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and

D.4.4.2

Report on interviews and outreach

Outcome of the Sub-Task 4.4.1 – ‘Analysis of Future Training Needs in Fisheries, Aquaculture, and Seafood Processing’ and Sub-Task 4.4.2 – ‘Interviews with professionals’

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1 Introduction

The COFASP ‘Cooperation in Fisheries, Aquaculture and Sea food Processing’ ERA-NET is an FP7 project aims at strengthening cooperation in European research on sustainable exploitation of marine resources in the seafood chains. The project consortium consists of 26 partners from 15 member states and associated countries. The ERA-NET scheme puts focus on coordination and cooperation of national and regional programmes and as such, it aims at national and regional programme managers.

The COFASP ERA-NET was launched to underpin implementation of specific segments of the overall ‘Europe2020 Strategy’. Bioeconomy, being one of them, is an important element of the created European Research Area. It is multidisciplinary in nature and it pushes the partners to be interdisciplinary in our approach and to overcome the segmentation of research and innovation into narrow themes. It is therefore well placed to show how organizations can work together to build a competitive maritime economy in Europe, avoiding duplication of supporting efforts and tackling fragmentation that undermines the efficiency of European research.

The European Commission has issued the European Strategy ‘Innovating for sustainable growth: a bioeconomy for Europe’¹ paving the way to a more innovative, resource efficient and competitive society that reconciles food security with the sustainable use of renewable resources, while ensuring environmental protection. Within European flagship initiatives ‘Innovation Union’ and ‘Resource-efficient Europe’ the following actions are envisaged in the field of fisheries, aquaculture, seafood and blue biotechnology:

- enhancement of scientific knowledge and innovation reinforcing advice on fisheries management supporting decision making and strengthening an ecosystem-based fisheries management as central principle of the revised Common Fisheries Policy;
- implementation of the EU Strategy for the Sustainable Development of Aquaculture² through development of strategic guidelines and implementation of national strategic aquaculture plans;
- promotion consumption of safe, nutritious and healthy European seafood and ensure traceability of seafood from net and cage to plate;
- boosting the development of innovative non-food products and services derived from aquatic living resources to stimulate blue growth.

The COFASP project, covering the entire production chain (from net to fork) directly addresses innovation and sustainable management issues. Building on the findings of earlier ERA-NETs MariFish and SEAS-ERA projects, the initiative focuses on capture fisheries,

¹ EC COM(2012) 60 final

² EC COM(2013) 229 final



aquaculture and seafood processing including distribution to consumers. To achieve its goals a common research programme will be agreed upon and three calls for research projects are to be organized. This process will also help to:

- lay the basis for exploitation according to the precautionary principles and to enhance innovation in and competitiveness of the primary sectors fisheries and aquaculture as well as subsequent seafood processing and distribution to the consumer;
- define the science, information and data necessary to underpin the revision of the CFP and to ensure its successful implementation by designing complementary national research programmes and outlining monitoring and information/data sharing systems needed.

COFASP task 'Training for human capacity building' and the analysis of future training needs in aquaculture, fisheries and seafood processing aim at **reviewing strategic documents of key organizations in the three fields and investigating the RTD competence, knowledge and skills needed for the sectors to grow**. While a lot of effort has been put into defining proper capacity building policies in the European marine/maritime sector (e.g. SEAS-ERA and JPI-OCEANS studies), a study on emerging knowledge gaps and market needs has been missing. This analysis is a part of the COFASP 'Dissemination and capacity building' work package (WP4), and has been conducted **in order to identify thematic gaps in HCB** and eventually suggest the implementation of concrete actions within suitable frameworks. This analysis also constitutes recommendation guidance to the COFASP funding agencies in their task to organize joint calls within the COFASP ERA-NET. The identified training activities may also be implemented within different framework, by multiple stakeholders and through different typologies of actions.

2. Methodology, consultation and analysis

The COFASP task 4.4. 'Training for Human Capacity Building' looks at the available HCB courses in the FASP sectors in Europe, interviews selected main organizations which offer or plan to offer courses, and analyses current training needs in order to feed updated information into project calls.

Work on this task begun with acquiring information from over 70 universities and organizations from 13 COFASP partner countries on available training courses in fisheries, aquaculture and seafood processing. The list allows for identification of thematic gaps but does not provide information on whether there is current demand for filling them. Therefore the task 4.4. focuses on the knowledge and competence needs, and the information collated on the existing HCB opportunities is presented in the annex to the analysis as additional related information.

As envisaged in the COFASP description of work, the analysis itself comprised of the following thread of activities:

- A review of strategic documents: research agendas of key organizations, the COFASP analysis and report on contents of common programmes and joint call in fisheries, aquaculture and seafood processing'; reports from COFASP workshops (COFASP foresight exercise and case study workshops);
- Interviewing professionals to identify knowledge, skills, and attitudes needed for a sustainable development in European fisheries, aquaculture, and sea food processing - Sub-Task 4.4.2.
- Analysis of training needs and competences, listing the ones in high demand per FASP sector - Sub-Task 4.4.1.
- Revision and update of the 4.4.1./4.4.2 findings by COFASP partners – by correspondence;
- Public outreach and dissemination of the study results via the COFASP project website and other websites e.g. the ICES Training Programme site (to be done once the report has been approved) - D4.4.2.

3. Identification of knowledge and skills needed for a sustainable development of European FASP

In order to identify current demand for knowledge and skills, strategic documents of key organizations were reviewed and interviews with managers were conducted. Beginning with the European technology platforms (as they represent a large number of private companies and organizations in their sectors and therefore directly shape of the spectrum of emerging competence needs), strategic documents of the European Aquaculture Technology and Innovation Platform and European Fisheries Technology Platform) have been reviewed.

Both platforms identify capacity building as an action type of high importance, pointing to lifelong learning as crucial element for the future sustainability of the business sectors. It is essential for blue growth to ensure that a highly competent and knowledgeable workforce is available to meet the visions of the private sector.

- **EATiP: The European Aquaculture Technology and Innovation Platform / FEAP: Federation of European Aquaculture Producers.**

The EATiP developed 'Vision 2030' which should result in European aquaculture achieving average annual growth of 3.1% - providing 4.5 million tons of sustainable food products, worth €14 billion and more than 150,000 direct jobs by the year 2030. An increase of about 30,000 jobs compared to 2010. The latter requires a more numerous supply of skilled professionals and thus intensified education and training.

EATiP tries to marry short term expectations from industry to mid-term expectations from scientists. The platform adopted baseline principles to guide its work of which one considers training: 'Guarantee the training and skill development of those working in the sector and attract talented professionals'. Consultation with the Chairman of FEAP and General Secretary of the EATiP provided some key training needs in the aquaculture sector: It was pointed that the **WAVE project (Validation of working experience in aquaculture)** looked at the competences needed in aquaculture. It showed that academic experience does not fully qualify graduates to work farms. Sometimes one needs to forget what he/she had learnt in college because that has little to with what you do at a fish-farm. For example in the course "planning production", farmers have to plan what they are going to do and this links to financial literacy. Upfront planning is utterly important in terms of the financial sustainability of operations. Only very few

university courses teach this. In other words business management planning is an education/training area which needs high priority.

The outcomes of the **WAVE** and **VALLA (Validation of All Lifelong Learning in Aquaculture)** projects also provide a strong response to skills and competences in demand. The picture of available training in the aquaculture sector is not clear enough. Because one of the obsessions is fish diseases (one can lose a fish stock in 1-2 days), training focus is on disease exposure which is to reduce financial losses. More innovative and automated, advanced warning systems are missing on farms. A manager needs to be able to respond quickly and remotely to a given threat. This requires functional computer systems and relevant competence, tailored to individual circumstances and types of farming operations.

There is a clear prediction that aquaculture plants will move further away from the coast because of space and other issues e.g. in combination with wind farm developments which would also provide anchoring and energy for the farms. However, it has really been looked at whether the logistics of management are efficient e.g. if there is a wind farm 30-40 km away from the coast how to monitor what is going on in the farms and in the environment.

The VALLA developed a sectoral online “Learning Outcome” Tool. The tool is an online step-by-step dedicated software tool based on existing European best practices, which enables trainers to define non-formal training units in terms of competences and learning outcomes as well as describing level, assessment, evidence requirements, delivery, credit value etc.

Job scenarios in **AQUAINOVA** showed that there is only one area in fresh water aquaculture that is most likely to grow in the EU and that is if you have organic eco label. The way to efficiency and competitiveness is to have higher productivity within a market niche like eco-labelled products.

Also business running, time management and raising awareness in the public (communication, especially with a wide, international value chain, for topics like e.g. genetic engineering in disease resistance) are the missing skills within the current competency and the available training offer in Europe. Such courses (e.g. on production chains, business planning, risk assessments, budgeting, marketing, communication, time management) would be beneficial for the whole sector.

- **European Fisheries Technology Platform (EFTP)**

In May 2013 interviews were held with various EFTP stakeholders, who were asked about emerging research priorities and training needs. The EFTP identified “sustainability and management of the sea-fishing industry” as the highest priority area. Other sector-specific priority issues have been presented in chapters 4-6. The



EFTP does not have a centralized secretariat, therefore individual partner organizations were interviewed:

Interviewing professionals - views of selected EFTP stakeholders organizations:

ANFACO/CECOPESCA functions as an association of canned fish producers / technical centre for preservation of fish products. The association has a link with University of Vigo and coordinate training for affiliated companies, basically technical training (e.g. laboratory skills, environmental awareness, internationalisation, marketing, legislation). Continuous needs for training in reduction of waste and use of freshwater in seafood production as well as in the field of internationalization of seafood markets (and relevant legislation) were recognized.

Vigo Port Authority

Training: the main issue they see is that people involved in fish catching need to change the way they think, to appreciate that a fishing boat is part of the supply chain, a food processing platform with all the food safety and hygiene issues that implies.

The main knowledge gap issues with the supply chain are:

- Fishers: issues of quality (on-board preservation) and what to do with “discards”;
- Fishers tend to be poorly educated (a cultural issue). Appropriate training could be required as part of the conditions for issuing a license to fish. Training in basic marine biology for fishermen and vessel owners as well as in relations between quantity of seafood products produced and their market value would be appreciated.

ARVI as well as other EFTP regional Associations and Producers’ Organizations comprising it, have been collaborating with fisheries research for many years by offering commercial data and fishing vessels for the boarding of observers and development of research surveys while coordinating pilot projects on experimental fishing. The following training priority was stressed: energy efficiency for ship officers.

Campus do Mar is a capacity building programme for international excellence and has main three objectives:

- To identify projects of aggregation in specialized areas to improve competitiveness in the global world;
- To strengthen the interaction of university campuses with local and regional stakeholders through aggregation and strategic alliances;
- To identify strengths of knowledge with social and economic, local and territorial agents.



The group's following training needs were pointed to:

- Sustainable use and management of marine resources;
- Development of new technological processes for culture of marine species;
- Economics and social issues for management of aquaculture: sustainability and environmental quality assessment;
- Assessment and mitigation of the impact of marine resources exploitation;
- Skills in optimizing market competitiveness: technological progress and business management (incl. automation and robotics in industrial processes for safety & security on board, ports and in maritime activities);

InTerAct 'Industry-Academia Interaction in the Marine Sector'

The following describes results of an InTerAct project study of the needs for higher education in the aquatic food value chain. Various education endeavors in Aquatic Food Production was started because of a relative low interest of students in study programs like food science, aquaculture and engineering. The education in Aquatic Food Production was a reshaping of already existing study programs and expertise in the Nordic countries with a focus on the aquatic food value chain.

Collaboration of industry and academia has been identified as one of the key drivers to enhance innovation in companies as well as preparing students for future carriers. Communication barriers between industry and academia may however arise because of different expectations towards higher education, the qualification of students may not fit to the need of the industry, and competitive business issues may hinder collaboration and development. There are various established forms of collaboration i.e. visits to companies, collaboration in R&D projects, short term study visits in companies, and various internship practices, which enhance the employability of students after graduation (Ólafsdóttir et al., 2013).

Specific aims of the InTerAct project to complement the AQFood Nordic master programme are following:

- Interact with industries in the aquatic value chain in order to align their needs with educational content;
- Define what is needed to establish sustainable platforms for industry and academia interaction in educational programmes;
- Promote the marine sector's image as an attractive career opportunity for students with a higher education degree;
- Strengthen the image of the Nordic marine sector by using new media to reach to students and stakeholders.



According to Ólafsdóttir et al. (2013) the comments at the InTerAct stakeholder meetings gave in general a priori negative image towards marine higher education and it was underlined that education dedicated to the marine industry was lacking at all levels in the school system. It was noted that the importance of the fishing industry for the economy was not reflected at all in the educational system. Few study offers are available and there is a lack of study programmes that cater to the special needs of the aquatic food industry.

A theme running through comments and the general discussion was the lack of interest by the industry in university education. While this was reckoned to pose serious problems to the industry, its rate of innovation and thus overall competitiveness, the situation was also thought to provide plenty of opportunities for amendments. Examples are the design and implementation of short courses in life-long learning programmes, high quality distance education that would offer more flexibility for students and establishment of study programmes focusing on the needs of the industry in terms of business and marketing education, processing and logistics.

Participants also mentioned the possibility to create stronger links between particular study programmes and the industry. This could be achieved by creating opportunities for students such as practical training within companies and taking part in R&D projects as well as through direct financing through scholarships. Hence, the companies would increase their investment in education and potentially appreciate its value. During discussions, it became evident that the industry was indeed positive towards students' projects and there are already channels and established connections mostly based on initiatives of individual teachers and their contacts within companies in the aquaculture and seafood industry.

- Another source of HCB information is the comprehensive **foresight exercise**, conducted by the **COFASP consortium** in 2013 and 2014. The foresight process towards a research agenda in fisheries, aquaculture and seafood processing was based on a scenario building method. Together with stakeholders from the policy, research, NGO and industry community the network's partners worked towards devising a strategy for cooperation in research and innovation and identified future research priorities. These are to develop incentives for knowledge transfer from science to business application, outline needs for human capacity building and training and support the design of programs serving this purpose.

These exercises pointed to needs like to provide scientific basis for a societal cost-benefit analysis of different maritime activities, aquaculture in particular. Strategic and



managerial skills are required in order to have maritime activities managed in a sustainable and efficient way, taking into account socio-economic trade-offs and following local and national spatial plans. Detailed subjects of interest are listed in chapters 4, 5, and 6.

- The **COFASP** case studies:

The COFASP consortium explored similarities and differences that are observed in research priorities between different regions of the thematic areas covered by the COFASP partnership. The three cases relevant to this report are:

- Regionally integrated fisheries and ecosystem management
- Seafood processing – pan-EU challenges
- Aquaculture regional differences

The **COFASP case study on Regionally-Integrated and Spatially-Explicit Fisheries and Ecosystem Management** also points to the importance of managerial and maritime spatial planning skills. Fisheries management has multi-purposes and objectives and implies trans-sector considerations under the ecosystem approach, therefore designing and evaluating management measures that address multiple objectives and sectors is currently a challenge and thus competences in this area are especially sought.

Developing effective spatial management schemes requires setting up a cycle of Management Strategy Evaluations and Management Effectiveness Evaluations specifically tailored for spatial management and addressing multiple objectives, sectors and spatial scales. In order to identify possible trade-offs and apply them in decision making, two areas need to be further developed: the knowledge on functional habitats and spatially-explicit end-to-end models.

A grand challenge is developing management strategy evaluations for ocean management as a whole (i.e. including fisheries but also other sectors and conservation objectives) and making it operational in a spatially-explicit context. Accounting for the trade-offs between various ecosystem components or spatial scales impacted or used by different sectors requires understanding the ecological functionality of habitats and how these contribute to diversity and productivity of the ecosystem components.

Science provides information and knowhow for industries to improve their performance and to create more value for society. Seafood processing has benefited and will benefit from research and development. Control of the production process, ecological and environmental sustainability are necessary, but not sufficient to ensure economic sustainability of European seafood processing enterprises. The **COFASP Seafood**



Processing stakeholder conversation case study points to several emerging knowledge gaps. One identified, is increase / maximization / optimization of energy efficiency and efficiency of water usage and efficient logistics within Europe. Another is knowledge on specific health benefits of seafood consumption and its application in communication / marketing campaigns. Acquiring these competences would be helpful for promotion of seafood. From a business perspective health effect of consumption of farmed seafood alongside with alterations in feed, seems to be of one example of widespread interest. Another prominent one is the interest of entrepreneurs in new ways to utilize material harvested from the ocean. This knowledge need has emerged as a result of the EU landing obligation and market introduction of discarded species.

The COFASP Aquaculture Case Study: Addressing Regional Issues in European Aquaculture provided an encompassing overview of knowledge gaps and skills in demand, as in its workshops, it brought together industry leaders from companies that represented 30-35% of the total production of the Mediterranean sea bass/sea bream sector and close to 60% of the total Norwegian, and more than 30 % of the global atlantic salmon production. The case study points to priorities specific for European north, such as sea lice control, low-stress grading systems, fish welfare, packaging and shelf-life, and also priorities specific for the south, such as are feed research, matching supply with the market, product quality and traceability and disease control.

The case study also identified several **top cross-interest and common research priorities for the whole Europe**. These are:

- social acceptance/communication
- biomass control/estimation
- technology innovation (especially for real time estimation of total number of fish and size distribution with a good enough accuracy)
- monitoring environmental and biological indicators
- robustness, juvenile quality and selective breeding

Both research and competence development in these fields are perceived by the private sector as crucial for aquaculture development.

- **The COFASP Deliverable 2.21: 'Draft programme and joint call content: analysis and report on contents of common programmes and joint call in fisheries, aquaculture and seafood processing'** points to areas of common interests, research gaps and possible duplications. Similarly to this exercise, based on a COFASP (WP2) questionnaire and consultations with external stakeholders, key priorities were identified and show the following areas of common interest, which reflect some educational / training needs:



- Analyses of production systems and chains including ecological dimension, competition of fisheries with other forms of sea use;
- Integrated ecosystem assessment, monitoring and management;
- Multi-sectorial and broad-based stakeholder input to management plans;
- Bio-economic models: optimization of models in the sustainable management of fisheries;
- Development of sustainable harvesting strategies for fisheries which consider socio-economic factors, the wider eco-system and address issues of uncertainty, and risk;
- Development and adaptation of new technologies, such as remote sensing, for obtaining and analysing data to address environmental processes affecting fish production on the right temporal and spatial scales with greater efficiency;
- Introduction of technologies that minimize the ecosystem impacts of fisheries and ensure that fisheries can flourish alongside other economic activities in the sea, such as renewable energy;
- Develop methods to facilitate traceability of produce via certification and promote labelling as source of information to guarantee sustainability of production and safety for consumption;
- Increase the understanding of markets for fish and fish products in order to satisfy consumer demand through local production and processing for the benefit of European society and its economy;
- Development of decision-making tools to appraise the economic, social and environmental costs and benefits of different uses of resources such as fisheries, aquaculture, recreation, conservation, renewable energy, and carbon capture and storage so as to inform marine spatial planning;
- Managing discards as a common theme for fisheries, aquaculture and seafood processing (incl. alternative feeds);
- Sustainability of global maritime distribution pathways;
- Spatial planning of aquaculture and fisheries/habitat mapping/marine protected areas for sustainable fisheries;
- Integrating fisheries (raw material of feed) and aquaculture as well as agriculture regionally (recycling nutrients, net-loading system);
- Investigation of the use of marine resources in food ingredients or other bio-products such as pharmaceuticals;
- Support for technologies which decrease energy consumption and reduce the ecological footprint of aquaculture, fisheries and seafood processing.

The study recommended the following joint call themes of highest importance:

- Efficient, multi-stakeholder management systems to handle uncertainty in implementation of the ecosystem based management;
 - Long-term seafood production profitability; new species, traceability, and seafood products of highest market preference;
 - Spatial plans to optimize bioeconomy components of coastal fisheries and aquaculture;
 - Environmental, economic and social implications of fisheries management plans (including implementation of bio-economic models);
 - Innovative technologies which decrease vessel energy consumption and reduce the ecological footprint of aquaculture, fisheries and seafood processing.
- **The COFASP study 'New tools for capacity building: Proposal of new tools to be used for capacity building/lifelong learning in partner institutions'** (D.4.3.4.) points to the fact that the FASP sectors in Europe depend on cutting edge scientific and technological developments to overcome the constant challenges which the globalized economy poses. This is why engaging people in lifelong learning (continued professional development) is crucial to matching professional skills with changing market demand.

The 2010, the Flagship initiative "New Skills for New Jobs", one of the seven Flagship Initiatives from "Europe 2020", presents the mismatch between formal studies and market needs. Therefore knowledge related to the blueeconomy, including the FASP sectors, should be integrated in the training programmes and more flexibility is needed to adapt to rapidly emerging new fields of economic activities. For that reason, HCB programmes should integrate academia, technological centers and industry.

- **SEAS-ERA** 'Towards integrated European research strategy and programmes' (2010-2014) was a project funded within the EU FP7 ERA-NET scheme. SEAS-ERA was a partnership of the leading Marine RTD Funding Organizations in 18 countries. In addition, a range of observers were associated with the project. SEAS-ERA aimed at coordinating the national and regional RTD activities.

The following three reports of SEAS-ERA Work Package 5 (Capacity building), shed a light on knowledge needed to optimize and enhance human capacity building activities, and establish basis for improving science and technology development and its utilization in Europe:

- D.5.2.1. Identifying needs, specificities and imbalances;
- D.5.3.1. Proposal for human capacity building calls within common programmes and joint calls;



- D.5.3.2. A pan-European training and mobility strategy for human resources in marine science.

These reports show that HCB is increasingly becoming part of marine research programme at national level. They point to:

- Countries with specific strategy for HCB (e.g. Ireland);
- Countries with HCB as part of main research funding schemes / programmes (e.g. Greece, Italy);
- Countries without any particular strategy nor program for HCB besides regular activities at university / national level (e.g. Germany, Norway, Portugal and Spain).

Examples of successful human capacity building initiatives have been accounted for, e.g. EuroMarine training plan, BONUS Young Scientist Club, BUSN-Black Sea Universities Network, as well as regional differences in approach to HCB. They place high prioritization for: building professional figures like researchers, technologists, and technicians, mostly in the sector of basic research, fishery and sea resources; focusing on themes like environment, engineering and technology, and biology; through training actions, and specific education paths at school. The SEAS-ERA Era-Net developed its regional strategic research agendas. These also provide some indications of HCB needs of the support and creation of new generation marine scientists in order to support the new research topics and multi-disciplinary research regarding marine biotechnology, marine renewable energy sources, marine spatial planning and deep sea research techniques.

- **JPI OCEANS**

In 2014 the Joint Programming Initiative for Healthy and Productive Seas and Oceans (JPI-OCEANS) delivered the following two analysis within its support action project: *Needs and gaps in infrastructure and human capacity building to feed the SRIA (Strategic Research and Innovation Agenda)* and *Mapping and preliminary analysis of infrastructures, observation data and human capacity building (not available on the JPI website)*.

The JPI-OCEANS mapping exercise was conducted via stakeholder consultations and workshops. The focus was on HCB associated to access to research infrastructure, and on a tentative overview of non-academic training in marine and maritime sector with particular reference to HCB aspects in the framework of research support to industry and policy. The mapping was completed by a comparison among HCB actions in the framework of international marine projects. Although that study focuses on priorities like good environmental studies, ecosystem functioning or climate change, it points to several topics of COFASP importance like research to support the sustainable management of fisheries and Maritime Spatial Planning.



- **European Marine Board WG on Marine Graduate Training**

A 2014 consultation with the Chair of the **European Marine Board Capacity Building Group** and co-author of the [EUROMARINE database of marine courses](#)) (University of Ghent) pointed to the importance of the EUROMARINE database of available marine courses. It consists of 200+ master/PhD/short term programmes in marine sciences in Europe and gives a comprehensive overview of the available HCB opportunities in Europe. This endeavor was a 1-time activity which has not been updated and will soon disappear from the consortium's website.

The consultation pointed to the following observations:

- Available courses on natural sciences and maritime engineering prevail, whereas there is a clear deficiency of programmes in aquaculture, maritime dredging and blue biotechnology;
- The major challenge is the lack of link between the private sector and the educational programmes. Therefore the programmed do not necessarily fit the needs of business which can be observed in the aquaculture sector (mismatch between graduate knowledge and business expectations);
- Europe does not have a central, updated repository of available courses. Candidates need to search on many websites of individual organisations; In order to overcome this caveat the idea of a centralized access point for education and training in the field of marine sciences was born within the EMBRC.

- **EuroMarine**

The EuroMarine Consortium is a continuation of the FP7 project which aimed at integrating the scientific networks created with the three main, ocean-related, FP6 Networks of Excellence:

- MarBEF
- EurOceans
- Marine Genomics Europe

One of the objectives of the EuroMarine project was defined as: *“Train the next generation of marine scientists. Establish the educational landscape of marine biological sciences in the context of the “new 21st century” marine scientist in a cross-disciplinary perspective”*. The Marine Biology Research group of Ghent University took the lead in this task. The group compiled a [list of training possibilities](#) in the different partners of the three former NoE's and made it accessible through an online portal. This listing could in the future serve as the starting point for trainees to get access to information about marine education.

- The **EMBRC (European Marine Biological Resource Centre)**

The Centre decided to build on the EUROMARINE base, update it, and launch its own online 'training portal' in (the EMBRC has long-term funding for this exercise from the ESFRI and national programmes). As a result the MarineTraining.eu site was launched in 2014.

The portal has been designed and is developed to help European scientists, technicians and other stakeholders to navigate in the jungle of courses and training opportunities. Marinetraining.eu offers a variety of services to both training organizers and trainees and points to thematic areas already covered by long and short term training. The initiative is supported by a growing number of projects and organizations. The training office located at Ghent University - Belgium is in charge of the daily maintenance. It is divided into two main sections: programmes leading to a degree and short courses.

- The FP7 '**Towards an integrated marine and maritime science community'** **MARCOM+** project identified and listed key areas of common interest for marine and maritime research and technology development communities in Europe. These have been acknowledged to be crucial for the future inter-sectoral cooperation and capacity building. These areas are:

- Aquatic living resources (sustainability, coastal and sea-based aquaculture, capture fisheries, transport and processing, future vessels);
- Ocean energy (synergies between ocean energy/fisheries and aquaculture, green off-shore installations, cost-effectiveness);
- Ocean resources for blue biotechnology (pharmaceuticals, material research for maritime products);
- Impact of climate change on maritime activities;
- Human activities and impact on ecosystems (resilience, vulnerability, marine litter);
- Maritime spatial planning (incl. building with nature, coastal architecture and maintenance);
- Human health and wellness (from the oceans);
- Non living sea resources (incl. extraction technologies);
- Maritime transports and bioinvasions.

- **Aqua-tnet** is the European Thematic Network in the field of aquaculture, fisheries and aquatic resources management. The network was recently funded under the European Commission Lifelong Learning Programme, running from 2011-2014.

Consultation meeting with Aqua-tnet agreed that a combination of traditional training and e-learning (on-line or part face-to-face and part on-line) should be delivered,



budget and time permitting. Traditional courses could be delivered in collaboration with ICES or Campus do Mar.

Priority could be given to:

- Project management;
- Time management;
- The art of presenting research results. This includes: writing for funding, scientific writing, oral presentations, communicating in general;
- Data management and statistics: data collection, experimental design, survey design, data storage, data exploration (in R); data analysis.

- **The Black Sea Commission and the General Fisheries Commission for the Mediterranean**

Both organizations included capacity building as one of the priorities of their bilateral 2012 Memorandum of Understanding. Following that, the 2013 joint GFCM-BSC Workshop on IUU Fishing in the Black Sea identified the need for providing technical assistance to strengthen capacity in the domain of data collection/processing/analysis/sharing. A key thematic component was to facilitate, through competent organizations, technical assistance and capacity building opportunities for the control of fishing fleets, including through VMS, in the Black Sea. A need for joint training in inspections, monitoring and control of fisheries was stressed. Joint trainings of fisheries inspectors have been planned.

The GFCM is implementing its Framework Programme (FWP) which consists on a series of actions towards empowering the Commission to achieve its goal of developing sustainable fisheries and aquaculture in the Mediterranean and Black Sea. The FWP includes a number of actions towards capacity building on GFCM Members, addressing both training and research needs. The following are some of the main gaps on training and research needs identified. Several actions are currently being executed to address these needs. In relation to training, ongoing actions include training of inspectors, training on data collection, training on stock assessment, including for data limited stocks and stocks that require specific methods such as red coral, training for several aspects of aquaculture such as indicators and allocation of AZAs (allocated zones for aquaculture) as proposed by the Aquaculture Multi-stakeholders platform (AMShP). In relation to research needs, ongoing actions include improving the knowledge on stock status, socioeconomic variables, small-scale fisheries.

- **The European Association of Fisheries Economists** is an independent association of economists working in fisheries, including the catching, aquaculture and on-shore sectors.



Its annual conference in 2013 shed a light on the following identified knowledge / skill gaps:

- Social role of fisheries - the cultural and social values of fisheries, distribution of wealth from fisheries;
- Business performance, risk and return in stock recovery situations;
- Economic implications of Ecosystem-Based Management (EBM) of fisheries and how fishing at sustainable levels changes the financial prosperity of the fishing industry.

The above desktop study is further detailed below by listing specific, most commonly mentioned, training needs per activity sector, identified within the strategic documents and questionnaires, as well as supplemented with indications received from the COFASP partner organizations. The task 4.4 results will be used for the purpose of the 3rd COFASP call for projects and disseminated to the public through the internet in order to allow funding agencies, the private sector and the European Commission to fill in the identified knowledge gaps by implementing suitable initiatives, e.g. opening calls for projects.

4. Specific emerging training needs in the fisheries sector

The [COFASP foresight exercise](#) pointed to the following emerging priorities in the field of fisheries:

- development and use of technology to improve monitoring and surveillance will be required in addition to continued improvements in monitoring and data collection;
- how do organize and manage activities related to different commercial use of marine space and resources and how does competition between alternative uses of resources develop.

A challenge in the exploitation of fish stocks will be the balance between stock and ecosystem status and the exploitation of marine resources, therefore a wide range of competence, from ecosystem modelling, through stock assessment, to managing of social and economic trade-offs is needed.

The **COFASP analysis and report on contents of common programmes (D.2.2.1)** points to the following priorities in the field of fisheries:

- development of sustainable harvesting strategies for fisheries which consider socio-economic factors, the wider eco-system and address issues of uncertainty;
- multi-stakeholder management systems to handle uncertainty in implementation of the ecosystem based management;
- environmental, economic and social implications of fisheries management plans.

Consultations within the COFASP consortium has revealed emphasis on the following training needs:

- the impact of different fishing gears on juveniles fish stages, in order to reduce discards;
- the impact of different fishing gears on protected species, including marine mammals, in order to reduce by-catches;
- the effects of climate change on fish communities;
- aligning fish otolith readings, in order to improve the output of age-based fish assessment models (sensible theme in the Mediterranean, especially with regard to anchovies);

- identifying and implementing common models for an ecosystem approach to fisheries and aquaculture;
- a need for improved gear technology to further develop in situ separation of fish;
- a need for improved models to provide information on the impacts of increasing water temperatures on the availability of current species fished and new species replacing current species.

The GFCM is implementing its Framework Programme (FWP) which consists on a series of actions towards empowering the Commission to achieve its goal of developing sustainable fisheries and aquaculture. The following are some of the identified main knowledge / expertise gaps in fisheries:

- **Inspectors:** There is a need to improve the Monitoring Control and Surveillance (MCS) systems in place in the Mediterranean and Black Sea, in order to reduce and fight Illegal Unreported and Unregulated (IUU) fishing. This involves improving the means allocated to MCS, but also providing training for inspectors, both on land and at sea.
- **Data collection:** There is also a need to improve the data collection at Mediterranean scale. Management of stocks which are often shared between countries requires some coordination in data collection. The GFCM has adopted a new Data Collection Reference Framework that provides a minimum set of data required to be able to obtain a standard set of information that ensure the minimum information for common management of resources. Collecting and sharing information in a standardized way requires training, especially in the Mediterranean, where there are sub-regional differences in the conditions for collecting data from the fleet (different landing sites, fleet, accessibility, etc.)
- **Stock Assessment:** There is also a need for increasing the number of scientist able to perform quantitative assessment on the status of stocks. This includes the possibility to use direct (surveys) and indirect (assessment models) methods to assess the status of stocks for which a variety of information exist, from data rich to data limited stocks.
- **Management:** There are several skills in high demand, which are related to management, including: training on self-management, multi-sectoral management and management of maritime operations at national scale.

The **European Fisheries Technology Platform** lists the following topics as key for HCB in Europe:

- Improving the robustness and minimize the uncertainty in the scientific assessment on stocks;
- Improving the exploitation patterns of fisheries;
- Making fishing more profitable and ecology friendly;
- Making progress in the application of the ecosystem approach to fisheries management;
- Creating a collaborative link between the European fishing industry and society and project a positive image of the sector;
- Improving the selection capacity and efficiency of fishing gears;
- Reducing the effects of fishing gears on the seafloor, vulnerable habitats and endangered species;
- An integrated research need to adapt training to e-learning (especially in the field of risk optimization at sea) is recognized.

5. Specific emerging training needs in the aquaculture sector

The [COFASP foresight exercise](#) pointed to the following emerging priorities in the field of aquaculture:

- organic aquaculture with the main challenge of lowering production costs relative to conventional methods;
- multi-trophic aquaculture;
- multiple potential aquaculture species, how could a diversified production scheme look like.

The **COFASP analysis and report on contents of common programmes (D.2.2.1)** points to the following priorities in the field of aquaculture (mostly related to maritime spatial planning):

- Development of decision-making tools to appraise the economic, social and environmental costs and benefits of different uses of resources such as fisheries, aquaculture, recreation, conservation, renewable energy, and carbon capture and storage so as to inform marine spatial planning;
- Support for technologies which decrease energy consumption and reduce the ecological footprint of aquaculture;
- Spatial plans to optimize bioeconomy components of coastal fisheries and aquaculture.

Consultations within the COFASP consortium has revealed emphasis on the following training needs:

- In assessment of quality of harvested fish production, in order to increase its value also through the release of Protected Designation of Origin (PDO) brands;
- In identification and implementation of common models for an ecosystem approach to fisheries and aquaculture;
- In sustainable processes of discards reuse to enhance the production chain (e.g. feed for aquaculture);
- In the effects of different diets for farmed fish, in order to improve the quality of fish production;
- In development of new aquaculture methods and fish species.

EFARO

The Association of European Fisheries and Aquaculture Research Organisations (EFARO) identified, in its strategic document [EFARO's View on the Future of European Fisheries and Aquaculture Research](#) a need for novel education and high-quality training to produce research scientists, technicians and research managers with a wider, interdisciplinary and intersectoral knowledge of ecosystem-based science, advice and management. Efforts should tackle the typically limited interdisciplinary collaboration, and lack of understanding, between natural, technological, economic, social and political sciences. Thus there is a call for novel education and training to produce professionals with a wider awareness and understanding of the diverse facets inherent in ecosystem based science, advice and management in particular geographic areas.

In response to the '[Strategic Guidelines for the sustainable development of EU aquaculture](#)', issued by the European Commission in 2013³, the EFARO in its 'outline of RTDI topics identified by the Aquaculture Strategic Working Group' (April 2013) listed the following priority areas for aquaculture:

- Provide the right tools for an integrated approach in management; develop decision-making tools to appraise the economic, societal and environmental costs and benefits of different uses of resources so as to inform marine spatial planning;
- Develop environmental impact assessment of aquaculture (and other multiple human activities) and its cumulative or synergistic effects on the ecosystem functioning;
- Investigate, develop and provide advice on suitable acceptable and effective governance models to facilitate sustainable aquaculture growth;
- Develop methods to manage diseases affecting aquaculture to improve productivity and reduce risks to wild populations;
- Develop protocols and systems to improve fish welfare, focussing on reducing mortality, stresses during transport and relocation;
- Develop technologies that will reduce escapes from aquaculture to minimise risks to the natural environment;
- Increase understanding of markets for fish and fish products in order to satisfy consumer demand through local production;
- Identify the key factors that can make the European aquaculture industry internationally competitive. This will include consideration of consumer preferences, price, market segments and channels, supply chain and the role of retailers on the European seafood market.

³ EC COM(2013) 229 final

- Identify and develop high quality, healthy, nutritious and safe fish and shellfish products that respond to consumer demand;
- Develop methods to facilitate traceability of produce via certification and promote labelling as source of information to guarantee sustainability of production and safety for consumption;
- Development of a general framework for international accepted certifications and labelling of commodities and products from an environmental, social and economic perspective;
- Fundamental understanding of the kinetics viral (e.g. vibrio) uptake and removal in bivalve molluscs and other seafood. Environmental parameters to enhance virus depuration should be optimized;
- Stocktake of newly/emerging biotoxins and toxin producing phytoplankton relevant to European waters and their method of analysis;
- Investigate the potential for genetic improvements in production efficiency traits in domestic fish strains such as improving feed conversion efficiency and reducing the quantity of waste to reduce the environmental footprint and increase competitiveness of the aquaculture industry;
- Develop sustainable fish feeds with high and customized nutritional value that make aquaculture one of the most efficient producers of safe, high value food with low impact on wild forage fish populations;
- Advance aquaculture technology and systems that are economically sustainable and are sensitive to animal welfare;
- Support technologies (such as RAS and IMTA) to decrease energy consumption and reduce the ecological footprint of aquaculture, fisheries and seafood processing;
- Development of a methodology for integrated multi criteria assessment of cultivation and market perspectives in order to identify high potential species for aquaculture given local environmental and marketing conditions.

During the EFARO General Assembly in May 2013, [a number of marine fisheries science priorities for Horizon 2020](#) were identified. The identification was based on an analysis of research required to implement policy principals of major European strategies, policies and directives, such as the CFP, MSFD, EU Maritime Policy, EU Strategy 2020, EU Sea Basin Strategies and European Strategy for Marine and Maritime Research, but also global commitments such CBD. At the EFARO General Assembly in May 2014 the priorities were updated taking into account coverage of topics in the H2020 work program 2014/2015, as well as the 1. Call of the EraNet COFASP issues in 2014.

As the global demand for aquaculture products soars, risk management is a fast growing business, now of considerable size and employing an ever increasing number of people,



in many cases in places where it is hard to provide other jobs. Risk management creates its educational needs. Companies like 'Amus Ltd, UK' provide training in fundamentals of aquaculture insurance (against extreme weather, disease, allergies etc).

WEFTA

The West European Fisheries Technologists Association was consulted for emerging capacity building needs during its 2014 conference 'Seafood for a changing demand'. The following priorities were identified:

- Knowledge on relations between obesity and seafood consumption (as differences in data and trends are perceived between countries). As a result of that different health guidances are provided by health authorities in different regions (e.g. on the role of omega3 fatty acid in prevention of diseases or seafood consumption during pregnancy). Research methods used need to be validated (in some cases it is restricted to 5-10 specimen of fish);
- Knowledge on the role of dietary selenium in food quality and safety (to what extent does it prevent DNA damage);
- Which are the right packaging systems to create consumer confidence in seafood products as easy to prepare;
- Knowledge on the relation between feed quality and enzymes in seafood (compounds that make up human bodies antioxidant defence);
- Natural vs synthetic antioxidants – their effects on human health;
- Establishment of international reference limits of marine biotoxins (PCBs, pesticides) in seafood.

The GFCM is implementing its Framework Programme (FWP) which consists on a series of actions towards empowering the Commission to achieve its goal of developing sustainable fisheries and aquaculture. The following are some of the identified main gaps on training in aquaculture:

- **Spatial planning and allocated zones for aquaculture training on:** Geographic Information System tools for zoning and for the establishment of AZA; national capacity building on technical and legal aspects and establishing AZA; identification of mitigation measures and management issues (Environmental Quality Standard.); Application indicators and reference points (economic, social, environmental and governance) for site selection and monitoring in aquaculture.
- **Aquaculture and environment interactions;** on Better Management Practices for farmers at regional level on, inter alia, stocking density; harvest calendar; feeding protocols; disease diagnosis; reporting; surveillance and control; bio-technical methods to assess and minimize the negative impact of alien species on the environment; on efficient use of water resources and

maintenance of water quality (integrated multi-trophic aquaculture, recirculating aquaculture ...); impact of pathogens introduced by aquaculture on wild populations; tools and models for the AZA, environmental impact assessment (EIA) and EMP; on restocking good practice; on indicators and reference points on environmental risk analysis; effects of climate change on aquaculture and adaptation and mitigation measures;

- **Disease management and aquatic animal health;** Capacity building in risk assessment and biosecurity measures for disease prevention; on technologies and systems to reduce the incidence of disease/ parasite infestations (genetic selection towards increased immunity of aquatic organisms); diagnostic skills at the national level and systems for the early diagnosis of pathogens;
- **Governance and regulatory frameworks;** guidelines and national capacity building aimed in supporting the simplification of administrative process for licensing aquaculture activities and farms⁴;
- **Research, knowledge sharing and technology transfer;** Develop innovative tools and communication/dissemination methods to efficiently and effectively transfer knowledge to the industry and the research needs from the industry to research; on establishment networks to foster international partnership and transnational cooperation including research;
- **Sustainable feed production and management;** on improved quality and cost-effectiveness of the feed; on minimize environmental impact from aquafeed; on adoption and implementation of good feed management practices at farm level;
- **Technology innovation and diversification** disseminate results and knowledge outputs on research technology innovation and diversification species and of product type differentiation; Develop and disseminate results and knowledge outputs on research technology innovation and diversification
- **Social responsibility and empowering aquaculture farmers' organizations;** training available target user group in health and safety practices, procedures and policies; training activities and national capacity building related to social risk management in aquaculture and corporate social responsibility; facilitate capacity building through providing technical

⁴ These issue have also been highlighted as key in the CEFAS report Background information for sustainable aquaculture development, addressing environmental protection in particular - Sustainable Aquaculture Development in the context of the Water Framework Directive and the Marine Strategy Framework Directive, Lowestoft 2014

assistance/training for farmers to increase their competitiveness and risk management capabilities;

Consultations with the FEAP / EATIP pointed to the following topics are in high demand for HCB:

- Advanced warning systems in mariculture;
- Technical competences in aquaculture: better engineering support , better technical support, feed support from feed producers/suppliers/companies when you develop and establishments of new farms;
- Economy and business. Upfront planning is much more important in terms of the financial sustainability of your operation. Only few university courses teach this. In other words business management planning is an education/training area which needs high priority.

6. **Specific emerging training needs in the seafood processing sector**

The [COFASP foresight exercise](#) pointed to the following emerging research priorities in the field of seafood processing:

- towards more flexible production units: with a production sector with a more diverse (and more seasonal) production and a European market characterized by multiple market segments (high-value (non-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;
- production technologies for new resources such as seaweed and algae such as the production of biodegradable packaging (from seaweed).

The main challenge in the seafood processing industry was found in addressing an increased need to more rapidly adjust to changes in production and demand, in consumer perceptions and in supply changes on global markets. Therefore managerial competence and short-term courses, updated and tailored to emerging needs, are and will be in demand.

The **COFASP analysis and report on contents of common programmes (D.2.2.1)** points to the following priorities in the field of aquaculture:

- Increase the understanding of markets for fish and fish products in order to satisfy consumer demand through local production;
- Develop methods to facilitate traceability of produce via certification;
- Promote labelling as source of information to guarantee sustainability of production and safety for consumption.

Consultations within the COFASP consortium has revealed emphasis on the following training needs:

- better understand consumer perceptions (especially in the Mediterranean area as they have market diversity and specific difficulties, contrary to the 'salmon north');
- a need to provide new food products that utilise all fish caught in a mixed fishery, including those not currently consumed.

7. Executive summary

Education and training of students and researchers is at the core of the *Europe2020* Strategy. In particular, the *Innovation Union Strategy*⁵, *Youth on the Move Agenda*⁶, and the *Agenda for new skills and jobs*⁷, are contributing to creation of growth and jobs, support and stimulate actions to modernize higher education, to develop new curricula addressing skill gaps.

As many people working in the seafood industry tend to be poorly educated, appropriate training could be required as part of the conditions for issuing a license to fish or farm. In many cases, even academic experience does not fully qualify graduates to work on farms and in seafood processing firms. While observing internationalization of seafood markets and frequent changes in seafood perception / consumer attitudes, the European blue growth it is in need to ensure that a highly competent and knowledgeable workforce exists, to meet the visions of the private sector. If growth forecasts become reality (especially with regards to certain types of aquaculture: organic-labeled and low trophic), the profile of workforce will need to change or attract professionals from outside of Europe.

Effective mechanisms of transferring competence needs from the private to the public sector need to be established and supported. Ongoing collaboration of industry and academia has been identified as one of the key drivers to enhance innovation in companies as well as to prepare students for future carriers. The COFASP case studies are one-off examples of success in this field. The acquired information on knowledge gaps and key bottlenecks for progressing the management of ecosystems and maritime activities in Europe will need to be up-taken by research and education funding organizations to support the European blue growth.

In the marine/maritime field in Europe, numerous other initiatives have been taken on, in order to catalogue, update and disseminate the available education and short term training opportunities. What has been missing, were, clearly identified and confirmed by multiple stakeholders, up-to-date knowledge gaps and defined relevant research needs which. This information, applied in properly tailored training instruments, may help fill these gaps in order to allow the private sector (fisheries / aquaculture / seafood processing) to build suited human capital for competitive business.

COFASP deliverables directly responded to these needs. The COFASP Deliverable 2.21: *'Draft programme and joint call content: analysis and report on contents of common*

⁵ KI-32-13-062-EN-C, 2013

⁶ <http://ec.europa.eu/youthonthemove/>

⁷ <http://ec.europa.eu/social/main.jsp?catId=958>

programmes and joint call in fisheries, aquaculture and seafood processing' points to areas of common interests, gaps and possible duplications in available research results. Similarly to that exercise, this study identifies knowledge gaps and up-to-date training needs. It allows to prioritize HCB goals and choose from, in order to include relevant actions in possible calls for projects (in a timely fashion to be considered in the final COFASP call for proposals in 2016 but also for the use of any organization having interest in filling educational gaps in the fields of fisheries, aquaculture and seafood processing).

The conducted analysis of training needs in fisheries, aquaculture, and seafood processing of strategic documents, information gathered from the COFASP consortium partners, as well as information acquired from external key stakeholders, allow to draw conclusions from previous and parallel activities and to list the following most commonly mentioned and most urgent HCB areas of common interest / competences in demand:

1. 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;

2. 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;

- 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 AZAs).

3. 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);

4. Interdisciplinary needs

- Training in discard management as a common theme for fisheries, aquaculture and seafood processing (incl. alternative feeds);
- Training in management of maritime operations considering the available spatial plans, to optimize bioeconomy components of seafood production.

Annex 1: Interviewing professionals - results from COFASP questionnaire on existing training opportunities

COFASP partner organizations were asked to supply information on the following question: which training courses are available in your country?

- In fisheries
- In aquaculture
- In seafood-processing

In this context “training” refers to scientific courses in aquatic science and technology at national academic institutions.

A total of more than 74 universities and organizations from 13 COFASP partner countries have submitted information on training courses in fisheries, aquaculture and seafood processing:

- **Denmark**

- International Council for the Exploration of the Sea
- Technical University of Denmark

- **Finland**

- University of Eastern Finland
- University of Helsinki

- **France**

- Ecole supérieure d'ingénieurs de l'université de Caen Basse-Normandie
- Institut Universitaire de Technologie de Cherbourg
- Institut Universitaire Européen de la Mer
- LYCEE AGRICOLE SAINT CHRISTOPHE
- Marine Sciences and Techniques Institute
- Polytech Nantes, school of engineering of the university of Nantes
- Université Montpellier
- Université Pierre et Marie Curie
- University of Bordeaux

- University of Caen
- University of Rennes
- University of South Brittany
- University of the Littoral Opal Coast
- University of Western Brittany

- **Germany**

- Humboldt-University of Berlin
- Hochschule Bremerhaven
- University of Bremen
- Georg-August-University Gottingen
- Christian-Albrecht-University of University of Kiel
- University of Hamburg
- University of veterinary medicine Hannover
- University of Oldenburg
- University of Rostock

- **Greece**

- University of Athens
- Aristotle University of Thessaloniki
- University of Crete
- University of Thessaly
- Agricultural University of Athens
- University of Ioannina
- University of the Aegean

- **Ireland**

- Galway – Mayo Institute of Technology
- The Strategic Marine Alliance for Research and Training
- University College Cork, Ireland

- **Italy**

- Distretto Tecnologico AgroBioPesca Sicilia, in collaboration with: CORISVI, The University of Messina, University of Palermo and CNR
- Sicilia Navtec
- Università Politecnica delle Marche
- University of Bologna



- University of Genova
- University of Torino

- **Netherlands**

- Wageningen University
- Rijksuniversiteit Groningen

- **Norway**

- Norwegian School of Veterinary Science
- Norwegian University of Life Sciences
- Norwegian University of Science and Technology
- University of Bergen
- University of Nordland
- University of Oslo
- University of Tromsø

- **Portugal**

- CESAM Universidade de Aveiro
- Faculdade de Ciências da Universidade de Lisboa
- Universidade do Algarve
- University of Porto / Faculty of Sciences

- **Romania**

- Dunarea de Jos University of Galati

- **Spain**

- EAFP Meeting Secretary
- e-magister
- Fundación Foesa. Observatorio español de Acuicultura
- Instituto Agronómico de Mediterraneo de Zaragoza
- Instituto Galego de Formación en Acuicultura
- UNIVERSIDAD CATÓLICA DE VALENCIA SAN VICENTE MÁRTIR
- Universidad de Alicante
- Universidad de Barcelona
- Universidad de Cádiz
- Universidad de Las Palmas de Gran Canaria

- Universidad de Vigo
- Universidad del País Vasco/Euskal Herriko Unibertsitatea
- Universidad Politécnica de Valencia
- University of Vigo

- **United Kingdom**

- The Scottish Association for Marine Science
- University of Aberdeen

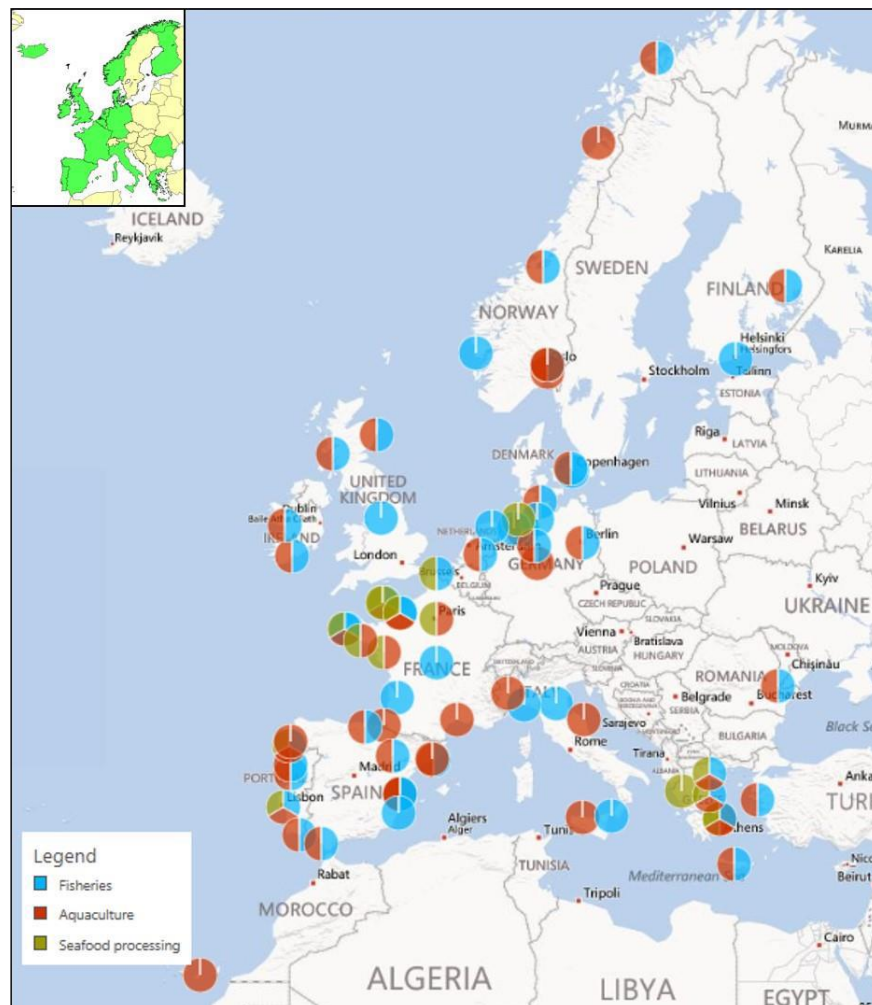


Figure 1. Location of universities and organizations reported by COFASP partners. Replies to the questionnaire on training courses in fisheries, aquaculture and seafood processing.

Responses from individual COFASP partners:

ICES

Fisheries

The ICES Training Programme: In response to the needs for enhanced scientific capacity to give advice on human activities affecting, and affected by marine ecosystems ICES has in 2009 initiated a Training Programme to help building capacity to support scientific advice. ICES ensures that scientists who do work related to the advisory process, have the necessary skills to deliver the best available science-based information to the advisory process. ICES offers training courses by high-profile scientists and instructors. Specifically the training programme is designed to:

- ensure that participants in expert Working Groups and other parts of the advisory process have the skill needed to deliver high quality advice;
- ensure a common understanding of ICES advisory practice;
- disseminate insight throughout and outside the ICES community;
- intensify cooperation with expertise from other organizations to bring in new disciplines and perspectives in ICES science and advice.

The ICES training links in to national expertise on teaching (national institutes, universities) and will add to existing training programs. The ICES training program should not compete with existing national universities and institutions but should rather fill the gaps of marine scientists operating in the advisory process.

National laboratories, universities, and other institutions or research networks are invited to develop courses on specific topics and recommend course instructors, including chairs of relevant ICES Expert Groups. The Training Group reviews and selects courses to be offered. New courses are added and the existing courses are evaluated regularly, based on feedback from the participants, and the course's relevance to the needs of the ICES Advisory and Science programmes.

The ICES Training Programme has been successful in meeting its objectives. Courses have been offered on a wide diversity of skills, including: stock assessment (introductory and advanced), ecosystem modeling, model building, management strategy evaluation, Bayesian inference, fisheries advice, trawl survey design and evaluation, integrated ecosystem assessment, analyzing and visualization of VMS, communication of science and advice, and how to lead an effective technical meeting. Each course was taught within the context of the ICES science and advisory system to demonstrate best practices as well as state-of-the-art technical skills.

Denmark

The Technical University of Denmark (DTU) offers higher education (MSc and PhD) in Aquatic Science and Technology which focuses on fisheries, aquaculture, oceanography and management of aquatic resources. Course titles are given in the following. More information [here](#).

Fisheries

- [Computational Marine Ecological Modelling](#)
- [Biological Oceanography](#)
- [Fisheries Ecology and Assessment](#)

- [Fisheries Oceanography](#)
- [Fisheries Systems – management and modelling](#)
- [Genetic Methods in Fisheries and Aquatic Biodiversity conservation](#)
- [Mathematical Biology](#)
- [Recreational Fishing; Biological impacts, management and human dimensions](#)

Aquaculture

- [Advanced Course in Recirculating Aquaculture Systems: Design and Application](#)
- [Fish Physiology in Aquaculture](#)
- [Genetic methods in aquaculture](#)
- [Marine Aquaculture](#)
- [Recirculating Aquaculture Systems](#)

Fisheries and Aquaculture

- [Aquatic Ecosystem Management](#)
- [Chemical Oceanography](#)
- [Design of Survey and Monitoring Systems](#)
- [Fish Nutrition and Bioenergetics](#)
- [Mathematical Models in Ecology](#)
- [Physical Oceanography](#)

Italy



Several Italian universities offer courses in fisheries and aquaculture. Distretto Tecnologico AgroBioPesca Sicilia, in collaboration with: CORISVI, The University of Messina, University of Palermo and CNR; Sicilia Navtec; Università Politecnica delle Marche; University of Bologna; University of Genova; University of Torino. Course themes with links to more information are given in the following.

Fisheries

- [Advanced training course on innovative energy technologies applied to the shipping sector](#)
- [Biologia della Pesca](#)
- [MODELLI DI VALUTAZIONE E GESTIONE DELLE RISORSE ALIEUTICHE](#)

Aquaculture

- [Training for technological innovation in aquaculture competitiveness of Sicilian aquaculture and traceability of fishing industry products](#)
- [Acquacoltura e Acquariologia](#)
- [Aquaculture](#)

Norway

Several Norwegian universities offer courses and higher education (MSc and PhD) in fisheries and aquaculture: Norwegian School of Veterinary Science; Norwegian University of Life Sciences; Norwegian University of Science and Technology; University of Bergen; University of Nordland; University of Oslo; University of Tromsø. Educations with links to more information are given in the following.

Fisheries

- [MSc in Marine Coastal Development, Fisheries and marine resources, Marine biology and biochemistry](#)
- [MSc in Fisheries Biology and Management; MSc in Marine Biology; MSc in Nutrition - marine](#)
- [Master of Science in Marine Ecology](#)
- [Master of science in International Fisheries Management](#)

Aquaculture

- [Veterinary medicine \(Cand. Med. Vet.\)](#)
- [European Master of Science in Animal Breeding and Genetics; Master of Science in Aquaculture](#)

- MSc in Marine Coastal Development, Aquaculture; MSc in Marine Technology, Marine Resources and Aquaculture
- MSc Aquaculture biology
- Master of Science in Aquaculture
- Fish health

Fisheries and Aquaculture

- Marine biology and limnology (programme option)
- Master in fisheries and aquaculture science

Spain

Several Spanish universities offer courses and higher education (MSc and PhD) in fisheries and aquaculture: Fundación Foesa. Observatorio español de Acuicultura; Instituto Agronómico de Mediterraneo de Zaragoza; Instituto Galego de Formación en Acuicultura; UNIVERSIDAD CATÓLICA DE VALENCIA SAN VICENTE MÁRTIR; Universidad de Alicante; Universidad de Barcelona; Universidad de Cádiz; Universidad de Las Palmas de Gran Canaria; Universidad de Vigo; Universidad del País Vasco/Euskal Herriko Unibertsitatea; Universidad Politécnica de Valencia; University of Vigo. Educations with links to more information are given in the following.

Fisheries

- European MSc in Marine Environment and Resources
- Master in Biological Sciences; Degree in Marine Sciences; Master in Marine Biology; Master in Oceanography; Masters in climate science: meteorology, physical oceanography and climate change
- FISHERIES

Aquaculture

- Formación Profesional en Acuicultura
- Master interuniversitario en acuicultura (Valencia)
- MÁSTER UNIVERSITARIO EN GESTIÓN PESQUERA SOSTENIBLE
- Màster en Ciències del Mar: Oceanografia i Gestió del Medi Marí
- Máster Universitario en Cultivos Marinos / UNIVERSITY MASTER IN MARINE AQUACULTURE
- Máster en acuicultura
- Técnico Superior en Producción Acuícola

- Master in Aquaculture
- 16th International Conference on Diseases and Shellfish
- Master universitario en cultivos marinos
- Máster Universitario en Acuicultura
- Máster Universitario en Acuicultura y Pesca: Recursos Marinos y Sostenibilidad
- AQUACULTURE

Seafood processing

- Master in Science and Technology Conservation Fishing Products; Degree in Chemistry

Germany

Several German universities offer courses and higher education (MSc and PhD) in fisheries and aquaculture: Humboldt-University of Berlin; University of Bremen; Christian-Albrecht-University of University of Kiel; University of Hamburg; University of Oldenburg; University of Rostock; Georg-August-University Gottingen. Courses in seafood processing are offered by Hochschule Bremerhaven

Fisheries

- MSc Biological Oceanography
- MSc Marine Ecosystem and Fisheries Science
- MSc Marine Environmental Sciences
- Marine Biology MSc.

Aquaculture

- Agricultural Sciences BSc, MSc
- MSc Fishery Science and Aquaculture
- Agricultural sciences BSc - specialisation marine aquaculture
- MSc Marine Microbiology
- Maritime Technologies BSc, MSc
- Veterinary studies

Seafood processing

- BSc Food Technology / Food Economics

The Netherlands

Wageningen University, the Aquaculture and Fisheries Group is responsible for academic teaching and research in the field of aquaculture and fisheries. The following courses are offered in a Master of Science programme:



- Fisheries Ecology
- Life History of Aquatic Organisms
- Aquaculture Production Systems
- Nutrition, Welfare and Reproduction in Aquaculture
- Marine Resources Management
- Sustainability in Fish and Seafood Production
- Building with nature

List of PhD topics & candidates

A Master of Science programme in Marine Biology is jointly taught by several research groups in Marine Biology at the University of Groningen in co-operation with our partner institutions: the Royal Netherlands Institute for Sea Research, the Centre for Estuarine and Marine Ecology, and the Institute for Fisheries Research.

France

Several French universities offer courses and higher education (MSc and PhD) in fisheries and aquaculture: Ecole supérieure d'ingénieurs de l'université de Caen Basse-Normandie; Institut Universitaire de Technologie de Cherbourg; Institut Universitaire Européen de la Mer; LYCEE AGRICOLE SAINT CHRISTOPHE; Marine Sciences and Techniques Institute; Polytech Nantes, school of engineering of the university of Nantes; Université Montpellier; Université Pierre et Marie Curie; University of Bordeaux; University of Caen; University of Rennes; University of South Brittany; University of the Littoral Opal Coast; University of Western Brittany

Fisheries

- Master Marine Biological Sciences & Doctoral Program
- MASTER Aquatic Resources and Sustainable Exploitation & MASTER Ecosystem approach to Fisheries; MASTER Applied Economics: Agriculture, Sea, Environment; MASTER Environmental engineering option: Fisheries and Aquaculture sciences
- Joint Master programme Marine Environment and Resources (MER)
- ESIX agro A: The Food Science Engineering programme; Master AQUACEAN PRO & RESEARCH
- Technicien Supérieur de la Mer Génie Biologique-Halieuistique-Aquaculture – Bachelor Océanographe-Prospecteur - Manager des entreprises d'aquaculture
- Masters of sciences in Marine Biology & Doctoral Program

Aquaculture

- [BTSA Aquaculture](#)
- [European Master in Aquatic Productions Management](#)
- [Master 2 Bioprocesses and Marine Biotechnology](#)
- [International Master Biology of marine organisms: fundamental and applied bases](#)
- [Master Marine Environment and Biotechnology](#)

Seafood processing

- [Master food science, quality in fish processing](#)
- [Degree PRO in Seafood Processing](#)

Romania

Aquaculture

- [MSc courses in aquaculture at Dunarea de Jos University of Galati](#)
- Modeling, Simulation and Control of Bioprocesses.

UK

MSc and PhD courses have been reported from The Scottish Association for Marine Science and University of Aberdeen and they are given below.

Fisheries and Aquaculture

- [Ecosystem based management using Ecopath with Ecosim; Marine Invasive Species Identification Workshop; Algaculture for Biotechnology; Algal Biotechnology Masters](#)
- [Applied Marine and Fisheries Ecology](#)

Portugal

Four Portuguese universities offer courses and higher education (MSc and PhD) in fisheries and aquaculture: CESAM Universidade de Aveiro; Faculdade de Ciências da Universidade de Lisboa; Universidade do Algarve; University of Porto / Faculty of Sciences. The courses and links to more information are given below.



Fisheries, Aquaculture and Seafood Processing

- Master Degree in Fisheries and Aquaculture;
- Climate change impacts on marine ecosystems;
- Curso de Identificação de Peixes dos Ecossistemas Fluviais de Portugal;
- Escrita Científica – Como elaborar artigos científicos de forma mais eficaz;
- PhD in Marine Sciences;
- Biodiversidade Aquática: uma ferramenta de monitorização ambiental;
- Curso de identificação de invertebrados aquáticos;
- Master Degree in Sea Sciences;
- Curso de Identificação e caracterização de peixes ósseos da Costa Portuguesa; Análise de Dados em R
- Marine Biology
- Masters in Aquaculture and Fisheries
- Marine Biology Master Course –University of Algarve
- Mestrado em Recursos Biológicos Aquáticos

Greece

Overview of education and training Institutions in Greece related to fisheries, aquaculture and processing (Conides et al., 2013).

The tertiary level education in Greece comprises of 2 types of educational Institutions: the Universities - more or less for theoretical sciences - and the Technical Educational Institutes - more or less for applied sciences- producing scientists and technicians respectively. Before, these 2 types were separated under the Greek legislation with only the Universities belonging to the tertiary level education and the Technical Educational Institutes as completely separate level of education.

However following a EU decree based on the level and time period of education provided in the Technical Educational Institutes, both types today belong to the tertiary education level as equals.

The following list includes the universities/Technical Educational Institutes and their departments which provide education and training on fisheries, aquaculture and processing of fishery products (among other products) which are of interest for the COFASP-eranet including a short keywords list to indicate the specific knowledge offered for each subject.

A. At University Level

1. Fisheries

- University of Athens
 - Department of Biology
 - Keywords: biology, population dynamics, classification, ecology
- University of Thessaloniki
 - Department of Biology
 - Keywords: biology, population dynamics, classification, ecology
- University of Crete at Heraklion, Crete
 - Department of Biology
 - Keywords: biology, population dynamics, classification, ecology
- University of Patras
 - Department of Biology
 - Keywords: biology, population dynamics, classification, ecology
- University of Aegean at Lesvos Island
 - Department of Sea Sciences
 - Keywords: fisheries technology, fisheries management and exploitation

2. Aquaculture

- University of Athens
 - Department of Biology
 - Keywords: rearing technology, feeding, biology, reproduction, breeding, ongrowing
- University of Thessaloniki
 - Department of Biology
 - Keywords: rearing technology, feeding, biology, reproduction, breeding, ongrowing
- University of Crete at Heraklion, Crete
 - Department of Biology
 - Keywords: rearing technology, feeding, biology, reproduction, breeding, ongrowing
- University of Patras
 - Department of Biology
 - Keywords: rearing technology, feeding, biology, reproduction, breeding, ongrowing
- University of Thessaly at Larissa
 - Department of Biochemistry and Biotechnology
 - Keywords: feed technology
- University of Thessaloniki
 - Department of Veterinary Medicine
 - Keywords: pathology, treatment

- University of Thessaly at Karditsa
- Department of Veterinary Medicine
- Keywords: pathology, treatment, fish farm operation, fish hatchery operation
- University of Thessaloniki
- Department of Agriculture
- Keywords: culture of fish, fish farm operation, fish hatchery operation
- University of Thessaly at Volos
- Department of Agriculture, Plant Production and Agriculture Environment
- Keywords: fish farm operation, fish hatchery operation
- University of Thessaly at Volos
- Department of Agriculture, Ichthyology and Aquatic Environment
- Keywords: fish farm operation, fish hatchery operation
- University of Aegean at Lesbos Island
- Department of Sea Sciences
- Keywords: fish farm operation, fish hatchery operation

3. Processing

- University of Thessaloniki
- Department of Agriculture
- Keywords: processing
- University of Thessaly at Volos
- Department of Agriculture, Plant Production and Agriculture Environment
- Keywords: processing
- University of Thessaly at Volos
- Department of Agriculture, Ichthyology and Aquatic Environment
- Keywords: processing
- Agriculture University of Athens
- Department of Food Science and Technology
- Keywords: processing
- Agriculture University of Athens
- Department of Animal Productions and Aquaculture
- Keywords: processing
- University of Athens
- Department of Chemistry
- Keywords: food chemistry
- University of Thessaloniki
- Department of Chemistry
- Keywords: food chemistry
- University of Ioannina
- Department of Chemistry
- Keywords: food chemistry
- University of Crete at Heraklion

- Department of Chemistry
- Keywords: food chemistry
University of Patras
- Department of Chemistry
- Keywords: food chemistry

B. At Technical Educational Institute Level

1. Fisheries

Technical Educational Institute of Epirus at Igoumenitsa

- Department of Fish Husbandry and Fisheries
- Keywords: fishing technology

Technical Educational Institute of Messolonghi

- Department of Aquaculture and Fisheries Management
- Keywords: fishing technology

Technical Educational Institute of Thessaloniki at Moudania

- Department of Fisheries Technology and Aquaculture
- Keywords: fishing technology

2. Aquaculture

Technical Educational Institute of Epirus at Igoumenitsa

- Department of Fish Husbandry and Fisheries
- Keywords: aquaculture technology, farm and hatchery operation, reproduction, breeding, ongrowing

Technical Educational Institute of Messolonghi

- Department of Aquaculture and Fisheries Management
- Keywords: aquaculture technology, farm and hatchery operation, reproduction, breeding, ongrowing

Technical Educational Institute of Thessaloniki at Moudania

- Department of Fisheries Technology and Aquaculture
- Keywords: aquaculture technology, farm and hatchery operation, reproduction, breeding, ongrowing

3. Processing

Technical Educational Institute of Thessaloniki

- Department of Animal Production
- Keywords: processing

Technical Educational Institute of Larissa

- Department of Animal Production
- Keywords: processing

Technical Educational Institute of Western Macedonia at Florina

- Department of Animal Production
- Keywords: processing
Technical Educational Institute of Epirus at Arta
- Department of Animal Production
- Keywords: processing

Ireland

Two organizations and one University have reported courses and higher education (MSc and PhD) in fisheries and aquaculture: Galway – Mayo Institute of Technology; The Strategic Marine Alliance for Research and Training; University College Cork, Ireland. The courses and links to more information are given below.

Fisheries, Aquaculture and Seafood Processing

- [Accredited Postgraduate Module in Applied Marine Biological Sampling and Data Collection](#)
- [Science @ Sea](#)
- [Biology – Marine Biology](#)
- [Seafood Innovation](#)

Finland

Finnish Universities have reported courses and higher education (MSc and PhD) in fisheries and aquaculture: University of Eastern Finland and University of Helsinki. The courses and links to more information are given below.

Fisheries and Aquaculture

- [Ecological Basis of Risk Analysis for Marine Ecosystems; Introduction to Bayesian inference in fishery science; Introduction to General Population Dynamics Model](#)
- [Methods on Fish Biology; Ecology of fisheries and cray fisheries; Methods in Fish Biology](#)

Also there are the following MSc-level courses in University of Jyväskylä:

WETS401 Stream Restoration (4 ECTS cr.)

Lecturer [Heikki Hämäläinen](#)

Contents: Elements of structure and function of running waters. Needs, targets, methods and monitoring of stream restoration. Restoration exercise.

WETS501 Early Development of Fishes (4 ECTS cr.)

Professor [Juha Karjalainen](#)



*WETS502 Fish Bioenergetics (4 ECTS cr.)*Professor [Juha Karjalainen](#)*WETS602 Methods for Aquaculture Research (5 ECTS cr.)*[F]yliopistonlehtori [Juhani Pirhonen](#)

Contents: Lectures, practical exercises at Laukaa Fish Farm (2d) and Konnevesi Res. Station (5d). Preparation of dry feed, methods to estimate feed intake and growth, smolting, yolk utilization efficiency, oxygen consumption, tagging, swimming capacity, physiological measurements. This course is for a maximum of 12 students and the selection for the course will be based on earlier studies (WETS111 and WETS601) or earlier studies related to aquaculture. The course will be given in English if needed.

*WETS703 Fisheries Management (4 ECTS cr.)*Lecturer [Timo Marjomäki](#)

Contents: Contemporary views of fisheries management process and operation, coping with uncertainty and risk, precaution principle. Emphasis on small scale inland fisheries.

*WETS701 Echo-sounding in Fish Research (2 ECTS cr.)*Lecturer [Timo Marjomäki](#)

Contents: Principles of aquatic acoustics, structure and operation of echo sounder systems, fish density estimation, spatial distribution, monitoring fish movements.

*WETS702 Fish Population Dynamics and Stock Assessment (7 ECTS cr.)*Lecturer [Timo Marjomäki](#)

Contents: NOTE: This is a compulsory prerequisite course for WETS104 and WETS703. Basic population parameters mortality, growth and recruitment, and their dependence on population density and environmental variables, density estimation, fishing effort, CPUE and sustainable yield, dynamic pool models, surplus yield models, principles of economics, stochastic simulation.

*WETS704 Survey Sampling in Fisheries Science (4 ECTS cr.)*Lecturer [Timo Marjomäki](#)

Contents: Basic concepts, the effect of survey method on deviation of results, bias and error, data collection, imputations, analysis and presentation.

WETS711 Social Aspects of Fisheries (4 ECTS cr.)[F]projektitutkija [Kari Muje](#)**Belgium**

There are currently no training courses on a regular basis in the three fields. There is an integrated training programme for aquaculture in development. Also ILVO is the only Belgian research institute responsible for fisheries matters. ILVO scientists usually participate to the ICES training courses on fisheries. Product technology is more spread and diffuse. ILVO are not aware of training courses in product technology [Kris Cooreman, Scientific director, Instituut voor Landbouw- en Visserijonderzoek / Institute for Agricultural and Fisheries Research, www.ilvo.vlaanderen.be]