

Impact Objectives

- Build on recent/current national initiatives for species diversification in aquaculture in order to overcome the documented bottlenecks in the production of these species
- Support the diversification of the aquaculture industry and help in expanding production, increasing aquaculture products and development of new markets

Building a solid foundation for Europe's aquaculture industry

Drs Constantinos C. Mylonas and Rocio Robles are the Coordinator and Dissemination Leader, respectively, of a five-year project that seeks to expand the EU's aquaculture sector through diversification of farmed fish species. Below, they discuss the species investigated and highlight the progress they have made so far



What are some of the biggest challenges facing Europe's finfish aquaculture industry?

CM: Aquaculture is undertaken in all EU and EEA (European Economic Area) Member States, and plays an important role in the supply of high quality seafood to the European consumer. World aquaculture production in 2014 reached 101.1 million tons with a value of more than €132.8 million. However, while the worldwide contribution of aquaculture towards fish consumption is 50 per cent, in the EU only 24 per cent of the consumed seafood originates from EU aquaculture; 65 per cent of seafood consumption is imported from other countries. In fact, currently, EU seafood imports increase by more than €1 billion per year, as Europe shows an increasing demand for a diverse range of fish products.

How is it hoped that the DIVERSIFY project will address some of these challenges?

RR: The DIVERSIFY project has identified a number of new or emerging, fast-growing and/or large finfish species, which are believed to be excellent candidates for

the expansion of the aquaculture industry of Europe. The emphasis is on the Mediterranean or warm-water cage culture industry, but pond culture, freshwater recirculation systems and cold-water species are also addressed. These new and emerging species are generally marketed at a large size and can be processed easily into a range of products to provide the consumer with both a greater diversity of fish species and new processed products. In collaboration with a number of SMEs, DIVERSIFY is building on recent national initiatives for species diversification in aquaculture, and is making significant progress in overcoming the documented bottlenecks in the aquaculture production of these selected species.

The project focuses on six specific species. What criteria informed the decision to include them?

RR: DIVERSIFY focuses on meagre and greater amberjack for marine warm-water cage culture; wreckfish for warm- and cool-water marine cage culture; Atlantic halibut for marine cold-water culture; grey mullet – an euryhaline herbivore – for warm-water pond, extensive and integrated culture; and pikeperch for freshwater intensive culture using recirculation aquaculture systems. These species were selected based on their biological and economical potential and also to cover the entire European geographic area and stimulate different aquaculture types.

Given that the results from this work will

hold much interest for the aquaculture industry across Europe, how do you intend to make sure there is open access to the results?

RR: The scientific results will be published in peer-reviewed journals, and an effort will be made to publish in open access journals. Regarding the aquaculture industry, we are planning to hold species-specific workshops during the last year of the project, where we will present all the information resulting from the project in the form of production protocols for each phase of production for the six species. These workshops will be open to any interested stakeholder and participation will be free of charge.

Are there any upcoming workshops or events that will be of interest to readers?

RR: In October 2017, within the Aquaculture Europe conference which will be organised in Dubrovnik, Croatia, by the European Aquaculture Society (EAS), DIVERSIFY will hold a special full-day session. The presentations will include the most recent data from research from all six species, in the different scientific disciplines. We expect a large audience both for the special session and the conference itself. The last EAS conference, which took place in Edinburgh in September 2016, was attended by 1700 participants from more than 60 different countries.

Partners

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Leading species diversification

Within the structure of the DIVERSIFY consortium, a Species Leader (SL) has been appointed for each selected species, with the responsibility of coordinating the identification of the existing industrial bottlenecks in the production of each species. 'The SLs were selected from among the consortium based on their involvement, expertise and excellence in research with the particular species,' says Dr Constantinos C. Mylonas. As the five-year DIVERSIFY project approaches the halfway mark, the researchers have had to overcome several hurdles in producing some successful results. The SLs share some of their experiences below.

Dr Nikos Papandroulakis, Greater Amberjack Leader: 'The availability of high quality greater amberjack eggs was a significant hurdle at the beginning of the project. After overcoming this issue, the results of the larval rearing trials achieved in 2016 represent a significant breakthrough in the production of the species, as survival rates of more than 30 per cent were achieved for the first time in the species.'

Dr Chris Secombes, Fish Health Leader: 'Analysis of the fish health status has been a challenge and we have had to be

opportunistic with respect to the diseases found in our stock and collaborating fish farms rearing meagre and greater amberjack. However, we are gaining a good overview of the main disease issues, and now have a battery of immune markers to aid analysis. Several treatment approaches have promise and a bacterial vaccine is being tested for efficacy in Atlantic halibut.'

Dr Alicia Estévez, Meagre Leader: 'We have characterised a large number of the available brood stocks in Europe, demonstrating that they have the necessary genetic diversity to be used as a base population for breeding selection. We are making very good progress in developing feeding management methods based on the behaviour and learning ability of this species.'

Dr Pascal Fontaine, Pikeperch Leader: 'When dealing with RAS (recirculating aquaculture systems) to culture fish, it is very important to rely on the right design and the finest control methods to guarantee production. Pikeperch work within DIVERSIFY is focused on the use of RAS, so it has been crucial to develop the adequate experimental set up.'

Dr Blanca Álvarez, Wreckfish Leader: 'One of the biggest problems encountered was the capture of live wild wreckfish specimens in order to study their growth and use them as future broodstock, due to the shortage in the Northwest area of Spain over the last few years. For the larval culture, we found larval quality problems related to some factors, such as broodstock nutrition, handling and harvesting conditions. Larval malformations led us to dedicate efforts to improve the breeders' feed in order to ensure better larval survival. We saw positive results from the spawning in all stocks, both spontaneous and hormonally induced. They have reached fertilisation rates of up to 95 per cent and hatching rates of 56 per cent. In addition, formulated feed has improved breeding and handling conditions, and environmental conditions in the incubation phase and larval culture. We characterised the fatty acid profile of oocytes from wreckfish females to understand the relationship between broodstock nutrition and oocytes composition, showing there is a clear difference between the newly designed wreckfish diet and the conventional semi-moist feed.'

Diversifying aquaculture to develop new markets

The DIVERSIFY project explores the biological and socioeconomic potential of new and emerging candidate fish species for the expansion of the European aquaculture industry. The findings of this five-year investigation will support the diversification of the industry and help expand production, ultimately leading to the development of new markets

The aquaculture industry in Europe employs some 190,000 people with a €7 billion ex-farm value. While there are 35 aquatic species cultured in Europe, a very limited number of finfish species, such as Atlantic salmon, rainbow trout, common carp, European seabass, and gilthead seabream, represent a significant proportion of finfish aquaculture production. This lack of diversity in European aquaculture products is reflected in the substantial amount of imported seafood.

In addition, the lack of diversity has led to periods where production has surpassed demand, thereby lowering prices to levels that are sometimes below the cost of production – a situation that is obviously untenable. Thus, there is an evident need to find a means of providing an efficient, sustainable and market-oriented expansion of the European aquaculture sector, one that is based on diversifying species and reducing the dependence on imports from countries with production standards that are often questionable.

THE SIX SPECIES OF INTEREST

With that in mind, a five-year project began in 2013 to explore the biological and socioeconomic potential of some new fish species, in order to expand the European aquaculture industry. Called DIVERSIFY, the project is made up of a consortium of research and production organisations from across Europe.

The consortium, including Project Coordinator Dr Constantinos C. Mylonas and Dissemination Leader Dr Rocio Robles, has identified six species to focus on: meagre, greater amberjack, wreckfish, Atlantic halibut, grey mullet and pikeperch. 'DIVERSIFY includes species that are already cultured to some degree and for which there is a need to

improve production technologies, diversify products and enhance marketing aspects,' explains Robles. 'We want to boost the growth of the aquaculture industry, through the production of new aquaculture species that have a high biological and economical potential.'

DISSEMINATING THE DIVERSIFICATION FINDINGS

The project is now at the halfway point and significant progress has been made in culturing the six species. Feeding behaviours have been assessed, breakthroughs have been made in the reproduction and juvenile production of the species, heavy mortality rates have been overcome, and a bacterial vaccine is being tested to improve fish health. 'Full-day seminars on "Know-how Transfer" of the aquaculture of each of the DIVERSIFY species will be organised during the last year of the project, with presentations on selected aspects, such as reproduction and spawning induction, juvenile production, nutrition, final product diversification and quality,' explains Robles. 'The workshops will be organised in countries where the particular species are cultured – or have the potential to be cultured – and will be located centrally in a region with interested aquaculture operations.'

Ultimately, in combining biological, technical and socioeconomic research, the DIVERSIFY consortium will help diversify the European aquaculture industry, expand production and develop new markets.

Project Insights

FUNDING

This five-year-long project (2013–2018) has received funding from the European Union's Seventh Framework Programme (FP7) for research, technological development and demonstration (KBBE-2013-07 single stage, GA 603121, DIVERSIFY). The consortium includes 37 partners from 12 European countries – including nine SMEs, two large enterprises, five professional associations and one consumer NGO – and is coordinated by the Hellenic Centre for Marine Research, Greece. Further information may be obtained from the project website at www.diversifyfish.eu.

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PROJECT COORDINATOR BIOS

Dr Constantinos C. Mylonas is Deputy Director of the Institute of Marine Biology, Biotechnology and Aquaculture within the Hellenic Centre for Marine Research in Greece. His research activities focus on the study of reproductive biology and endocrinology in finfish; the identification of reproductive dysfunctions that occur in both male and female brood fish in captivity; and the development of pharmacological methods for the control of reproduction, induction of spawning and improvement of sperm quality in commercially important cultured fish. A major application of this research is the development of controlled-release delivery systems (implants) for agonists of the neuropeptide gonadotropin-releasing hormone (GnRH_a). Some of the species of interest include the meagre (*Argyrosomus regius*), wreckfish (*Polyprion americanus*), greater amberjack (*Seriola dumerili*) and Atlantic bluefin tuna (*Thunnus thynnus*).

