-trophic aquaculture;
- Training in developing methods to (remotely and automatically) manage diseases affecting aquaculture; o Training in risk assessment / management and in fundamentals of aquaculture insurance;

- Training in spatial planning and allocated zones for aquaculture (incl. geographic information system tools for zoning and for the establishment of Allocated Zones for Aquaculture).

Seafood Processing

- Training in traceability of produce via certification and in labelling as a source of information to guarantee sustainability of production and safety for consumption;
- Training in production technologies of new resources such as seaweed and algae, as well as in usage of biodegradable packaging (from seaweed).

Interdisciplinary needs

- Training in discard management as a common theme for fisheries, aquaculture and seafood processing (incl. alternative feeds);
- Training in spatial plans to optimize bio-economy components of coastal fisheries and aquaculture.

2.6 STRATEGIC POSITIONING

There are some common themes being identified in the different research agendas and discussions in Europe. Developing the marine bioeconomy and the environmental impact of activities on the marine ecosystem, and in this the implementation of the Marine Strategy Framework Directive and attaining Good Environmental Status, including Climate Change, is an overarching theme. Data collection and use of data, regionalisation and smart specialisation[3] will influence the way research will be organised.

Moving towards a strategy for research it is of prime importance that in the short run the discussions on regionalisation together with smart specialisation and the fundamental set up of data collection, management and use in this constellation is being held. Adjacent to this is a rather fundamental perception of how in the future marine research and research funding is going to be organised.

In the table below we can see how some of the specific Long Term research priorities as identified by the COFASP foresight exercise relate to the priorities as formulated by SCARFish, JPI Oceans and SEAS ERA and how they are currently being implemented by the COFASP network partners in national research programmes.

Given the objectives of COFASP it is of course not surprising that the COFASP priorities are clearly focusing on the areas of fisheries, aquaculture and seafood processing. Apart from fisheries management in general terms and technology development in aquaculture there are few issues that are equally covered by the other research agendas.

The most practical way forward for the COFASP partnership is to position itself among SCARFish, JPI Oceans and the individual research programmes of the Member States. The priorities as defined in the COFASP foresight exercise are still valid in this landscape. With its more focused scope and well-established network it would be advantageous for the COFASP partnership to continue in a new public-public instrument and develop new targeted joint calls to address specific research needs for the further development of fisheries, aquaculture and seafood processing.

With SCARFish and the possibilities to develop research priorities under for example the EU H2020 programme the more short term and policy driven priorities can be shared. With JPI Oceans the more longer term and rather more fundamental marine and maritime topics could be shared. Also it is noted that already a number of topics are being addressed by individual Member States. It can be explored whether these individual research programmes can be expanded, for example to the regional level, and cooperation can be stimulated by additional coordination activities or by formulating joint calls around these topics.

3 The Smart specialisation' approach combines industrial, educational and innovation policies to suggest that countries or regions identify and select a limited number of priority areas for knowledge-based investments, focusing on their strengths and comparative advantages (OECD, 2013).
https://ec.europa.eu/jrc/en/research-topic/smart-specialisation

COFASP LONG-TERM PRIORITIES	SCARFISH	JPI	SEAS ERA	ALREADY ADDRESSED IN COFASP
MARINE SCIENCE IN GENERAL				
Optimal use of the seas	✓			
Value of use of the seas				
ENVIRONMENT				
Low impact products		✓		
Sustainable use strategies				
Modelling and risk assessment		✓		
Species adaptation to ecosystem change				
FISHERIES				
Monitoring and Management	✓		✓	✓
Adaptation strategies	✓	✓		
Data use		✓		
Recreational Fisheries				
AQUACULTURE				
Market demand	✓			
Organic aquaculture				
Technology development	✓	✓	✓	✓
Species enhancement			✓	✓
SEAFOOD PROCESSING				
Towards more flexible production units				
Maximise processing efficiency				✓
New products and new production technologies				
VALUE CHAIN				
Increased sustainable efficiency				
Setting standards				✓
Information in the value chain				✓
GOVERNANCE				
Control	✓			
Licence to produce				
Participation	✓			

Some of the Long Term research priorities as identified by the COFASP foresight exercise relate to the priorities as formulated by SCARFish, JPI Oceans and SEAS ERA. Some are currently being addressed by the COFASP network.

ANNEX 1: GLOSSARY

BONUS	Joint Baltic Sea Research and Development Programme
CCTV	Closed-circuit television
CFP	EU Common Fisheries Policy
DCF	EU Data Collection Framework
ECTS	European Credit Transfer System
EFARO	European Fisheries and Aquaculture Organisation
EMFF	European Maritime and Fisheries Fund
ERA-MBT	Marine Biotechnology ERA-NET
FAO	Food and Agriculture Organisation of the UN
FASP	Fisheries, Aquaculture and Seafood Processing
GFCM	General Fisheries Commission for the Mediterranean
HCB	Human Capacity Building
IBTS	International Bottom Trawl Survey
ICES	International Council for the Exploration of the Seas
IMTA	Integrated Multi-Trophic Aquaculture
JPI Oceans	Joint Programming Initiative Healthy and Productive Seas and Oceans
MARIFISH	ERA-Net Coordination of European Marine Fisheries Research
MARINERA	ERA-Net Coordination of National and Regional Marine RTD Activities in Europe
MPA	Marine Protected Area
MSFD	EU Marine Strategy Framework Directive
MSPD	EU Marine Spatial Planning Directive
MSY	Maximum Sustainable Yield
OMICS	Field of study in biology ending in -omics, such as genomics, proteomics or metabolomics.
R&D	Research and Development
RAS	Recirculating Aquaculture System
RTDI	Research, Technology Development and Innovation
RV	Fisheries Research Vessels
SCAR	EU Standing Committee on Agriculture Research
SCARFish	Fish subcommittee of SCAR
SEASERA	ERA-Net Towards integrated European marine research strategy and programmes
VMS	Vessel Monitoring System

Cooperation in Fisheries,
Aquaculture and Seafood Processing

COFASP
ERA-net

Bredgade 40
DK-1260 Copenhagen K
Denmark

P: +45 3544 6200
F: +45 3544 6201
E: management@cofasp.eu
I: www.cofasp.eu

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