575235-EPP-1-2016-1-NO-EPPKA2-SSA-N
Agreement number 2016 – 3452
Erasmus Plus Sector Skills Alliance LOT 1 project
www.blueedu.eu

Fostering Growth in the Blue Economy by developing an action plan for innovative European aquaculture VET and harmonized qualifications

D3.1 Analysis and investigations of existing studies and research-based data on skills gaps in aquaculture industry and VET supply

WP 3 Analysis and investigation

Author: Steven McKillop[1]

Contributors: John Bostock[1]
Martyn Haines[2]
John Birger Stav [3]

[1] University of Stirling, Institute of Aquaculture (UK)
[2]Pisces Learning Innovations (UK)
[3] Norwegian University of Science and Technology NTNU (Norway)

Version: Final

Date: 30.10.2018

Funded by the Erasmus+ Programme of the European Union

This project has been funded with support from the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use, which may be made of the information contained therein

Summary

Vocational Education and Training (VET) is an important component of any national educational system and supports workforce development in many fish producing European countries. The role VET plays in the education system is sometimes understated, and qualifications achieved through VET are perceived by some to be of a low quality or second rate. However, VET can offer an important and accessible education pathway that can prepare an individual for a specific job, thereby helping them to find initial employment, or improve their practical skills and knowledge for their current role. The low perception of VET in some countries as a credible educational pathway does not always apply in every sector. For example, VET is central to certain trades such as construction and engineering which are generally held in higher regard. Conversely, there appears to be some negative association with employment in aquaculture which is seen as a last resort in some countries. This can make it difficult to promote aquaculture VET as a career path due to the negative social association in countries where higher education in university is the aspiration of many. A Cedefop public opinion survey carried out in 2017 (2) found that VET may not be viewed with high regard as an educational pathway by those surveyed, but the general perception was that VET can prepare people well for the world of work and is a positive pathway towards finding employment.

Web based research for specific VET in each of the 12 BlueEDU countries included in the project confirmed that each country does have a formal VET system, but frequently, an aquaculture or aquaculture related curriculum is missing. There is evidence to suggest that most countries do have some form of aquaculture education and training activity, but this is commonly fragmented, informal and lacking structure, or aimed at higher education.

Identifying aquaculture VET currently available is an essential first step in establishing who is delivering what, where and how. The research for BlueEDU revealed that there is an existing VET system in each of the BlueEDU countries, but a very limited number of aquaculture VET programmes. This was an expected result but still something that had to be confirmed. Norway and Scotland both have long established VET systems that are respected and well structured. Both systems have benefits that could bring positive results if they were replicated in other countries. The system in Norway is well supported across the country by the Norwegian aquaculture industry, whereas the system in Scotland appears to be confined to delivery from two centres, NAFC in the Northern Isles and Inverness College, both of which are part of the University of the Highlands and Islands (UHI). The systems used in both Norway and Scotland are currently being evaluated by other countries aiming to setup an aquaculture VET system to support their growing industries, namely, Iceland and Faroe Islands.

There are aquaculture VET systems ongoing in Spain, France, Italy and Greece although the options available in Italy and Greece are very limited. France has a well-established VET and aquaculture full time course provision distributed across the country. There is however a general lack of aquaculture VET provision in southern European countries where tertiary education at university is held in high esteem. Information on countries in southern Europe was difficult to obtain as online searches would reveal very limited information. Requests for information sent to contacts generally received little or no response. There have been several EU supported projects in southern Europe that have developed a wide range of learning tools aimed at:

- fish health monitoring and disease control,
- improving fish welfare,
- improving skills and general aquaculture knowledge,
- creation of an aquaculture glossary,
- improve research knowledge and infrastructure and
- creation of a Europe wide networking system.

These initiatives have led to the creation of a number of online courses and training tools that could be utilised by any aquaculture VET system to help address knowledge gaps. It appears that most of the resources created are no longer in use or are rarely used. This may be down to the lack of effective promotion and they may be put to good use if updated and promoted to a wider audience.

Table of Contents

List of Figures

List of Tables

Appendices

Appendix 1 - Adapted from the Croatian National Strategic Plan for Aquaculture Development 2014-2020 (76)

Appendix 2 - Details of the courses and modules designed for the FISHFARM Project.

Appendix 3 - PerformFISH Expected Results

Appendix 4 - Details of the four courses available on AQUAEXCEL 2011-2015

Appendix 5 - Details of the nine training courses available on AQUAEXCEL 2020

Appendix 6 - ParaFish Control Project objectives

Appendix 7 - Six recommendations of the Skills Review for the Aquaculture Sector in Scotland 2018 (136)

Appendix 8 - Knowledge and Skills Guidelines for Aquaculture Technicians (Competency list), 2001 (129)

Appendix 9 - Business issues, skills needs and solutions for the UK Aquaculture sector in UK Skills assessments (134)

Appendix 10 - Aquaculture Work Based Learning (WBL) project example responses to survey questions (135)

1 Introduction

1.1 Background

The human population is growing globally and as it does the demand for food will also increase. To meet this demand food production and harvesting methods are under pressure to increase output, sustainably and responsibly. Fish and other aquatic organisms are an important part of the diet for many people but harvesting from wild stocks is no longer sustainable and cannot satisfy the global demand. Aquaculture is currently playing an important role in filling the gap and satisfying this demand, with approximately half of all fish consumed globally now coming from aquaculture.

Global aquaculture production has grown steadily over the years and from 2008 -2014 had increased from 52.5 million tonnes to 73.8 million tonnes (125) an increase of 21.3 million tonnes (40%). The EU over the same time period increased from 0.85 million tonnes to 1.3 million tonnes an increase of 0.45 million tonnes (53%) (43). The EU 28 including other BlueEDU countries trading in the economic area (Norway, Faroe Islands and Iceland) significantly increase the European output. European production (EU plus Norway, Faroe Islands and Iceland) increased from 1.75 million tonnes in 2008 to 2.72 million tonnes in 2014 an increase of 0.96 tonnes (55%).

	2008 Aquaculture production (million tonnes)	2014 Aquaculture production (million tonnes)	Production increase million tonnes (%)
Global production	52.5	73.8	+21.3 (40)
Europe production	0.85	1.3	+0.45 (53)
EU production (includes Norway, Faroe Islands and Iceland)	1.75	2.72	+0.96 (55)
12 x BlueEDU countries	1.63	2.52	+0.89 (55)

Table 1 - Global, European, EU and BlueEDU total aquaculture production in millions of tonnes. Adapted from FAO (36) & STECF EU Aquaculture data (43)

The BlueEDU project focused on twelve European countries responsible for the bulk of European production collectively. The twelve BlueEDU countries produced 1.63 million tonnes in 2008 and the EU, Norway, Faroe Islands and Iceland, collectively produced 1.75 million tonnes (36) Table 1.

The BlueEDU total for 2008 accounted for 93% of the total European production. In 2014 the twelve BlueEDU countries produced 2.52 million tonnes and the EU, Norway, Faroe Islands and Iceland as a whole produced 2.72 million tonnes. The BlueEDU total for 2014 accounted for 92% of the total European production. The five top aquaculture producing countries in the EU (UK, Greece, Spain,

Italy, France) are included in the BlueEDU project but much of the growth experienced in Europe can be attributed to Norway, the BlueEDU project lead partner.

The aquaculture industry in the EU had >11 000 active enterprises in 2014 employing >69 000 staff (FTE >31 000) (43). When Norway, Faroe Islands and Iceland are included this increased to >12 000 companies employing >76 000 staff. Aquaculture makes a significant contribution to the EU economy with a sales value in 2014 of €4 257 million with the top five EU producing countries accounting for €3 286.7 (77%) of the total. When the EU as a whole is considered with Norway, Faroe Islands and Iceland the total value in 2014 was €10 231 million. The twelve Blue EDU countries accounted for €9 536.8 (93%) of the 2014 total.

Globally aquaculture is the fastest growing food production sector and it is estimated that by 2030 over sixty percent of all fish consumed will come from aquaculture (1). In the EU there is a predicted target of 100% increase in production output of marine finfish by 2030. When other sectors are included, shellfish and freshwater, the predicted target for all EU aquaculture output is still expected to achieve an average increase of approximately 67% (124). If the industry grows as predicted then the demand for labour should also increase, and as the production technology improves to cope with increases in production so will the need for a trained workforce.

In the EU, as for other countries globally, there is a challenge facing the labour market, which will require a workforce that is mobile and flexible. To face this challenge education and training will be essential, particularly formal Vocational Education and Training (VET) and lifelong learning. The primary aim of all VET and lifelong learning should be to equip people with theoretical and practical knowledge which will help them to gain employment, which in turn will contribute to the economy of their country and the EU as a whole.

1.2 Purpose of the Work Package

The main aim of Work Package 3 ‘Analysis and investigations of existing studies and research-based data on skills gaps in aquaculture industry and VET supply’ of the BlueEDU Project, is to conduct a desk study of European aquaculture skills needs, aquaculture industry demands and VET supply to identify and address and any skills gaps, information gaps and research needs.

It is anticipated that this study will reveal the state of VET supply, and more specifically aquaculture VET where it exists, in each of the 12 countries identified in the BlueEDU project.

The specific tasks of Work Package 3:

- Identification of available reference sources in the public domain through a web-based search and databases containing research results.
- Source relevant information held in the 12 target countries by FEAP, their member associations, producer organisations, academia and/or other agencies through direct communication to request access.

- Investigate and analyse all available reports and data to establish the information and research evidence base, regarding industry skills needs and VET supply and demand. This includes evidence addressing digital skills as an instrument to increase the access to VET for farm operatives maintaining and operating advanced technology and equipment and green skills in relation to environmental management.
- Complete the data analysis and identify information gaps to be addressed through further research of qualitative and quantitative data in WP 5 and WP 6.
- Summarise existing knowledge and available results in a documented report, for circulation and publication at the BlueEDU web site.

2 Methodology

The web search conducted of the public domain was initially very straightforward. A general search was done following the format below and then narrowing the searches by using more specific search information:

- A general search of Aquaculture VET in EU to identify any previous EU studies/surveys/research.
- A general search of VET in EU to identify any previous EU studies/surveys/research which have looked at VET.
- A specific search for aquaculture VET in each of the 12 countries identified in the BlueEDU project.
- A search for VET in each of the 12 countries identified in the BlueEDU project.
- A search to identify any aquaculture member associations, producer organisations, academic/educational and training suppliers in each of the 12 countries identified in the BlueEDU project. The information gathered in this search is being used to create a contact list. A draft information request will be created, which will be sent to each of the organisations identified unless they have already responded through FEAP.

When general information on VET had been sourced for each of the 12 Blue EDU countries, a more specific analysis of each country was carried to find out what is available within that country before conducting a comparative study between the 12 countries.

It was anticipated that additional information sources would come through FEAP and its members. Information requests were sent out and some members responded. Follow up requests failed to gather any information from non-respondents. Pisces Learning Innovations (PLI) completed a stakeholder analysis for Scotland with agreed contacts shared between UoS and PLI. This included producer organisations, aquaculture production companies, academic and training suppliers and other important industry suppliers such as feed, medicine and equipment supply companies. This provided useful information for WP5&6, however some of the contacts were useful for collating any information held on VET and general training that may have been available in the past or still offered to date.

3 Results

The general web search for VET in the EU has shown that there have been a number of studies and reports completed which have identified VET, Lifelong Learning and validation of non-formal & informal learning as important to the future needs and development of the EU workforce. This has been vital in providing VET across a range of sectors, based on sound research to identify needs and the tools required to fill any skills or knowledge gaps.

Access to a range of modes of learning from short course, work-based VET or full time college based must be available to all, including younger people and mature adult learners. A trained and educated population will contribute more effectively to the workforce, which is especially important as it will align with the EU target of 75% employment among the 20-64-year-old age group as set out in the Europe 2020 Strategy (29).

Successfully achieving the 75% target will require a high degree of innovation and flexibility in delivery to ensure not only the participation of learners of all ages, but also long-term engagement with any learning programmes proposed. If successful the EU aquaculture and its workforce will be well equipped to compete globally.

The Summary of the 27 multiannual National Aquaculture Plans, (2016) (30) described the approaches necessary for enhancing competitiveness of EU aquaculture. They focussed on:

- Research & Development
- Co-operation of stakeholders
- Promotion of environmentally sustainable practices
- Diversification and Marketing

It was noted however that if the approaches were to be achieved the infrastructure to facilitate lifelong learning had to be created.

The countries which have completed National Aquaculture Strategies based on the Multiannual National Plans recognise that production output will expand, whilst ensuring any industry expansion is environmentally sustainable, maintains fish health at a high level and will require improved marketing and product diversification. To achieve this will require modernised production and processing methods and increased use of technology. There appears however to be very little recognition that a trained and educated workforce will be essential in ensuring the targets are achieved.

3.1 European Qualifications Framework

The European Qualifications Framework (EQF) was adopted in 2008 based on the recommendation of the European Qualifications Framework for Lifelong Learning (31). The EQF is a reference system that links different EU countries qualification systems and frameworks together making EU citizen lifelong learning and mobility easier when moving between jobs, education systems and countries. The EQF was developed as a tool to enable countries to relate national qualifications to qualification systems, and covers all general, vocational and higher education qualifications. The national qualifications or frameworks of each country are cross referenced to the EQF, which has eight levels. Each of the levels carries a description of the knowledge & understanding and practical competency of an individual who has achieved that level. The EQF has since been updated in May 2017 (32) and was revised to include new elements that will help the framework to adapt to the current and future challenges. This included an invitation to Member States to keep the referencing of their NQFs to the EQF up-to-date, their qualifications quality assured, and to improve information exchange between Member states highlighting the EQF.

4 Analysis of aquaculture VET and general VET in each BlueEDU country

There are 12 BlueEDU countries, each with a different education system and social attitudes regarding VET. Each country has been researched to:

- Establish the scale of the aquaculture industry within that country;
- The structure of the education system Including VET and;
- Whether any aquaculture VET system exists, or has existed

To assist with this research an extensive web search was conducted for each country and any relevant information gathered or contacts identified. An information request was sent to any relevant contacts informing them about BlueEDU and asking for assistance with identifying aquaculture VET in their country. This approach produced some useful information despite a limited response rate.

4.1 Faroe Islands

In the Faroe Islands the main fish species farmed is Atlantic salmon (*Salmo salar*). The total aquaculture production in the Faroe Islands for 2014 was 86 449 tonnes (33) which was made up entirely of Atlantic Salmon. The Faroese industry is growing fast and currently sits as the third largest producer of Atlantic Salmon in Europe, with a production value >€440 million in 2014. There are currently three main companies in the Faroese aquaculture industry, Bakkafrost, Hiddenfjord and Marine Harvest. The largest producer in Faroe is Bakkafrost, a Faroese company, which produced >44 000 tonnes in 2014. Bakkafrost employed 837 staff across the company in 2014 split as male 498 and female 339 (34). The distribution map shown in the Bakkafrost report for 2016 (35) indicates that there are 29 company sites located throughout Faroe from fish oil and meal production to harvesting and processing. This would suggest that Bakkafrost as a company is fully consolidated throughout the whole production process.

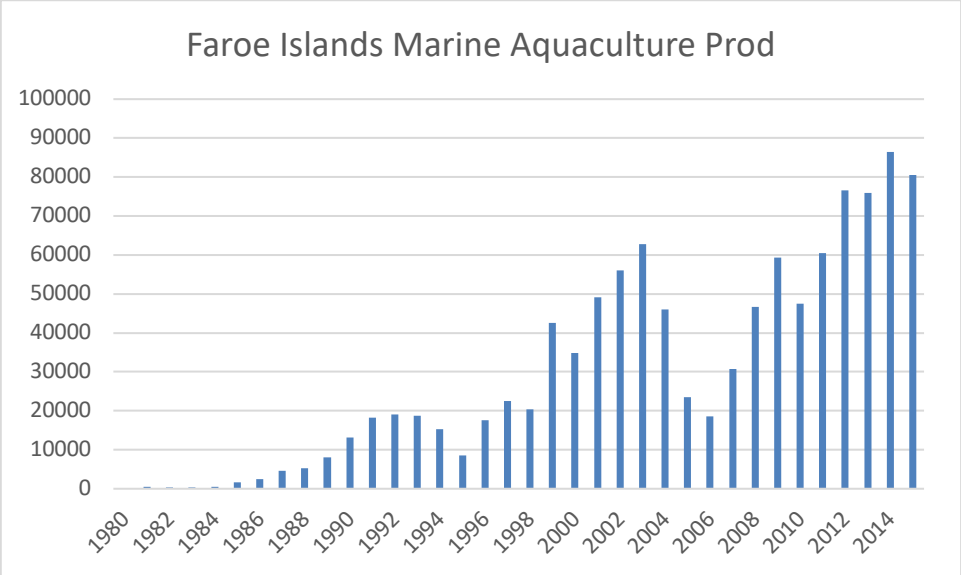

Fig 1. Adapted from FAO data. (36)

Aquaculture has become a significant contributor to the Faroese economy over the past decade, as can be seen from the rapid growth in Fig 1. The aquaculture industry in Faroe faces many challenges, particularly with the weather, but strategies have been put in place to address those challenges and allow the continued expansion of the industry. Some of those strategies include, improvements to technology and equipment, stocking sea sites at times of the year when weather conditions are more favourable, improved sea site location and stocking with larger smolts grown on land based/sheltered sites to reduce time spent in the sea.

The industry in Faroe will continue to grow but as it does there will be more reliance on technology, which in turn will require staff to be trained/qualified to cope with the technological advances and increased production challenges. This offers up an opportunity for an aquaculture VET system to be established to provide the education and training that will be necessary to meet the potential challenges of future growth.

4.1.1 Education and Training

The Faroe Islands are part of the realm of Denmark but are highly autonomous and have full responsibility over their education system. The Ministry of Research Education and Culture has administrative and financial control of all schools. Although the education system in Faroe is autonomous from Denmark, they share a similar system. Denmark has aligned their National Qualifications Framework (NQF) to the European Qualifications Framework (EQF), but it appears that there is no alignment to the EQF in the Faroe Islands. Information request to relevant bodies received no response and so it is difficult to establish whether there is an intention to complete a Faroese NQF and EQF alignment.

In the Faroes there do not appear to be any aquaculture specific courses but are more integrated with other subjects such as fish processing and the fishing industry. There is a basic fisheries qualification (SIF) available which gives students professional skills and qualifies them for HE in subjects related to Fisheries and aquaculture.

There are also additional studies regarded as Professional offered at some institutions in the Faroe Islands in areas such as marine fisheries and maritime occupations, but those appear to be full time study at HE establishments.

The Faroes Fisheries College (Vestmanna) offers a three-year course of secondary education designed to train students for the Faroes fish processing and fish breeding industries. This also appears to be full time study, with the focus mainly on the needs of the Faroes industry. Information requests sent to the Vestmanna College received no response and so course structure, content and level could not be established at this time.

The Faroese aquaculture industry has seen a rapid expansion over the past decade but the development or need for aquaculture training and qualifications appear to be a low priority or non-existent. This is something however which may need to be addressed as the industry grows. The Faroese Fish Farmers Association, will be essential for any progression in aquaculture VET. It is comprised of Faroese fish farmers and represents the whole industry as all fish farmers are members. The Association organises seminars and training courses to raise the profile of the industry and improve the qualifications and competence in the Faroese aquaculture industry.

Vocational Education and Training (VET) and apprenticeships exist in the Faroes in a number of areas such as, business & commerce, office and administrative skills, construction and ships cook. This demonstrates that a VET system exists, and so could be used as a template to establish a new aquaculture specific qualification if required. New VET courses are authorised by the Vocational Education Board. The Board is made up of employers and public authorities. The Board can only authorise courses, not establish them. It would appear that this responsibility lies with Ministry of Research, Education & Culture.

4.2 Iceland

In Iceland the main aquaculture species farmed are Arctic char (*Salvelinus alpinus*) and Atlantic salmon (*Salmo salar*). The total aquaculture production for 2014 was 8 290 tonnes of which 3 411 tonnes was Arctic char and 3 965 Atlantic salmon (33), with a production value >€48 million euros. There are other species farmed but in smaller quantities. It can be noticed on Fig.2 that the industry has been slow to grow, and experienced a dip around 2008, but it has increased back to previous levels and looks set to see continued growth in the future and is attracting Norwegian investment.

The industry has been active for a number of years but is still relatively small. This can be attributed to a range of factors, including a complicated licensing system but most importantly the lack of suitable areas available for sites especially in the marine environment. The Icelandic coastline is very exposed in certain areas and can experience severe weather and due to its northerly geographic location experiences low ambient temperatures. There are also large areas where aquaculture siting would not be permitted, due to environmental restrictions (37). Although the Icelandic aquaculture industry is small but there is scope for expansion however as the number of licence applications would indicate a tenfold increase in production output if all applications were accepted (38).

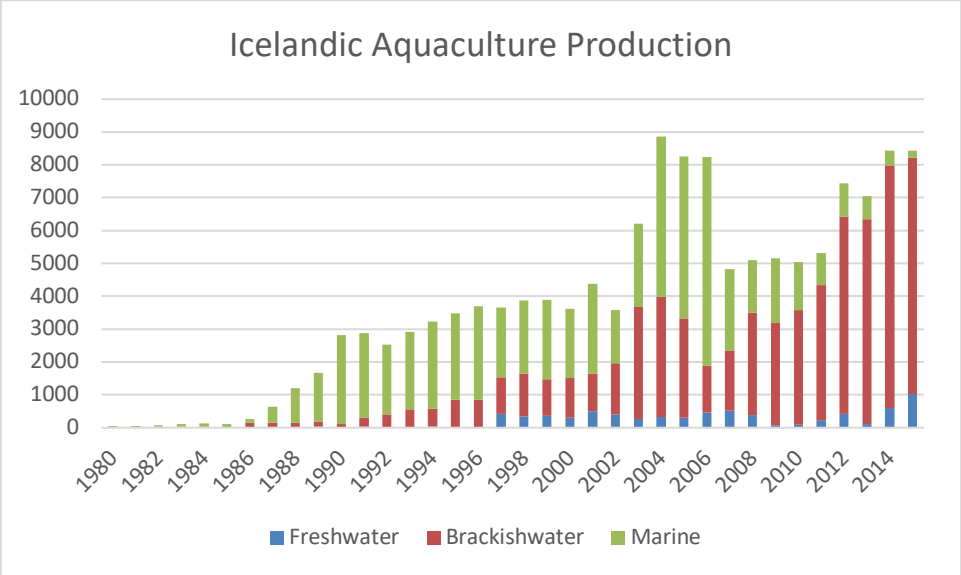

Fig 2. Adapted from FAO data. (36)

It has been difficult trying to establish how many aquaculture companies are active in Iceland, but there are at least 10 main companies operating who are responsible for the bulk of production (39). As it has been difficult to identify how many companies are active it has also been difficult establishing how many staff are employed at those companies. In 2016 the Icelandic aquaculture industry as a whole employed approximately 560 people split as 360 in land and marine farms and 200 in related services e.g. feed and feed transportation (39). This employment figure has increased by 20% since 2014 and will continue to grow as the industry expands.

Site suitability has been viewed as a constraint to the industry, however Icelandic aquaculture is projected to grow in the future. Projections are that current production will increase massively by 2028 due to improved licensing regulations using the Norwegian system for marine farming (40). In line with this, aquaculture employment will also be expected to grow to cope with the increase in production, especially in the marine environment.

If the Icelandic aquaculture industry is allowed to grow at the predicted rate there will be more reliance on technology and improvements to production systems. This will be necessary to ensure compliance with the regulations which have contributed to the past constraints on the industry. There will be a demand for trained/qualified staff to cope with the technological advances and increased production challenges to ensure the industry can see continued growth.

4.2.1 Education and Training

In Iceland the Ministry of Education, Science & Culture is responsible for most public initial education and training, Continuous Vocational Education and Training (CVET) and the design of standard frameworks for workplace training. The Ministry works with Occupational Councils to plan, develop and analyse skills needs and updates where necessary. The Occupational councils are made up of social partners and Ministry personnel. This was backed up in 2010 when a new Act of parliament was passed.

The Adult Education Act (2010) was an Act of parliament that was passed to meet the needs of the labour market and adults with little or no formal education. The main aim is to increase the knowledge and skills of those outside upper secondary schools and universities or have no upper secondary level education. To achieve this, aim the Education & Training Service Centre (ETSC), Fræðslumiðstöð atvinnulífsins (FA) was set up. The ETSC was established in 2002 by the Icelandic Confederation of Labour (ASI), in 2010 it has come under the combined ownership if the ISA, Confederation of Icelandic Employers (CA) Federation of State and Municipal Employees (BSRB), Ministry of Finance and the Association of local authorities.

Funding for the ETSC comes from the Ministry of Education, Science and Culture which has a service agreement, that provides state funding for the operation of the Education & Training Service Centre (ETSC). This funding also services the Educational Fund, which finances education and training courses, counselling and validation (RPL/VPL) by accredited educational providers.

The main responsibilities of the ETSC are: create curriculum for adult education, develop recognition of informal and non-formal learning and develop counselling and guidance services for adults.

To achieve their remit the ETSC works with 11 Lifelong Learning centres, which are operating throughout Iceland. The LLL centres are mainly concerned with adult education focussing on low qualified & low skilled individuals, including providing educational and vocational guidance.

Aquaculture training and qualifications do not appear to feature as a high priority in Iceland, but this may need to be addressed as the industry grows. In Iceland there currently do not appear to be any aquaculture specific courses. There are a number of courses available where aquaculture is integrated with other subjects such as fish processing and the fishing industry. This is the case up to tertiary level, where the tertiary courses available offer aquaculture as a part of the curriculum or in some cases as an elective subject, but no longer as an aquaculture degree programme. The programmes that offer this are mainly full-time attendance (there are distance learning options) at the institution offering the courses with opportunities to experience practical techniques through visits and short-term placements. Some of the institutes/organisations that offer aquaculture training are shown below:

- University of Akureyri www.english.unak.is
- Agricultural University: http://holar.is/en/english
- Icelandic College of Fisheries https://www.fiskt.is/
- Snaefellsnes College https://fsn.is/
- Educational Center of Workers/Employees Federations http://frae.is/um-fa/about-us/ & http://framhaldsfraedsla.is/
- University of Iceland http://english.hi.is/
- Westfjords Educational Center https://www.frmst.is/

There is a Basic study course for fish processing workers available at the Westfjords Educational Centre, which is used to evaluate the knowledge and experience of candidates. The objective of this course is to allow candidates to demonstrate their experience and skills at work, assess how they can improve their skills to prepare for work and shorten the time spent in further education. This course can be used to assist candidates in improving their knowledge of the job they do, assess

where they are academically or aid access to further study options specifically at the Icelandic College of Fisheries (Fisktaekniskoli Islands).

The main objective of the study program is to increase a candidate's knowledge of seafood processing as well as enhancing their practical abilities. The course recognises the prior learning and experience of candidates. The Recognition/Validation of Prior Learning (RPL/VPL) is an important part of any VET system. This is of particular importance when engaging with mature learners, which is the demographic this course targets as the candidates have to be over 18 on enrolment.

<table>
<tr><th>ISQF level</th><th colspan="3">Examples of Qualifications</th><th>EQF level</th></tr>
<tr><td>7</td><td colspan="3">Doctorate degree</td><td>8</td></tr>
<tr><td>6</td><td colspan="3">Master and Candidatus degree</td><td>7</td></tr>
<tr><td>5</td><td colspan="3">Bachelor degree</td><td>6</td></tr>
<tr><td>4</td><td>Diploma at higher education level Additional studies at upper secondary level</td><td rowspan="2">Preliminary higher education</td><td>Additional studies at upper secondary level</td><td>5</td></tr>
<tr><td>3</td><td>Matriculation examination</td><td>Vocational examination for professional rights</td><td>4</td></tr>
<tr><td>2</td><td colspan="2">Upper secondary school leaving certificate, other final examinations</td><td>Vocational qualification for professional rights</td><td>3</td></tr>
<tr><td>1</td><td colspan="3">Upper secondary school leaving certificate, other final examinations, compulsory school final examination</td><td>1&2</td></tr>
</table>

Table 2. Icelandic Qualifications Framework (ISQF) compared to the European Qualifications Framework (EQF) adapted from Reference report of the Icelandic Qualifications Framework ISQF to the European Qualifications Framework for Life Long Learning EQF, 2014 (41)

The Basic study course for Fish Processing workers is levelled as 1 on the ISQF which is the equivalent of level 1-2 on the EQF (Table 2). It should be noted that the ISQF has seven levels as opposed to the eight levels of the EQF. This is due to the requirements for compulsory and upper secondary school in Iceland having enough of an overlap between the upper levels of compulsory school and the lower levels of upper secondary school, whilst focussing on general education.

The Basic study course for fish processing workers is divided into 13 study components (Table 3) and describes the studies of fish processing workers who are employed in the processing and preparation of seafood.

The program of study for the fish processing course has a duration of 128 hours, which involves 48 hours of educator supported study/training and 80 hours of vocational training.

Study Component	Hours	ISQF Level
Fish processing – fishing, processing sectors and marketing	4	1
Work facilities and posture	4	1
Safety in the work place	4	1
Hygiene and bacterial proliferation	4	1
Internal controls in a fish processing company	4	1
The economy, personnel and the pay systems	4	1
Co-operation and interactions in the work place	4	1
Intercultural society	4	1
First aid	4	2
Confidence building	4	1
Environmental concerns and responsible fishing	4	1
Quality and treatment of foodstuffs - from fishing to processing	4	1
Vocational training	80	1
Student work contribution	**128**	

Table 3 study components required to achieve the Basic study course for fish processing workers. Adapted from Curricula – Basic Study Course for Fish Processing Workers (Fraedslumidstad Atvinnulifsins 2nd edition 2016) (42)

There still appears to be a public perception issue to overcome in Iceland in that seeking employment in the fish sector is viewed as low status and possibly the same view is held with Vocational Education and Training (VET). VET and apprenticeships exist in Iceland in other subject areas and there is a pathway to the Journeyman's certificate in some trades, so it has been embraced in some sectors and does not appear to attract the same lack of confidence. Further research on vocational training in other sectors may paint a different picture however.

The lack of confidence in VET and the low status perception of employment in the fish sector will have to be overcome to improve uptake in aquaculture education. Changing social attitudes towards a career in aquaculture and fish generally will be a difficult challenge, and attempts are being made to address this problem.

There is currently an aquaculture course under development at Fjölbrautaskoli Snæfellinga, which is aimed initially at younger people who may wish to seek employment in the aquaculture industry or use it as a way to gain access to aquaculture studies in higher education at the University of Hólar, or potentially overseas. The course is being developed in collaboration with others including Icelandic aquaculture companies who will allow students access to their sites to experience and develop the practical skills required. It is anticipated that this programme of study will start in 2018 and will take

up to two years to complete. There has been a collaborative campaign started by the Fjölbrautaskoli Snæfellinga and its partners using promotional video and other media to highlight the industry, careers and education being offered. This programme may also be introduced in the Faroe Islands in 2019.

An organisation which will be essential for any progression in aquaculture VET will be the Icelandic Aquaculture Association (TIAA). The TIAA represents all fish farmers in Iceland as a unified voice, at government level and matters relating to legislation. The Association also offers an advisory facility to fish farmers, training courses for fish farm workers, and education about fish farming and its importance to the economy.

4.3 Finland

The aquaculture industry in Finland is dominated by Rainbow trout (*Oncorhynchus mykiss*) culture, although there are a range of other species farmed in smaller quantities. Total aquaculture production in 2014 was 11722 tonnes of which 10681 tonnes was large Rainbow trout. There are other species farmed, but in much smaller quantities. The Finnish aquaculture industry had a production value of €54 million in 2014 with responsibility for 50% of the total production attributed to the 10 largest aquaculture companies in Finland. There were 170 aquaculture enterprises active in 2014 with 152 of those companies employing five staff or less. A total of 515 staff (FTE 329) were employed in the Finnish aquaculture industry in 2014. All data sourced from STECF (43).

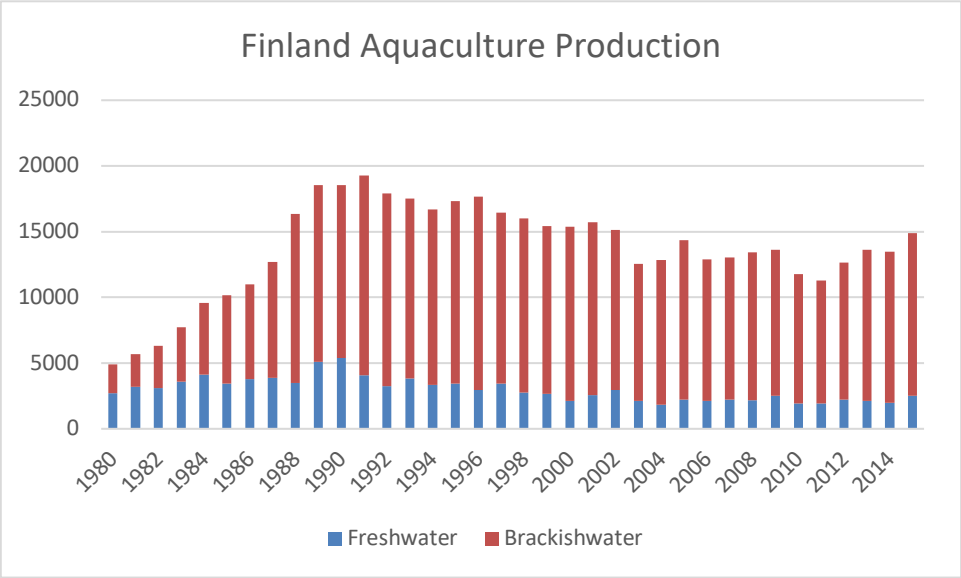

Fig 3. Adapted from FAO data. (36)

Finnish fish production peaked in the 1980's after experiencing a period of rapid growth (Fig 3), which in turn led to increased growth in the domestic fish processing and market industries.

This rapid growth was viewed as unsustainable due to environmental concerns and so environmental permit applications where introduced. The environmental permits detailed

regulations on the areas where fish farming activities can be carried out, production volumes and production methods to be used. The introduction of stricter regulations on obtaining environmental permits for aquaculture enterprises slowed down the industry growth and closed down some aquaculture enterprises. (44)

The aquaculture industry does make a reasonable contribution to the Finnish economy and is predicted to grow by >40% by 2020 (45). The growth of aquaculture will be vital to the local and the national economies, but any growth must be compatible with Finland's environmental objectives. In Finland there is a national spatial planning program for aquaculture. This program identifies the most suitable and productive areas for aquaculture production in marine areas. Technological improvements may make it feasible to consider siting marine units further offshore or increased use of water treatment technology and Recirculation Aquaculture Systems (RAS) may be utilised to boost production, which in turn may increase demand for staff training/qualifications. The use of RAS may be viewed as a potential solution to the slow growth of the industry in Finland as they are the only aquaculture enterprises, in the continental area, which are currently granted new permits (46).

The Nordic countries have identified a need for a collaboration on RAS and any associated education and training. The collaboration includes various industry and educational organisations in the following countries; Norway, Denmark, Finland, Sweden and Iceland. The partners have proposed that all information on any aquaculture and RAS training should be made available on one website e.g. the Nordic Network on RAS http://www.nordicras.net. In Finland there is a proposal to organize a RAS summer school in the University of Jyväskylä in the summers of 2018 and 2020. It is not clear at this stage whether the training will be vocational, and who the target audience is academics, university students or aquaculture employees (46).

4.3.1 Education and Training

The Ministry of Education & Culture in Finland makes all decisions on the general national objectives of general upper secondary education, the administration and responsibility for all VET and the structure of qualifications and the core subjects. The VET system in Finland is enshrined in law with the following two Acts; Vocational Adult Education Act (631/1998) & Vocational Education and Training Act (630/1998).

The Ministry delegates responsibility for National Core Curricula and the requirements of competence-based qualifications to the Finnish National Agency for Education (FNAE).

The FNAE decides on the national qualification requirements for each vocational qualification in co-operation with employer organisations, trade unions and the Trade Union of Education and student unions. National Education & Training Committees and representatives from the world of work also consult and advise on the curriculum development. The core curriculum, as drawn up by the FNAE, defines the objectives and core contents of each subject, subject grouping and subject modules. It also includes provision for assessment, student counselling, apprenticeship training and learning in the workplace.

In Finland the education system is structured in a way that ensures equal opportunities are available for all to receive an education. Education is focussed more on learning and less on assessment with only one national examination, the matriculation examination held at the end of general upper

secondary education. The results of the matriculation examination are normally considered for admission to higher education. Teachers and education providers have responsibility for the practical teaching arrangements and assessment of their subject areas to achieve the objectives set out in the curriculum.

4.3.2 Competence based qualifications

There is another pathway open, particularly for adult learners, to obtain vocational qualifications using competence-based qualifications. This pathway offers adults a more flexible opportunity to enhance and maintain their vocational skills. To achieve the qualification learners, have to demonstrate the skills and competencies required for the relevant job role by completing a competence-based test which recognises a learner's vocational competencies that have been acquired through work experiences and studies. The FNAE defines the skills and competencies required in collaboration with employers, employees and teachers, who all play an active role in the planning, and assessing of competence-based qualifications.

Competence based qualifications have three levels:

- Vocational qualifications indicate competence to enter employment in the field.
- Further vocational qualifications indicate the vocational skills required of skilled workers in the field.
- Specialist vocational qualifications indicate a command of the most demanding tasks in the field.

Responsibility for the Finnish National Qualifications Framework (FiNQF) comes under the Finnish National Agency for Education (FNAE), which is the National Coordination point for the EQF. The FiNQF covers the entire education system and will improve the clarity and effectiveness of the Finnish qualifications system, increase the national and international transparency and comparability of qualifications, and promote national and international mobility.

Provisions on the National Framework for Qualifications and Other Competence Modules are laid down in Act (93/2017) and Government Decree (120/2017) on the National Framework for Qualifications and Other Competence Modules as of 1 March 2017 (47). The Government Decree positions all qualifications at one of the eight levels of competence of the Finnish National Qualifications Framework (FiNQF) shown in Table 4.

FiNQF levels	Example qualifications	EQF levels
8	Licentiate Doctor Specialist medical doctors, dentists and veterinarians	8

	General staff officer examination	
7	Advanced vocational higher education Master	7
6	Vocational higher education qualifications Bachelor	6
5	Specialised VET qualifications Basic qualification for air traffic controllers Vocational qualification for construction production Qualification for police officer Qualification for officer, rescue services	5
4	Upper secondary education, general and vocational Certificates for prison warders Certificates for police Certificates for rescue workers Certificates for professionals working in alarm-centres	4
3	(Older) vocationally-oriented basic education and VET	3
2	Compulsory education certificates	2
1		1

Table 4 (48) Provisional Finnish National Qualifications Framework (FiNQF) compared to the European Qualifications Framework (EQF) adapted from Global inventory of regional and national qualifications frameworks, 2017 Volume II: National and regional cases. The completed Finnish NQF is unavailable at this time.

The Finnish Fish Farmers Association may be essential for any progression in aquaculture VET. The Association organises seminars and lectures for members on topical issues such as fish health. It also updates members on the latest reforms, education and employment vacancies. The Association represents Finnish fish farmers on the aquaculture development group, appointed by the Ministry of Agriculture and Forestry. The aquaculture development group deals with the bureaucracy concerning environmental licensing, marketing, disease control and finances. The Association also arranges training for members where required. An example of training currently underway is a management training for entrepreneur's programme which is aimed at fish farmers and fishers. This programme is offered in co-operation with an independent organisation (Työtehoseura), which specialises in management training and will run from January 2017 – November 2018 (49).

4.3.3 Aquaculture studies in Finland

There are a number of educational organisations/institutes in Finland where aquaculture or aquaculture related subjects can be studied. Research to date for BlueEDU has not revealed what the student uptake is for any of the courses/qualifications on offer, but it does appear that aquaculture and related work in the fish sector is not highly regarded in Finland. This could in part be due to the low perception of vocational employment or studies and/or the slow down in growth of the industry. As the aquaculture industry is expected to grow it should be anticipated that there will be an increase in demand for suitably qualified staff, and flexible vocational qualifications which can be accessed by those already working in the industry. Currently in Finland aquaculture and aquaculture related subjects can be studied in the following organisations/institutes:

Vocational and Further Education:

- Livia College - http://www.livia.fi/en
- Salpaus VET & Further Education - https://en.salpaus.fi/
- Lappia Vocational College http://www.lappia.fi/sites/en-US

Higher Education:

- University of Helsinki - http://www.helsinki.fi/ymparistotieteet/english/index.html
- University of Jyvaskyla - https://www.jyu.fi/en
- University of Eastern Finland - http://www.uef.fi/en/web/aquatic-ecology
- Abo Akademi University - https://www.abo.fi/en/

4.3.4 FishEDU Project

The University of Eastern Finland (UEF) have a partnership project running from 2017-2020 called FishEDU (50). This project is a collaboration between UEF and the Kyrgyz National Agrarian University (KNAU), aimed at building capacity in the Kyrgyz Republic in fisheries and aquaculture education. The collaboration aims to provide an enabling environment for teaching fisheries and aquaculture, at both vocational and bachelor level, by training of trainers, developing teaching and study material and developing the teaching infrastructure at KNAU.

The main activities of FishEDU are:

1) training of trainers on fisheries and aquaculture subjects and pedagogics

2) piloting of courses in two newly developed curricula and development of course material

3) establishment of an aquaculture demonstration and training centre and an e-library.
http://www.uef.fi/en/web/fishedu

The UEF has been involved in other activity delivering an MSc programme Fisheries Aquaculture and Fish Processing for Kyrgyz students; curriculum design of two programmes for KNAU one is a Bachelor programme in fisheries and aquaculture and a VET programme in Fish Farming. The Finnish Fish Farmers Association and the UEF are collaborating on a twinning project in Nepal focussed on

carp farming with female fish farmers. Although Fish EDU and the other UEF projects are not marine cage farming related and are being run outside the EU they may still be relevant as it is aquaculture VET activity which may reveal important information and data in the final results that could be adapted for use within the EU aquaculture industry.

4.3.5 Vocational Qualification in Fishery

There is a Vocational Qualification in Fishery (51) available in Finland which can offer a range of pathways to candidates who wish to specialise after completing the compulsory modules. The qualification appears to be levelled at 4 on the FiNQF & level 4 on the EQF. The qualification is available as Upper Secondary VET (curriculum based) or as a Competence based Qualification (mainly aimed at adults). Candidates that complete the qualification can specialise as one of the following:

- Fishers
- Fish farmers
- Fish processors
- Fishing instructors

Completion of the vocational qualification allows a candidate to demonstrate that they have the skills and knowledge required to work in their chosen field and develop their vocational skills further.

4.3.6 Key Competencies

The Finnish qualifications system includes key competencies for lifelong learning, which are considered important for continuous learning and personal development socially and in the world of work. The competencies are included in the objectives of core subjects and the vocational skills requirements of vocational qualification modules and their assessment criteria. Most of the key competencies identified are integrated throughout the modules but others must be separately assessed. The competencies which require separate assessment are 1 – 4 on the following list of key competencies for lifelong learning:

1. learning & problem-solving
2. interaction & co-operation
3. vocational ethics
4. health, safety & ability to function
5. initiative & entrepreneurship
6. sustainable development
7. aesthetics
8. communication & media skills
9. mathematics & natural sciences
10. technology & information technology
11. active citizenship & different cultures

4.4 Ireland

In Ireland the main aquaculture species farmed are Atlantic salmon (*Salmo salar*), Pacific Oyster (*Crassostrea gigas*) and Blue Mussel (*Mytilus edulis*). There are also a range of other species farmed in smaller quantities. The total aquaculture production in 2014 was 31 700 tonnes of which marine stage Atlantic salmon production was 9 700tonnes. The bulk of the production weight is composed of shellfish species at 20 900 tonnes. Irish aquaculture production value in 2014 was €116.3 million of which salmon production accounted for €58.8 million. There were 277 aquaculture enterprises operating across Ireland in 2014 employing >1800 staff (FTE 941) (43).

Irish aquaculture dropped away rapidly after a peak in 2002 (Fig 4) but has started increasing again and is expected to increase by approximately 45 000 tonnes by 2023 (52). The expected increase in production could be achieved but will rely heavily on technology to minimise the environmental impact and ensure sustainability of the industry.

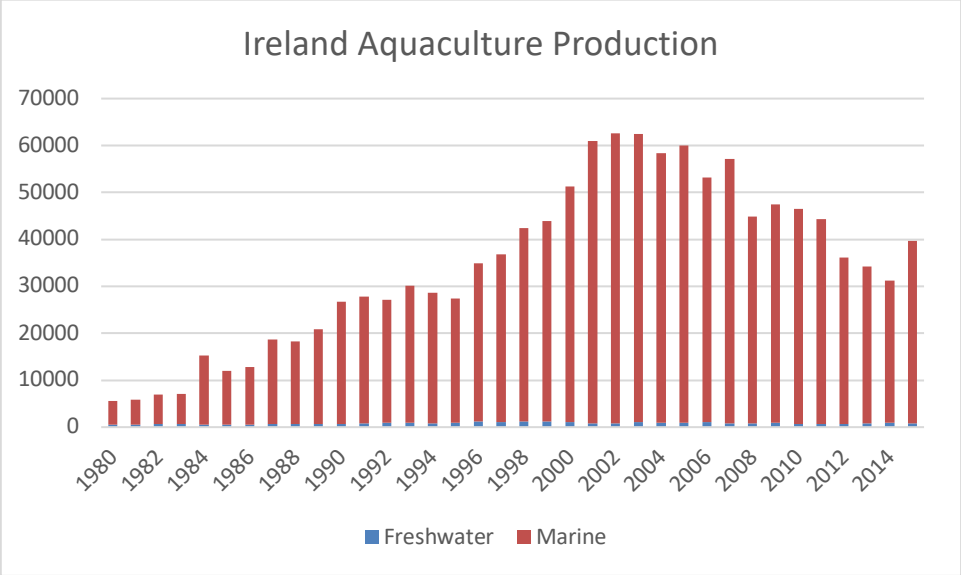

Fig 4. Adapted from FAO data. (36)

4.4.1 Education and Training

In Ireland the Department of Education and Skills (DES) has responsibility for all VET and courses which are delivered in non-tertiary colleges and centres of further education. The Quality Assurance and Qualifications Act (2012) requires that the National Qualifications Authority of Ireland (NQAI) established and maintains a framework of qualifications (Table 5). The Irish National Framework of Qualifications (NFQ) were established in 2003 and referenced to the EQF in 2009. To validate programmes and set the standards of knowledge and skills competences required for each award, the Quality and Qualifications Ireland (QQI) are responsible for the certification of all education and

training post-secondary school and non-tertiary. The QQI has a board appointed by the Minister for Education and Skills.

NFQ Levels	Examples of Qualifications	EQF Levels
10	Doctoral degree	8
9	Master degree Postgraduate diploma	7
8	Honours bachelor degree Higher diploma	6
7	Ordinary bachelor degree	6
6	Advanced certificate Higher certificate	5
5	Level 5 certificate Leaving certificate	4
4	Level 4 certificate Leaving certificate	3
3	Level 3 certificate Junior certificate	2
2	Level 2 certificate	1
1	Level 1 certificate	1

Table 5 (53) Irish National Qualifications Framework(INQF) compared to European Qualifications Framework (EQF) adapted from Referencing of the Irish National Framework of Qualifications (NFQ) to the European Qualifications Framework for Lifelong Learning (EQF), 2009a

The VET system in Ireland is well established in many sectors, but it appears unclear if this is the case with aquaculture. As an industry aquaculture is mainly confined to rural areas and doesn't have the higher profile of other industries such as construction and engineering. This will need to change as the industry continues to grow, to address a potential shortfall in the workforce. This will also

require staff who are suitably qualified/trained to work with the technology that will become necessary to help the industry grow.

In Ireland there are aquaculture courses/training available mainly delivered through Bord Iascaigh Mhara (BIM) (Table 6). This is the national agency with responsibility for training in the seafood sector. There is a facility at the National Fisheries College of Ireland (NFCI) at Greencastle, Co. Donegal and at Castletownbere in Co. Cork. The agency has a mobile training unit which can be used to deliver hands on training at a range of locations if required. An information request was sent to the BIM asking for additional information on training, workshops or courses they offered but no response was received.

Course title	Delivery centre	QQI level	Course duration
Aquaculture	BIM, Dun Laoghaire	3	20 hours
Aquaculture	BIM, Dun Laoghaire	4	30 hours
Aquaculture	BIM, Castletownbere	5	4 months FT, 2yrs PT
Farmed fish welfare	BIM, Dun Laoghaire	6	1 week
Seaweed Ongrowing	BIM, Dun Laoghaire	5	3 weeks

Table 6. Aquaculture courses offered by BIM, Ireland

The Irish aquaculture industry is represented by the Irish Farmers Association Aquaculture Section. The salmon and shellfish sectors are represented by organisations, Irish Salmon Growers Association (ISGA) and Irish Shellfish Association (ISA), both well represented in the IFA Aquaculture Section.

The support of the IFA and ISGA will be crucial for any future progression of aquaculture VET. The IFA represents all Irish farmers, including fish farmers, at government and EU level, and offers advice and expertise to individual farmers across Ireland.

An information request was sent to the aquaculture section of the IFA asking for additional information on training, workshops or courses they offered and they referred the request to the BIM.

4.5 Scotland

In Scotland the main aquaculture species farmed is Atlantic salmon (*Salmo salar*), however there are a range of other species farmed in smaller quantities including both fin fish and shellfish.

The total aquaculture production for the UK in 2014 was 214 700 tonnes (43). The bulk of this production was Atlantic salmon grown in Scotland with 179 700 tonnes. It can be noticed on Fig 5 that salmon production output decreased slightly in 2015 but over the long-term Scottish salmon production is predicted to increase to between 300 000 – 400 000 tonnes per annum by 2030 (54). The total production value for aquaculture output in the UK in 2014 was 993 million, with Scottish salmon responsible for 90% of this value (43). There were 550 aquaculture enterprises operating throughout the UK in 2014 employing a total of 3310 staff (FTE 2761), with 1700 of those staff

employed in the salmon industry. The bulk of the UK production in 2014 could be attributed to five multinational salmon companies (43).

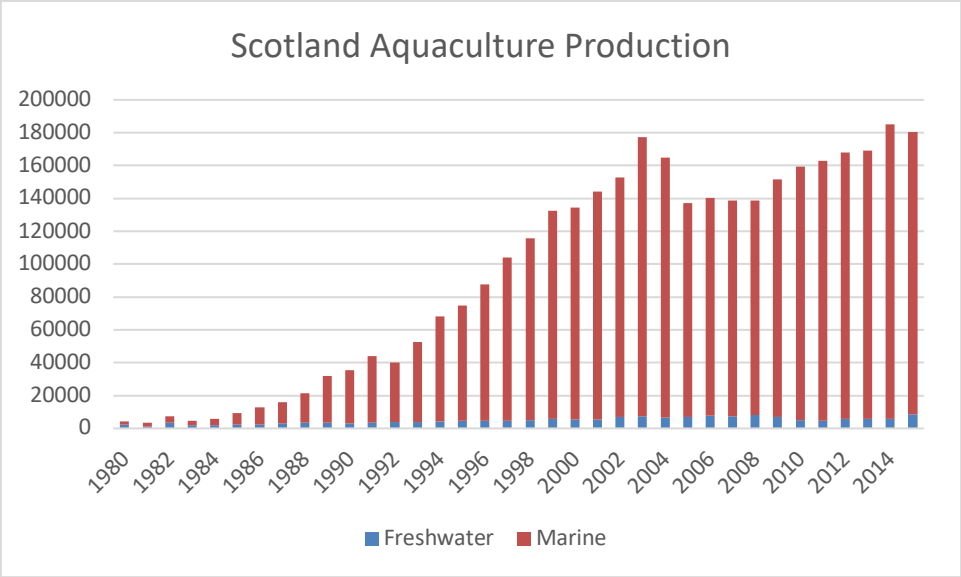

Fig 5. Adapted from FAO data. (36)

4.5.1 Education and Training

The Scottish Government has overall political responsibility and legislative control of all education in Scotland under the Scotland Act 1998. The principal legislation governing all education in Scotland is the Education (Scotland) Act 1980. Inspections and audits of educational standards in Scottish education are the responsibility of:

Care Inspectorate (Social Care and Social Work Improvement Scotland-SCSWI) – Provides public assurance and protection of vulnerable individuals and those at risk, including inspection of care standards in pre-school provision;

Education Scotland – responsible for supporting the delivery of learning and teaching in pre-school, primary, secondary and further education;

Quality Assurance Agency for Higher Education (QAA) – responsible for higher education

Local authorities own and operate all state schools and have responsibility for the provision of education in primary and secondary schools. As such the local authorities perform the function of Education Authorities.

SCQF levels	Examples of Qualifications	EQF levels
12	Doctoral Degrees, Professional Apprenticeships, Professional Development Awards (PDA), Award	8
11	Master's Degrees, Integrated Master's Degrees, Professional Apprenticeships, SVQ5, PDA, Postgraduate Diplomas, Postgraduate Certificates, Award	7
10	Bachelor's Degrees with Honours, Professional Apprenticeships, SVQ, PDA, Graduate Diplomas, Graduate Certificates, Award	6
9	Bachelor's/Ordinary Degrees, Technical Apprenticeships, PDA, SVQ4, Graduate Diploma, Graduate Certificates, Award	6
8	Higher National Diplomas (HND), Diplomas of Higher Education (DipHE), Technical Apprenticeship, PDA, SVQ4, Award	5
7	Higher National Certificates (HNC), Modern Apprenticeships, PDA, SVQ3, Certificates of Higher Education (CertHE), Scottish Baccalaureate, Advanced Higher, Award	5
6	Higher, Modern Apprenticeships, SVQ2, PDA, National Progression Award (NPA), National Certificate, Award	4
5	National 5, Modern Apprenticeships, SVQ2, NPA, National Certificate, Award	3
4	National 4, SVQ1, NPA, National Certificate, Award	2
3	National 3, NPA, National Certificate, Award	1
2	National 2, NPA, National Certificate, Award	
1	National 1, Award	

Table 7 (55) Scottish Credit and Qualifications Framework (SCQF) compared with the European Qualifications Framework (EQF) adapted from QAA: Qualifications can cross boundaries: a rough guide to comparing qualifications in the UK and Ireland, "014

4.5.2 SQA

The Scottish Qualifications Authority (SQA) (56) is the national awarding and accrediting body in Scotland. The SQA is responsible for the development, accreditation, assessment and certification for all national qualifications at secondary and post-secondary level (non-degree), delivered through

schools, colleges and training centres. All SQA qualifications have been developed and routinely updated in partnerships with representatives from the world of work and those who work in education. The SQA manages the development and validation of all new and updated awards including VET qualifications. The SQA is also responsible for the approval of all Vocational Education & Training (VET) centres that deliver SQA awards, validation of all new VET qualifications and Quality Assurance (QA) of VET systems in place with approved centres. The QA system is required to ensure that standards of assessment are maintained in all delivery centres.

4.5.3 SCQF

The Scottish Credit and Qualifications Framework (SCQF) (57) (58) is the national credit transfer system, which brings all mainstream Scottish educational qualifications together. It was created to enable comparisons to be made between all academic levels from lower secondary school to university level including vocational and other work-based qualifications. All qualifications, academic and vocational, offered in schools, Further Education (FE) colleges, Higher Education (HE) universities and the workplace are included in the framework. Each qualification is given a credit level on a scale of 1-12 and includes all mainstream qualifications from Access to Doctorate level. The SCQF is a tool which can assist learners in planning their learning goals or pathways and improve their understanding of the Scottish qualifications structure Table 7.

The Scottish Credit and Qualifications Framework Partnership (SCQFP) is responsible for the management of the SCQF and is made up of representatives from the QAA for HE, College Development Network (CDN), Universities Scotland and the SQA.

The main aims of the SCQFP are:

- To develop and promote the SCQF as a lifelong learning tool in Scotland;
- All assessed learning and qualifications in Scotland are included within the framework;
- To extend the recognition of informal and non-formal learning;
- To develop international relationships.

4.5.4 Sector Skills Councils (SSC)

Sector Skills Councils (SSC) (59) are independent, employer led organisations, which actively involve trade unions and key stakeholders. They are a UK wide network of sectoral representative organisations, which are responsible for identifying the skills, education and training needs of the workforce in each sector they represent and maintaining the National Occupational Standards (NOS) of those sectors. All SSCs in the UK are licensed by the UK government, and all SSCs have the same four key goals:

- reduce skills gaps and shortages
- improve productivity, business and public service performance
- improve learning supply

- increase opportunities to boost the skills of all individuals in the workforce

4.5.5 National Occupational Standards (NOS)

National Occupational Standards (NOS) (60) are statements which specify the standards of performance, knowledge and understanding, which individuals are required to achieve when carrying out functions in the workplace. The NOS are developed through the relevant SSC with employers and are agreed as fit for purpose by employers. The NOS are used to inform the development and revision of all national qualifications. In Scotland the NOS are used by SSCs, in partnership with industry and awarding bodies, to create qualifications such as the Modern Apprenticeship (MA) in Aquaculture. The awards are then validated by SQA, before going live. The NOS have been used to define the practical skills and knowledge requirements of the MA, which has been composed prescribing mandatory units, and a selection of optional units. The award offers optional units to give flexibility to the learners who can choose the units which are the best fit for the job they are doing. This design is the award structure at all levels (MA 2-4).

4.5.6 Scottish Vocational Qualifications (SVQ)

A Scottish Vocational Qualification (SVQ) (61) is a certificate of vocational education in Scotland, which is available to learners of all ages. SVQs are qualifications made up of units derived from NOS, which assess the practical skills and underpinning knowledge of an individual to carry out a specific job role to the standard required in the NOS. The delivery of SVQs can be flexible and the underpinning knowledge can be studied in college, with training providers, in the workplace or a combination of any of those options which would suit the employer and learner. However, the assessment of practical skills must be undertaken in a real place of work.

SVQs are available at five levels, defined as:

1 – aimed at those tasks which requires basic, routine work skills (SCQF 4, EQF 2)

2 – requires a broad range of skills where learners have to demonstrate competence in a range of tasks, some of which are complex and includes some individual responsibility and teamwork. (SCQF 5, EQF 3)

3 – learners perform a wide range of activities complex and non-routine and includes more emphasis on individual responsibility and supervisory skills. (SCQF 6-7, EQF 4-5)

4 – a high degree of personal responsibility required in a wide range of complex and technical activities. Includes considerable management skills and responsibility for others. (SCQF 8-9, EQF 5-6)

5 – requirement for competence and understanding of complex principals and techniques across a wide range and variety of contexts. Candidates will have significant responsibility at a personal level and for the work of others. Requires a high level of senior management skills, which include analysis and diagnosis, design, planning, execution and evaluation. (SCQF 11, EQF 7)

4.5.7 Higher Education

Entry to Higher Education (HE) in Scotland is available to all who can satisfy the entrance requirements. For school leavers this is normally at the end of S5 or S6 where students will have completed Highers or Advanced Highers. The grade requirements for completed Highers/Advanced Highers will differ between courses and universities, with some requiring higher grades in specific subjects.

Adult learners, mature students (>21yrs), who don't have the required academic qualifications for entry to HE can access university using other routes. There are access courses available that are designed to prepare adult learners for HE, which upon completion can guarantee entry. Learners can also use another pathway to university or HE Institution to access a degree programme. If a learner has not achieved the required grades to qualify for direct access to university, they can enrol on a higher national VET course at an FE college. This can either be used to gain employment or as a stepping stone to gaining access to university. Some FE colleges and universities have articulation arrangements to allow access to university upon successful completion of an HNC or HND course. Qualifications which are VET or Higher National level are recognised by universities as relevant for access to HE. Successful completion of those programmes, with an appropriate grade can allow access directly to the second year of a degree programme in an HE institute, bypassing the first year of study.

The undergraduate degree programmes in Scotland are known as first degrees. A first-degree programme in Scotland requires four years of study for an Honours degree, but an Ordinary degree can be achieved after three years of study. The Honours degree programmes normally have specialisation requirements in years 3 and 4. Upon successful completion of an Honours degree the qualification will be classified as either first class, upper/lower second class or third class.

The curriculum and delivery for HE programmes is normally the responsibility of the university or HE institution offering the course. The curriculum for Scottish Higher Education Institutions is developed and maintained by the departments within each university. The curriculum for courses which lead to professional qualifications are treated differently as they will normally be created in collaboration with the appropriate professional body. Higher Education programmes are designed to be delivered using a combination of methods such as lectures, laboratory and field work. Some courses are available using distance and flexible learning combined with attendance at seminars and workshops, but there appears to be very little available that is entirely distance learning or VET.

4.5.8 Compulsory education

In Scotland all children between the ages of 5-16 years of age are entitled to receive compulsory education. This includes primary schools from 5-11 years of age and secondary school 12-16 years of age.

4.5.8.1 Lower secondary level

The compulsory stage of secondary school (4 years) can be recognised as lower secondary as students have an option to choose other pathways once they reach 16 years of age. During this compulsory stage pupils attend school full time receiving a general education, with occasional

vocational options. Students can leave school at this stage, known as S4, to take up employment, progress to further study at college or additional training such as the Modern Apprenticeship (MA).

4.5.8.2 Upper secondary level

The upper secondary level is normally completed at the same school as the student completes lower secondary level. Upper secondary is up to two years called S5 & S6, for 16-18-year olds. Some pupils will stay for the S5 year to get higher qualifications at a grade which will allow them to proceed to Further Education at College or Higher Education. Students that opt to stay on for S6 will generally do so to either do more higher qualifications or gain advanced higher qualifications which are levelled at SCQF 7-8, EQF 5.

4.5.9 Further Education Colleges

Further Education Colleges in Scotland are the main providers of further education and Vocational Education & Training (VET) to young people and adults. This includes courses ranging from half/one day courses up to two years or more. Colleges generally have strong links with the local communities and work with employers and other organisations to deliver training opportunities, for individuals, communities and employers. They promote wider access for all, offering courses full time, part time, distance learning or work based, to enable individuals to become lifelong learners.

Most of the college courses offered are vocational and can range from access level (SCQF 1-3, EQF 1) to courses at higher national level (SCQF 7-8, EQF 5), also known as higher VET. There are also opportunities to gain awards accredited by other awarding bodies, which can be industry specific. The courses include a combination of theory and practical, which prepares the learner for further study or entry to the labour market. Students can continue further studies at university as most colleges will have links to universities, which will accept students with relevant higher national qualifications onto degree programmes.

The awards offered in Scotland's FE colleges are compiled using units which have been validated by SQA and as such have been standardised. This standardisation ensures that all centres are assessing the performance and knowledge of learners at the same level, irrespective of their geographical location. Each of the units from the SQA catalogue will define the learning outcomes and evidence requirements, including performance and assessment criteria.

The main awards offered in Scotland's FE colleges are listed below:

1 Year Access courses – 12 credits (SCQF 2-4, EQF 1-2)

1 Year National Certificates (NC) – 18 credits (SCQF 5-6, EQF 3-4)

1 year Higher National Certificates (HNC) – 12 credits (SCQF 7, EQF 5)

2 year Higher National Diplomas (HND) – 30 credits (SCQF 8, EQF 5)

A credit is worth approximately 10 hours of learning e.g. a 12-credit course - 10 hrs x 12 credits = 120 hours of learning.

4.5.10 Modern Apprenticeships

The Modern Apprenticeship (MA) (62) programmes are available to those over 16, including adults. There are no academic entry requirements for the MA level 2 (SCQF 5, EQF 3), but candidates must be over 16 years of age and be employed in an industry which is relevant to the MA pathway selected. The employer will be actively involved in practical training and some assessment activities and so has to agree to the qualification being undertaken by the candidate. This is important as assessment of practical skills will usually take place in the working environment and there will be a requirement for an assessor to observe the candidate working and on-site witness testimony provided by the manager or site supervisor. Knowledge assessment can also take place on site under invigilated assessment conditions, or in an assessment centre.

Successful completion of the MA level 2 provides the candidate with an opportunity to progress to MA level 3, which is an award with more of a supervisory content.

All MA programmes provide learners with the opportunity to train in their industry of choice whilst being paid. The learning process normally entails a combination of methods; practical training on site, distance learning, college attendance and short course training. Modern Apprenticeships are designed for training in the workplace. However, they can have some flexibility whereby apprentices can attend college for additional training. This is normally done on a short-term basis which can be anything from day release to two weeks, which helps minimise disruption to the employer. The MA programme is also flexible regarding the time given to complete the course. There is no fixed term start dates or course length of study times, but each programme normally takes 1-2 years for a candidate to complete.

Modern Apprenticeship frameworks are developed by the industry they are relevant to and are normally levelled up to SVQ 3 (SCQF 6-7, EQF 4-5), which not only includes the skills relevant to that job role but can also prepare learners for a supervisory position. There is an option for provision of an MA (Can also be referred to as a Technical Apprenticeship) level 4 (SCQF 8, EQF 5), which is an award aimed at managerial level. This award is currently being offered at NAFC Shetland and has been well received by industry. The MA award levels and employment positions they are aimed at are shown below:

- MA Level 2 Operative (SCQF 5, EQF 3)
- MA Level 3 Supervisory (SCQF 6-7, EQF 4-5)
- MA level 4 Managerial (SCQF 8, EQF 5)

4.5.11 Employer engagement with colleges

Colleges will work closely with local industry and employers, who will advise on the content of programmes or courses, to ensure that the programmes they deliver suit the needs of the world of work. This can also include employers sending staff to the college for training and in return employees can get on the job training when they return to work, which can extend to providing work placement opportunities for other students. Close relationships are formed between colleges and employers in their local area, including employers being represented on the Board of Management.

4.5.12 Skillseekers Programme

The Skillseekers programme offer vocational training which leads to a nationally recognised qualification up to SVQ 3. Skillseekers are aimed at young people 16-25, with priority generally given to the 16-19 year old age group. The programmes are open to those who have left school, in work or looking for work.

4.5.13 Work-based learning

Employers are increasingly becoming more aware of the importance of training staff, and how this can impact on their own business. Some employers will provide inhouse training either independently or in collaboration with colleges or other awarding bodies. Private training providers are also available who can specialise in particular subject areas and can offer work-based training courses from a few hours long to full training programmes.

There are options where work-based learning and training agreements can be set up between colleges and industry. This allows flexibility in the assessment and certification of trainees, who can be assessed both in the workplace and at college if required.

The work-based learning options require co-operation and partnerships between employers/industry and colleges:

- colleges and employers can have an agreement where training is split between college and the workplace, with all support provided by the colleges;
- the college can become a contracted training centre, for an employer, having responsibility for all training needs;
- colleges can negotiate an arrangement to train apprentices through a partnership with local employers or a Sector Skills Council (SSC).

4.5.14 Skills for Work courses

There is a scheme in Scotland called Skills for Work (63) which is aimed at secondary school students (S3&S4). The courses are designed to introduce young people to the world of work and provide pathways to employment, skills training and further education. The students are given the opportunity to work in real practical situations and learn skills linked to the vocational area selected. The courses can be delivered in school, the workplace, college or a combination of all dependant on resources available. The learners will have the opportunity to develop employability skills, build confidence and as they are encouraged to gather evidence give them a more responsible attitude. All of which are important to employers.

The young learners are continuously assessed on the courses through practical observation, written assessment and personal evidence record keeping.

4.5.15 Recognition of Prior Learning (RPL)

There are many terms used to describe the Recognition of Prior Learning (RPL) (64) (65), including Accreditation of Prior Learning (APL), which includes evidence gathering towards the completion of a qualification. It is the recognition of any form of learning which has occurred in the past. Learning is not restricted to formal learning or qualifications but also applies to life skills and experience. The SQA and SCQF both have effective systems and guidelines in place to assist users with accrediting prior learning, and ensuring any evidence supplied meets the evidence requirements of the national standards and can therefore be accredited.

4.5.16 Curriculum for Excellence

In the Scottish education system, the 'Curriculum for Excellence (CfE)' (66) has been published to improve the learning, attainment and achievements of young people aged 3-18 years of age. The main aims of the CfE is to develop successful learners, confident individuals, responsible citizens and effective contributors.

4.5.17 Core Skills

The Scottish qualifications system has incorporated five important competencies known as 'Core skills' (67). The core skills are dynamic in that they can be added to and improved over time and are widely regarded by education and the world of work as important skills throughout life for all, young and old.

The five core skills are:

1. Numeracy

2. Communication

3. Problem solving

4. Working with others

5. Information and Communication Technology

4.6 Norway

In Norway the aquaculture production for 2014 totalled 1 370 090 tonnes (33) and was valued at €5 486 million (36). The main aquaculture species farmed is Atlantic salmon (*Salmo salar*) which in 2014 totalled 1 290 000 tonnes (33). There are other species farmed and in 2014 the following was produced, Rainbow trout (*Oncorhynchus mykiss*) 75 000 tonnes (33), Cod (*Gadus morhua*) 3000 tonnes (33), Halibut (*Hippoglossus hippoglossus*) 1 600 tonnes (33). The aquaculture industry in Norway has experienced rapid growth since the 1980's (Fig 6), with the bulk of the production attributed to the salmon industry. In 2014 there were 147 companies active in the ongrowing phase

of production of salmon and trout, and 118 active in the hatchery phase. Those companies employed 5751 staff split as 4294 in ongrowing and 1457 in the hatchery (68).

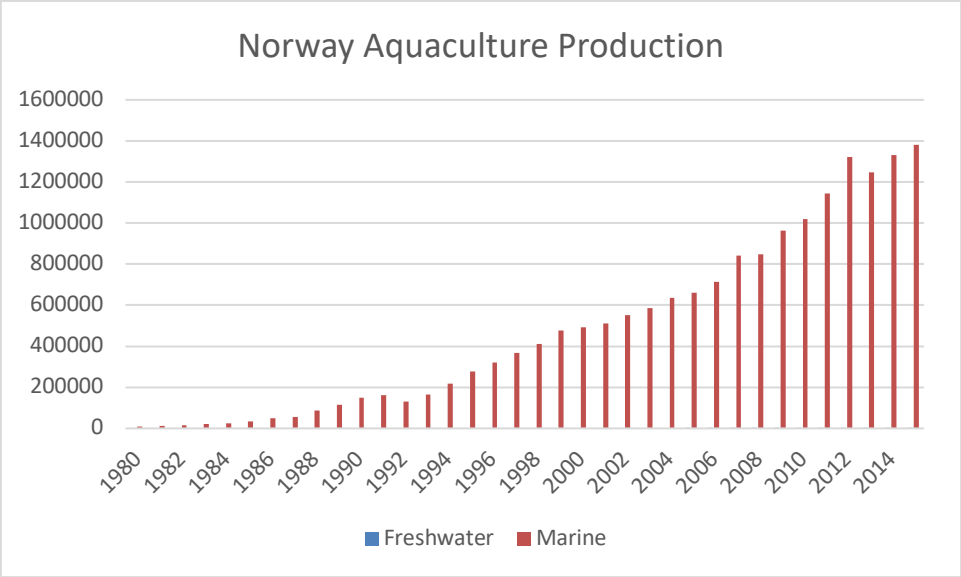

Fig 6. Adapted from FAO data. (36)

4.6.1 Education and Training

The responsibility of all education, including VET, in Norway ultimately is with the Ministry of Education and Research. However, to reduce the administrative burden the system has been divided into three administrative levels:

- National policy development and administration of all education and training is the responsibility of the Ministry of Education and Research (Kunnskapsdepartementet) (70).
- The planning, organising and financing of primary and lower secondary education is the responsibility of the municipalities (kommuner) (71).
- Planning, organising and financing of public upper secondary education is the responsibility of the counties (Fylkeskommuner). The responsibilities of the counties also include Vocational Education and Training (VET) and apprenticeship training (72).

The county level administration is of particular interest to the aquaculture industry as there is a well-established and regulated system of close cooperation in upper secondary and tertiary VET, both formal and informal, between social partners and education and training authorities. Employer organisations and trade unions also actively participate in the development of vocational training. The social partners include representatives from business, industry and the public sector. Social partner involvement in advisory bodies ensures that any changes such as advances in technology or changes to the labour market are considered in any decision-making process.

Social partners are represented in all main advisory bodies at national and county level and ensure that upper secondary VET provision meets the skills needs of the labour market by advising on

curriculum development, structure of training programmes, examinations and quality assurance at national, county and local level.

4.6.2 Upper Secondary VET

When a young person has completed compulsory lower secondary education, they have a statutory right to three years of upper secondary education (73). There are a range of options available to the learners at upper secondary level including full time school-based programmes and VET programmes. The full-time school-based programmes do not lead to formal craft or trade certification, but the VET programmes do. The VET programmes can use different models specific to the requirements of the trade or craft, but most are four years. This can vary from one year in school and three years apprenticeship, or three years school and one-year apprenticeship. The standard VET model is two plus two, which entails two years school education followed by two years training and productive work in a training enterprise. Once the two years apprenticeship is complete the candidate will take a practical and theory-based examination. Successful candidates will be awarded a trade certificate for industrial and service trades (Fagbrev), or a journeymans certificate for traditional crafts (Svennebrev). Both certificates have equal status and lead to a qualification levelled at NQF 4A or EQF 4 as shown in Table 8. Some elements of the journeymans certificate may be considered to be at a higher level than NQF 4A & EQF 4, and so the levels shown on the NQF should be used as a guide. The Norwegian NQF (NNQF) has seven levels with no qualifications at level 1. There are two levels (4 & 5) with parallel learning outcome descriptors for qualifications in each of those levels. Both levels have been allocated two descriptors as the EQF descriptors for those levels are more general than the NNQF descriptors.

NNQF levels	Examples of Qualifications		EQF levels
8	PhD degree		8
7	Masters degree		7
6	Partial bachelor (short higher education)	Bachelor (Bologna first cycle)	6
5	Certificate of completed post-secondary VET 1 (*Fagskole*)	Certificate of completed post-secondary VET (*Fagskole*) 2	5
4	(A) Certificate of completed vocational upper secondary education (*Fagbrev*) (*Svennebrev*)	(B) Certificate of completed general upper secondary education	4
3	Certificate of partially completed upper secondary education and training		3

	(*Kompetansebevis*)	
2	Certificate of primary and lower secondary education	2
1	Not part of the NQF. No qualifications included.	1

Table 8 (69) Norwegian National Qualification Framework (NNQF) compared to the European Qualification Framework (EQF)

There is another option for VET programme learners who have completed two years of study on a VET programme. Learners can transfer to a third-year supplementary study programme which will qualify them for entry to higher education. This year comprises a group of six key academic subjects which will satisfy the general admission requirements to higher education. Learners choosing this pathway will not receive a trade or journeyman certificate but will receive a qualification at NNQF level 4B; EQF 4, as for the certificate of completed general upper secondary education.

There will be learners who will be unable to meet the standards required to enrol on the trade or journeyman certificate courses, but there is a learning option which targets those learners. This option is known as the training candidature scheme (lærekandidatordningen).

The scheme offers learners the opportunity to achieve a qualification which is levelled lower (NNQF 3; EQF 3) than the trade or journeyman certificate. A learner undertaking this option may have an opportunity during the training period to convert from the scheme onto an apprenticeship contract, which leads to a trade or journeyman certificate.

Formal post-secondary education and training in Norway, Tertiary VET (NNQF 5; EQF 5) and higher education (NNQF 6-8; EQF 6 – 8), are all described as tertiary (tertiær). No distinction is made in higher education between non-vocational, vocational and professional courses as all are considered part of the higher education system.

A learning pathway is available to those learners who have achieved either the trade or journeyman certificate and may wish to progress to further or higher education. There is an option to undertake further study at a tertiary vocational education college, which is not higher education but is regarded as a significant alternative to higher education. All of those programmes of study must be approved by the Norwegian Agency for Quality Assurance in Education (NOKUT), the agency responsible for accreditation and quality control. These programmes can last up to two years and lead to a qualification levelled at NNQF 5, EQF 5.

Options for access to higher education are:

- upper secondary school leaving certificate based on successful completion of a general or academic programme in upper secondary education;
- learners who have a trade or journeyman certificate, and successfully completed the one-year supplementary study programme which qualifies learners for admission to higher education;
- learners aged 23 or older who have a minimum of five years' work experience, or a combination of work experience and education and have successfully completed the

supplementary study programme which qualifies learners for admission to higher education. This is known as the 23/5 route;

- third year supplementary study programme for VET learners, which qualifies learners for admission to higher education;
- learners aged 25 or older can be individually assessed for formal, informal and non-formal qualifications, known as recognition of prior learning (RPL);
- there is a VET option for higher education (Y-veien) which applies to certain courses, particularly engineering. For those courses there are specific vocational qualifications from upper secondary level which can satisfy admission criteria to higher education.

4.6.3 Master craftsperson education

Individuals who would like to set up in business or target a management position in their chosen field, and have achieved the trade or journeyman certificate, have another progression pathway available. This pathway is known as master craftsperson education and leads to a master craftsperson certificate (Mesterbrev) (74). In addition to the relevant trade or journeyman certificate applicants for the master craftsperson certificate must also have several years' experience working in their chosen craft or trade.

The master craftsperson programmes are a public certification arrangement under the Ministry of Trade, Industry and Fisheries, with administration of the training programme the responsibility of the Master Craftsperson Certificate Committee (MCC). The MCC consults with professional Master craftspeople and social partners and uses this input to define the curriculum and standards of the training. The training offered on the master craftperson certificate courses cover areas such as business management, marketing and vocational craft/trade theory. The training can take up to two years, and once completed the MCC awards certification and the candidate can use the title 'Master Craftsperson'. Online research to date has not identified any Master Craftsperson programmes in aquaculture.

4.6.4 Adult VET

In Norway, as mentioned previously, everyone has a statutory right to an education and this includes adults (25+). The adult education system in Norway provides adult returners with the opportunity to complete upper secondary education and training, and have any prior learning and experiences validated. It is also a statutory right for adults to have any prior informal and non-formal learning assessed and validated against the national curriculum. This validation process can be used as a stepping stone to being credited with a trade or journeyman certificate. Suitable candidates with at least five years continuous work experience in their chosen trade/craft have a right to take the trade or journeyman examination without having served an apprenticeship. To be considered suitable, candidates must demonstrate they are competent in their chosen craft/trade, with any relevant previous education being credited.

4.6.5 Other VET options

There are opportunities for VET outside public education and in the working environment, using adult learning associations and distance education institutions. There are a range of study options available including full time, part time and evening classes. The delivery and assessment of distance learning education will normally require an innovative blended learning approach and may combine class-based teaching with e-learning.

The courses on offer are varied and can range from personal interest courses to those which are work related, with the majority of courses being delivered part time. As the distance learning courses are open to all, adult learners will use them to prepare for upper secondary and trade or craft examinations.

4.7 Croatia

In Croatia the main species farmed in the marine aquaculture environment are sea bass (*Dicentrarchus labrax*), gilthead sea bream (*Sparus aurata*) and Atlantic blue fin tuna (*Thunnus thynnus*) with a range of other species in smaller quantities. The Croatian aquaculture has been growing slowly but can be seen to have steady growth apart from a dip experienced in 2012 (Fig 7) that could be attributed to a range of factors including the unpredictability of the blue fin tuna industry, which relies on wild caught juveniles for ongrowing.

The total aquaculture production in Croatia for 2014 was 12 660 tonnes with a production value of €73.5 million. Approximately 70% (8410 tonnes) of the total Croatian aquaculture production for 2014 was made up of marine fin fish divided as Atlantic blue fin tuna 2312 tonnes, sea bass 2772 tonnes and sea bream 3326 tonnes with a combined value of €65.5 million. There were 175 active aquaculture enterprises in 2014 employing 2231 staff (FTE 1117) (43).

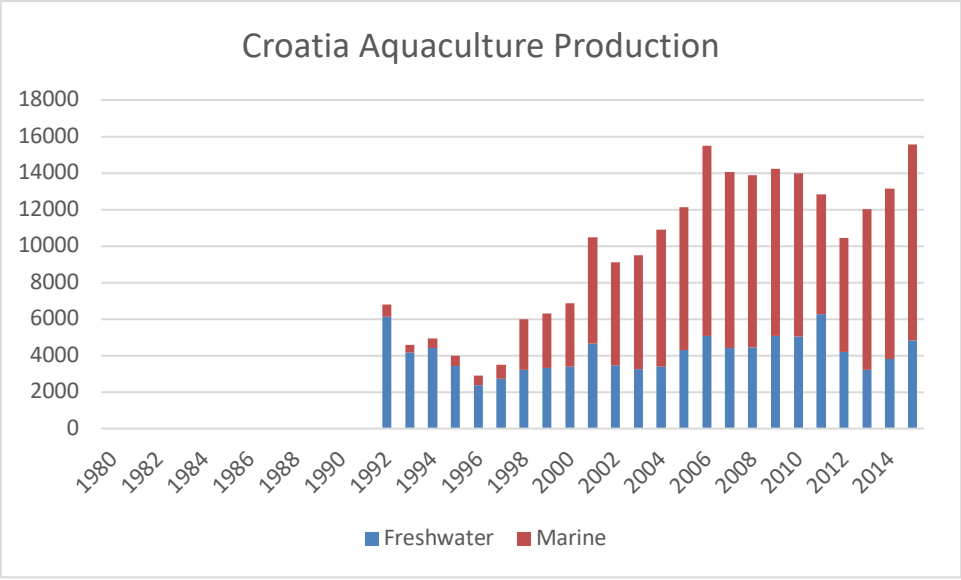

Fig 7. Adapted from FAO data. (36)

The Ministry of Agriculture (75) has overall responsibility for the administration of aquaculture and fisheries. There are no aquaculture producer organisations currently active in Croatia, but there is an

organisation called the Association of Fisheries and Fish Processing (AFFP)which is part of the Agriculture, Food Industry and Forestry Department. The AFFP has an aquaculture sub-group which acts through the Committee for Freshwater Farming & Committee for Mariculture. The AFFP and associated Committees are not producer organisations but may be essential for any progression in aquaculture VET. The roles of the committees are to represent members at government level, trade agreements, advise members and organise trade fairs/exhibitions.

The aquaculture industry in Croatia does not appear to make a significant contribution to the national economy but does contribute significantly to the local economies in the areas where it is an important activity. There is scope for expansion of the industry, but this is currently limited by a range of factors including socio-economic, environmental restrictions and bureaucracy.

Research carried out for the Croatian National Strategic Plan for Aquaculture Development 2014-2020 (76) included a SWOT analysis for Mariculture in Croatia (Appendix 1). The SWOT analysis clearly shows that Croatian marine aquaculture has many strengths and opportunities including developing new products and technologies and connections with food processing sector, establishing land-based recirculation systems and development of organic and ecological aquaculture systems. To achieve those opportunities however will require many of the identified weaknesses to be addressed. Of particular importance will be the establishment of a producer organisation (to give farmers representation at government level and creation of a marketing strategy), improved co-operation between the research /science sector and industry, improvements to working conditions and health and safety procedures and more importantly for BlueEDU Vocational Education & Training (VET) systems established linked to a lifelong learning framework. A trained workforce would be well equipped to adapt and cope with any technological changes required to improve the production output of the country, whilst ensuring it can be achieved efficiently with a reduced environmental impact.

4.7.1 Education and Training

In Croatia the Ministry of Science, Education and Sport (77) is responsible for VET supported by the Agency for VET and Adult Education (78), which was set up under the Vocational Education and Training Act. The main responsibilities of the Agency are:

- The VET curriculum (development of qualifications)
- CPD of VET teachers
- Establish and maintain the Quality Assurance system
- Ensure the VET systems are updated and aligned to the requirements of the labour market.
- Alignment and updating of VET systems is completed in partnership with Sector Councils which include representatives from all stakeholders involved in VET.

In 2017 Cedefop published results of a public opinion survey on VET (2), that acknowledged the important role VET will play in developing and maintaining a workforce that can meet the challenges faced by the EU. This survey showed that public perception of VET in Croatia as a way to achieve qualifications is quite high (78%) and had one of the highest VET participation levels (68%) of any EU country. Learners can start VET on completion of compulsory education with >71% of upper

secondary learners participating in Initial VET (IVET) at the beginning of the 2015/16 school year (84).

Approximately two thirds of those VET learners were in four-year school-based programmes levelled at 4.2 on the CROQF, EQF 4 (Table 9), while the other third started the three-year programme levelled at 4.1 on the CROQF, EQF 4. The four-year programmes are school based but have a work-based learning component. Completion of the four-year programme can allow progression to tertiary education after taking a *matura* exam. The three year programmes are generally regarded as apprenticeships with work based learning within companies providing access to the labour market (84).

Croatia faces the same labour market challenges as other EU countries, particularly in relation to developing and maintaining the workforce required. The role VET will play in facing this challenge is important as VET will prepare the workforce for specific job roles. If VET is to be successful however the systems developed must be based on analysis of the job markets to ensure they are filling a need and can be maintained to remain valid. As the aquaculture industry grows this will become more of a challenge as there will be advances in the production systems and technology used which will require routine updates to maintain a flexible and mobile trained workforce.

CROQF levels	Examples of qualifications	EQF levels
8.2	Postgraduate university(doctoral) studies: Defence of a doctoral thesis not involving a taught study programme	8
8.1	Postgraduate research master of science studies	
7	Graduate university studies Specialist graduate professional studies Post-master specialist university studies	7
6	Undergraduate university studies Undergraduate professional studies	6
5	Professional higher education studies Vocational post secondary development and training Master craftsman programmes	5
4.2	General secondary education; four and five year vocational secondary education	4
4.1	Three year vocational education	

3	One and two year secondary school vocational education	3
2	Vocational training	2
1	Primary education	1

Table 9 Croatian Qualifications Framework (CROQF) compared to the EQF Refs adapted from The Croatian Qualifications Framework Act 2013. (79)

The main focus of aquaculture education in Croatia has been aimed at the tertiary level (HE) with a number of universities offering aquaculture related programs or courses. Some institutes also offer specific modules to graduates. The tertiary level institutes are located across Croatia and although they offer academic learning there does not appear to be anything offered that could be considered VET at any level.

This style of higher academic education and training with a limited practical or interactive input is necessary to improve academic understanding and contribute to research. A new aquaculture education and training strategy is required however and the current system will be undergoing a significant change in the near future. It is proposed that a new Aquaculture law will be introduced in 2018 (83) which will define a new education model and will be organised by the Ministry of Agriculture and the Aquaculture Advisory Service of the Ministry. The new education system will target people currently working in the aquaculture industry, who hold no formal aquaculture qualifications up to degree level. The proposed system will deliver education and training through organised workshops and lectures at least twice each year. This should help improve the existing aquaculture VET that is going on in Croatia, which currently is fragmented and offered an add on to other programmes of study.

Online research has shown that there are vocational training options available which cover aquaculture training as part of wider training or qualifications. The Nautical High School in Split offers an educational programme for a fishery and nautical technician, but no information could be found online or through an information request to the school.

There are also community colleges that offer aquaculture training, as part of the fishery and nautical technician training programmes aimed at those over age 15. The community colleges are based in Šibenik, Rijeka, Zadar and Split. The study programmes are offered as initial training and a vocational retraining option. The length of study can vary from 6 months – 2 years and combine classroom and work based practical delivery. The course content is varied but does cover the following aquaculture related subject areas:

- Mastering the skills of fishing, processing and breeding
- Developing ecological awareness;
- Acquiring basic knowledge of renewable resources of the sea
- Knowledge of the technological processes of marine organisms processing and the basics of microbiology of fish processing
- Mastering the basic theoretical and practical knowledge in the area of breeding of marine organisms
- Knowing how to apply safety rules at work and comply with safety regulations
- Having basic practical and theoretical knowledge of safety and survival at sea in all situations

Existing Croatian legislation, the Law on Marine Fisheries 2010 (80) & Freshwater Fisheries Act 2001 (81), requires that each aquaculture enterprise must employ qualified technical staff who have passed a specialised aquaculture examination, to be legally compliant. The existing exam does not focus on production technology, but places more emphasis on legislation, both national and international.

The new education system proposed for introduction in 2018 will also place a legal obligation on each aquaculture farm to employ a suitably qualified person, or someone who has passed the exam. The new system will take aquaculture training and education a step further by introducing production methods and technology, including a proposal for an advanced level of aquaculture education which will not be mandatory but will cover additional topics and subject areas considered important to the aquaculture industry. This proposal may offer opportunities to staff for educational progression that have not been available in the past. If all of the proposals go ahead as predicted this will provide a much-needed change to aquaculture education and training in Croatia that will ultimately benefit the whole aquaculture industry in the country.

4.7.2 BlueSMART Project

The BlueSMART (Blue Education for Sustainable Management of Aquatic Resources) Project (82) has been set up to address the shortage of skilled staff in the blue sector, a challenge not only in Croatia but across the EU, which is predicted to increase as the sector grows. The project is a partnership part funded by the European Maritime and Fisheries Fund. The project is co-ordinated by the University of Zadar (Dept. of ecology, agronomy and aquaculture), Cromaris, WWF Adria and the Agency for Rural Development of Zadar County (AGRRA) and is expected to conclude at the end of 2018.

BlueSMART will build and improve on the skills and competencies of the fishery and aquaculture sectors, and in so doing identify and fill any existing skills gaps in the blue economy sector. This will help those already employed to develop their skills which in turn can improve career progression prospects or facilitate employment mobility. People who are unemployed or seeking a career change could also use the course to retrain for a career in the fishery or aquaculture sectors.

This will be achieved through an innovative e-learning model, which will develop online modular learning materials that will be available on an open platform accessible to universities, VET providers and companies in the fishery and aquaculture sectors.

The Blue SMART project has been designed with the general objective to create new skills and competences in the blue economy sector and increase the employability of current and future sectors' workers in the County of Zadar, and more widely Croatia. This includes both the fishery and aquaculture sectors. The project will specifically aim to:

- Create conditions for training of a new generation of students and professionals equipped with the appropriate skills to match the needs of the industry.
- Provide people already working in the field with the new skills required.

4.8 Spain

In Spain the main aquaculture species farmed in the marine environment are gilthead sea bream (*Sparus aurata*), sea bass (*Dicentrarchus labrax*), turbot (*Psetta maxima*) and Mediterranean mussel (*Mytilus galloprovincialis*). The total aquaculture production in Spain for 2014 was 288 244 tonnes, of which 270 400 tonnes was produced in the marine environment (43). In 2014 Spain was the largest EU producer by volume accounting for around 23% of the total production weight of the EU 28. The bulk of this production was the Mediterranean mussel at 222 600 tonnes. Marine fin fish production in 2014 was as follows Sea bream 18 148 tonnes; Sea bass 17 292 tonnes; Turbot 7 933 tonnes and Atlantic blue fin tuna 3 088 tonnes. The total value of Spanish aquaculture in 2014 was €543.9 million with marine fin fish aquaculture accounting for €330.8 million. There were 3035 business enterprises active in 2014 employing a total of 19914 staff (FTE 5946), 77% (15 333) of which were employed in 2 340 small enterprises with <= 5 staff (43).

The aquaculture industry in Spain makes a significant contribution to the national economy, but the industry has remained fairly stable in production output over the past decade (Fig 8) however there is scope for further expansion. There is an expectation in Spain, as there is in other EU countries to grow the industry by 2030. Innovation Norway have projected moderate figures for marine fin fish production in Spain of >120 000 tonnes per annum (85).

Any significant growth will require improvements to current production and health management methods, improved licensing, new technology and possibly sourcing of new areas to locate aquaculture units. As the aquaculture industry grows it would be expected that aquaculture employment will also grow to cope with the increase in production. A significant increase in staffing levels may not necessarily be required however as there will be more reliance on technology, especially when dealing with constraints to expansion into other areas. This may in turn require staff to be better trained/qualified to cope with the technological advances and increased production challenges that the industry may face with future expansion.

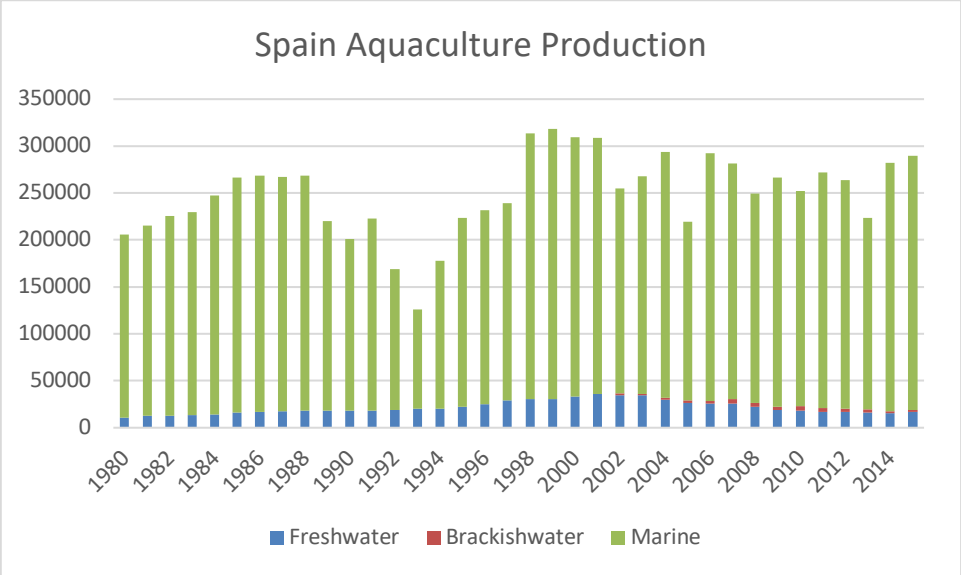

Fig 8 Adapted from FAO data. (36)

4.8.1 Education and Training

In Spain the Ministry of Education, Culture and Sport (MECS?) is responsible for the proposal and setting up of national VET policy. The responsibility for Initial Vocational Education and Training (IVET), which is aimed primarily at young people, also falls under the remit of the Ministry.

The government main advisory body is the National Education Council (NEC?). The NEC has representatives from all stakeholders within the education sector including, teachers, students, families, social partners, central government and regional education councils (86). The role of the council is to report on the current state of the VET system and put forward proposals for improvements if required. Another relevant advisory body on VET is the General Council on Vocational Training (CGFP). The CGFP is made up of education and labour authorities responsible for VET at the regional and national level, who work together with trade unions and employer associations.

The Ministry of Employment and Social Security (MESS) is responsible for administering government policy on employment, social security and is also responsible for VET in the employment system and Continuous Vocational Education and Training (CVET).

Vocational training for employment falls under the remit of the MESS. It is based on cooperation between labour authorities and social partners (employers and trade union organisations) at national and regional level (86). Mediation and collective sector negotiation at national level, thus constituting a single framework based on the agreements reached between the social partners and the government (86). The VET on offer is aimed at both employed and unemployed people. The aim of vocational training for employment is to offer training which is aligned to the needs of the labour market.

The education and labour authorities have responsibility for the award of formal VET qualifications under the national system for qualifications and vocational training. The education authorities also

provide basic education for adults which can provided in a number of ways, full time, part time or as a modular programme.

ESQF/MECU levels	Example qualifications	EQF levels
8	Doctoral degree(doctorado)	8
7	Master degree(master)	7
6	Bachelor degree (Grado)	6
5	Advanced technician(Técnico superior)	5
4		4
3		3
2		2
1		1

Table 10 Spanish Qualifications Framework (ESQF/MECU) aligned to the EQF (87) Adapted from Publication analysis and overview of national qualifications framework developments in European countries. Annual report 2016, Cedefop, 2017

The Spanish National Qualifications Framework (ESQF/MECU) referenced to the EQF is shown in Table 10. It can be seen that there are qualifications entered from levels 5-8 but nothing in levels 1-4. This is due to a challenge of trying to map together qualifications, particularly VET at levels 3-4, that are awarded by different bodies and are of a different nature, workload, delivery and quality assurance mechanism (87).

4.8.2 Aquaculture training

Some courses are available at Spanish universities aimed at post graduate level, but there do not appear to be any courses that could be specifically regarded as VET. Some of the tertiary level courses have a VET element, but this on the main is part of subjects that are elective. There are career programmes classed as professional training which include aquaculture either as part of a more general course of study or can be subject specific. Two courses offered which both take two years to complete are:

- Aquaculture Technician
- Senior Technician in Aquaculture

These two courses are offered at various locations throughout Spain. Both courses look to be college/learning centre based, but with a vocational element for the practical requirements. The Aquaculture Technician course looks to be aimed at upper secondary level learners and the Senior Technician course looks to be aimed at tertiary level learners. Additional information such as

levelling and final qualification have been difficult to establish. Further research identified occupational training courses specific to aquaculture, that are available, but as before it has been difficult to establish what the courses are and their content or structure. An organisation which may be essential for any progression in aquaculture VET will be The Asociacion Empresarial de Productores de Cultivos Marinos (APROMAR) (88). This association represents marine fish farmers in many areas, including at government level, marketing, research and innovation promotion, and offers advice to members. APROMAR has reference to Health and Safety courses on their webpage and a programme called HealthyFISH (Section 5.19.), but an information request on occupational courses or any of the training offered by APROMAR came back as negative.

4.9 Greece

In Greece the main species farmed in the marine aquaculture environment are gilthead sea bream (*Sparus aurata*), sea bass (*Dicentrarchus labrax*) and Mediterranean mussel (*Mytilus galloprovincialis*). The total aquaculture production in Greece for 2014 was 118 000 tonnes, of which 103 163 tonnes was produced in the marine environment (43). There are a range of fish and shellfish species produced in Greece but the main fin fish species which made up the bulk of production in 2014 were Sea bream (51 498 tonnes) and Sea bass (33 892 tonnes). The total production value of the Greek aquaculture industry in 2014 was €448 million, of which Bream and Bass accounted for €418.2 million.

There were 248 aquaculture enterprises active in 2014 employing 5129 staff (FTE 4640). Many of those enterprises were small employing<= 5 staff, but there must be a high level of consolidation within larger companies as all bream and bass output is produced by 60 enterprises. The 7 largest enterprises were responsible for 70% of the total Greek sea bream and sea bass production in 2014 (43).

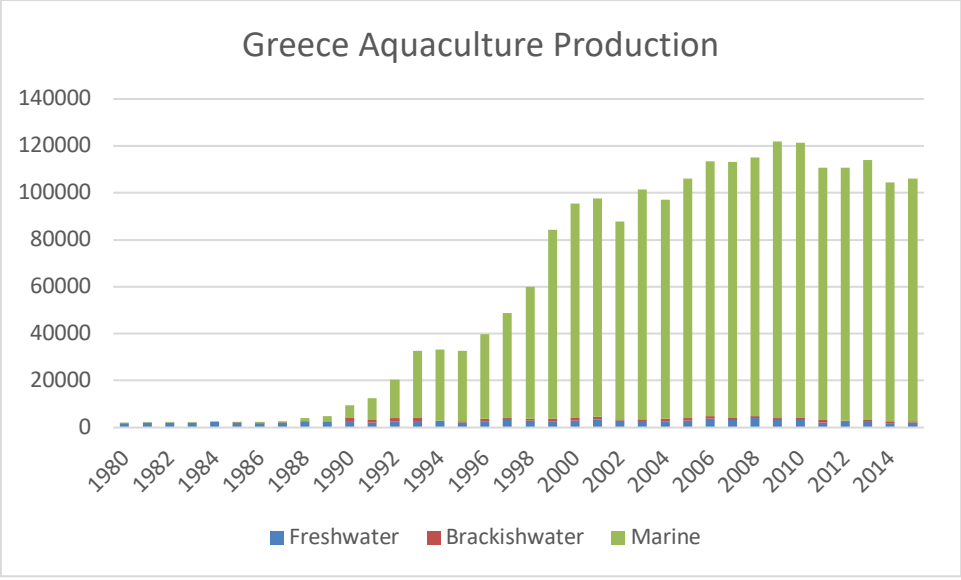

Fig 9 Adapted from FAO data. (36)

The Greek aquaculture industry has shown a gradual decline over the past decade which appears to have slowed (Fig 9). Although the aquaculture industry in Greece makes a significant contribution to the national economy and out performs the Greek capture fishery, this slowdown could be attributed to many factors but the most important is likely to be competition with the growth of aquaculture in other countries. There is scope for further expansion of the industry as a lot of sites are producing below capacity due to historical issues. To ensure sustainable growth the aquaculture sector will have to improve the production process, technology and research, feed production and the marketing of the products. The future growth of aquaculture in Greece is predicted to double by 2030 (89).

4.9.1 Education and Training

In Greece responsibility for VET policy and course approval is with the Ministry of National Education and Religious Affairs (MoNE) (90) and the Ministry of Labour, Family, Social Affairs & Equal Opportunities (MDDSZ) (91). The administration and certification of VET is the responsibility of other organisations.

The National Organisation for the Certification of Qualifications and Vocational Guidance (EOPPEP) (92) develops and certificates job profiles for VET. To ensure the job profiles are current and valid they are created in co-operation with social partners from the world of work.

The MoNE leaves the administration of any vocational training which is outside the formal education system to the General Secretariat for Lifelong Learning (GSLL). This type of education is described as non-formal but leads to certification. Examples are IVET (certificated by EOPPEP) and CVET mainly aimed at adult learning. CVET and general adult education is provided by Lifelong Learning Centres (LLC's). All LLC's are evaluated and monitored by the Ministry of Education and EOPPEP.

IVET is provided at Institutes of Vocational Training and leads to certification, although it is not formally thought of as education as it leads to employment in the labour market (93).

HQF levels	Examples of qualifications	EQF levels
8	Doctorate (Didaktoriko diploma).	8
7	Master's degree (Metaptychiako diploma eidikefsis)	7
6	Bachelor degree (Ptychio)	6
5	Vocational Upper Secondary School 'Degree'* Post-secondary cycle (Apprenticeship class) (Ptychio Epaggelmatikis Eidikotitas, Ekpaidefsis Kai Katartisis)	5

	Iinitial Vocational Training (IEK) Vocational Training Diploma (Diploma Epaggelmatikis Eidikotitas, Ekpaidefsis Kai Katartisis) (post secondary level) Post Secondary and NOT higher education diploma or 'Degree'* (Diploma/Ptychio Anoteras Scholis)	
4	Vocational School (EPAS) Certificate (post lower secondary level) (Ptychio EPAS) 2nd Vocational Upper Secondary School (EPAL) 'Degree'*(Ptychio Epaggelmatikis Eidikotitas, Ekpaidefsis Kai Katartisis) 1st EPAL Certificate (Apolitirio Epaggelmatikou Lykeiou) General Upper Secondary School Certificate (Apolytirio Lykeiou)	4
3	Vocational Training School (SEK) 'Degree'* (post lower secondary level) (Ptychio Epaggelmatikis Eidikotitas)	3
2	Lower secondary school certificate (compulsory) (Apolytirio Gymnasiou)	2
1	Primary school certificate (compulsory) (Apolytirio Dimotikou)	1

Table 11 *Degree in this context is not the same as a HE degree but is a direct translation from Greek. Greek Qualifications Framework (HQF) aligned with the EQF adapted from: EOPPEP (2016) (94)

4.9.2 Vocational Education and Training (VET) - Apprenticeship Programmes

The participation in VET is generally low in Greece with only 21% of respondents who took part in the *European public opinion survey on vocational education and training* (2) confirming the education they received between 16-18 was primarily vocational. This may in part be due to public perception of VET as a route for low achievers who did not qualify for access to tertiary education at university.

Steps have been taken in Greece to address this by improving the quality and effectiveness of VET. Some of the steps taken include:

- Restructure the initial VET programs to ensure compatibility with the needs of the labour market, in co-operation with stakeholders,
- Improve the quality and attractiveness of VET by establishing a national approach for the quality assurance in VET

Increase the number of students/graduates participating in apprenticeship programs by:

- Redesigning the apprenticeship programmes for 150 specialisations/professions

- Improving the curricula
- Providing practical training in Maritime Academies
- Developing and designing apprenticeship programmes for EPAL and IEK graduates,

School	HQF/EQF level	Qualification achieved	Programme duration	Eligible next steps
SEK	3	Vocational Training School (SEK) Certificate (Table 11)	3 years (final third year apprenticeship) Over 20 year old or employed can enrol on 4 year evening school.	No information to date
EPAS	4	Vocational School (EPAS) Certificate. Table 11	2 Years	Licenced practitioner of trade/profession, Enrol in 2nd grade of the EPAL, Register at an IEK for a similar specialisation
EPAL	4	1st Vocational Upper Secondary School Certificate (Table 11) 2nd Vocational Upper Secondary School 'Degree' (Table 11)	3 years (+optional apprenticeship year)	Access to HE, Licenced practitioner of trade/profession, Enrol in an IEK, Enrol in apprenticeship year
IEK	5	Initial Vocational Training Diplomas (Table 1)	Five semesters (2-3 years??)	No information to date

Table 12 Structure of the main Vocational Education and Training programmes available in the Greek education system. Adapted from EOPPEP (2016) (94)

There are generally four programmes recognised in the Greek education system as VET, described in Table 12. The curriculum of the Vocational Upper Secondary School (EPAL) consists of general education subjects and technical-vocational education subjects. Vocational School (EPAS) students do not need the same theoretical studies as EPAL but are mainly focussed on practical specialities. Students undertaking the EPAS programme are in paid employment on an apprenticeship programme. Generally, students undertaking the EPAS programmes are absorbed into the labour market as skilled technicians, whereas EPAL students can seek employment or have the options to advance to higher studies.

The VET system in Greece is mainly aimed at young people in a wide range of areas. There are pathways that offer aquaculture as an option:

Non formal post lower secondary school education (SEK) – Craftsman of Fisheries & Aquaculture

Vocational Upper Secondary School (EPAL) – Technician Animal Production (Not directly aquaculture but is a related topic)

Online research did not reveal any information on the structure, content or where delivered for both of the pathways described above. It has been difficult to establish if there are any other pathways for aquaculture VET available. Information requests were sent out but no relevant feedback was received.

Information requests were sent to producer organisations but no information has been received. The co-operation of the following organisations would be vital for any progression in aquaculture VET in Greece. The Federation of Greek Mariculture (95) represents approximately 70% of the marine fish farmers in Greece. Small to medium enterprises are represented by the PanHellenic Union of Small-Medium Fish Producers (PANEMI). There is also a group called the Greek National Council for Aquaculture.

In Greece there is a cultural trend of targeting higher education, over VET, as it is seen as more prestigious. Changing this cultural attitude will be difficult to achieve. VET is generally viewed as a last resort by many despite evidence which suggest that people with technical and vocational qualifications are more able to find employment than those with general education (93).

Aquaculture training currently offered in Greece appears to be aimed at post graduate level education. There has been a lot of Greek participation over the years in researching and developing EU programmes that focussed on aquaculture VET in a range of topics e.g. INTRANEEMA (Section 5.11.) and PESCALEX (Section 5.9.). In spite of the interest and participation of Greek organisations BlueEDU research to date shows very little activity on aquaculture VET being offered at undergraduate or further education level.

4.10 Cyprus

In Cyprus the main species farmed in the marine aquaculture environment are gilthead sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*), with other species farmed in much smaller

quantities. The total aquaculture production in Cyprus for 2014 was 4890 tonnes, of which 4 800 tonnes was produced in the marine environment (43).

Cypriot marine production was split as Sea bream 2 966 tonnes and Sea bass 1 826 tonnes for a combined value of €31.2 million. The production value of all aquaculture sales in Cyprus for 2014 was €32.3 million. There were 16 aquaculture enterprises active in 2014 employing 388 staff (FTE 341) (43).

The aquaculture and fisheries industry in Cyprus is an important activity, particularly in rural areas, but is a small contributor to the Cypriot economy. The Cypriot aquaculture industry is small in comparison to other EU countries but has grown steadily in the past decade (Fig 10), but there is scope for further expansion of the Cypriot aquaculture industry if carried out sustainably and take account of environmental impact and the effects on other industries such as tourism.

To ensure sustainable growth the aquaculture sector will have to consider diversification into farming other species, improve the production process, technology and research, feed production and marketing of the products, especially to export markets. As for other EU countries Cyprus expects to grow its aquaculture industry by the year 2023 (96).

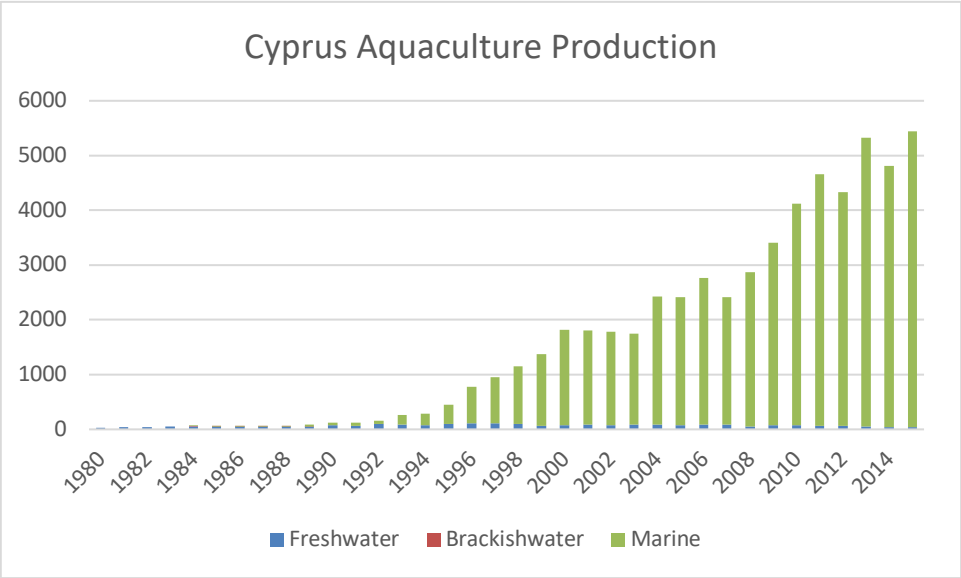

Fig 10 Adapted from FAO data. (36)

4.10.1 Education and Training

The Ministry of Education and Culture (MoEC) (97) is responsible for the development and implementation of educational policy in Cyprus (98). MoEC is also responsible for the administration and educational budgets of all schools from pre-schools to university and the supervision of private schools. Continuous education and training, including VET, is offered by MoEC aimed at improving the knowledge and skills of low skilled adults through one and three-year afternoon and evening classes through technical schools.

The main organisation which is responsible for and promotes training for employees is the Human Resource Development Authority (HRDA) (99). The HRDA has a board made up of representatives

from government, employment and trade unions. The HRDA has analysis completed on sectoral demand forecasts and estimates of employment needs in professions. It also approves and subsidises training programmes and carries out annual studies of training needs in the job market. The HRDSA is funded by a levy paid by all companies.

The Cyprus Mariculture Association (CMA) represents all Cypriot marine aquaculture companies. Attempts to establish contact with the CMA with an information request about training, workshops or courses were unsuccessful as no response was received.

CYQF levels	Example qualifications		Professional System of Vocational Qualifications (SVQ) levels	EQF levels
8	Doctoral degree			8
7c 7b 7a	Master degree Postgraduate diploma/Postgraduate certificate Postgraduate certificate		5	7
6	Bachelor degree (Ptychion)		4	6
5c 5b 5a	Higher certificates and diplomas (three years or more) Post-secondary certificates and diplomas (two years) Post-secondary certificates and diplomas (one year)		3	5
4	Upper secondary general education and evening schools certificates (12th class or 12th and 13th class for some private schools)-*Apolyterion*	Upper secondary technical and vocational education and evening technical schools certificates (12th class)-*Apolyterion*	2	4
3	Lower secondary education certificate (10th class)	New Modern Apprenticeship	1	3
2	Compulsory lower secondary education certificate (9th class)	Preparatory programme (New Modern Apprenticeship)		2

1	Compulsory education certificate (Elementary School leaving certificate, and/or graduates of 7th and/or 8th class)	1

Table 13 Cypriot Qualifications Framework (CYQF) aligned to the EQF Refs adapted from The Referencing of the Cyprus Qualifications Framework to the European Qualifications Framework for Life Long Learning, 2016 (100).

The referencing of the CYQF to the EQF is shown in Table 13. Both frameworks have eight levels however it is obvious that levels 5 and 7 on the CYQF have been split into multiple levels. This was done to accommodate the currently awarded qualifications in Cyprus as a single level would not fully represent the Cypriot education system or the employment market of the country (100). In the case of level 5 it was split as follows:

- 5a – a one year certificate or equivalent
- 5b – two year diploma or equivalent
- 5c – three year higher diploma or equivalent

The participation in VET is low in Cyprus with only 18% of respondents who took part in the *European public opinion survey on vocational education and training* (2), confirming the education they received between 16-18 was primarily vocational. This may in part be due to public perception of VET as a route for low achievers who did not qualify for access to tertiary education at university. Research for BlueEDU has revealed that technical and vocational education and training is available in Cyprus at levels 2 – 5 with some VET carried out at tertiary level. The Department of Secondary Technical and Vocational Education offers a range of programmes to school leavers and adults. The range includes topics such as construction, engineering and tourism but there is no reference to aquaculture or any aquaculture related topics.

Students can undertake VET through a number of pathways as shown below:

Formal upper secondary technical and vocational education – Three-year programme offering either a theory or practical programme to students. Both programmes share a common first year with specialist options selected for second and third years. Eleven fields of study are offered and successful completion will lead to a certificate equivalent to Secondary General education, which allows access to work or institutes of higher education.

Second Chance Formal Initial Vocational Education:

- **Evening Technical Schools** – Programmes offered are equivalent to mainstream secondary technical and vocational education programmes. Successful completion leads to a certificate that entitles the graduate to pursue further study at an institute of tertiary education.
- **Three year afternoon and evening classes at Technical Schools** – Three year programme that offers formal initial education and training to employed or unemployed adults, Successful completion leads to a certificate equivalent to the Upper secondary general or upper secondary technical and vocational education award.

VET at Post Secondary Level – One and two-year programmes are offered that include practical training in industry and business/enterprise. The programmes offer graduates the opportunity to further their technical and vocational education.

The Apprenticeship Scheme – Two year programme of study that combines general education and vocational training at school. Course structure is two days at technical school/week taking general studies and three days paid practical training with industry.

New Modern Apprenticeship (NMA) – Two year Apprenticeship aimed at young people 14-21 years of age. NMA's have two levels:

- **Preparatory Apprenticeship** – 1-2 years duration for students who have dropped out of Lower Secondary School aged 14-16 years.
- **Core Apprenticeship** – Up to three years duration for those aged 15-21 years completing Lower Secondary School but dropped out of Upper Secondary or Technical and Vocational schools.

Training for Employees -Supported by the Human Resource Development Authority (HRDA), the MoEC, Ministry of Labour & Social Insurance (MLSI), colleges, training institutions and businesses to offer a range of courses for adults.

It is apparent that the VET system in Cyprus is mainly aimed at young people in a wide range of areas including building trades, engineering, hospitality, design and hairdressing. However, there are options available for adults to achieve qualifications using different pathways that would not require them to leave their employment.

The information gathered to date so far indicates that aquaculture VET in Cyprus is non-existent. Information requests were sent to the CMA and other organisations but no responses were received. This makes it difficult to state definitively that there is no aquaculture VET in any form being carried out in Cyprus. There will no doubt be informal and non-formal VET taking place within aquaculture companies, but as no contact could be established this could not be confirmed.

The situation in Cyprus may be that staff currently employed in aquaculture attend overseas training especially at the tertiary level and so may be over qualified. Over qualification may well be an issue as higher education is viewed as higher value than other levels of education especially VET. It could also be the case that formal qualifications and training are not viewed as a priority area and all staff will be trained as and when required by those on site.

4.11 Italy

In Italy the main fin fish species farmed in the marine aquaculture environment are gilthead sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*). The total aquaculture production in Italy for 2014 was 185 801 tonnes (43) of which 24 000 tonnes was marine fin fish. The total production value of all Italian aquaculture in 2014 was €566.9 million with marine fin fish accounting for €181

million. There were 587 active aquaculture enterprises in Italy in 2014 employing a total of 5112 staff (FTE 1695). A large number of those active enterprises (325 in total) employed 5 staff or less. This possibly points to a large number of small-scale family run enterprises (43).

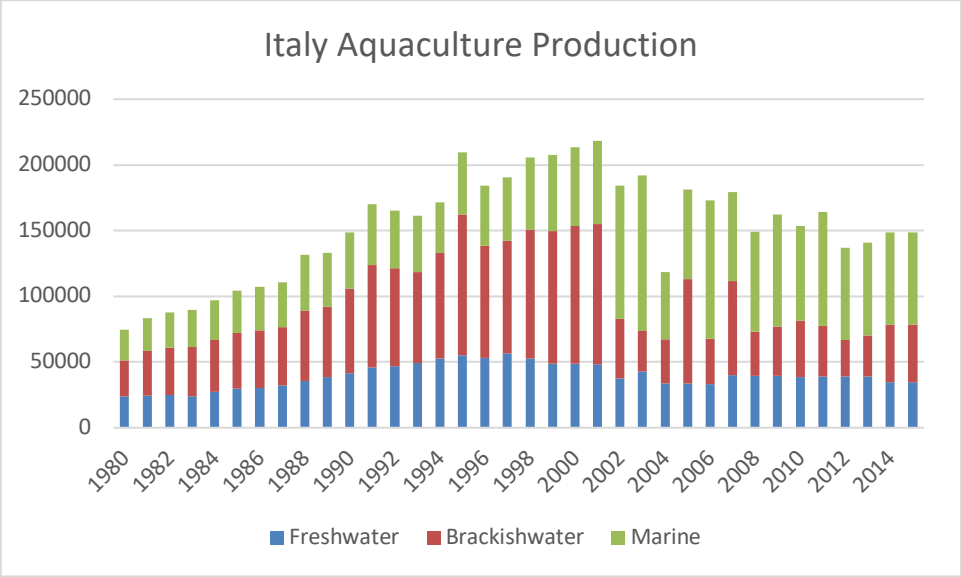

Fig 11 Adapted from FAO data. (36)

The aquaculture industry in Italy is an important activity, particularly as employment in rural areas. The industry has shown a lower than expected growth over recent years (Fig 11), which could be attributed to a number of factors including a complicated bureaucratic licensing process and increased competition from imports (101).

The Italian aquaculture industry has a target to increase overall production by 32% by 2025 (102). Any increased production and growth of the Italian aquaculture industry must be sustainable both economically and environmentally.

4.11.1 Education and Training

Responsibility for the development and implementation of educational policy in Italy, comes under the Ministry of Education, University and Research (MIUR) (103). This includes responsibility for VET framework in technical and vocational schools.

The Ministry of Labour and Social Policies (MLPS) (104) sets the framework for IeFP (Vocational Education & Training), but devolves responsibility for all planning, organisation and provision of VET. The Italian regions and autonomous provinces have devolved responsibility for planning, organisation and provision of IeFP, ITS, IFTS, post higher education, Continuous Vocational Education & Training (CVET) and the majority of apprenticeship schemes.

EQF levels	Example qualifications
8	Research doctorate (Dottorato di ricerca) Academic diploma for research training (Diploma accademico di formazione alla ricerca) Specialisation diploma (Diploma di specializzazione) Second level university master (Master universitario di secondo livello) Academic specialisation diploma (II) (Diploma accademico di specializzazione (II)) Higher specialisation diploma or master (II) (Diploma di perfezionamento o Master (II)
7	Master degree (Laurea magistrale) Second level academic diploma (Diploma accademico di secondo livello) First level university master (Master universitario di primo livello) Academic specialisation diploma (I) (Diploma accademico di specializzazione (I)) Higher specialisation diploma or master (I) (Diploma di perfezionamento o Master (I))
6	Bachelor degree (Laurea) First level academic diploma (Diploma accademico di primo livello)
5	Higher technical education diploma (Diploma di tecnico superiore)
4	Professional technician diploma (Diploma professionale di tecnico) Upper secondary education diploma (Licei diploma liceale) Upper secondary education diploma – technical schools (Diploma di istruzione tecnica) Upper secondary education diploma – vocational schools (Diploma di istruzione professionale) Higher technical specialisation certificate (Certificato di specializzazione tecnica superiore)
3	Professional operator certificate (Attestato di qualifica di operatore professionale)
2	Compulsory education certificate (Certificato delle competenze di base acquisite in esito all'assolvimento dell'obbligo di istruzione)

1	Lower secondary school leaving diploma (Diploma di licenza conclusiva del primo ciclo di istruzione)

Table 14 Example showing how Italian qualifications could map against the EQF, adapted from: First Italian Referencing Report to the European Qualifications Framework (EQF), 2012 (105).

The qualifications framework shown in Table 14 has been adapted from information in the First Italian Referencing Report 2012. BlueEDU research failed to find a completed referencing of the Italian NQF to the EQF. The delay in establishing a national framework may in part be due to regional differences in education and training (105).

Italian technical and vocational schools have a VET framework that aims to develop professional specialisations at post-secondary level that meet the labour market requirements in the public and private sectors (106). There are two programme options available:

- **Higher Technical Education and Training programmes (istruzione e formazione tecnica superiore, IFTS)** - delivered by partners, either through formal partnerships, temporary associations or as a consortium. The partners must comprise at least four VET providers from schools, vocational training providers, universities and the world of work.
- **Programmes at the Higher Technical Institutes (istituti tecnici superiori, ITS)** - offer non-academic training opportunities at tertiary level and are accessible to young learners and adults with at least an upper secondary education diploma. ITS are set up as foundations, which must include a university, training provider accredited by the region for higher education, local authority and the world of work. The world of work must provide at least 50% of the training provision.

BlueEDU research to date has failed to identify any aquaculture VET provision but there are courses available at tertiary level, although limited. There are also post graduate courses available which are related to aquaculture, but not specific. The Ministry of Agriculture, Food & Forestry Policies (MiPAAF) (107), offer workshops and training courses. Research failed to identify any specific information on the courses offered or whether this Ministry deals with aquaculture at any level. Training courses and workshops are offered by other organisations, government agencies and Universities (101). Information on the types of short courses/workshops offered has been difficult to identify.

The aquaculture industry in Italy is represented by two producers' organisations:

The Italian Association of Fish Producers Associazione Piscicoltori Italiani, API (108), represents the majority of marine and freshwater fish culture companies.

The Mediterranean Aquaculture Association Associazione Mediterranea Acquacoltori, AMA (109), represents 72 cooperatives and companies mainly shellfish farmers.

The main aims of the API are to protect, develop and consolidate all activities related to fish culture in fresh, salt and brackish waters. This includes promoting financial, scientific, technical, professional and legal interventions where necessary to achieve the aims. An information request was sent to the

API asking about any training, workshops or courses they offered to members but no response was received.

4.11.2 The Institute for the Development of Vocational Training for Workers (ISFOL)

ISFOL is a national research institute which focusses on Vocational Education and Training (VET) (110), employment and social policies. ISFOL reports to the Ministry of Labour and Social Policy and provides support to central government and local authorities.

The Institute has a commitment to promoting employment, social inclusion, people and skills development and fostering growth and innovation. ISFOL have designed an information system which can be used to match skills to a job profile (111). The system allows a user to input information, which will then be compared to an occupation to measure suitability for a job role. Once a job role has been identified the following list of options is generated.

- Tasks/Detailed Work Activities
- Knowledge
- Skills
- Abilities
- Activity
- Work Context
- Work Style
- Work Values
- Interests
- Examples of Related Occupations

Each option on the list contains a selection of outcomes which would have a score set against them based on the information input by someone creating a job profile. The final score will then establish the suitability of someone for the job profile, based on the information entered.

There is a job role for an aquaculturist which generates a list of learning outcomes each under a general heading e.g. Catch Fish. It does appear to break down further into some of the criteria required to demonstrate competency in catching fish. As it was designed as a tool for creating job profiles it is useful, but it is subjective as the information input could create a very different output on an individual basis.

4.11.3 IeFP programmes

The IeFP programmes (percorsi triennali e quadriennali di istruzione e formazione professionale) offer young people the opportunity to fulfil their right/duty to education and training. There are several important elements to the training:

- A set of training standards for basic skills to be developed in the three- and four-year programmes;

- A set of minimum standards (valid at national level) for technical and vocational skills in relation to the occupation profiles included in the national qualifications register (Repertorio nazionale delle qualifiche);
- Intermediate and final certifications that are valid at national level.

In 2011 the Italian National Qualifications Register (NQR) (112) was created. The register contains national occupation profiles and the minimum education and training standards required. This includes qualifications and learning programmes or learning pathways.

All qualifications which lead to a national occupation profile are described using learning outcomes and matched against the appropriate EQF level.

An aquaculture search on the NQR indicates that there are 15 qualifications available on the Design and management of aquaculture farms, although looking at the list it would suggest there are actually 18. This may be due to overlap in qualifications, but the search would not allow any further progress than this stage and so it was difficult to establish if the qualifications are still available and where they are delivered. The qualifications are broken down as follows:

- Process Sequences / ADA
- Design and management of aquaculture farms qualifications: 15
- ADA.1.247.823 - Design of aquaculture activities qualifications: 0
- ADA.1.247.824 - Programming and management of aquaculture activities qualifications: 5
- ADA.1.247.825 - Health prevention and monitoring of breeding species qualifications: 1
- ADA.1.247.826 - Operation of facilities for raising fish and other fish products. Qualifications: 12

4.11.4 Post-leFP programmes

Specific job-oriented training courses are available to those who have achieved an upper secondary diploma or completed the leFP three/four-year vocational training programmes.

These training courses generally target young unemployed people, adults, migrants and the disabled. The courses are designed to satisfy the needs of the local labour market and will generally last 400 to 600 hours. Upon completion of a course, a regional vocational certificate commonly referred to as a ‘second level qualification’ is awarded, although they are not recognised nationally as there are no regional courses on the national qualifications register (106).

4.11.5 Post graduate VET

Those who have completed a university degree can access post-higher education courses offering a regional qualification which corresponds to a specific occupation not listed in the NRQ. Occasionally these courses may be exclusively addressed to disadvantaged groups (such as migrants, Roma population, disabled people, certain age groups) with the aim of increasing their labour market integration (106).

4.11.6 Apprenticeship programmes

Apprenticeship in Italy designates a work contract with a specific training purpose; it includes both on-the-job and classroom training. The apprenticeship contract, which is distinct from other work-based learning, must be drafted in a written form. It defines the roles and responsibilities of all parties as well as terms and conditions of the apprenticeship, the probationary period, the occupation tasks, wage increases, both the entry and final grade levels and the qualification to be obtained. The training programme is an integral part of the contract. Both the contract and the training programme must be signed by the employer and the apprentice (106).

The apprenticeship system includes three types of contract:

Apprenticeships leading to a professional operator certificate and a professional technician diploma (apprendistato per la qualifica ed il diploma professionale):

These programmes target 15 – 25-year olds, and last three or four years offering the opportunity to achieve qualifications at operator (EQF level 3) or technician level (EQF level 4).

- **Professional apprenticeships** (apprendistato professionalizzante o contratto di mestiere):

  These programmes target 18 – 29-year olds, have a maximum duration of three years and award a regional qualification.

- **Higher education and research apprenticeships** (apprendistato di alta formazione e ricerca):

  This programme targets 18 – 29-year olds and offers opportunities for learners to achieve a range of qualifications normally offered through school, higher education and universities. The qualification levels available encompass EQF levels 4 – 8 and can enable apprentices to engage in research and achieve up to doctoral level degree.

4.11.7 Adult education

Adult education programmes are a set of programmes/courses or education and training activities aiming to update adult vocational skills or improve literacy, delivered by provincial centres for adult education (113) Centri provinciali per l'istruzione degli adulti, (CPIA). The centres are organised to establish a close link with local governments, the world of work and the regulated professions, to provide education according to learning levels:

- First-level programmes, delivered by the CPIA, leading to a first-cycle qualification (a compulsory education certificate) and certification attesting basic skills related to compulsory education (certificato delle competenze di base acquisite in esito all'assolvimento dell'obbligo di istruzione)
- Second-level programmes, delivered by education institutions offering technical, vocational and artistic programmes, leading to an upper secondary education diploma: these may be technical schools, professional schools and artistic licei (diploma di istruzione tecnica, professionale e di licei artistici)

4.12 France

In France the main fin fish species farmed in the marine aquaculture environment are sea bass (*Dicentrarchus labrax*) and gilthead sea bream (*Sparus aurata*). Other marine fin fish species are also produced in small quantities. The total aquaculture production in France for 2014 was 225 921 tonnes, of which 191 500 tonnes was produced in the marine environment (43). Marine aquaculture production in France is dominated by bi- valve molluscs, mainly Pacific oyster (*Crassostrea gigas*) and Blue Mussel (*Mytilus edulis*). Total finfish production in France for 2014 was 41 641 tonnes. This included Rainbow trout (*Oncorhynchus mykiss*) 34 000 tonnes, Common carp (*Cyprinus carpio*) 3000 tonnes, Sea bass 2 021 t and sea bream 1 105 t (33). A range of other species are also produced in much smaller quantities. There were 2953 aquaculture enterprises active in 2014 employing 16 454 staff (FTE 9113), with 2665 active as shellfish enterprises. The total value of the French aquaculture industry in 2014 was €833.9 million. (43)

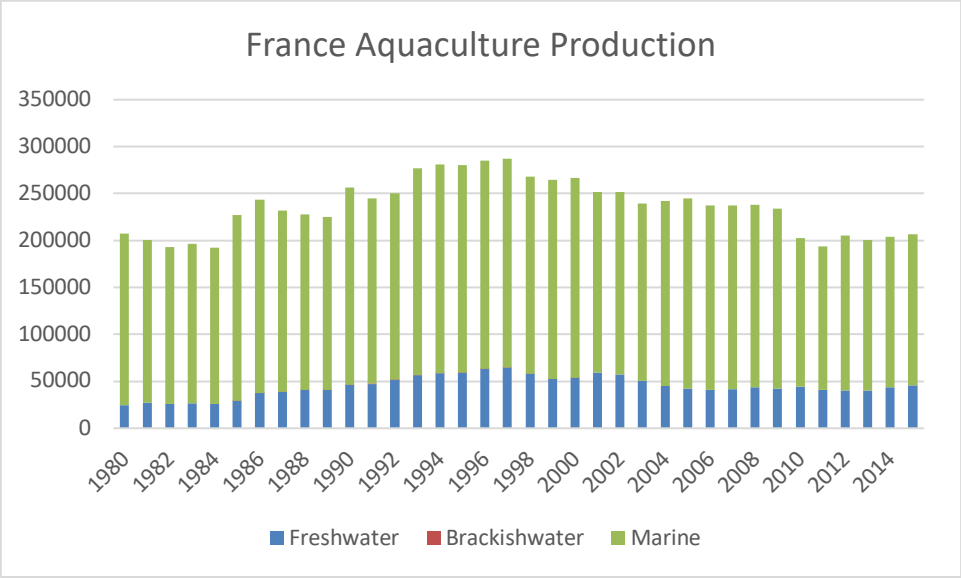

Fig 12 Adapted from FAO data. (36)

Aquaculture in France is not a major contributor to food production overall, however as an industry it is a significant contributor on a regional level particularly employment in coastal regions. (114)

The French aquaculture industry had dropped away in production (Fig 12) from a high point in 1998 to levels in 2015 that were last seen in the 1980's. Despite this reduction in output France expects to increase production output to 265 000 tonnes by 2020 (115).

Further expansion of the French aquaculture industry is necessary but will have to negotiate some obstacles due to a range of factors. This includes competition for space with the tourism sector, environmental and licensing constraints and imports of aquaculture products from other countries. There are opportunities for expansion of the industry, which include improving technology, improving stock and rearing methods, moving rearing sites further offshore, targeting niche markets and improved marketing of the products.

The aquaculture industry in France is represented by different unions or national bodies depending on the production sector. The main organisations are:

- The French Aquaculture Federation (Fédération Française d'Aquaculture) FFA. This is a national organisation made up as a union of regional professional syndicates which represents both freshwater and marine fish farmers
- The Interprofessional Committee for Aquaculture Products (CIPA), of which the FFA is a member (119)
- The French Union of Marine and New Aquaculture (SFAMN)
- Union of Overseas Aquaculturists (UAOM)
- The National Union of Trade Unions and Associations of Aquaculturists in Ponds and Basins (UNSAAEB)
- The French Association of Professionals of Pond Fish Culture (AFPPE)

There are two committees which represent marine aquaculture, the National Committee for Maritime Fisheries and Marine Aquaculture and the Regional and Local Committees for Maritime Fisheries and Marine Aquaculture. Neither committee is representative of freshwater aquaculture in France.

4.12.1 Education and Training

Education and educational policy is the responsibility of The Ministry of Education (116). This includes Initial Vocational Training (IVET) in schools and apprenticeships, although vocational training in agriculture is the responsibility of The Ministry of Agriculture and Fisheries (117). Continuing Vocational Training is the responsibility of the Ministry of Employment (118).

Regional councils have responsibility for some parts of vocational training such as apprenticeships and vocational training for unemployed young people and adults.

Fench Nomenclature	Example qualifications	EQF levels
I-Docorat	Doctoral programmes (Doctorats)	8
I-Master	Master degrees (Masters) Degrees in engineering (titre d'ingénieur) (titles at level I)	7
II-Grade de licence	Bachelor programmes (Licences) Vocational bachelors (Licence professionnelle) (titles at level II)	6
III	Undergraduate technician certificates (Brevet de technicien supérieur) (BTS) Undergraduate technician certificates in agriculture (Brevet de technicien supérieur agricole) (BTSA)	5

	Undergraduate certificates in technology (Diplôme universitaire de technologie) (DUT) Master qualifications (Brevets de maîtrise) issued by the Chambers of Trade (Chambre des métiers)	
IV	Vocational baccalaureates (Baccalauréat professionnel) Technological baccalaureates (Baccalauréat technologique) Professional certificates (Brevet professionnel) Applied arts certificates (Brevet des métiers d'art) Technician certificates (Brevet de technicien)	4
V	Secondary vocational certificates (Certificat d'aptitude professionnelle) (CAP), Brevet d'études professionnelles (BEP)) Secondary vocational certificates in agriculture (Certificat d'aptitude professionnelle agricole) (CAPA) Brevet d'études professionnelles agricoles (BEPA))	3
	No French qualifications and certificates at these levels	1&2

Table 15 Adapted from The French National Qualifications Framework (NQF/RNCP) aligned to the EQF (120)

4.12.2 Training

Education in France is compulsory between the ages of 6 and 16. When children reach 11 years of age they go to *college* (school) for four years with each year known as a class. When a student has completed *college* they are awarded a national certificate (*brevet*). Having successfully completed the third class at 15 years of age they will attend a lycée (High school) until they reach their final year. (121)

The structure of education from *college* to *lycee* for 11 – 18 years of age is shown in Table 16.

Age (Years)	Class	School type
11-12	sixth	collège
12-13	fifth	collège
13-14	fourth	collège
14-15	third	collège
15-16	second	lycée
16-17	first	lycée

17-18	terminal	lycée

Table 16 The age structure of college and lycee attendance at each stage of education from 11 – 18 (121)

Students undertaking vocational courses will acquire knowledge and practical skills required in the world of work at a vocational high school run by either the Ministry of Education or Ministry of Agriculture, or apprenticeship training centres. Studies using these pathways can enable students to achieve; a Certificate of Professional Aptitude (CAP), Vocational Education Certificate (BEP) or a Secondary Vocational Diploma (BacPro).

4.12.3 Initial vocational qualifications

The initial qualifications a student will take at a vocational secondary school, apprenticeship training centre or other training provider are (121):

- **Vocational Aptitude Certificate *(Certificate d'Aptitude Professionnelle* CAP)**
  The *certificat d'aptitude professionnelle* (CAP) is a period of study over two years that focusses on vocational training. It gives students the practical knowledge and skills required to make it possible to enter directly into employment.

- **Technical School Certificate *(Brevet d'Etudes Professionnelles* BEP)**
  The *brevet d'études professionnelles* (BEP) is a period of study over two years that focusses on general education and teaches students higher level technological standards. This pathway differs from CAP as it is more suitable for students aiming to continue studies for a professional or technological *baccalauréat*.

4.12.4 Progression from college

If students follow the usual pathway through education they will take a baccalaureate exam at the end of the final year after studies at a lycee. Successful completion of the exam can lead open up access to university on a degree or can provide access to other options. Students can take professional studies or preparatory classes that will lead to entrance exams to centres of educational excellence (Grand écoles)

When students progress to an upper secondary education at a lycee they can choose from one of three options:

- **General lycee** – students complete general studies over three years to sit a final general baccalaureate exam.
- **Technology lycee** – students complete technological studies over three years to sit a final technological baccalaureate exam

- **Vocational lycee** – students complete general education with high level technical knowledge studies combined with work-based training over three years to sit a final professional baccalaureate exam.

The qualification achieved at the end of this study period is known as a baccalaureate either a Vocational baccalaureates (Baccalauréat professionnel) or a Technological baccalaureates (Baccalauréat technologique)

- **Vocational Baccalaureate (Baccalauréat Professionnel Bac Pro)**
  The baccalauréat professionnel (Bac Pro) is a period of study over two years for students who have successfully completed the CAP or BEP. The Bac Pro can lead to direct employment upon completion or access to further study in higher education.

Candidates can achieve a baccalaureate using one of three pathways (121):

1. candidates sit an external exam (written, oral and practical) (*épreuves ponctuelles*
2. candidates undergo continuous internal assessment (*contrôle en cours de formation* CCF)
3. candidates can have their professional experience validated (la Validation des Acquis de l'Expérience VAE)

Candidates who have worked are entitled to have their experience and knowledge considered when in the process of obtaining a qualification listed in a National Vocational Certification Register (*Répertoire national des certifications professionnelles* or *RNCP*). This is known as la Validation des Acquis de l'Expérience VAE (Recognition of Prior Learning) process (123).

The register provides up to date information on which qualifications/certifications are available and can assist with access to employment and professional mobility. All qualifications on the register are recognised across France.

There are a number of aquaculture qualifications available on the National Vocational Certification Register (Répertoire National des Certifications Professionnelles) RNCP. The French aquaculture sector is a relatively small employer, but there are a range of aquaculture courses available from EQF level 3 – 7 Table 17.

Course Title	Qualification	EQF level	French level
Maritime Shellfish Aquaculture Fitness Certificate	CAP	3	V
Maritime Professional Studies Certificate of Marine Crops	BEP	3	V
Agricultural Professional Studies Certificate Aquaculture Works	BEPA	3	V

Professional Baccalaureate Aquaculture Productions	Bac Pro	4	IV
Professional Bachelor's Degree in Marine Cultures	Bac Pro	4	IV
Higher Agricultural Technician Certificate Aquaculture	BTSA	5	III
Professional Bachelor Agronomy, specialty Aquaculture: quality and environmental management	Professional License	6	II-Grade de licence
Professional License Professional License Animal Productions, Specialty Continental Aquaculture and Aquariology	Professional License	6	II-Grade de licence
Professional License Animal Productions, specialty Aquaculture and sustainable management of its environment	Professional License	6	II-Grade de licence

Table 17 French aquaculture qualifications, adapted from the RNCP (123).

4.12.5. Core skills

The Ministry of Education in France has established a common core of knowledge and skills (122) that should be achieved by each pupil as they end each phase of their schooling.

The core skills are defined as:

- Proficiency in French;
- Knowledge of a foreign language;
- Background in mathematics and science;
- Openness towards information technologies;
- Knowledge of the humanities;
- Social and civic skills;
- Independence and initiative.

4.12.6. Apprenticeships (122)

Apprenticeships involve a mix of training and instruction. This is known as *apprentissage*, which is a programme that divides the apprentices time between an apprentice training centre (centres de formation d'apprentis (CFA)) and the work place.
Apprentices can be aged 16 – 25 years of age and are paid for the work place element of their training. Apprenticeships are regarded as a form of initial training that can prepare trainees for further education and training such as secondary level certification, tertiary qualifications or vocational qualifications.

4.12.7. Additional training

Continuing Vocational Education & Training (CVET) for young adults, adult job seekers and private sector employees is the responsibility of the Ministry of the Economy, Industry and Employment.

CVET is suitable for people who are in work or starting work and is designed to help them in a number of ways including, remaining in employment, developing their skills and gaining vocational qualifications.

As is common across the EU, there is an ageing workforce in France. To ensure the ageing workforce, and the workforce as a whole, can meet the demands of the labour market including advances in technology and ICT, measures have been introduced. They include:

- An individual entitlement to training (*Droit Individuel à la Formation* – DIF), which entitles employees to a right to training and also to accumulate time for training, whilst in work.

- Improved access to vocational training for long term employed (>20 years), who are over 45 years of age. Eligible employees are entitled to an official assessment of their skills if they have worked for the current employer for at least one year.

- Greater scope for people in employment to train outside working hours;

- Introduction of the professionalisation contract (*contrat de professionnalisation*), a single contract allowing employment to be combined with training, for both young people (aged 16-25) and adults;

Employees on permanent contracts have access to professionalisation courses, which are aimed at keeping them in work. Employees can participate in vocational training or obtain a diploma or vocational certificate relevant in the industry or sector in which they are employed.

5. Skills needs in the Aquaculture sector

The information available on research into skills gaps and needs in aquaculture across Europe has been scarce and even more so in relation to specific areas such as marine cage aquaculture. There are a number of studies, mainly in Scotland, which have been carried out that look at aquaculture as a whole and in some cases target fin fish and more specifically salmonid aquaculture. In Norway there was a SINTEF report published which identified skills gaps. Unfortunately, this report is currently only available in Norwegian and as such a full evaluation and review could not be completed.

Although most of the studies and surveys available have been conducted in Scotland the skills gaps and issues identified will be familiar to many of the aquaculture sectors in each of the twelve BlueEDU countries and across the rest of Europe. Each country will have skills issues that may be very specific to the environment and fish species farmed e.g. marine aquaculture in the Mediterranean. However, the more general skills gaps and demands highlighted in this Work Package will be the same, with similar potential problems facing the aquaculture sector as a whole, irrespective of country. The EU predicts a 100% increase in marine fin fish aquaculture production output by 2030. Meeting this ambitious target will lead to an increased demand for labour and in particular skilled labour. If the aquaculture skills issues identified in Scotland are the same across Europe there could be a real danger of a skills shortage in the European aquaculture industry, which in turn would impact on the European sectors ability to achieve its growth ambitions by 2030.

The surveys and questionnaires, targeting the aquaculture sector, which have been conducted in Scotland over the years have asked questions in relation to skills and learning needs within the aquaculture industry. Some have been more in depth than others, however they appear to have identified a demand for skills that has still not fully been addressed to date.

Skills Review for the Aquaculture Sector in Scotland (136)	**A Strategic Framework for Scottish aquaculture (133)**	**Survey of training needs within the Scottish Salmon Industry (138)**	**UK skills assessment (134)**	**Aquaculture Work Based Learning project (135)**	**Aquaculture growth to 2030 (127)**
Production skills	✓	✓	✓	✓	✓
Leadership & organisational management		✓	✓		✓
Boat skills					
Engineering skills				✓	✓
Farm management-stock control	✓	✓	✓		✓
Fish health	✓	✓	✓		✓
Fish husbandry	✓	✓	✓		✓
Digital skills		✓	✓	✓	✓
Soft transferable skills	✓	✓	✓		
Analytical skills	✓	✓	✓		

Table 18 - Compares the aquaculture skills identified as in demand currently and in the future, by the HIE Skills Review (136), with earlier studies and surveys carried out in Scotland.

It can be seen in Table 18 that many of the skills identified in the HIE review have been identified as being in demand or important in previous studies, which in some cases goes back 15 years. This should be of a concern to an industry that has contributed to earlier studies and still finds the identified skills needs are not being addressed. The lack of action to address the skills issues may be the main driver behind the current inhouse training culture in the Scottish aquaculture sector. The industry has already acknowledged that inhouse training is costly and time consuming, but has taken steps to address the skills issues themselves through inhouse training.

Skills and learning are as important to the aquaculture sector as any other and were identified as a priority area in the Smart Successful Scotland report (137). The report described skills and learning as an area in which Scotland must succeed to achieve sustainable long-term economic growth. This applied to all areas of the economy and is as important to the aquaculture sector as any other. To be competitive in the global market the Scottish aquaculture sector must have access to the skills and expertise it requires. If this is not achieved then the Scottish aquaculture sector could be in danger of being at a disadvantage in the global market now and in the future.

The Strategic Framework for Scottish Aquaculture (133) acknowledged that aquaculture will need to be well resourced, and to be successful the industry will require a number of key elements in place including:

- Well qualified staff with opportunities for continuous skill development
- Fish health
- Sound R&D base
- Efficient infrastructure (including housing)

The Framework recognises that well qualified staff are an important requirement and it also acknowledges that the skills levels of aquaculture workers will increase as the industry grows. This will in part be due to the growth in production and the associated technological advances that will also be required to enable the predicted increase in production. If the aquaculture sector grows as predicted there will be an increase in technology and automation but this will not necessarily have a negative impact on the numbers of skilled staff required.

As the production output increases there should be an increase in employment opportunities across the sector, which will achieve one of the European Commission development targets for aquaculture in the EU, highlighted in the Strategic Framework which is:

- Increasing employment, especially permanent and skilled employment in rural areas and remote communities.

Employers have identified that demand is increasing for multi skilled staff and identified potential skills gaps in the following areas:

- Job specific skills
- Communication
- Problem solving

When skills gaps for a job role/occupation need to be identified it is useful to understand the skills required to do that job effectively. This is can be described as the occupational knowledge and skills or competencies. Aquaculture takes place in a variety of environments with a wide range of plant,

fish and shellfish species. This can make it difficult to create a general description of the skill set required to be an aquaculture worker or technician.

5.1. Aquaculture Technician Competencies

A definition was created in 1998 by a group of panellists, all active in the aquaculture industry at that time, at the Third Annual Rhode Island Aquaculture Conference in Warwick, Rhode Island (129). The panel described an aquaculture technician as the following:

"*An Aquaculture Technician is an accountable, resourceful person with a strong work ethic, responsible attitude, and good communication skills. A working knowledge in basic biology, computers, and the seafood industry is a must. The person in this position should possess competencies in the following areas: aquaculture equipment, pumps, plumbing, carpentry, electronics, basic business management, problem solving, and research applications. Previous experience with aquaculture technology and the aquaculture industry is a plus*."

The panel developed a definition of the occupational knowledge and skills competencies required for the job role (Appendix 8). The competencies describe what workers need to know and be able to do in order to perform their jobs well.

The competencies developed very closely align with the course curriculum that was being delivered in National Certificate (NC) full time courses in colleges across Scotland during the 80's and 90's. Interestingly although technology and techniques may advance, very little has changed in the basic knowledge and skills required by an aquaculture technician since those guidelines were created, with many of them still relevant today.

The occupational skills guideline for an Aquaculture Technician is used by the Marine Advanced Technology Education (MATE) Centre. Guidelines were also created for a range of marine job roles, and one which is becoming increasingly more relevant to the aquaculture industry is the ROV technician role. The role descriptions for Aquaculture Technician and Intermediate ROV courses can be found here: https://www.marinetech.org/workforce/

5.2. Training Needs Survey of the Scottish Salmon Industry

In 2008 a survey of training needs within the Scottish salmon industry was commissioned by the Scottish Salmon Producers Organisation (SSPO) and Lantra (138). The survey gathered information from the 11 largest companies active in the Scottish industry at that time, which represented 85% of the farmed Atlantic salmon production in the UK.

The survey examined job roles, skills needs/gaps and reasons why the gaps are not filled. The results identified that the following job roles were considered essential within the aquaculture sector in 2008:

- Fish farm senior management/owner/director
- Fish farm manager
- Fish farm worker
- Fish farm supervisor
- Marine operative

The job roles identified have always been important in some form or other since the aquaculture industry started in Scotland. Importantly the skills required to do the jobs and the gaps which may need filled have also been identified. The training needs survey revealed that the following skills were thought to be increasingly important as the industry grows:

1. Business and management skills
2. Technical/job specific skills
3. Essential skills (e.g. literacy, numeracy, communication and customer relations)

In 2018 those skills are still in demand with the sector facing a potential skills shortage in the current workforce and in the future if nothing is done to address this issue (136).

The training needs survey also identified skills gaps which will need to be addressed to ensure that the skills identified above can be improved upon. Skills gaps were identified in the following areas:

- Fish husbandry skills
- Computing/IT
- Management skills
- Financial/budgeting skills
- Health and safety

The aquaculture sector reports no real skills gaps in 2018 as a lot of the training provision in the sector is carried out inhouse. However, the skills gaps identified in the 2008 survey are at risk of becoming an issue in the future beyond 2018.

The acknowledgment by the Scottish aquaculture sector that there were no skills gaps is not unique to Scotland, as is a recognition that there are skills shortages and recruitment problems which may become more of an issue in the future as the aquaculture sector grows. In 2015 a study was undertaken to assess the profile and diversity of the occupations and skills requirements of enterprises in the different sectors that make up the Marine/Maritime Economy in Ireland (130), and to propose recommendations to ensure the right skill base to meet the enterprise needs. Aquaculture was one of the sectors researched for this study, but it was grouped together with other seafood and bio-product producers so there was very little information available that could be attributed only to aquaculture.

The majority of companies researched in the Irish study did not generally find skills or qualifications difficult to source, but did acknowledge some difficulties recruiting onshore operatives and boat handlers in the local/rural area. The aquaculture sector identified there was an increased demand for environmental monitoring which required upskilling of professionals.

Companies that were interviewed were asked about current and future qualification needs and they have predicted an increase in demand for professionals, managers and administrators. It was suggested that this implies an increase in the professionalism of the sector with the focus on the development of managers and professionals for a number of reasons including, to lead, manage and expand the sector. Those companies that were interviewed have been taking steps to address any potential skills issues by providing training using a range of methods including inhouse and external providers. The company interviews showed that 57% of companies provided 6-10 training days/year/employee for training. The delivery modes which appear most favoured were internally on or off the job (87%) or using private providers (60%).

In 2011, Lantra produced an Aquaculture Report (128) which described the aquaculture workforce as highly skilled, with the skills being achieved through non-accredited training methods which are frequently not recognised. This can usually be attributed to inhouse and short course non-certificated training. The report also stated that staff with qualifications within the aquaculture sector are at a much lower level than the national average across all land and environmental based sectors.

Interestingly the report stated that no businesses reported skills gaps in 2010-2011, which differs from the results found in the Lantra and SSPO survey in 2008 (138). This however was also the case in 2018(136) where businesses reported no skills gaps. This has also been largely attributed to the inhouse training programmes each company had in place, as in the earlier 2011 report (128).

When skills gaps are identified they may not always be due to a lack of training provision by the companies but could also be attributed to the following factors, which have been given as reasons for not filling job roles:

- Lack of suitable applicants
- Competition from other sectors
- Site remoteness
- Lack of affordable housing

This is important to recognise as the aquaculture industry is very itinerant and a lot of staff will move around between companies for a range of reasons, which can then narrow the pool of suitable applicants having the right skill set.

Even though technological advances will improve the efficiency of fish production it was generally felt by companies that employment demand will increase as production grows. The companies that adopt a culture of embracing staff training will reap the rewards of investing in staff seeing a return in their investment through:

- Increased staff motivation
- Increased staff confidence
- Increased staff proficiency

These rewards were generally perceived as the benefits of training in the 2008 survey (128), and can have an additional benefit in improving staff retention. However not all companies can or will invest in staff training as there may be barriers, some of which have been identified and can include:

- Time lost
- Travelling distance
- No staff cover

The barriers identified appear to be particularly problematic for smaller companies as they are less able to absorb reductions in staffing. The 2008 survey (128) recommended that the aquaculture sector has to work harder to retain staff and provide clear progression and development opportunities to attract labour. Investment in staff training must reflect the ‘industry needs’, with staff being kept up to date through training ‘schemes’ and the creation of flexible ‘bite sized’ learning opportunities.

5.3. UK Skills Assessment

The Lantra UK Skills Assessment (134) annual report analysed the current and future skills needs of the UK land based and environmental sectors, of which aquaculture is a sector. The Skills Assessment covered the period 2010-11 and was published in 2012. The report contained a summary of the business issues which apply to the UK aquaculture industry and the skills needed and training solutions recommended to address those issues (Appendix 9).

This was developed through consultations Lantra had with a range of stakeholders as part of a business needs analysis. Some of the recognised solutions to the many skills needs identified in this report were:

- Bite sized, unitised learning
- Knowledge transfer activities, awareness raising
- Recognition via CPD schemes
- Accurate careers guidance information and resources

The recognition that smaller 'bite sized' chunks of learning may be a solution to addressing some of the industry skills needs was central to the Aquaculture Work Based Learning project (135) which created two National Progression Awards (NPAs), that could be achieved by a candidate over an extended time period at their own pace. Successful completion of 'bite sized' chunks of learning would lead to a National Progression Award (NPA).

5.4. Aquaculture Work Based Learning (WBL) Project

The Aquaculture Work Based Learning project (135) was a collaborative partnership between Barony College, NAFC Marine Centre Shetland, Inverness College and Institute of Aquaculture, University of Stirling. The main aims of the WBL project were:

- To gauge the knowledge of the Scottish aquaculture sector in relation to existing aquaculture qualifications

- Inform the industry about new aquaculture qualifications under development

- Obtain the industry opinion on the suitability of the qualifications for the sector at that time.

The new aquaculture qualifications under development were 2 x National Progression Awards (NPA's) which each had 3 x mandatory units and a selection of 4 x optional units, from which a potential candidate would choose one Table 19.

SCQF/EQF levels	SQA Unit Number	NPA Salmonid Fish Husbandry	SQA Unit Number	NPA Fish Health and Feeding
		Mandatory Units		**Mandatory Units**
5/5	H03C 11	Fish husbandry	H03A 11	Fish Nutrition & Feeding
5/5	H03G 11	Water Quality	H039 11	Fish Health
5/5	H03D 11	Live Fish Handling	H038 12	Fin fish Biology
		Optional units		**Optional units**
5/5	H037 11	Cage Operations	H037 11	Cage Operations
5/5	H036 11	Aquatic Environments	H036 11	Aquatic Environments
5/5	H038 12	Fin fish Biology	H038 12	Water Quality
5/5	H03F 11	Salmonid Hatchery Operations	H03F 11	Salmonid Hatchery Operations

Table 19 – The two National Progression Awards (NPA's) created for the Aquaculture WBL project (135) showing the mandatory and optional Scottish Qualification Authority (SQA) units available in each award.

The survey asked if those being surveyed were familiar with the aquaculture qualifications available in Scotland, at that time, and if so which Scottish aquaculture qualifications (if any) those completing the survey had been involved with? Examples of the survey questions and the responses are available in Appendix 10.

The results showed that 41% of respondents had achieved a Scottish aquaculture qualification, which ranged from a basic introduction to fish farming to degree level courses. Although more than half of those responding did not have a Scottish aquaculture qualification, there was a 100% acknowledgement that aquaculture training and education was important to their business or company.

It was generally agreed (88%) that the NPA's and the units within them would meet the needs and future direction of the businesses/companies involved in the survey. The early development of potential candidates was described as crucial and it was agreed (94%) that the proposed NPA's would be suitable for induction training of new employees. When the respondents were asked which delivery modes would be most suited for their circumstances there was no one preferred mode of delivery. Approximately 62% felt a combination of day college release and online delivery methods would be most suitable at that time.

The WBL survey did not specifically set out to identify skills gaps, but rather offered solutions to fill a need which existed at that time. Additional information was provided by some respondents which flagged up areas of Continuous Professional Development (CPD) which they considered important:

- Aquaculture as a business
- Equipment in aquaculture
- Basic maintenance
- ICT
- Finance

This would suggest that something is lacking in those areas which could mean they were skills gaps that needed to be addressed. This project was not pursued after the development phase due to a range of unforeseen circumstances and the units developed were added to the SQA catalogue.

The NPA's were developed and are currently available on the Scottish Qualifications Authority (SQA) catalogue, but to date no centre is offering the awards or as yet is validated to do so. At the time of unit development, it was felt overall (100%) by the industry respondents that both NPA's would be welcomed by the Scottish aquaculture industry.

It should be noted that the SQA catalogue contains another unit, which is not part of the proposed NPA's but is an extremely important unit for the aquaculture sector generally. This unit is called Pen Farmed Fin-fish Containment (SCQF 5) (Refs Marine Scotland technical standard). Information on any surveys that were carried out to inform the creation of this unit could not be found, however it is an important unit that deserves mention in this report due to its relevance to marine cage aquaculture. The unit was created alongside the Technical standard for Scottish Finfish Aquaculture (132) which was developed by the Ministerial Working Group for Sustainable Aquaculture.

The main aim of the Working Group was to create a technical standard that could be used to advise procedures which would prevent fin fish farm escapes as a result of technical failure and related issues. The standard had to reflect innovation and best practice and advise on appropriate training. It was anticipated that every fish farm in Scotland would have its own Standard Operating Procedure (SOP) manual. The standard supplied an SOP template that could be used and adapted to suit the individual circumstances of each company/site.

The Standard stated that the manual should be available for all fish farm staff which must contain the mandatory elements as described in the template. The standard also stated that staff should receive appropriate training in connection with the installation, maintenance and operation of equipment. It has been difficult to obtain information on how much training in this area has been delivered and whether any training delivered has been inhouse or using NRQ's. The two units shown below are currently available on the Scottish Qualifications Authority catalogue.

- H037 11 Aquaculture: Cage Operations (SCQF 5) is an optional unit in the NPA's Fish husbandry and Fish health and nutrition. 2012

- H8 NK 45 Pen Farmed Fin-fish Containment (SCQF 5) published 2015. Currently no centres approved or offering this qualification

A request was made to SQA for information on the uptake of the two units, but very little information could be obtained. SQA confirmed that have been a total of 7 entries for the unit H037 11, Cage Operations (5 in 2012/2013 and 2 in 2013/2014). To date no certifications have been awarded. At this time there are no centres currently offering either of the units and no centre is currently approved to deliver either of the units.

The lack of uptake may be due to very little or no knowledge in the aquaculture sector of the units being available and their relevance.

5.5. National Strategy for Land-based Education and Training

In 2015 Scotland's Rural University College (SRUC) carried out a series of surveys as part of a National land-based strategy (131). The objectives of the surveys were:

- The development of a cohesive land-based curriculum strategy for the sector;
- Identification of current and future employment trends and curriculum requirements; and
- The development of a workable strategy to ensure delivery across SRUC and National Land-based Providers Group (NLBPG) Colleges and where appropriate, to allow realignment to meet future regional and national needs.

As part of the Strategy the Scottish aquaculture sector was surveyed in March 2015 with an employer survey analysis. The survey sent out 116 questionnaires to representatives of the aquaculture sector, with 20 returns which was a response rate of 17%.

Qualification	Number	%
Access/introductory level	8	40
Vocational	12	60
National Certificate	7	35
Higher National Certificate	8	40
Higher National Diploma	6	30
Other e.g. City and Guilds/NPTC/Degree	7	35
Legislative Certification	8	40

Table 20 – Employer responses to which qualifications they would look for in new, replacement or casual members of staff as asked in the National Strategy for Land based education and training, SRUC, 2015.

It can be seen in the Table 20 that the Scottish aquaculture sector identifies vocational qualifications as most sought after (60%), followed by access/introductory courses and Higher National Certificate courses (both 40%). The data obtained may indicate a need for general qualifications to train new entrants the 'basics' and Higher National courses to offer some kind of supervisory/management training either for existing staff or those recruited into a supervisory/managerial role.

Post recruiting for	Number	%
Entry level	3	15
Entry level/newly qualified	4	20
Skilled/experienced	13	65
Supervisory	1	5
Managerial	4	20
N/A	5	25

Table 21 – Employer responses to which job roles they have most difficulty recruiting for as asked in the National Strategy for Land based education and training, SRUC, 2015.

It is apparent, as shown in Table 21, that some of the respondents have found it difficult to recruit staff with relevant experience and skills, which in turn can impact on the pool available for recruitment of staff into a supervisory or management position. Interestingly the respondents did not appear to have a lot of difficulty in recruiting to supervisory/management roles. This does not necessarily mean they agree that the people recruited into the supervisory/management roles have all of the skills required to be a successful leader or manager.

The land-based industries include many sectors and so each sector had to create a Focus Group to consider a strategy for their sector, with the findings of each group included in the final report.

The Aquaculture Focus Group analysed the survey results and identified a number of key areas including recruitment, training and suggested recommendations to address any issues that were raised. The Focus Group acknowledged that there was a recruitment problem in the aquaculture sector, which was mainly attributed to a negative public perception of the industry and a lack of awareness of the potential career opportunities available in aquaculture.

The Focus Group did identify efforts that have been made to address those problems by the creation of a National Progression Award (NPA) for schools. This qualification provides school leavers with an opportunity to learn more about the sector and the career possibilities, but there still appeared to be a general lack of knowledge and awareness among schools, teachers and advisors. Older adult new entrants to the sector can be those seeking a career change, but may also be there as they need a job to stay in the area.

It was found by the Focus Group that college provision at that time was limited to work based programmes with many employers providing in house training for employees, which satisfies the requirements for their business. This however can limit the mobility of staff and qualifications gained as they may not be recognised by another employer if the staff member moves between companies. Training staff using Nationally Recognised Qualifications (NRQs) or national accreditation of all inhouse qualifications and training could benefit the employees and companies as this would negate the need for wasting resources retraining each new staff member recruited.

The Focus Group identified a potential opportunity for a full-time college programme to be developed that would bridge the gap between school leavers and those already employed in the industry. This type of full-time provision had been available in Scotland in the past, but a decline in candidate numbers over the years forced all full-time courses to close down. There are NRQs available, currently focused on SVQ & MA programmes which are offered at two centres in the Highlands and Islands at Inverness College and NAFC Shetland.

Aquaculture specific management qualifications were found to be lacking, but there was a general acknowledgment that there were generic management units and training courses available that could be used to fill the gaps. The Focus Group felt that an SVQ level 4 management qualification was required that would be specific to the aquaculture sector. The SVQ level 4 has now been developed and is currently being delivered by NAFC Shetland. To date the it would appear that the SVQ level 4 has been well received and all feedback is positive. Industry uptake of the MA's was viewed as a positive endorsement of part time provision, but may in part also be due to the lack of any other sector provision.

The Focus Group identified a number of areas within the sector which will require additional training to meet the future needs of the industry. These would be potential skills gaps and included RAS, feeding systems, laboratory skills and auditing processes. The Group recommended that delivery centres and industry should work collaboratively to:

- Explore the national demand for at least one introductory course in aquaculture.
- Review the existing short courses and other available short programmes, to examine the possibility of validating the existing provision and developing these into nationally accredited awards where appropriate.
- Explore the demand for online flexible delivery material.

No evidence could be found to confirm whether any of the Focus Group recommendations had actually been carried through. This does not necessarily indicate that the recommendations have

been ignored but may suggest they are still under development and not available in the public domain.

Although the information available on previous studies looking at skills needs in the twelve BlueEDU countries is virtually non-existent, other than in Scotland, the messages and lessons learned from the work carried out in Scotland over the years could be applicable elsewhere. In the past 2-3 years there appears to have been a more concerted effort in Scotland to address the issues facing the aquaculture sector currently and, in the future, including skills which are being recognised as a high priority.

5.6. Scottish Aquaculture: A view towards 2030

In 2017 an innovation roadmap and sector needs study was published which detailed a roadmap for the Scottish aquaculture industry (126). The roadmap looked at the current status of the Scottish aquaculture sector and the steps that will be required to achieve the industry ambition of increasing aquaculture production output to 350 000 tonnes for marine finfish and 21 000 tonnes of shellfish by 2030.

The roadmap identified a number of areas that will need to be addressed if the industry is to move forward and grow as predicted. One of those key areas was a need for more vocational skills training. This was identified as a high priority for the industry which should be addressed within 5 years. In earlier studies and surveys skills needs and training have been identified as lacking and required, but normally with no time scale for the issue to be addressed.

The roadmap study also identified that the demand for more vocational skills training will increase in the future as the industry becomes more reliant on advances in technology such as Recirculating Aquaculture System (RAS) and Closed System Aquaculture (CSA). The industry has usually relied on staff solving technical issues with little or no training, particularly in engineering related areas. This increasingly appears to be a problem area which historically was being addressed in part by the full-time college based qualifications delivered in Scotland during the 80's and 90's. The National Certificate (NC) course ensured candidates received training in areas such as welding, construction, engine maintenance and repairs and boat handling as core elements of their training. This produced graduates that had received basic training in most of the skills required by a fish farm worker.

Currently and in the future however there appears to be more demand for aquaculture specific engineering and technology training, which has been identified as something which is lacking in Scotland's aquaculture sector. It has been suggested that the industry should exploit the downturn currently being experienced by the oil and gas sector by recruiting the staff who are experienced in using marine technology and working in the offshore environment.

Due to the very practical requirements of the aquaculture sector there is a demand for a more hands on approach, with more vocational training to address the skills gaps which have been identified. The industry also recognises that education and training has always struggled to maintain pace with the technological and innovation advances of the sector. However, to address these issues it will require a much more collaborative approach between education/training providers and the aquaculture industry (producer, health and supply companies) to ensure new entrants or existing staff are receiving the most up to date education and training. This however can be problematic when dealing with younger potential trainees as site access is not always available due to health and safety restrictions.

5.7. Aquaculture Growth to 2030

In 2016, a Working Group of leading aquaculture businesses and organisations came together to create a growth strategy for aquaculture in Scotland to 2030 (127). The aim was to deliver an ambitious, industry-led plan for sustainable growth across the entire aquaculture value chain. The Working Group recommended, as part of the growth strategy, the formation of an Aquaculture Industry Lead Group (AILG) to drive sector growth and ensure alignment between industry and government. For high levels of sustainable growth to be delivered to 2030 and beyond the Working Group identified six strategic priority areas, which were:

1. Industry leadership and ambition
2. Enabling and proportionate regulation
3. Accelerating innovation
4. Skills development
5. Finance
6. Infrastructure.

In planning a growth strategy for the industry to 2030, the characteristics of a thriving aquaculture sector could range from leading regulation globally to world-class research and skills. One of the characteristics the Working Group would like to see is a 'skilled and diverse workforce'. This diverse workforce would have access to a wide and ongoing range of opportunities for training and skills development, and include aquaculture recruits with a range of relevant qualifications or experience, including:

1. Fish health
2. Husbandry
3. Engineering
4. Environmental science
5. Software development
6. Business management

The Working group had identified 20 strategic priorities and recommendations categorised as Lead priority, High priority and Lower priority. The mapping of future skills requirements was identified as a lead recommendation (highest priority). To achieve this goal the Working Group recommended that the existing workforce skills composition of the aquaculture and supply chain sectors should be mapped. This mapping would be led by the AILG, Highlands and Islands Enterprise (HIE), Skills Development Scotland (SDS) and the Scottish Aquaculture Innovation Centre (SAIC), and should target all levels of the workforce including apprenticeships through to leadership and management. Once completed this would enable a skills gap analysis to be carried out and a skills development strategy to be developed that would provide the skills most needed for growth in the industry.

5.8. Skills Review for the Aquaculture Sector in Scotland

The Scottish Aquaculture Growth Strategy (127) recommended that the existing skills set of the Scottish aquaculture workforce should be mapped to enable a skills gap analysis and a skills development strategy to be developed. A skills review study (136) of the aquaculture sector was carried out between July 2017 and January 2018 by ekosgen, in partnership with Imani Development, and commissioned by Highlands and Islands Enterprise (HIE) on behalf of the Aquaculture Industry Leadership Group (AILG).

In its conclusion the HIE Skills review study made six key recommendations:

- Promoting the sector as a career destination
- Develop leadership, management and business capacity
- Consistency and transferability of training and education
- Developing a digitally enabled workforce
- Enhance provision of work based learning and vocational training
- Widen the recruitment pool

More details of each recommendation can be found in Appendix 7, but it should be noted that most of the recommendations have been identified or described in earlier reports and studies as areas requiring attention to address the skills issues the industry faces.

HIE AILG Skills demand (2018)	**MATE Aquaculture Technician occupational competencies definition (1998)**
Production skills	Field experience, Basic business, Computer, keep up to date
Leadership and organisational management	Basic business, Communication, Analytical, Field experience, Maths, Time management, Internship experience, Computer, Keep up to date
Boat skills	Mechanical skills, keep up to date
Engineering	Mechanical skills, keep up to date
Farm management-stock control	Maths, Field experience, basic biology, analytical skills, computer skills, basic business skills, keep up to date
Fish health	Laboratory skills, basic chemistry, field experience, basic biology, keep up to date
Fish husbandry	Basic chemistry, basic biology, field experience, maths, keep up to date
Digital skills	Maths, communication, analytical skills, computer skills, keep up to date
Soft transferable skills	Communication, analytical skills, time management, internship experience, keep up to date
Analytical skills	Maths, communication, analytical skills, time management, computer skills, internship experience, keep up to date

Table 22 Comparison of the skills demands identified in the HIE Skills Review 2018 (136) with the MATE definition of the skills required by an Aquaculture Technician in 2001 (129).

It can be clearly seen in Table 22 that the skill demands identified in the 2018 skills review are very similar to the definition described for an aquaculture technician in the past. The occupational competencies defined in the MATE definition (129) aligns closely with the curriculum used for the Aquaculture National Certificate awards that were delivered in Scotland through the 80's and 90's. This may suggest that the National Certificate courses in Scotland were producing candidates with the skills required by the industry at that time. If this was the case, then there may be scope for a reintroduction of a similar qualification to address the skills needs identified in the HIE 2018 skills review. There may also be justification for revisiting the Scottish Higher National Certificate (HNC)

award which was aimed at providing candidates with the skills required to step on to the first rung of the supervisor and management career ladder.

The SRUC National Strategy (131) identified that there was a high demand for HNC level qualifications, and a higher demand for qualifications that are vocational. This would suggest that any education and training whether it be introductory or aimed at management should consider a more vocational approach to the qualification design and delivery.

To address the six recommendations in the skills review, and move the industry closer to achieving its future growth ambitions the Scottish aquaculture sector will face a number of challenges now and in the future. One of the main challenges will be meeting the current skills needs of the industry and the skills needs required to achieve the future growth ambitions of the sector. To do this successfully the workforce will have to be dynamic and able to adapt to changes within the sector. This will require all stakeholders to collaborate more and be proactive in identifying skills needs and addressing them quickly.

The skills review indicated that there is a demand for a range of skills in the aquaculture sector currently and in the future. Some of the skills are in high demand, whilst others are increasingly becoming more important as the industry has become more consolidated and production has increased.

Some of the skills identified as being in high demand are:

- Production skills - the highest demand
- Leadership and organisational management skills in demand across the sector
- Boat skills
- Engineering skills

Some of the skills that are becoming increasingly important include:

- Farm management skills- stock control
- Fish health skills
- Fish husbandry
- Digital skills - driven by expansion, automation
- Soft transferable skills e.g. team working, building positive relationships and customer care
- Analytical skills

All of the skills identified in the skills review are important to different areas such as fish production and staff management, but ultimately, they will all be essential for staff to meet not only the current needs of the sector but also the future ambitions as the sector grows.

In Scotland the skill demands of the industry should also lead to an increased demand for training courses, but the availability of suitable courses and qualifications which are aquaculture specific at this current time is low, and the shortage of suitable qualifications and training is critical. The demand appears to be there for a wide range of aquaculture specific courses/qualifications and includes those with a mainly vocational or practical element. Currently the only real options available to the sector are the SVQ and MA courses with training providers making attempts to address the demand for suitable qualifications that can cover all levels from operatives to management. Some of the qualifications and courses currently available are:

Apprenticeships to SVQ2 SCQF 5 (MA2)

Apprenticeships to SVQ3 SCQF 7 (MA3)
Technical MA in Aquaculture Management SVQ4 SCQF 9
SVQ Boat building and repair

Although the aquaculture sector is a growing industry, the numbers of skilled staff available is low. Employers are currently investing time and money with inhouse training and upskilling their staff, however this may not be happening at a rate that can keep pace with the demand. It is important to consider that there will be movement of staff between companies within the industry, which can be a particular problem when skilled staff move from one company to another.

The skills review study identified that employers are spending an increasing amount of time training staff due to the shortage in skilled staff availability. When companies invest time and money in staff training and the trained staff leave this could have an impact on their willingness to invest further in staff training unless it is required for statutory or compliance e.g. legislation or QA schemes. Aquaculture companies may also feel restricted in the availability of suitable aquaculture training courses due to a lack of availability.

There would appear to be a clear demand for more vocational training, but there is a perceived lack of training availability which may stem from the fact that the bulk of the Scottish vocational training provision is offered in the Highlands and Islands NAFC Shetland, with some provision through Inverness College. Some employers may feel that the courses and training on offer at NAFC Shetland may not be freely available due to the geographic location of the centre.

The report suggests that there may be scope for a cross sectoral approach to training in local areas which could overcome the perceived geographical problem for the provision of some vocational training and education. However, the sector will require much more collaboration between employers, training providers and educational establishments to address the skills needs of the industry currently and going forward. The report identifies that there is a need for more vocational education and training in key areas such as H&S, boat skills and management/leadership and a vocational/practical based degree. The requirement for management training and or a vocational degree may be in part be addressed by the Technical Modern Apprenticeship level 4 being offered by NAFC.

5.8.1. Management and leadership skills

In the past there was an element of the ‘grandfather’ rights culture in Scotland’s aquaculture sector, where the person who has been there longest or with the most experience of farming fish will get the manager role as it becomes vacant. It would appear this may no longer be the case as the industry has matured and grown, but it may still be prevalent in some areas due to circumstances such as geography and recruitment problems. Although fish farming experience and good stock management is essential it does not automatically mean an individual will be a good site and staff manager. An ability to manage the stock is obviously important, but managing people and a business whilst demonstrating leadership skills requires a much more extensive skill set. In an ideal situation of succession planning the staff member earmarked for a management role will have received training and been given the opportunity to gain experience in all that is required for the job role.

Good leadership and management are crucial for any business or organisation to function effectively, and the aquaculture sector is no different. Fish farm managers require a range of management skills, which include fish production management, leadership, business and

commercial skills. Those skills are important now and will continue to become more important in the future as the industry grows. This study identified that the aquaculture sector lacks suitable management skills in all levels of management from assistant managers to senior management and at a range of levels in between. This includes finance, marketing and HR. Producers have reported a lack of skilled assistant managers, which creates problems for succession planning and they face challenges recruiting or developing staff with the range of management skills they require. Unless addressed this may continue to be a major problem as the aquaculture sector workforce is ageing and recruitment of new entrants is low.

The 2008 Lantra survey (138) identified supervisor, manager and senior manager roles as among those that are essential to the industry. This is still the case in 2018 as the HIE skills review (136) shows. The demand for good leadership is even greater in 2018 and has grown due to the increased consolidation and intensification of the industry over the past 10-20 years. A study in Ireland in 2015 (130) found that there was also a demand for professionals and managers that will be required to lead, manage and expand the sector. The 2008 Lantra report (138) identified skills such as business and economics, team working, and soft skills as becoming increasingly important as the industry grows. The HIE 2018 skills review (136) clearly shows that this predicted demand is there, and needs to be addressed.

The Technical MA in Aquaculture Management SVQ4 SCQF 9 currently being offered by NAFC has been well received by the industry and is a step in the right direction. However, the number of centres offering the qualification may need to be more widespread to reach learners across a larger geographical area.

5.8.2. Biological skills

As fish production intensifies the potential for general health, disease and welfare issues will also increase. This report identified that there is a shortage of staff with relevant skills in biology, health and nutrition in the current workforce to meet the current demands and if this skills shortage is not addressed it will become a serious problem in the future.
Those concerns have been raised by previous studies and reports (133, 138, 135, 127), some of which highlighted job specific skills such as fish health, husbandry, welfare, feed and nutrition and environmental sciences as important to the industry now and in the future. The aqua WBL survey (135) shows that the industry rated qualifications in fish husbandry, feed and nutrition and fish welfare as very relevant to the industry at that time, and agreed that qualifications that included those subject topics would be welcomed by the industry.
As the industry grows with the increased potential for reliance on RAS and CSA systems, the need for staff with suitable biology, welfare, health, nutrition, environmental and chemistry qualifications will be vital and so it is something that the sector should consider addressing as a matter of urgency.

5.8.3. Technical, engineering and ICT skills

As the demand for aquaculture engineering and technical specialists is increasing and there are no providers offering the training required, the issue could become increasingly problematic as the industry looks at siting further offshore, where engineering, technical and boat handling skills and qualifications will be in high demand. The need for trained staff with more technical and engineering

skills has been recognised over the years, but has now become a major skills issue for the sector. The 2003 strategic framework (133) predicted an increased reliance on technology and automation as the industry increased production, with technical skills identified as increasingly important in the Lantra 2008 report (138). The need for more aquaculture specific engineering and technology training was suggested in the Scottish aqua view to 2030 report (126), with engineering and software development identified as skills required in the current workforce and in the future. The HIE report in 2018 (136) confirms that the demand is still there and has not been addressed. Failure to take steps to address this issue may have serious implications for the future growth of the Scottish aquaculture sector.

The sector took advantage of the downturn in the oil and gas sector and recruited staff with some of the skills required, however this could change very quickly as the oil and gas sector experiences renewed growth there will be competition for staff with desirable technical and engineering backgrounds.

This report confirms that the future demand for technical skills is expected to increase, with more specialist skills being required as the industry grows and technology develops.
With an expected increase in production there will also be an increase in reliance on technology and automation. There will be a requirement for staff with the technical and ICT skills including, ICT literacy, using digital technology and using environmental monitoring equipment and techniques. All of those skills are linked to the skill set required to maintain the health and welfare of fish stocks as monitoring and maintaining a well-balanced environment will help ensure the health and welfare of stocks is maintained at the highest standards. The HIE skills review highlighted that these skills are lacking, and are in high demand which will have to be addressed to meet the industry future growth ambitions.

If the aquaculture industry does become increasingly reliant on developments in Closed System Aquaculture (CSA), Recirculated Aquaculture Systems (RAS) and offshore production facilities, there will be a requirement for staff to be upskilled/requalified in working with new technology and possibly more in-depth training related to fish health and welfare. The demand for staff with technical and engineering skills is viewed as an immediate need that will continue to increase as technology changes. Retraining will not only be required for the aquaculture sector but also the supply companies who will supply any new technology to the sector. This review has shown that supply companies have identified a skills shortage across the sector with increasing demand for engineering and technical skills. The demands for engineering and technical skills are high and if not addressed the aquaculture sector could be in danger of failing to meet the 2030 growth ambitions of the industry.

5.8.4. Industry recruitment

The Scottish aquaculture sector has experienced recruitment problems over the years and in particular attracting people with the right skills. The recruitment demands of the industry have not been met with a lack of experienced workers joining the industry, problems attracting new recruits and low numbers of recruits from education.

The skills review study (136) acknowledged that the industry has become more reliant on international employees across the sector from processing and husbandry to more specialist veterinary professionals. The prospect of Brexit may have a negative influence on recruitment of international staff that may further increase the skills problems being faced by the industry, which in turn could have a negative impact on the Scottish aquaculture industries future growth ambitions.

The report identifies some of the main factors which could affect recruitment and offers potential solutions:

- Geographic location (remoteness)- Shift systems could be trialled which are based on the oil and gas sector way of working e.g. 2 weeks on and 2 off. If the industry started to adopt the system used in the oil and gas sector this could have a negative effect on the local community as there would be a loss of permanent members in the community.

- Lack of housing and other infrastructure (schools, health services)- Some companies have been working with housing associations and local authorities to address the housing issue.

- Low public perception of the industry- the industry has to be more proactive in raising the industry profile with an increased effort in promoting a more positive and accurate perception. This could be done through increased activity through the media and in schools and colleges.

Recruitment problems and factors which may affect them are directly related to skills gaps and it does highlight some of the problems being faced by the industry in trying to fill the gaps, which if not addressed will only continue to become more of a problem.

Employers in the aquaculture sector may be facing problems finding staff with suitable skills to fill the job roles but this study found that employers report relatively few skills gaps in the existing workforce. This has mainly been due to the ongoing inhouse training schemes being provided by companies.

Inhouse training can include a company's own internal training scheme combined with some external training provision e.g. short courses. The 2018 skills review (136) acknowledged that inhouse training is important but there is a lack of consistency across the sector. This lack of consistency can result in training being repeated if an employee moves between companies. This can be costly and time consuming, but it would appear the companies see this as the only option available to fulfil their training needs. The lack of consistency in training could be addressed by all companies using Nationally Recognised Qualifications (NRQ's) which would not only lead to consistency in staff training and qualifications across the sector but would also save time and money as staff will not require retraining if they move between companies. There is however a potential unforeseen problem with some staff reluctant to undertake training. This study reported a general perception that staff are reluctant to undertake accredited training as they fear a negative impact on their employment if they are unsuccessful. It is unlikely that this would be in any company policy, but more likely to be a fear of failure which is more of a cultural or social issue.

There would need to be a change in how vocational education and training is delivered, with a much more 'itinerant' approach to training provision rather than only offering training at one or two centralised locations. If there was a consistent approach to training provision and all training was accredited the mobility of the qualifications and training would be improved.

6. Vocational Education in Europe

6.1. Cedefop European public opinion survey on vocational education and training 2017

In 2017 Cedefop published results of a public opinion survey on VET (2). The aim of the survey was to explore EU citizens understanding and attitude towards VET and how it is viewed in their own country. The survey focussed on IVET at upper secondary level with some questioning on CVET. Approximately 36000 citizens over the age of 15 were interviewed face to face, and information collected on VET in four main areas:

(a) citizens' awareness and knowledge of VET;
(b) attractiveness and access to VET;
(c) experience and satisfaction of VET users;
(d) perceived outcomes and effectiveness of VET.

It is widely acknowledged that education and VET in particular has an important part to play in developing and maintaining a workforce that can meet the challenges faced by the EU countries in an increasingly competitive global market place.

The role of VET is important as it is a way of providing an education that prepares learners for a specific job, with VET graduates generally find a job quicker than general education graduates. The majority of respondents interviewed agreed that general education, which is traditional classroom-based learning, has a more positive image than VET in their country, and that VET was perceived to be lower in status as it was easier to achieve and hence has become associated with low achieving students.

Opportunities for progression to higher education are normally associated with general education and less so with VET. This survey showed that 46% of students opted for VET as a means to find a job whilst 45% chose general education to help them continue to higher education. However, the survey results showed that 54% of Europeans agreed that it is easy to continue to higher education after vocational education at upper secondary level, but the majority of respondents agreed that general education has a more positive image than VET.

The survey respondents from the EU 28 countries were asked if their upper secondary education was primarily general or vocational, with an EU average of 40% of the respondents declaring that their education was vocational. There were wide variations however and the majority of the BlueEDU countries generally had low levels of participation in vocational education below the EU average. The UK (23%), Cyprus (18%) and Ireland (12%) had the lowest figures. Two of the BlueEDU countries had above average figures for participation in vocational education at upper secondary level, Finland (48%) and Croatia (68%). There are no figures for Norway, Iceland, Faroe Islands as they are not part of the EU 28 and Scotland has no separate figures as it is part of the UK.

The information gathered in this survey showed that people generally have a positive perception of VET and value it as a way to find employment, strengthen the economy, reduce unemployment and tackle social exclusion problems. The survey however did show, in some countries, that there is still some negative perception associated with VET and it is viewed as a second choice for second rate students with fewer opportunities for progression in education. This misconception that VET is second rate and restricts progression to higher education for VET candidates reduces the attractiveness of VET as an option.

The misconception of VET as second rate may be due to the perception of national experts in most EU countries that VET is occupation specific and geared towards supplying skilled labour, but inferior to general education or more academic education pathways (3).

It is important that efforts are made to address the general perception of VET by promoting the pathway as a viable option that not only improves employment prospects but also supports education and lifelong learning whilst also improving the mobility of a workforce.

6.2. WAVE (Working in Aquaculture-Validation of Experience)

The WAVE project (4) established a European Master list of competencies for aquaculture primary production, which were developed using existing aquaculture activities and practices. The existing aquaculture activities and practices used to inform the competencies were identified through interviews carried out with aquaculture employees ranging from site operatives to managerial level using a number of production techniques and many aquaculture species.

This informed the creation of an inventory of technical competencies organised into 16 groups with 248 competencies, which aimed at making it easier to identify the knowledge, skills and competencies required to work in the industry. The competencies are organised in general categories for both shellfish and fin fish as hatchery operations and on-growing operations.

It has been difficult accessing the WAVE online tool as the link asks for a file association to continue. Access to the WAVE tool may have been useful to research and establish whether it has been kept up to date since completion in 2007. The NOS in Scotland have been updated since 2007 so it would be interesting to match the current NOS against the master list to confirm if all details are still relevant.

6.3. VALLA (Validation of all lifelong learning in Aquaculture)

The VALLA project (5) used the WAVE project as a basis for validating informal and non-formal learning in aquaculture via the European Qualifications Framework (EQF). The validation of informal and non-formal learning is commonly known as Recognition or Accreditation of Prior Learning (RPL/APL). The VALLA project produced a tool and methodology which could be used to describe and evaluate unaccredited training or learning using the learning outcome format. This can then be used to identify a learning outcome for a subject area and advises how the learning outcome can be acquired and assessed.

It has been difficult to access the online matrix, which in turn makes it impossible to research whether the matrix content is still relevant. The learning outcomes used in the matrix, samples found in other VALLA documents, look very similar to the Scottish NOS. The NOS in Scotland have been updated since the VALLA project ended in 2010. It would be interesting to establish whether the relevant updates have been entered onto the matrix. The link below no longer appears to be live.

6.4. MENTOR Project

The Blue Career Centre of Eastern Mediterranean and Black Sea (MENTOR) (6) is a two-year project set up as a consortium of seven partners and co funded by the European Maritime and Fisheries

Fund (EMFF). Two of the consortium partners are also target countries for BlueEDU, Cyprus and Greece. The project aims to improve the employment prospects of young job seekers and experienced workers in the key blue sectors of the Eastern Mediterranean region, which in turn will support businesses in finding suitably qualified staff.

To achieve the aim the project will:

- Attract higher education graduates or persons with a vocational/technical qualification to maritime professions through targeted and innovative education and/or training initiatives (including career guidance);
- Retrain and up-skill workers employed in other sectors and/or people currently unemployed for a job in the blue economy;
- Diversify and expand the skills of people currently employed in the blue economy to progress in their career and/or to facilitate their mobility to other maritime jobs.

There are many expected results for this project but the one that is most relevant to Blue EDU will be the development of online introductory e-learning courses for each of the selected maritime sectors, of which aquaculture is one. To date the courses have not been completed.

6.5. Entrefish Project

The Entrefish Project (7) aims to fulfil the skills needs of the aquaculture and fishery sectors in Italy and France by strengthening the entrepreneurial and managerial skills of those already employed in those sectors or prospective employees. The project will address the unattractive or negative image of those sectors by positive promotion of the sectors to attract graduates with higher education knowledge and skills and combine those with people from the 'primary production' end of the scale with practical expertise.

It has long been known that higher level education does not always fully prepare young graduates for the world of work but if those same graduates are merged on a common platform with those from the working environment they will share and exchange ideas and information leading to an increase in innovation for the sector. This in turn will improve the long-term sustainability of the sectors as it may encourage the younger generation to undertake a 'blue career'.

The Entrefish project will aim to improve awareness of the potential for skills development and employability in the aquaculture and fishery sectors through a co-ordinated programme of workshops, seminars and online promotion.

The project includes the development of learning/training packages to support the learners and so learning materials will be developed for the following:

- Development of guidance and training tools using Powerpoint, briefs and case studies. This will be delivered to entrepreneurs and workers in the aquaculture and fishery sectors with the aim of improving their skills.

- Development of guidance and training tools using Powerpoint, briefs and case studies. These will be delivered in a classroom environment and using e-learning tools, aimed at graduates and undergraduates in biology and economics.

- There will also be a vocational element where the practical skills required will be applied. Teams/groups will be formed that will allow graduates, undergraduates, entrepreneurs and workers to work together in a series of pilot traineeship activities.

6.6. FISHFARM Project

The EU Lifelong Learning Programme (LLLP) funded a project called FISHFARM (8) which involved the co-operation of six European nations (Turkey, Poland, Hungary, Italy, Lithuania and Iceland) and was completed in 2013. The main aim of the FISHFARM project was to create a sustainable scientific curriculum for fish culture and cage rearing operations towards solving persistent problems in aquaculture.

The project overall goal was to develop a new curriculum for fish farmers producing fish in the sea and freshwater in Europe, collecting the most recent information and research with the aim at finding solutions to recently emerged problems with rearing of fishes.

The project was in two parts with the first part involving a needs analysis in the form of a questionnaire sent to participants in each of the partner countries. *The questionnaire was completed across six countries with a total of 325 respondents.* The purpose of the needs analysis was to identify the current education and skills of fish farm workers and establish which skills they required for their job role. The majority of the survey participants were individuals currently employed in the aquaculture sector of their country. The experience levels of respondents also varied from very little or no experience to a wide-ranging experience. Participants were given a questionnaire which asked them to rate their current education and skills, then rate the skills described in the questions which they prioritised. There were 24 questions covering nine main aquaculture related categories as shown in Table 23.

Categories	Questions
Broodstock, spawning and egg handling.	1-3
Hatchery and on-growing.	4-7
Water quality and management.	8-10
Fish health management	11-13
Water management and disposal	14-15
Biology and ecology	16-17
Education	18-20
Legislations and standards.	21-23
Fisheries Products and human health	24

Table 23 Aquaculture question categories for the FISHFARM project adapted from FISHFARM Project, Need Analysis Report (9)

Participants were asked if they needed skills (expertise) in the fish farming categories referred to in the questionnaire. They were also asked to estimate their current and desired skill levels in each of the categories and prioritise the action required for each category. The skills were rated 1-5 with 1 = No skills, 3 = satisfactory skills and 5 = professional knowledge, and the priorities were rated A-C with A = very urgent, B = Completed within a year and C = No urgency.

Although there were differences observed between countries and the aquaculture categories there was a general positive response to the survey questions with overall 89.9% of the respondents agreeing that there was a need for more skills in the fish farming categories identified in the questionnaire. The highest average response rates were noted in the fish health (97.9%) and feeding (99%) categories. The Needs Analysis shows that the respondents were of the opinion there was substantial room for improvement on the skills and knowledge in the fish farming categories used in the survey.

The second part of the project was the creation of FISHFARM portal to host an online training resource informed by the results of the needs analysis survey. There were 14 modular courses created, each with learning outcomes and online assessments designed to assess the knowledge of potential candidates (Appendix 2). A FISHFARM handbook was also created to support the knowledge and understanding of potential candidates. As the overall goal of the FISHFARM project was to develop a new curriculum for fish farmers, marine and freshwater, in Europe this development contributes to that goal.

As the workforce in the EU is ageing (10) access to lifelong learning will become more important in many industries, including aquaculture. VET systems will play a major role in increasing participation in lifelong learning, raising the competence levels of the workforce and inevitably improve educational qualifications. There is a general apathy and lack of confidence towards VET in some countries, but this attitude and negative perception could be changed by improving the flexibility of VET systems, modes of delivery and assessment, progression routes and access to lifelong learning.

To raise the profile and boost participation in VET requires a close collaboration between education, training providers and employers. Efforts must be made to get employers on board and get them to appreciate that investing in staff development and training will be a huge benefit to the future of their own business. If collaborations can be formed, the qualifications and standards created will be real and aligned to the world of work, have credibility as they are endorsed by industry and have a much greater chance of being successful.

6.7. ONEDIN Aqualex

The ONEDIN (Online delivery of Interactive Modules in Marine Science and Aquaculture) project (11) was a Leonardo da Vinci three-year pilot project started in 1996.
The rationale for the project was to design, develop and deliver online vocational courses that would allow candidates to update their skills from the remote locations often associated with aquaculture sites.

The online modules available are as follows:

- Fish shellfish and crustacean meristics

- Cost effective feeding of fish in aquaculture
- Standard Operating Procedures (SOPs) for fish farm management and maintenance of fish health.
- Basic techniques in fish haematology
- Introduction to the marine environment

The online course modules were created and made available in three languages (English, Norwegian and Greek) on the Aqualex Multimedia Consortium Ltd (AMC) web portal. The online modules do not appear to be available at this time but may be restricted access. Various attempts to access the modules have been unsuccessful.

6.7.1. ONEDIN2

ONEDIN2 (12) was a continuation of the earlier project and was a dissemination project delivered through a series of multiplier workshops from 1999-2001. ONEDIN2 aimed to promote the content of the previously developed online courses and their delivery through international workshops offered to the aquaculture community.

6.8. ORION

ORION (13) was a Leonardo da Vinci project that run from 2001-2005. The main aim of the project was to create an environmental science Virtual Learning Environment (VLE), powered by a suite of innovative teaching/learning tools.

The output achieved in the ORION project is shown below:

Course materials, online assessment and tutor support in the following units:

- Marine environment
- Marine pollution
- Artemia, rotifer and phytoplankton production
- Otolith age determination
- Marine biodiversity
- Tropical ecology
- Content Management Tool for design and open-ended delivery of course materials
- Content Management Tool Manual for academic users
- Dedicated multilingual website www.orioninfo.org
- Online language learning units in English, Greek, Portuguese and Swedish with audio input
- Creation of new marine pollution glossary (1400 terms)
- Resource repository with
    a. Aquaculture bibliography BIMAQUE (8600 items);
    b. Fish, Shellfish and Crustacean Meristics
- AQUALEX glossary

The establishment of an ORION network was aimed at linking the partners for basic language learning units in English, Greek, Portuguese and Swedish, with restricted access to the course materials used to run academic courses. Some of the course materials can be accessed freely such

as, the AQUALEX glossary and the language learning areas. Various attempts to access the other materials have been unsuccessful to date.

6.9. PESCALEX

The PESCALEX project (14) was funded with support from the LEONARDO da VINCI pro-Gramme of the EU. The main aims of the project were to create online self-tuition Content and Language Integrated Learning (CLIL) courses for aquaculture.

The project targeted areas in Europe where aquaculture is economically significant and the languages of those countries (UK, Ireland, Greece, Hungary, Norway, Poland, Spain). The PESCALEX project aimed to create an educational hosting website that has the following multi-uses:

- Fish health/disease course
- Dedicated Multi lingual glossary
- Language learning (CLIL) modules (English, Greek, French, Spanish, Norwegian, Polish)
- Secure online student assessment facility

In addition, a workshop was planned which would be used to disseminate products such as a language learning simulation game based on fish diseases.

The PESCALEX project achieved the following outputs in English, Greek, French, Spanish, Norwegian and Polish:

- Fish health/disease courses
- Fish Pathology for Rainbow trout, Sea bass, Salmon and Carp
- A Fish Health Manual
- Basic techniques for fish pathology
- Fish nutrition
- Self-tuition language learning modules (levels1&2-CEFR A&B) including Portuguese and Swedish
- PESCALEX fish diseases glossary
- Language learning simulation game (English, French, Spanish, Norwegian and Polish
- Distributed network capable of inserting new course material and handle secure student short tests.

The PESCALEX learning materials are still available and can be accessed freely. They would be a useful addition to a course of learning that included fish health and disease modules.

6.9.1. PESCALEX 2

The PESCALEX 2 project (15) was set up to expand on the work already done for the previous PESCALEX project (2005-08). The main aims of PESCALEX 2 were to transfer the materials from PESCALEX to a wider audience.

- Transfer the PESCALEX materials to Turkey, Hungary, Galicia, Spain.
- Translate all PESCALEX materials into Hungarian, Turkish, Galician
- Transfer the fish health/disease content to new users

- Combine innovative Vocationally Orientated Language Learning (VOLL) with tutor led & online distance learning methods.

PESCALEX 2 achieved the following:

- Multilingual website portal containing all deliverables
- Online VOLL modules, with audio input in English, Greek, French, Spanish, Norwegian, Polish, Hungarian, Turkish and Galician
- Online glossary of fish diseases in English, Greek, French, Spanish, Norwegian, Polish, Hungarian, Turkish and Galician
- Printed handbook with 11 beginner language modules English, Greek, French, Spanish, Norwegian, Polish, Hungarian, Turkish, Galician Swedish and Portuguese
- International Workshop for dissemination to farmers and for playing online language game (English, French, Hungarian, Spanish)
- Diagnostic tool for diagnosis of turbot diseases (English, French, Hungarian, Spanish)

Online modules available in English, Greek, French, Spanish, Norwegian, Polish, Hungarian, Turkish, Galician:

- Basic techniques of fish haematology
- Fish health manual
- Fish pathology – Rainbow trout, Sea bass, Salmon, Carp, Turbot
- Cost effective feeding of fish

6.10. PerformFISH

The PerformFISH project (16) is a five-year project started in May 2017 till April 2022 and involves a consortium of 28 partners from 10 countries. Producer organisations from countries (Greece, Spain, Italy, France and Italy) representing 92.8% of the total EU sea bass and sea bream production, are also directly involved. The project has been started to address the growing concerns about the lack of growth in the Mediterranean Marine Fish Farming (MMFF) industry. It is anticipated that PerformFISH will work to ensure sustainable growth of the MMFF industry, based on consumer perceptions and real market requirements.

The expected results and specific objectives of the PerformFISH project are shown in the appendices (Appendix 3). Some of the objectives of particular relevance to Blue EDU are

- Identify and develop reliable diagnostic methods
- Generate different preventive strategies based on immune-prophylaxis and efficient treatments against the relevant diseases
- Outline practical methodologies for fish welfare awareness at farm level.
- Develop health management strategies for the industry in order to improve the current KPI's (mortality, morbidity and economic indexes)
- To develop a Code of Conduct and consolidate best practices and harmonised standards to raise consumer awareness and advocate social and environmental responsibility of the MMFF industry

- Capture key messages and outcomes for active Knowledge Transfer through training and appropriate communication channels
- Carry out Capacity Building and Training based on knowledge generated through the PerformFISH project across the MMFF
- Provide employment and trade in rural, peripheral and coastal regions
- Development of human capacity building
- To carry out capacity building activities (targeting technical, vocational and tertiary levels) that ensure transfer of best practice, create conditions for uptake and application of competitive knowledge by the MMFF, and build a competent, versatile workforce contributing to Blue Growth
- To effectively link to the relevant EU policy frameworks (Common Fisheries Policy, BLUEMED Initiative, Marine Strategic Framework Directive), contributing knowledge and recommendations for appropriate policy making in relation to marine aquaculture development.

6.11. INTRANEEMA (Innovation Transfer Network for Mediterranean Mariculture)

The INTRANEMMA project (17) was a two-year project funded by the EU Lifelong Learning Programme with a consortium of five partners from four countries (Greece, Spain, Turkey and Ireland). The project brought together Mediterranean mariculture industry partners to identify and improve the vocational skills needs of the sector. Once any knowledge and training gaps have been identified training courses would be developed which would fill the gaps and take the Mediterranean mariculture industry to a higher level of sustainability, particularly sea bass and sea bream aquaculture.

The aim of INTRANEEMA was to improve the quality and attractiveness of the European Vocational Education and Training (VET) system by adapting and integrating content and results from the WAVE (Working in Aquaculture Validation of Experience) project, into public and private vocational systems for mariculture companies in the Mediterranean region. The master list of competencies created by the WAVE project were used by INTRANEEMA as a starting point for training needs identification. Once the skills gaps were identified INTRANEEMA adopted the tools and methodologies developed for VALLA (Validation of All Lifelong Learning in Aquaculture) to develop suitable training based on a learning outcomes approach.

6.11.1. Project outcome

INTRANEEMA designed training tools/modules that would provide learners with the required competencies, in a familiar workplace environment. These were delivered as a series of training events in each of the host countries (Greece, Turkey and Spain) and were customised to take into consideration the different national curriculum or accreditation structures. The courses were competence based and designed to enable the validation of non-formally acquired competence skills. It was anticipated that:

- The aquaculture sector will benefit from innovative courses better equipped to respond to the immediate needs of the industry.
- The Mediterranean area will benefit from the transfer of knowledge and skills through courses and improved educational attainment of having courses accredited with the EQF.
- Consumer will benefit as the innovations will ultimately improve the end-product.

The web page or any modules for INTRANEEMA could not be accessed and as such it was not possible to verify if the training modules are still available for use, or if the website has been maintained.

6.12. Targetfish

The TargetFISH project (18) is a collaborative project run from 2012 -2017 with 30 partners from 10 EU member states, 2 associated countries 1 international Cooperation Partner Country (Chile). The project was funded by the EU under the 7th Framework Programme for Research and Technological Development.

TargetFish brought together leading European research groups that are experts on the fish immune system and enterprises from the Biotech and Veterinary sectors to advance the development of existing (but not sufficient) and new prototype vaccines against socio-economically important viral or bacterial pathogens of Atlantic salmon, rainbow trout, common carp, sea bass, seabream and turbot.

The main objectives of the TargetFISH project were to:

- Generate a knowledge- and technology-base for rational development of next generation fish vaccines by studying antigens and adjuvants for mucosal routes of administration
- Validate knowledge of immune responses for monitoring vaccine efficacy and safety, including issues associated with DNA vaccines
- Approach implementation of prototype vaccines by optimizing vaccination strategies, thus shortening the route to exploitation

The TargetFISH project has an element of Research and Development, but vocational training and education will be an important aspect of the project when testing and training will be necessary to ensure the efficient and effective delivery of the vaccine to the fish. Initial training events took place during the project, including demonstrations and training in new vaccination machinery use and the dissemination of information and results to the industry on vaccine developments and effectiveness.

6.13. AQUALEX

6.13.1. AQUALEX LINGUA

The AQUALEX LINGUA project (19) was set up with the specific objective to create a consistent body of terminology organised into a glossary providing full explanations of 2750 aquaculture terms in four languages (English, French, German and Greek).

The project used earlier work produced in 1986 as a baseline and expanded the glossary defining the range of terms including culture species, biology, farm environment, farm products and equipment used.

The AQUALEX LINGUA project achieved the following:

- 1995 - Presentation & paper, International Association of Marine Science Libraries (IAMSLIC)

- 1996 - AQUALEX Multimedia Consortium (AMC) Ltd set up to commercialise the glossary
- 1997 – AQUALEX glossary publication in four languages
- 1997 - Multilingual CD-ROM package with clickable terms and definitions and a native speaker sound archive for every term in the glossary
- 1998 – Production of a second CD-ROM, Basic Techniques in Fish Haematology
- 1998 – Third interactive CD-ROM published for LISBOA 1998-spotlight on Greek Marine Science
- 1998 – Construction of a dedicated website

6.13.2. AQUALEX 2 (1999-2001)

The AQUALEX 2 project (20) was a Leonardo da Vinci multiplier project which continued the work done on the earlier AQUALEX LINGUA project. The main aims of the AQUALEX 2 project were to:

- Disseminate the results of the AQUALEX LINGUA glossary
- Update the glossary contents to include new developments in genetics
- Translate the glossary into Spanish, Norwegian and Italian

The project ran from 1999 – 2001 and the following were achieved:

- Further development of the AQUALEX website
- Update the AQUALEX glossary (3500 items) in English, French, German, Spanish, Norwegian and Italian.
- International 3-day workshop in Szczecin, Poland with more than 100 participants
- AQUALEX: dissemination of a multilingual glossary in support of multimedia and online products related to fisheries and aquaculture

6.14. AQUAEXCEL (2011-2015)

The main aim of the AQUAEXCEL project (21) was to provide the European aquaculture community with a platform of top class infrastructures offering experimental capacities and expertise for all aspects of aquaculture research across a wide range of aquaculture production systems, environments, sizes and species. AQUAEXCEL involved a collaboration of 17 partners from 10 countries and 23 facilities with an overall objective of integrating, on a European scale, key aquaculture research infrastructures, in order to promote their coordinated use and development.

AQUAEXCEL will:

- Link and coordinate key research infrastructures in Europe: cage, recirculation and hatchery aquaculture systems, land and sea based, fresh and salt water installations in order to create the basis for synergistic research projects.
- Provide research teams with access to a wide range of the state-of-the-art infrastructures covering all important aquaculture species, systems, environments and expertise.
- Increase resource sharing and standardization between partners, notably but not exclusively for fish models and experimental methods developed in-house.
- Stimulate innovation through transfer of knowledge, harmonisation and development of best practices across fields of research, production systems and species.
- Execute joint research and development activities designed to improve the services currently provided by the infrastructures (remote access and monitoring, more accurate

performance evaluation, limitation of live animal use, applicability of results at industry scale, development of biological models).
- Bridge the gap between the scientific community and the industry through stimulation of problem-based research and enhanced knowledge transfer.

6.14.1. Expected Results

- Access to state-of-the-art aquaculture research infrastructures by research teams who would otherwise not normally have access to these facilities.
- Coordination of key research infrastructures in Europe, creating the basis for joint research projects.
- An online inventory of key aquaculture research infrastructures, facilities and services.
- Harmonisation and standardization of resources between partners, notably but not exclusively for fish models and experimental methods developed in-house.
- Transfer of knowledge activities, such as training early-stage researchers and technicians on the latest experimental methods in aquaculture research.

6.14.2. Actual results of AQUAEXCEL

- Project partners built an interactive map that provides an in-depth overview of over 100 aquaculture research institutes in Europe and their expertise, facilities and services. They mapped the research needs of European aquaculture research institutes, which helped to identify gaps.
- Best practices guidelines were developed, analysed and disseminated on various issues affecting the aquaculture industry. A data management tool was also created to organise, maintain and distribute data on aquaculture research.
- Transnational access resulted in the funding and implementation of 97 innovative projects. European aquaculture researchers from academia and industry were given the opportunity to conduct experiments in leading research institutes.
- Developed new phenotyping tools and methods to help provide more accurate data from experimental fish. It also created tools to analyse fish health under stress, to indicate the onset of puberty and to tag fish in early life.
- Coordinated access to outstanding aquaculture research institutes for European researchers.
- The creation of four technical courses aimed at improving staff performance and employability of European aquaculture professionals.

The four courses focused on different aspects of aquaculture experimentation as shown in Appendix 4

6.15. AQUAEXCEL 2020 (2015-2020)

AQUAEXCEL2020 (22) is a research infrastructure project funded under the EU's Horizon 2020 programme, started in October 2015. The consortium comprises 22 partners based in 12 European countries integrating 39 European aquaculture research facilities.

The main aim of the AQUAEXCEL2020 project is to further support the sustainable growth of the aquaculture sector in Europe by integrating a large group of leading European aquaculture research facilities and so advancing European aquaculture research and innovation.

AQUAEXCEL2020 is similar to the previous project AQUAEXCEL (2011-2015) and will build on the outcomes of AQUAEXCEL. To do this AQUAEXCEL2020 will:

- Provide training for Transnational access users, aquaculture researchers, technical staff and industry stakeholders.
- Provide a single access portal to high quality harmonised services and resources tailored to the needs of the European aquaculture community, support and conduct world class research and provide the basis for a European aquaculture innovation system.
- Create courses on aquaculture technology and fish biology that will be delivered face to face and distance learning over the five-year duration of the project.
- Develop standardised guides and new tools for aquaculture research including a dedicated e-infrastructure which will support both actual and virtual research experiments.

The AQUAEXCEL2020 training courses will be offered between April 2016 and November 2019 to anyone interested in the subject areas. A total of nine courses will be offered, six as face to face events and three as online distance learning courses. Details of the training courses offered are shown in Appendix 5.

6.16. ParaFISH Control

The ParaFish Control project (23) is an EU H2020 funded project with a consortium of 29 partners from 13 countries.

The project aims to increase the sustainability and competitiveness of the European aquaculture industry by improving the understanding of fish-parasite interactions and by developing innovative solutions and tools for the prevention, control and mitigation of the most harmful parasitic species affecting the main European farmed fish species.

Details of the objectives and expected results of the ParaFish Control project are shown in Appendix 6.

It is anticipated that the ParaFish Control project will lead to improvements in biosecurity and the health and welfare of farmed fish.

6.17. Aqua-tnet

Aqua-tnet (24) is the European Thematic Network that was originally set up in 1996 as a collaboration of university departments and research institutes. The network grew steadily over the years and by 2005 had become the largest multi-disciplinary European Education Network in the field of aquaculture, fisheries and aquatic resources management.

Aqua-tnet continues its leading co-operative role strengthening communication between higher education institutions, academic organisations, research institutions and industry. The ongoing work includes improving mobility, promotion of lifelong learning and innovative teaching and language learning deliverables. European Higher Education has been identified as having a vital and innovative contribution to realising a Europe of knowledge, particularly over the next decade up to 2020. The establishment of a European Higher Education Area (EHEA) in aquaculture, fisheries and aquatic resource management is fully supported by Aqua-tnet.

The Aqua-tnet network has a number of achievements and key milestones to its credit, but of most relevance to BlueEDU is the course database and teaching resources. The following education & teaching resources are accessible through the Aqua-tnet portal:

- Aquacase
- HealthyFISH
- AQUALABS
- Vocational AQUALABS

The structure and content of each of the resources are summarised below, but more information can be accessed using the weblinks provided:

6.18. Aquacase

Aquacase (25) is a portal designed as a supplement to traditional classroom teaching to provide information about different types of aquaculture facilities. The purpose of the portal is to create a virtual tour of aquaculture facilities that can be used as supporting information for assignments.

The site is divided into the following main categories:

- Hatcheries
- Ongrowing
- Mussels
- Seaweed
- Shrimps
- Country information
- Learning activities
- Other resources

There are a number of learning activities available to students and a teacher resource page. The learning activities available to date are shown below:

- Learning activity: What's the Salmon Survival Rate at Each Life Stage?
- Learning activity 1: Welfare in your rearing system
- Learning activity 2: Restoring water quality
- Learning activity 3: Selecting a species for aquaculture
- Learning activity 4: Finding the production potential for your site
- Learning activity 5: Estimating the number of juveniles needed for production of caviar

- Learning activity 6: Find the appropriate distance between mussel socks based on the mussel condition index
- Learning activity 7: Estimate the Carrying Capacity for Ecotourism activities in the marine-coastal area
- Learning activity 8: Is there an adequate availability of food for current mussel production in the culture area of Chalastra?
- Learning activity 9: Environmental Impacts of mussel farming on water quality

The learning materials for Aquacase can be freely accessed with resources available for both learners and teachers.

6.19. HealthyFISH

The HealthyFISH project (**App HEALTHY FISH**) was a project funded under the Erasmus+ programme with the objective to develop a Standardized Training Program at European level for the aquaculture sector. The project identified that there was a need to professionalise the aquaculture sector and by so doing improve its competitiveness. The project run from 2015-2017 and was led by the Spanish Marine Fish Farmers Association (APROMAR) in a consortium made up of five partners from four countries; Spain, Turkey, Italy and Croatia.

The project partners developed a standardised training programme for the aquaculture sector. This included the development of training modules for the qualification of professionals and training content required to train staff in health and welfare skills and the physical/chemical control of fish. The training programme was innovative and made use of new technology and designed an app called ‘App HealthyFISH’.

The HealthFISH programme was divided into 11 modules available in five languages, English, Spanish, Italian, Croatian and Turkish.

The following modules are available:

- Technologies and production management of auxiliary cultures
- Analytical technologies and methods of sanitary control in fish farming
- Technologies and production management of mollusks
- Technologies and production management of crustaceans.
- Facilities, innovation and systems of automation in fish farming
- Environmental Management of the aquaculture processes
- Ornamental aquaculture
- Project of implantation of a center of aquaculture production
- Risks management: Chemical and biological hazards
- Aquaculture Products. Processing trade and Public Health
- Best Practices in aquaculture farms

Each module has ten multiple choice questions and once the modules have been completed the candidate can take a final test of 30 questions, available in five languages.

The results of the project and the training programme were disseminated by the consortium partners to industry professionals, students, associations and other stakeholders within their respective countries.

6.20. AQUALABS

The AQUALABS project (27) delivered seven training events over the time period 2005-2006. The training courses were aimed at early stage aquaculture researchers with the objective of improving their practical skills using a combination of hands on laboratory and field experience. The training programme consisted of six advanced training courses and a final multidisciplinary workshop, with each course having three stages:

- Preparation – centralised internet-based system
- Training – 5-7 days intensive training (lectures, practical hands on experience, field trips)
- Sustainability – tutor support and online assessment

The training course titles were as follows:

- Molecular Biology and Ecology
- Freshwater Aquaculture and the Environment
- Fish Welfare
- Quality in Fish Products
- Aquatic Animal Disease Diagnostics
- Recirculation Technologies
- Student workshop

The courses and other Aqualab resources could not be accessed and may not still be live. There are no indications to suggest a permission to access may be required, however this may be the case.

6.21. Vocational AQUALABS

Vocational AQUALABS (28) was a two-year project (2009-2011) funded by the EU Lifelong Learning Programme. The main aim of the project was to improve Vocational Education and Training(VET), systems for researchers in the European aquaculture sector. Vocational AQUALABS identified the generic skills required in aquaculture research and developed modular courses (Table 24) that would be used to fill any skills gaps identified.

The Vocational AQUALABS project built on four other EU projects:

1. WAVE – Working in Aquaculture Validation of Experience

2. AQUALABS

3. VALLA - Validation of All Lifelong Learning in Aquaculture

4. AQUA-TNET 2008-11

The following modular courses were piloted by the Vocational AQUALABS project:

Course title	Location	Delivery date
Experimental Design	Ankara University, Turkey University of Stirling, Scotland	23rd November 2011
*Aquaculture Talent Hatchery (ATH) Challenge	Online pilot with a Greek, English, Spanish and Irish team with a final presentation in Rhodes, Greece (in English)	1st September 2011 - 21st October 2011
Data and Statistical Management	Aberdeen University, Scotland	16th November 2011
Scientific Writing and Introduction to Statistical Analysis of Aquaculture Data,	Aberdeen University, Scotland	17th and 30th November 2011
Project Management	Bodrum, Turkey (in English and Turkish)	25th October 2011
	Ankara University,Turkey (in Turkish)	3rd and 7th November 2011
Networking, Research Funding Procurement and Project Management	Bodrum, Turkey (in English and Turkish)	24th and 25th October 2011

Table 24 The modular courses, delivery locations and dates offered through the AQUALABS project.

6.21.1 Vocational AQUALABS - *Aquaculture Talent Hatchery (ATH) challenge

The Aquaculture Talent Hatchery (ATH) Challenge was one of the seven courses funded under the Vocational AQUALABS project. Four teams comprised of aquaculture students and early stage researchers competed, over a six-week period, against other national teams to develop a business plan under the Aquaculture Entrepreneurship Mentorship programme (www.aquaculturetalent.com)

The challenge

Each team of entrepreneurs formed a mini company to develop a plan which had the most potential for commercialisation. The four plans produced were as follows

- UK team - The commercialization of ShellPlant®: a closed system for bivalve farming
- Irish team – A plan on the cutting edge of lobster cultivation technology “Lobster Alive”
- Spanish team – A plan on sustainable production of marine microalgae oil to replace fish oil in fish feed production “Microoilfeed”
- Greek team – A plan on Omega 3 rich oil (85%) for human consumption based on the utilization of aquaculture and fisheries by-products “MedMarPlus”

The four national teams had an opportunity to present their business plan to a judging panel of ATH mentors and industry representatives at the Aquaculture Europe Conference in 2011. The UK team was voted as the winning team.

References

(1)- Global Aquaculture Alliance, accessible from https://www.aquaculturealliance.org/ accessed March 2018

(2)- Cedefop (2017). *Cedefop European public opinion survey on vocational education and training*. Luxembourg: Publications Office. Cedefop research paper; No 62. (http://www.cedefop.europa.eu/en/publications-and-resources/publications/5562)

(3)- Cedefop (2017). The changing nature and role of vocational education and training in Europe. Volume 2: Results of a survey among European VET experts. Luxembourg: Publications Office. Cedefop research paper; No 64. http://www.cedefop.europa.eu/en/publications-and-resources/publications/5564

(4)- WAVE-Leonardo project accessible from: www.vallaproject.com/index/7/wave.html

(5)- VALLA-Leonardo project accessible from: www.vallaproject.com

(6)-Blue Career Centre of Eastern Mediterranean & Black Sea, accessible from: http://mentor.cubiclemon.net/

(7)- Entrefish-European Maritime & Fisheries Fund (EMFF) program accessible from: http://www.entrefish.eu/

(8)- FISHFARM-EU Lifelong Learning Programme (LLLP) funded project accessible from: http://fishfarmeurope.eu/fishfarma/

(9)- FISHFARM project, Needs Analysis Report, 07.07.2013, Einarsson S.M

(10)- European Foundation for the Improvement of Living and Working Conditions (Eurofound), accessible from: www.eurofound.europa.eu/topic/ageing-workforce

(11)- ONEDIN (Online delivery of Interactive Modules in Marine Science and Aquaculture), Leonardo da Vinci pilot project, accessible from: http://www.aqualex.org/index.php/european-projects/joomla-page/page-offline-3

(12)- ONEDIN2 Leonardo da Vinci dissemination project, accessible from: http://www.aqualex.org/index.php/european-projects/joomla-page/page-offline-4

(13)- ORION Educational Database, Leonardo da Vinci pilot project, accessible from: http://www.aqualex.org/index.php/european-projects/joomla-page/page-offline-6

(14)- PESCALEX, Leonardo da Vinci funded project, accessible from: www.pescalex.org

(15)- PESCALEX 2, Lifelong Learning Transfer of Innovation Programme, accessible from: www.pescalex.org

(16)- PerformFISH project, European Union Horizon 2020 research and innovation funded programme, accessible from: www.performfish.eu

(17)- INTRANEEMA project, EU Lifelong Learning Programme, accessible from: www.intranemma.eu

(18)- TargetFISH project, EU funded under the 7th Framework programme for Research and Technological Development, accessible from: http://targetfish.eu/project

(19)- AQUALEX LINGUA project accessible from: www.aqualex.org/index.php/european-projects/joomla-page/page-offline

(20)- AQUALEX 2, Leonardo da Vinci multiplier project, accessible from: http://www.aqualex.org/index.php/european-projects/joomla-page/page-offline-2

(21)- AQUAEXCEL project, European Community's Seventh Framework Funded programme, accessible from: www.AQUAEXCEL.eu

(22)- AQUAEXCEL 2020 EU Horizon 2020 Research and innovation funded programme, accessible from: www.aquaexcel2020.eu/

(23)- ParaFISH Control, EU H2020 funded project, accessible from: http://www.parafishcontrol.eu/

(24)- Aqua-tnet European Thematic Network, funded under the EC Lifelong Learning Programme, accessible from: (www.aquatnet.com)

(25)- Aquacase Teaching Resource Website, accessible from: (www.aquacase.org)

(26)- HealthyFISH Moodle platform, accessible from: http://healthyfish.apromar.es/

(27)- AQUALABS project, European Community's Sixth Framework Funded Programme, accessible from: https://cordis.europa.eu/result/rcn/48057_en.html

(28)- Vocational AQUALABS, EU Lifelong Learning funded programme, accessible from: (www.aqualabs.eu)

(29)- Europe 2020 Strategy, accessible from: https://ec.europa.eu/info/business-economy-euro/economic-and-fiscal-policy-coordination/eu-economic-governance-monitoring-prevention-correction/european-semester/framework/europe-2020-strategy_en

(30)- Summary of the 27 multiannual National Aquaculture Plans (2016), accessible from: https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/27-multiannual-national-aquaculture-plans-summary_en.pdf

(31)- European Qualifications Framework for Lifelong Learning, accessible from: https://ec.europa.eu/ploteus/sites/eac-eqf/files/leaflet_en.pdf

(32)-The European Qualifications Framework: supporting learning, work and cross-border mobility, accessible here: http://ec.europa.eu/social/main.jsp?catId=88&eventsId=1296&furtherevents=yes&langId=en

(33)- FEAP European Aquaculture Production Report 2008-2016, accessible from: http://www.feap.info/Default.asp?SHORTCUT=582

(34)- Faroe Islands in Figures 2014, Hagstova Foroya, accessible from: http://www.hagstova.fo/sites/default/files/Faroe%20Islands%20in%20figures%202014_0.pdf

(35)- BAKKAFROST –Capital Markets Day Report, 7 June 2016, R.Jacobsen & G.Nielsen, accessible from: http://www.bakkafrost.com/media/1316/2016-06-07_bakkafrost-presentation-cmd.pdf

(36)- FAO Fishery Statistical Collections, Global Aquaculture Production, Statistical Query Results accessible from:

http://www.fao.org/figis/servlet/SQServlet?file=/usr/local/tomcat/8.5.16/figis/webapps/figis/temp/hqp_2638913183769692296.xml&outtype=html

(37)- Aquaculture in Iceland, Licensing Process, Monitoring and Environmental Impact Assessment, A.R.Böðvarsdóttir *et al*, accessible from: https://notendur.hi.is/runam/annaposter.pdf

(38)- Icelandic Seafood Market Report, 2015, accessible from: https://islandsbanki.is/library/Skrar/Seafood-Reports/Islenski%20Sjavarutvegurinn%202015%20-%20ENSKA.pdf

(39)- Icelandic Aquaculture Association, accessible from: http://www.lf.is/is/fiskeldi-a-islandi-2/fyrirtaekin-i-fiskeldi-a-islandi/

(40)- Fish Farming Expert 14/02/2017 accessible from: https://www.fishfarmingexpert.com/article/braced-for-icelandic-boom/

(41)- Reference report of the Icelandic Qualifications Framework ISQF to the European Qualifications Framework for Life Long Learning EQF, 2014 accessible from: https://ec.europa.eu/ploteus/sites/eac-eqf/files/EQF_Reference_Report_2014.pdf

(42)- Curricula – Basic Study Course for Fish Processing Workers (Fraedslumidstad Atvinnulifsins 2nd edition 2016)

(43)-Scientific Technical & Economic Committee for Fisheries (STECF) – EU aquaculture Sector Data, accessible from: STECF 16-19 report

(44)- Fish Farming in Finland, published by the Finnish Fish Farmers Association

(45)- Finland: Multiannual national plan for the development of sustainable aquaculture an overview, accessible from; https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/summary-aquaculture-strategic-plan-finland_en.pdf

(46)- An overview of aquaculture education in the Nordic countries, with special emphasis on recirculating aquaculture systems (RAS) Prepared by Hanna Ahonen and Juhani Pirhonen, 2017, accessible from: https://www.luke.fi/wp-content/uploads/2018/03/uaculture_education_Nordic_countries.pdf

(47)- Finnish National Agency for Education, Qualification Frameworks, accessible from: http://www.oph.fi/english/curricula_and_qualifications/qualifications_frameworks

(48)- Global inventory of regional and national qualifications frameworks, 2017 **Volume II:** National and regional cases, accessible from: http://www.cedefop.europa.eu/en/publications-and-resources/publications/2222

(49)-TTS Workers Association, accessible from: http://www.tts.fi/kouluttaudu/koulutustarjontamme/johtaminen_ja_yrittajyys

(50)- University of Eastern Finland, accessible from: http://www.uef.fi/en/web/fishedu

(51)- Finnish National Board of Education; Requirements for Vocational Qualifications, VOCATIONAL QUALIFICATION IN FISHERY 2010 Regulation 22/011/2010, accessible from: http://www.oph.fi/download/150247_VQ_Fishery_2010.pdf

(52)- National Strategic Plan for Sustainable Aquaculture Development, accessible from: https://www.agriculture.gov.ie/media/migration/seafood/marineagenciesandprogrammes/nspa/NationalStrategicPlanSusAquaDevel181215.pdf)

(53)- Referencing of the Irish National Framework of Qualifications (NFQ) to the European Qualifications Framework for Lifelong Learning (EQF), 2009a

(54)- Aquaculture Growth to 2030, accessible from: http://scottishsalmon.co.uk/wp-content/uploads/2016/10/aquaculture-growth-to-2030.pdf

(55)- QAA: Qualifications can cross boundaries: a rough guide to comparing qualifications in the UK and Ireland, "014, accessible from: http://www.qaa.ac.uk/en/Publications/Documents/Qualifications-can-Cross-Boundaries.pdf

(56)- Scottish Qualifications Authority (SQA) official site, accessible from: https://www.sqa.org.uk/sqa/70972.html

(57)- SQA Scottish Credit and Qualifications Framework (SCQF) description, accessible from: https://www.sqa.org.uk/sqa/71374.html

(58)- Scottish Credit and Qualifications Framework (SCQF) official site, accessible from: http://scqf.org.uk/

(59)- Scottish Government; Work and Skills, accessible from: http://www.gov.scot/Topics/Education/skills-strategy/making-skills-work/sectorskillscouncils

(60)- National Occupational Standards for Learning and Development, March 2010 accessible from: https://www.sqa.org.uk/files_ccc/Appendix%209%20-%20NOS_learn_and_dev.pdf

(61)- Scottish Vocational Qualifications and other SQA accredited qualifications, accessible from: https://www.sqa.org.uk/sqa/2.html

(62)- Modern Apprenticeships, accessible from: https://www.sqa.org.uk/sqa/79473.html

(63)- Skills for Work, accessible from: https://www.sqa.org.uk/sqa/5951.html

(64)- Recognition of Prior Learning, accessible from: https://www.sqa.org.uk/sqa/67029.html

(65)- Guide to Recognition of Prior Learning (RPL), accessible from: http://scqf.org.uk/rpl-introduction/

(66)- Scottish Government; School Curriculum and Qualifications, accessible from: http://www.gov.scot/Topics/Education/Schools/curriculum

(67)- About Core Skills, accessible from: https://www.sqa.org.uk/sqa/37801.7292.html

(68)- Norwegian Directorate of Fisheries, Statistics for Aquaculture, accessible from: https://www.fiskeridir.no/English/Aquaculture/Statistics

(69)- The referencing of the Norwegian Qualifications Framework for Lifelong Learning to the European Qualifications Framework (EQF) and self-certification to the Qualifications Framework of the European Higher Education Area (QF-EHEA) 2012, accessible from: https://ec.europa.eu/ploteus/sites/eac-eqf/files/the_norwegian_referencing_report_0.pdf

(70)- Norwegian Ministry of Education and Research, accessible from: https://www.regjeringen.no/en/dep/kd/id586/

(71)- The main functions of county municipalities and municipalities in Norway, publication number H-2120E, accessible from: https://www.regjeringen.no/en/dokumenter/Publication-number-H-2120-E/id420670/

(72)- Feasibility study of the introduction of the Hamburg Model into Norwegian vocational education system, accessible from: http://www.vet-bsr.eu/wp-content/uploads/2015/09/Feasibility-study-2015-Norway.pdf

(73)- Vocational Education and Training in Norway, Norwegian Directorate for Education and Training, accessible from: https://www.udir.no/globalassets/upload/fagopplaring/4/vocational_education_and_training_in_norway.pdf

(74)- Overview of Master Craftsperson Qualification, accessible from: www.ecvet-projects.eu/Documents/SMEMasterPlus_overview_master_craftsperson.doc

(75)- Croatian Ministry of Agriculture, accessible from: http://www.mps.hr/

(76)- Croatian National Strategic Plan for Aquaculture Development 2014-2020, accessible from: http://www.mps.hr/ribarstvo/UserDocsImages/akvakultura/NSPA%202014-2020_eng.pdf

(77)- Croatian Ministry of Science, Education and Sport, accessible from: https://mzo.hr/

(78)- Agency for Vocational Education and Training and Adult Education, accessible from: http://www.asoo.hr/default.aspx?id=93

(79)- The Croatian Qualifications Framework Act 2013, accessible from: http://www.kvalifikacije.hr/sites/default/files/documents-publications/2017-09/The%20CROQF%20Act.pdf

(80)- Croatian Law on Marine Fisheries 2010, accessible from: http://www.fao.org/faolex/results/details/en/c/LEX-FAOC105817/

(81)- Croatian Freshwater Fisheries Act 2001, accessible from: http://www.fao.org/faolex/results/details/en/c/LEX-FAOC115133

(82)- The BlueSMART (Blue Education for Sustainable Management of Aquatic Resources) Project, accessible from: https://www.bluesmart.hr/en/e_learning_course/about_the_course/

(83)- Vlasta Franicevic, Croatian Ministry of Agriculture, *per comm,* 22/02/2018

(84)- Cedefop Spotlight on VET CROATIA 2016, accessible from: http://www.cedefop.europa.eu/en/publications-and-resources/publications/8108

(85)- Spain: Opportunities in Aquaculture Madrid, February 2017, Innovation Norway, accessible from: https://aquatechcluster.no/wp-content/uploads/2017/04/opportunities-in-the-spanish-aquaculture-v-final_webinar.pdf)

(86)- Cedefop Spain: VET in Europe: Country Report 2012 accessible from: http://www.cedefop.europa.eu/en/publications-and-resources/country-reports/spain-vet-europe-country-report-2012)

(87)- Publication analysis and overview of national qualifications framework developments in European countries. Annual report 2016 Cedefop, 2017; SPAIN European inventory on NQF 2016), accessible from: http://www.cedefop.europa.eu/files/spain_-_european_inventory_on_nqf_2016.pdf

(88)- Asociacion Empresarial de Productores de Cultivos Marinos (APROMAR), accessible from: http://www.apromar.es/

(89)- FAO National Aquaculture Sector Overview Greece, accessible from: http://www.fao.org/fishery/countrysector/naso_greece/en#tcN700EF

(90)- Greek Ministry of National Education and Religious Affairs (MoNE), accessible from: http://www.minedu.gov.gr/

(91)- Ministry of Labour, Family, Social Affairs & Equal Opportunities (MDDSZ), accessible from: http://www.mddsz.gov.si/en/areas_of_work/labour_market_and_employment/labour_migration/movement_of_services/greece/

(92)- National Organisation for the Certification of Qualifications and Vocational Guidance: (EOPPEP), accessible from: http://www.eoppep.gr/index.php/en/

(93)- Cedefop Vocational education and training in Greece 2014, accessible from: http://www.cedefop.europa.eu/files/4130_en.pdf

(94)- EOPPEP (2016). Greece EQF Referencing Report, accessible from: https://ec.europa.eu/ploteus/sites/eac-eqf/files/greek_referencing_report_2016.pdf

(95)- Federation of Greek Mariculture (FGM), accessible from: https://fgm.com.gr/english/index.php

(96)- Cyprus: Multiannual national plan for the development of sustainable aquaculture an overview, accessible from: https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/summary-aquaculture-strategic-plan-cyprus_en.pdf

(97)- Official website of the Cypriot Ministry of education and Culture, accessible from: http://www.moec.gov.cy/en/

(98)- Cyprus: VET in Europe: country report 2012, accessible from: http://www.cedefop.europa.eu/en/publications-and-resources/country-reports/cyprus-vet-europe-country-report-2012)

(99)- Official website of the Human Resource Development Authority (HRDA), accessible from: http://www.hrdauth.org.cy/

(100)- Referencing of the Cyprus Qualifications Framework to the European Qualifications Framework for Life Long Learning, 2016 accessible from: http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetailDoc&id=28726&no=7

(101) – National Aquaculture Sector Overview, Italy, accessible from: http://www.fao.org/fishery/countrysector/naso_italy/en

(102)- Italy Multiannual National Plan for the development of sustainable aquaculture overview, accessible from: https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/summary-aquaculture-strategic-plan-italy_en.pdf

(103)- Ministry of Education, University and Research (MIUR), accessible from: http://www.miur.gov.it/

(104)- The Ministry of Labour and Social Policies (MLPS), accessible from: http://www.lavoro.gov.it/Pagine/default.aspx

(105)- First Italian Referencing Report to the European Qualifications Framework (EQF), 2012 accessible from: http://www.anpal.gov.it/europa/European-Qualifications-Framework/Documents/EN-Primo-Rapporto-Referenziazione-nazionale-EQF.pdf

(106)- CEDEFOP: Italy: VET in Europe: country report 2014, accessible from: http://www.cedefop.europa.eu/en/publications-and-resources/country-reports/italy-vet-europe-country-report-2014

(107)- The Ministry of Agriculture, Food & Forestry Policies (MiPAAF), accessible from: https://www.politicheagricole.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/202

(108)- The Italian Association of Fish Producers, Associazione Piscicoltori Italiani, (API), accessible from: http://www.api-online.it/index.cfm/en/home/

(109)- The Mediterranean Aquaculture Association, Associazione Mediterranea Acquacoltori (AMA), accessible from: http://www.a-m-a.it/chi-siamo-2/),

(110)- The Institute for the Development of Vocational Training for Workers (ISFOL), accessible from: http://www.isfol.it/en/institute/about-us

(111)- ISFOL Occupational Roles information system, accessible from: http://fabbisogni.isfol.it/scheda.php?limite=1&id=6.4.5.1.0

(112)- Italian National Qualifications Register(NQR), accessible from: (http://nrpitalia.isfol.it/sito_standard/sito_demo/atlante_repertori.php

(113)- Centri provinciali per l'istruzione degli adulti, CPIA, accessible from: http://www.cpiaimola.gov.it/inglese.htm

(114) - National Aquaculture Sector Overview, France, accessible from: http://www.fao.org/fishery/countrysector/naso_france/en

(115)- France: Multiannual national plan for the development of sustainable aquaculture an overview), accessible from: https://ec.europa.eu/fisheries/cfp/aquaculture/multiannual-national-plans_en

(116)- French Ministry of Education, accessible from: www.education.gouv.fr/

(117)- French Ministry of Agriculture and Fisheries, accessible from: http://agriculture.gouv.fr/

(118)- French Ministry of Labour, accessible from: http://travail-emploi.gouv.fr/

(119)- The Interprofessional Committee for Aquaculture Products (CIPA), accessible from: http://www.poisson-aquaculture.fr/le-cipa/

(120)- The French National Qualifications Framework (NQF/RNCP) aligned to the EQF adapted from: Referencing of the national framework of French certification in the light of the European framework of certification for lifelong learning, 2010, accessible from: https://ec.europa.eu/ploteus/sites/eac-eqf/files/Report-FR-NQF-EQF-VF.pdf

(121)- Vocational Education and Training in Scotland and France a Comparative Study, Liz Speake, Education and Training Consultant, Scottish Executive, Edinburgh, April 2007), accessible from: www.gov.scot/Publications/2007/08/30154331/0

(122)- Vocational education and training in France, Short description, 2008, accessible from: www.cedefop.europa.eu/en/publications-and-resources/publications/5190

(123)- National Vocational Certification Register (*Répertoire national des certifications professionnelles* or *RNCP*), accessible from: http://www.rncp.cncp.gouv.fr/grand-public/qualificationsFramework

(124)- The Long-term Economic and Ecologic Impact of Larger Sustainable Aquaculture; A. Lane, C. Hough, J. Bostock, 2014, accessible from: http://www.europarl.europa.eu/studies

(125)- FAO (Food and Agriculture Organization of the United Nations). 2016. The state of world fisheries and aquaculture 2016: contributing to food security and nutrition for all. FAO, Rome, accessible from: http://www.fao.org/3/a-i5555e.pdf

(126)- Scottish aquaculture: A view towards 2030. An innovation roadmap and sector needs study, 2017.

(127)- Aquaculture Growth to 2030: A strategic plan for Farming Scotlands Seas, Scotland Food and Drink, 2016.

(128)- Aquaculture Factsheet, Lantra, 2010-2011.

(129)- Knowledge and Skills Guidelines for Aquaculture Technicians, Marine Advanced Technology Education (MATE) Centre, 2001. https://www.marinetech.org/workforce/

(130)- A Study of the Current and Future Skills Requirements of the Marine/Maritime Economy to 2020, Expert group on Future Skills Needs, 2015.

(131)- National Strategy for Land-based Education and Training, SRUC, 2015.

(132)- Marine Scotland: A Technical Standard for Scottish Finfish Aquaculture, Scottish Government, 2015.

(133)- A Strategic Framework for Scottish Aquaculture, Scottish Executive, 2003.

(134)- UK Skills Assessment, Lantra, 2012.

(135)- Aquaculture Work Based Learning Survey, Barony College, 2011.

(136)- Skills Review for the Aquaculture Sector in Scotland, Highlands and Islands Enterprise (HIE), 2018.

(137)- A Smart Successful Scotland, Scottish Executive, 2001.

(138)- The Survey of Training Needs within the Scottish Salmon Industry, Lantra & SSPO, 2008.

Contact person for this report:

John Bostock - j.c.bostock@stir.ac.uk

Disclaimer:

This project has been funded with support from the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use, which may be made of the information contained therein.

APPENDICES

Appendix 1 - Adapted from the Croatian National Strategic Plan for Aquaculture Development 2014-2020 (76)

Appendix 2 - Details of the courses and modules designed for the FISHFARM Project.

Appendix 3 - PerformFISH Expected Results

Appendix 4 - Details of the four courses available on AQUAEXCEL 2011-2015

Appendix 5 - Details of the nine training courses available on AQUAEXCEL 2020

Appendix 6 - ParaFish Control Project objectives

Appendix 7 - Six recommendations of the Skills Review for the Aquaculture Sector in Scotland 2018 (136)

Appendix 8 - Knowledge and Skills Guidelines for Aquaculture Technicians (Competency list), 2001 (129)

Appendix 9 - Business issues, skills needs and solutions for the UK Aquaculture sector in UK Skills assessments (134)

Appendix 10 - Aquaculture Work Based Learning (WBL) project example responses to survey questions (135)

Appendix 1 Adapted from the Croatian National Strategic Plan for Aquaculture Development 2014-2020 (76)

Strengths

• Favourable environmental conditions
• Tradition in mariculture farming. The farming of shellfish started several centuries ago, with a great upswing in production during the 20th century. Fish farming has a tradition of almost 40 year, among the earliest in Europe, and tuna has been farmed since the 1990s.
• Production of food of high nutritive values in relation to competition due to the particularity of the Adriatic Sea
• Sustainable mariculture through conserved biodiversity and ecosystem services also ensuring a possible higher product market value
• Favourable economic and environmental factors– "low carbon footprint"and specific spatial planning criteria for mariculture zones are in place.
• Ability to provide a permanent supply to the market through constant product quantity and quality
• Proximity and trading relations with main markets (EU and external): the share of aquaculture products in total exports has grown continuously. The majority of the farmed fish except tuna is placed on the EU market (especially Italy). There has been a constant growth in the production, due to the increase in domestic consumption and the stabilisation of the prices in the EU market. Tuna production is almost exclusively for the well-established Japanese market.

Weaknesses

• Insufficient capacities of the existing fish hatcheries: domestic production in land-based hatcheries covers less than 50% of the needs of the installed farming capacities
• Non-existence of shellfish hatcheries
• Poor diversification of species and products
• Poorly developed coastal infrastructure
• Non-existence of producer organizations
• Non-existence of marketing strategy and lack of product branding and licensing
• Insufficient cooperation between science and the sector and lack of applied scientific and research projects
• Insufficiently developed work conditions in terms of health and safety
• Limitations for the performance of farmed fish medical treatment and lack of medicine registered in the Republic of Croatia
• Lack of lifelong learning framework
• Lack of processing capacities and production of products with a higher added value
• Undefined epidemiological zones
• Inadequate disposal of waste generated in the production process
• Possibility of escape of alien species from the farm into nature which can lead to their intersections with specimens from the wild and modified genetic features

Opportunities

• Availability of ESI funds
• Availability of further development for the implementation of

Threats

• Frequency of natural disasters and adverse weather events
• Market instability

Integrated Coastal Zone Management
• Contribution to the development of island communities (employment, related activities)
• Diversification of production by introducing new species in commercial farming
• Development of new products and technologies and connection with food processing sector
• Establishment of land-based recirculating aquaculture systems (RAS) on the land
• Development of organic and ecological fish farming
• Production price increase due to ever stricter requests of nature and environmental protection, hygiene and safety
• Losses caused by diseases
• Impossibility of renewing a concession for using a maritime domain
• Potentially increased costs and limitations in farming due to Natura 2000 areas
• Damage caused by fish-eating birds, mammals and other animals
• Introduction of new diseases through import

Appendix 2 Details of the courses and modules designed for the FISHFARM Project.

No	Course	Module No and Title	Learning Outcome No and Title
1	**Why Aquaculture**	1. What is aquaculture and why is it important?	1 What is aquaculture 2 Why aquaculture ?
		2. Nutritive value of aquaculture products	1 Aquaculture foods 2 Nutritive value of aquaculture foods
		3. Aquaculture sector in the world	1 Aquaculture sector statistics in the world 2 Livelihoods in aquaculture sector 3 Aquaculture sector in Europe 4 Overview of the aquaculture sector in FISHFARM Partners' Countries
2	**Fish Biology**	1.Fish biology	1 External structure of fish 2 Internal structure of bony fish
		2.Fish species in partner countries and in Europe	1 Fish species in Europe 2 Fish species in partner countries
3	**Water quality and water treatments**	1.Water quality and water treatments	1 Water quality and water treatments 2 Water quality and water treatments ?
		2.Overview of land-based aquaculture systems	1 Land-based aquaculture systems 2 Advantages and disadvantages different aquaculture systems
		3.Aeration, oxygenation and water treatments	1 Aeration, oxygenation and water treatments 2 Water treatments 3 System monitoring and control
4	**Fish farming methods and equipment**	1.Fish farming methods and equipment	1 Fish farming structures 2 Advantages and disadvantages of different farming methods
		2.Equipment used in feeding, grading and transport of fish	1 Transport, grading and counting of fish 2 Feeding technology and monitoring systems

No	Course	Module No and Title	Learning Outcome No and Title
5	**Brood stock and larval stage management**	1.Freshwater Fishes	1 Broodstock management and selective breeding 2 Egg storage, incubation, feeding and smoltification
		2.Marine fishes	1 Broodstock management and incubation of eggs 2 Larval rearing, weaning and transfer of fish
6	**Fish nutrition, feeding and feed additives**	1.Proteins in fish nutrition	1 What is proteins and amino acids? 2 How can we meet the protein requirements of the aquatic animals?
		2.What are carbohydrates and lipids?	1 What is carbohydrates and lipids? 2 How can we meet their requirements
		3.Vitamins and minerals for fish farming	1 What are vitamins and minerals? 2 How can we meet their vitamin and mineral requirements?
		4.Metabolism of nutrients and diet formulation in fish?	1 Nutrient metabolism and diet formulation in fish 2 What is the origin of natural feeds for fish?
7	**Fish diseases and treatment methods**	1.Biotic fish diseases	1 Viral diseases 2 Diseases caused by bacteria 3 Diseases caused by fungi and algae 4 Diseases caused by parasites 5 Diseases caused by fish pests
		2.Abiotic fish diseases	1 Diseases caused by environmental factors 2 Diseases of not well understood etiology
8	**Contaminants and Residue Problems in Aquaculture, and EU Legislations**	1.Introduction to contaminants in aquaculture	1 What are the important chemical contaminants and toxins in fish and fish products? 2 The major sources of food safety challenges in aquaculture
		2.Risks from fish contaminants to human	1 What is the most important contaminants that have risk to human?
		3.Origin of contaminants in aquaculture	1 Environmental contaminants 2 Organic contaminants in aquaculture 3 Heavy metals and elements as contaminants for aquaculture

No	Course	Module No and Title	Learning Outcome No and Title
			4 Feed based contaminants and veterinary drugs 5 Mycotoxins 6 Legislations in EU and partners countries on contaminants in aquaculture
9	**Sanitation, biosecurity, and applying HACCP for fish farming to product safety**	1.Sanitation, biosecurity, and applying HACCP for fish farming to product safety	1 Definitions 2 Elements of HACCP 3 Logical sequence of HACCP analysis 4 Hazard analysis in fish breeding, fish production and table fish production 5 Water chemistry threshold limit values
10	**Sanitation, biosecurity, and applying HACCP for fish farming to product safety**	1.Why aquaculture is considered a non-sustainable activity?	1 Why aquaculture is considered a non-sustainable activity?
		2.Main negative impacts attributed to aquaculture	1 Negative effects
		3.What to do for a sustainable aquaculture?	1 Strategies and possible solutions for a sustainable aquaculture
		4.Possible solutions	1 Solutions
		5.Action taken	1 Actions
		6.Outlook	1 General outlook
11A	**Fisheries Products and Human Health: a) Fish and Heart**	1.Fish and heart health	1 Fats and fatty acids in fish meat 2 Mechanism of actions of Omega 3 fatty acids on cardiovascular system
11B	**Fisheries Products and Human Health: b)Fish (Omega-3 Fatty Acids) and Eye Health**	1.Fish (Omega-3 fatty acids) and eye health	1 Effects of omega-3 fatty acids on eye health and dry eye syndrome 2 Source of omega-3 fatty acids and eye health

No	Course	Module No and Title	Learning Outcome No and Title
12	**Slaughtering and processing methods**	1.Slaughtering and packing of whole fish	1 Slaughtering and packing of whole fish 2 Sorting, grading and packing of fish to markets
		2.Methods used in processing fish produced in fish farming	1 Processing fish and fish farming products 2 Main methods of fish preservation
13	**Marketing and cost management for fish farming**	1.What is marketing management and why is it important?	1 What is marketing management? 2 What is marketing mix? Do you know promotion tools in fish farming?
		2 Business Plan	1 Business plan 2 Balance sheet assets. 3 Evaluation of the investment efficiency
14	**The Future of European Aquaculture**	1.Trends and triggers of the EU aquaculture	1 What is the main function of aquaculture? 2 What has the aquaculture in future taken guiding principles for the role of European aquaculture?
		2.A vision for the future in aquaculture	1 Future of European Union aquaculture 2 The challenges for aquaculture
		3.The European challenge for aquaculture	1 Opportunities for Europe for aquaculture 2 Fish projections of OECD and FAO for 2012 – 2021 3 Bremerhaven declarations on the future of aquaculture

Appendix 3 PerformFISH Expected Results

Increased competitiveness and improved consumer and society perceptions of MMFF by enabling the industry to adopt a holistic approach to:

- produce safe and healthy food with a low ecological footprint
- provide employment and trade in rural, peripheral and coastal regions
- reduce European dependency on importation of seafood
- Substantial improvement of the performance of the focal fish species through the formation and measurement of sector accepted Key Performance Indicators (KPIs)

Consolidated and widely-promoted best practice in fish farming through:

- endorsed certification and quality assurance
- development of human capacity building
- engagement with consumers and societal actors to promote MMFF practices and products

Objectives

To improve predictability, quality and sustainability of the hatchery phase of seabream and sea bass by exploiting existing technical and biological knowledge and when necessary conduct original research to fill gaps.

Specific Objectives:

- Investigate the correlation between egg quality and larval with juvenile performance by identifying, optimising and validating robust indicators of larval and juvenile quality (KPIs) for commercial hatcheries
- Determine the main sources of egg, larval and juvenile quality variation across European commercial hatcheries and establish standard operating procedures (SOP) to improve predictability of hatchery production
- Correlate fish quality between different ontogenetic stages in several hatcheries and correlate morphological quality between the juvenile (1.5g) and fish of commercial size
- Identify developmental plasticity in hatchery stages using early programming strategies to exploit species maximum biological capacity towards SOPs and improved KPIs
- Create a reference framework for a European juvenile quality certificate through the use of advanced analytics using biochemical, molecular, morphological and immunological indicators of larval and juvenile quality.

Appendix 3 (cont) PerformFISH Project Objectives

PerformFISH has the direct support and endorsement of the MMFF industry, with producers' associations from Greece, Spain, Italy, France and Croatia directly involved as partners in the project

Their involvement will ensure that the needs of the sector are met and knowledge is transferred effectively to their members. PerformFISH will work to ensure sustainable growth of the MMFF industry, based on consumer perceptions and real market requirements. It aims to support fish farms to operate not only in optimal economic and environmental conditions, but also in a socially and culturally responsible manner.

Objectives

Evaluate the most relevant factors related to fish health which impact on productive KPI's to provide the Mediterranean finfish aquaculture with efficient diagnostic, prevention and treatment tools to improve these KPI's. Results of new diagnostic approaches, preventive measures and vaccination will be combined to evaluate their impact on KPI for fish health and welfare (WP7). Specific Objectives:

- Provide deeper insight into identification, tracking, prevention and control of the most relevant diseases for Mediterranean seabream and sea bass farming
- Identify and develop reliable diagnostic methods
- Generate different preventive strategies based on immune-prophylaxis and efficient treatments against the relevant diseases
- Outline practical methodologies for fish welfare awareness at farm level.
- Develop health management strategies for the industry in order to improve the current KPI's (mortality, morbidity and economic indexes)
- To assess the impact of TRL advances (from WP1-4 and WP6) on farm efficiencies through KPIs (growth rate, mortality, feed efficiency, fish welfare) and environmental performance
- To develop a Code of Conduct and consolidate best practices and harmonised standards to raise consumer awareness and advocate social and environmental responsibility of the MMFF industry
- Capture key messages and outcomes for active Knowledge Transfer through training and appropriate communication channels
- Carry out Capacity Building and Training based on knowledge generated through the PerformFISH project across the MMFF
- Perform Outreach activities targeted at the general public and consumers.
- Substantial improvement of the performance of the focal fish species, through the formation and measurement of sector accepted Key Performance Indicators (KPIs)

Appendix 3 (cont) PerformFISH Specific Objectives

Scientific and Technical

- To develop customised genomic tools for marker-assisted selection and validate and apply them in on-going industrial breeding programmes
- To validate novel larvae rearing protocols based on early programming strategies that exploit species maximum biological capacity and improve juvenile quality
- To determine optimal product quality and performance metrics for different stages of the production cycle and construct growth trajectory curves to predict performance and establish management tools to improve production predictability
- To develop sustainable, cost-effective fish feeds to meet the updated nutritional requirements for consumers and markets throughout the production cycle and support enhanced growth performance, robustness and welfare
- To optimise feed management through advanced modelling and technology development and to estimate cage biomass in production systems
- To advance epidemiological mapping and molecular tools to implement a multidisciplinary integrated diagnostic approach, and to test and validate effective preventive measures (vaccines, prophylactics, nutraceuticals) to reduce mortalities and alleviate negative impacts of stressors
- To establish a validated framework of Operational Welfare Indicators
- To combine new knowledge on marker-assisted selection, rearing practices, feeding strategies and disease management into integrated efficient industrial solutions applicable across the complex production landscape of European MMFF
- Benchmarking and Certification
- To establish a quantitative benchmarking system based on KPIs to cover all aspects of the MMFF performance and to serve as an effective management tool
- To establish a framework for a European juvenile quality certificate
- To develop a code of conduct and implement good practices, and effectively communicate them to raise consumer awareness and advocate social and environmental responsibility
- To ensure the PerformFISH project legacy resonates beyond the funded duration of the project by drawing-up and implementing common MMFF strategic actions and measures

Consumer and Society

- To capitalise on the existing fish food health claims and design innovative and smart marketing actions to address consumer desires and market needs, thereby increasing confidence in the activities and products of the MMFF industry
- To construct a generic branding framework for a “Made in EU” MMFF product label to accommodate the standards of product quality, environmental and social responsibility

- To carry out capacity building activities (targeting technical, vocational and tertiary levels) that ensure transfer of best practice, create conditions for uptake and application of competitive knowledge by the MMFF, and build a competent, versatile workforce contributing to Blue Growth
- To effectively link to the relevant EU policy frameworks (Common Fisheries Policy, BLUEMED Initiative, Marine Strategic Framework Directive), contributing knowledge and recommendations for appropriate policy making in relation to marine aquaculture development.

Appendix 4 Details of the four courses available on AQUAEXCEL 2011-2015

Course No	Title	Provider	Mode of delivery	Location	Date available
1	Recirculating Aquaculture System (RAS) Technology'	Aquaculture and Fisheries Group, Wageningen University with the expertise of NOFIMA, IFREMER and IMARES.	Face to face	Wageningen, the Netherlands	22 – 25 April 2013
2	Contribution of Genomic Approaches to the Development of Sustainable Aquaculture for Temperate and Mediterranean Fish	INRA	Face to face	Rennes (France),	16-18 October 2013
3	The Application of Chromosome Set Manipulations and the Importance of Gamete Collection and Management in Aquaculture'	IoA University of Stirling	Face to face	Stirling (UK)	18-22 of November 2013
4	Efficient Utilisation of New Monitoring and Control Systems in Fish Experiments	NTNU & SINTEF Sealab	Face to face	Trondheim, Norway	19 - 22 May 2014.

Appendix 5 Details of the nine training courses available on AQUAEXCEL 2020

Course No	Title	Provider	Mode of delivery	Location	Date available
1	Experimental data management: from generating protocols to sharing data	University of South Bohemia in České Budějovice	Online, recorded lectures and Q&A	NA	Live element completed with all materials available online
2	Recirculating Aquaculture System (RAS) Technology	Institut Francais de Recherche pour L'Exploitation de la Mer (Ifremer), Wageningen University (WU)	Face to face	Ifremer Sète research station, France	24-28 October 2016
3	Training in the use of the Fish and Chips tool	Institut National de la Recherche Agronomique (INRA)	Online	NA	May 2018
4	Recirculating Aquaculture System (RAS) Technology	Aquaculture and Fisheries group, Wageningen University (WU) and Ifremer	Face to face	WU, The Netherlands	September 2018
5	Using modelling of scale effects as a tool for experimental design	SINTEF Fiskeri og havbruk AS (SINTEF)	Online	NA	January 2019
6	Fish nutrition and feeding	INRA Nutrition, Métabolisme, Aquaculture (INRA-NuMeA)	Face to face	France	March 2019
7	Laboratory animal science for aquatic research facilities	Institute of Marine Research (IMR)	Face to face	IMR, Norway	June 2019
8	Development and application of pipelines for NGS RADseq and RNAseq protocols	University of Stirling (UoS)	Face to face	UoS, United Kingdom	September 2019
9	Planning and conducting experimental infection trials in fish	Danmarks Tekniske Universitet (DTU)	Face to face	Denmark	November 2019

Appendix 6 ParaFish Control Project objectives

- To generate new aquaculture-relevant scientific knowledge concerning key fish parasites. Areas of knowledge gain will include life-cycles and the genomic, biochemical, physiological and molecular mechanisms involved in immune-evasion, host invasion, virulence and transmission.
- To identify key elements of the host immune response, including patterns of gene/protein expression, and downstream effects on parasites.
- To investigate the epidemiology of parasites that show reciprocal movements between farmed and wild fish host populations.
- To develop novel prophylactic tools, including vaccines, feed additives, biological controls and management interventions at the farm level.
- To provide advanced tools for the identification and quantification of parasites causing relevant diseases, which can detect and discriminate between parasite-specific molecules associated with certain biological processes (e.g. feeding, reproduction, cell division) and stages (e.g. strains or species, virulent phenotypes).
- To develop and validate cost-effective, specific and sensitive diagnostic tools for the most relevant parasitic diseases.
- To provide advanced or alternative treatments for parasitic diseases.
- To establish best practices for optimising the efficiency of environmentally-friendly treatment methods to mitigate disease outcomes and to minimise the threat of existing and emerging parasites.
- To leverage the existing capabilities of the EU's new marine parasite BioBank as a unique central hub for the collection, storage and distribution of farmed fish parasite samples and supporting metadata arising from project activities.
- To assess the risk factors involved in the emergence, transmission and pathogenesis of parasitic diseases in farmed fish and to provide strategies to minimise their impact on farmed stocks.
- To map the zoonotic risks associated with helminth parasites in fish and to provide a catalogue of good husbandry practices to obtain safe fish products strengthening the competitiveness and the image of EU aquaculture producers.
- To provide manuals of best practice for hands-on diagnosis and integrated pest management of parasitic diseases, for producers, diagnostic laboratories, veterinary practitioners and other key stakeholders.
- To reinforce the confidence of fish processors, traders and consumers in farmed fish products by providing a certification process and accompanying documentation and publicity for the control of zoonotic (helminth) parasites in aquaculture fish products.

Appendix 6 (cont) ParaFish Control Expected results

- The project will create new scientific knowledge of the selected fish parasites and their interactions with hosts, which is essential for the development of targeted control measures. In vivo and in vitro models will be developed for both metazoan and protistan parasites, which will be used to screen for anti-parasitic compounds/treatment strategies.
- Genetic markers and assays will be developed to assess the potential transfer of parasites between wild and farmed fish. Linking the outputs of several Work Packages will help to define the most appropriate measures for farmers to minimise wild/farmed fish interactions.
- Prophylactic measures integrating management and improved biosecurity measures with vaccination strategy will be developed.
- Highly accurate and cost-effective diagnostic tools and methods to detect parasites in fish and in the environment will be developed. The impact of these improved tools will be crucial for an early detection of parasites, assisting stakeholders involved in management (diagnostic labs, fish health professionals and farmers) to quickly decide upon the most appropriate strategies to prevent spread of the disease. This will minimise epizootics and disease outbreaks.
- The project will improve current treatments and develop novel treatments in compliance with European legislation to avoid parasite resistance, toxicity of chemicals, and persistence of chemical residues in fish and the environment. The treatments will be based on drugs, plant extracts, feed additives, natural parasite predators and bioactive compounds from fish-associated bacteria and will result in ready-to-be-registered products as well as innovative strategies for parasite treatments.
- Risk factors for the introduction, establishment and spread of parasites in/between fish farms and the relevance of such risk factors (likelihood estimates) will be identified through expert consultation and epidemiological studies, taking parasite biology, concurrent infections and current management practices into account.
- A Food Safety Program including protocols/good practice guidelines will be established to help aquaculture producers to avoid/decrease zoonotic risks in farmed fish and improving veterinary/food safety surveillance and better fish traceability.

Appendix 7 - Six recommendations of the Skills Review for the Aquaculture Sector in Scotland 2018 (136)

1. **Promoting the sector as a career destination**

   To attract people- clear communication of the roles to potential recruits, people and organisations that influence career decisions.
   -should be promoted as a fast growing and technology driven sector
   -should be promoted as a career destination for all qualifications and skill levels. Promote to school leavers, graduates, post graduates and other potential recruits.
   -A short term focus could be on engineers which are in high demand across the sector in production and the supply chain.

2. **Develop leadership, management and business capacity**

   Leadership development should be built into education and learning across all subject areas. Learners in aquaculture related subjects should be given opportunities to develop leadership and business skills as part of the study and should be introduced as soon as possible. Currently there are initiatives in place that are designed to develop leadership and management skills in business leaders and future leaders. For all of the above to work any barriers to participation should be addressed including financial, time commitments and attitude and should be looked at in the short to medium term

3. **Consistency and transferability of training and education**

   Employers use inhouse induction and skills training to address skills gaps in the current workforce and new entrants. Positive and proactive approach. Downside is not consistent across the sector as it is not accredited, lack of industry QA,
   advantage to the employer = staff trained in their workplaces
   disadvantage to the employer = if staff move across companies they usually get retrained, a waste of time and resources.
   Employers resist sharing and aligning their inhouse training. Overcoming this barrier would benefit employees as their training would be recognised across the sector, aid career progression and provide greater mobility. Benefit employers, reduced need to provide a bespoke training programme for all new recruits to the business.
   Employers worry about staff migrating to other companies/sectors, but having a consistent accredited training programme would improve the skills capacity of the sector and reduce time and resources being wasted retraining every employee.

4. **Developing a digitally enabled workforce**

   IT and digital skills currently in demand and will continue to develop and change as technology advances. Staff must have skills to use digital technology and ability to upskills as required. Digital literacy should be a key component of training and learning across the sector. Companies should be directed to initiatives and support that will help and develop digital skills in the existing workforce. Updating digital skills and responding to technology changes will be an ongoing requirement and should be addressed in the short term to keep up with developments.

5. **Enhance provision of work based learning and vocational training**

   Work based learning is highly valued by employers as it provides skills development for staff in the workplace, considered more effective and aligned to working practices.
   With right delivery can be more accessible to a wide population who may not be willing or able to relocate or travel for learning.
   Can be expanded to SCQF and above
   Consider undergraduate provision of aquaculture courses to meet industry needs and includes a workplace element.
   Should be accessible to all learners full time or in employment
   Could be done by increasing the places on offer, spreading the geographic location of availability/delivery.
   WBL opportunities should be widely promoted.
   This is a high priority that should be initiated immediately.

6. **Widen the recruitment pool**

   Aquaculture workforce largely male and ageing.
   Important to diversify the workforce as it will widen the pool of recruits to include more women and younger people.
   Raise awareness of career opportunities and learning and education.
   Employers could be supported in developing their recruitment processes.
   Businesses guidance and encouragement to consider more flexible working practices, a key tool for retaining staff.

Appendix 8 - Knowledge and Skills Guidelines for Aquaculture Technicians (Competency list), 2001 (129)

A. LABORATORY SKILLS

1. Monitor water quality
2. Maintain good records/data
3. Use and maintain laboratory equipment
4. Practice safe work habits
5. Handle organisms
6. Apply aseptic techniques
7. Use hatchery lab skills
8. Use a microscope
9. Diagnose disease

B. MATH SKILLS

1. Use basic mathematics
2. Calculate rates
3. Calculate volumes
4. Calculate conversions
5. Apply statistics
6. Use algebra
7. Design research projects

C. KNOWLEDGE OF BASIC CHEMISTRY

1. Practice safety (e.g., OSHA)
2. Monitor water quality
3. Possess a working knowledge of environmental chemistry
4. Identify poisons
5. Identify toxins
6. Possess a working knowledge of basic chemistry (e.g., atoms, molecules)
7. Possess an awareness of chemical reactions/interactions
8. Make solutions

D. FIELD EXPERIENCE

1. Practice safety
2. Maintain equipment
3. Understand the natural environment
4. Handle organisms
5. Keep accurate records in the field
6. Possess seamanship skills with small boats
7. Conduct proper field sampling protocol(s)
8. Conduct on-site public relations
9. Practice good time management
10. Organize equipment
11. Improvise

E. KNOWLEDGE OF BASIC BIOLOGY

1. Manage water quality
2. Practice efficient and effective feed management skills
3. Practice animal husbandry skills (e.g., feed, harvest)
4. Possess a working knowledge of the anatomy and physiology of aquatic organisms
5. Manage brood stock
6. Possess a working knowledge of aquatic pathology
7. Possess a working knowledge of ecology
8. Possess a working knowledge of basic genetics
9. Possess a working knowledge of human pathology

F. MECHANICAL SKILLS

1. Maintain aeration equipment
2. Act in an innovative and resourceful manner
3. Maintain filters
4. Work with electrical systems
5. Work with piping
6. Work with/on electronics (e.g., instrumentation)
7. Work on boat engines and pumps
8. Perform basic carpentry
9. Drive and/or use non-traditional equipment
10. Tie knots and mend nets

G. COMMUNICATION SKILLS

1. Use good verbal communication techniques
2. Use good written communication techniques
3. Read and write technical information
4. Apply good people management skills (i.e., interpersonal relations)
5. Interpret/translate data to others
6. Practice good public relations
7. Practice social awareness (e.g., dress, how to address people)
8. Communicate using a second language
9. Present/speak in public
10. Practice good grant writing skills

H. ANALYTICAL SKILLS

1. Possess an awareness of regulations and statutes
2. Record and interpret data
3. Perform experiments
4. Use statistics
5. Design research projects

I. INTERNSHIP EXPERIENCE

1. Perform real- life experience(s)
2. Develop confidence
3. Practice career-related skills

J. TIME MANAGEMENT SKILLS

1. Make sound decisions
2. Meet deadlines
3. Schedule
4. Prioritize tasks
5. Delegate responsibility

K. COMPUTER SKILLS

1. Use word processing software
2. Use spreadsheet software
3. Use e-mail
4. Use the Internet
5. Apply statistics
6. Apply basic programming
7. Use graphics software
8. Create computer-assisted presentations
9. Work with various types of computer hardware (e.g., printers)

L. BASIC BUSINESS SKILLS

1. Write clearly
2. Maintain inventory records
3. Demonstrate business “street smarts”
4. Interpret accounting data
5. Calculate profit and loss
6. Make long-range plans
7. Assist in product development
8. Perform forecasting
9. Possess a working knowledge of economics
10. Provide input to marketing plans

M. STAYING UP-TO-DATE

1. Possess an awareness of regulations, statutes (e.g., permitting), and changes in them
2. Stay informed of aquaculture technology advances
3. Read trade journals
4. Participate in professional activities (e.g., conferences, workshops)
5. Know food safety and regulations
6. Apply vertical integration
7. Collect information from libraries
8. Maintain association memberships

Appendix 9 - Business issues, skills needs and solutions for the UK Aquaculture sector in UK Skills assessments (134)

Aquaculture	
Key issues	**Skills needs and training solutions**
Government strategies: -Renewed strategic framework for aquaculture -EU aquaculture strategy -Food security/food policy	Many businesses are not aware that the EU is supporting aquaculture and some awareness raising activity, perhaps through workshops is needed.
-Impact of aquaculture and Fisheries Scotland Act (Scotland) 2007 - Compliance with industry code of good practice	Training in containment to ensure compliance with Act. Businesses need a better understanding of sea lice counting and recording.
-Changes to the planning regime resulting from the Marine Act 2010, the Town and Country Planning (Marine Fish Farming) (Scotland) Order 2007 and the Planning etc (Scotland) Act 2006	-Training will be needed in relation to predator management. There may be training needs resulting from the other legislation in terms of Environmental Impact Assessment (EIA) requirements.
Animal Health and Welfare legislation higher professional standards and duty of care now required of all people handling animals	-CPD training in animal health and welfare to develop staff competence in accordance with good practice. -Training should include raising awareness of the duty of care and the legislation. -Requirements of audit -Record keeping
New legislation and impact on education and training issues for businesses	Businesses need to understand the key messages from new legislation with regard to training and education.
Health and Safety legislative requirements: -Safer working environment -Reduction in accidents and ill health for staff and clients -Workload -Workforce planning issues -Bureaucracy	Improved learning provision in terms of CPD: -Awareness raising of legislation -Industry specific health and safety training to improve competency, knowledge and understanding. -Training in risk management for business. -Record keeping

	-Implications for working with schools/student placements
Change in business practice: -Globalisation -Diversification -New products -Consumer behaviour -Employment law and implications -Stakeholder involvement	-Business advice and guidance (through CPD and knowledge transfer programmes (KTP)) -Information and raising awareness of KTP schemes and available funding. -Sales and marketing. -Customer service. -Business planning and development. -Updating on industry practice. -Market analysis/economic positioning and interpretation. -Understanding of employment law. -Training needs associated with meeting the WWF standard once it is finalised. Other standards (e.g. Freedom Foods) being used by aquaculture in addition to food quality standards, which may require awareness raising/implementation training.
Environment & Biodiversity: -Habitats directive/birds directive etc -Waste management	-Environmental management and legislative knowledge, particularly for staff preparing site planning applications but knowledge at farm manger level is also important for audit. -Embed sustainable principles into activities and training within the various sectors. -High level communication skills, customer service skills and record keeping. -Knowledge of applicable regulation and legislation.
-Food safety traceability	-Knowledge of legislation. -Hazard Analysis Critical Control Point (HACCP) and Risk Assessments. -Record keeping.

-Customer demand	-Quality training and auditing (understanding the many different quality standards e.g. ISO, IiP). -New product development. -Financial business development and record keeping.
Technological Advances: -New products/markets -Research & Development -New machinery -Investment opportunities	-Technology transfer (new technologies). -Skills training for new technology and equipment including ICT. -Negotiation skills for capital investment
Recession: -Access to finance -Business planning -Market realisation	Economics, business studies and cost and profitability analysis etc. -Banking industry needs to be educated- convey to them the importance of the industry

Appendix 10 - Aquaculture Work Based Learning (WBL) project example responses to survey questions (135)

Respondents were asked if they were familiar with aquaculture qualifications in Scotland, and if yes to rate the importance of the following criteria:

Criteria	Very important/relevant(%)	Quite important/relevant(%)	Not very important/relevant(%)	Not at all important/relevant(%)
Length of study	40	60	0	0
Assessment of knowledge and skills	90	10	0	0
Progression potential (in-company or education)	70	20	10	0
Course content	90	10	0	0
ICT	40	50	10	0
Self study	20	70	0	10
College day release	0	70	30	0
Nationally recognised qualifications	80	20	0	0
Paperwork load	40	30	20	10
Core skills Development	90	10	0	0

Appendix 10 (cont) - Respondents were asked to read through the proposed NPA's and grade the relevance of the course aims.

Aims of proposed NPA's	Very relevant (%)	Some relevance (%)	No relevance (%)
To provide an industry standard to support the development of your business/company	76.5	23.5	0
To provide employees with a career progression route for those wanting to advance in supervision/management	75	25	0
To provide employees with a Nationally Recognised Qualification (NRQ) and potential progression to higher education	70.6	29.4	0
To improve the husbandry knowledge and skills within the business company	94.1	5.9	0
To develop and improve employees understanding of the business/company	70.6	23.5	5.9
To develop and improve core skills attainment in numeracy	47.1	47.1	5.8
To develop and improve core skills attainment in communication	56.3	37.5	6.2
To develop and improve core skills attainment in problem solving	58.8	35.3	5.9
To develop and improve core skills attainment in working with others	58.8	35.3	5.9
To develop and improve core skills attainment in information technology	47.1	47.1	5.8

Appendix 10 (Cont) - Respondents were asked to rate the criteria in the table for existing qualifications against the proposed NPA qualifications.

Criteria	Very important/relevant (%)	Quite important/relevant(%)	Not very important/relevant(%)	Not at all important/relevant(%)
Length of study	26.7	73.3	0	0
Assessment of knowledge and practical skills	73.3	20	6.7	0
Progression potential (in-company or education)	53.3	46.7	0	0
Course content	78.6	21.4	0	0
ICT	46.7	46.7	6.6	0
Self-study	26.7	60	13.3	0
College day release	26.7	40	26.7	6.7
Nationally recognised qualifications	66.7	33.3	0	0
Paperwork load	20	60	20	0
Core skills Development	73.3	26.7	0	0

Appendix 10 (Cont) - Respondents were asked for the units in each NPA to be rated on their relevance to industry needs at that time.

NPA unit	Very relevant (%)	Some relevance (%)	No relevance (%)
Fish husbandry	100	0	0
Fish welfare	100	0	0
Live fish handling	88.2	11.8	0
Fish feeding & nutrition	94.1	5.9	0
Fish health	94.1	5.9	0
Fish biology	64.7	35.3	0
Aquaculture floating cages	64.7	29.4	5.9
Water supply	47.1	47.1	5.8
Salmonid hatchery operations	23.5	47.1	29.4
Aquatic environments for aquaculture	47.1	47.1	5.8

Contact person for this report:

John Bostock - j.c.bostock@stir.ac.uk

Disclaimer:

This project has been funded with support from the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use, which may be made of the information contained therein.