

project news

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AQUAEXCEL (Aquaculture Infrastructures for Excellence in European Fish Research) is an EU FP7 project that integrated key aquaculture research infrastructures across Europe in order to promote their coordinated use and development.

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Sign off from the AQUAEXCEL Coordinator



Marc Vandeputte, AQUAEXCEL Coordinator

After four years of fruitful collaboration, **AQUAEXCEL** has fulfilled its strategic objectives through the integration of 17 key partners and 27 top class infrastructures, and has been rewarded by numerous applications from Europe and beyond to access our facilities,

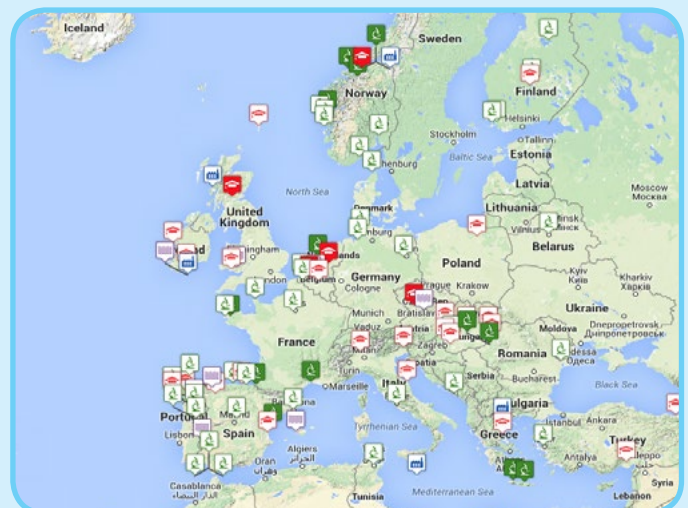
resulting in 97 innovative and highly original Transnational Access (TNA) projects taking place.

AQUAEXCEL has also successfully delivered four new pioneering technical training courses that focus on different aspects of aquaculture experimentation. These courses were the only ones of their kind putting emerging aquaculture infrastructure centres of excellence at the forefront. All four courses were hugely successful and the feedback from the trainees was extremely enthusiastic with more sessions requested across the board.

AQUAEXCEL's interactive map is now the most comprehensive and dynamic inventory of aquaculture Research Infrastructures (RIs) in Europe and now allows for the addition of more information on fish lines, management data and performance data for relevant traits at each facility. To further contribute to the growth of the sector, an analysis of the research needs of European aquaculture RIs was undertaken. This investigation highlighted some perceived gaps in European aquaculture RIs which were discussed in depth with the partners at the project's final meeting.

Lots of work has been devoted to analysing and spreading best practices, for example guidelines for sanitary issues linked to fish transport between infrastructures, for measuring and accurately defining traits and phenotypes, and for developing traits and environmental conditions ontologies. This was an important task, and efforts to promote its adoption by a wider circle of aquaculture scientists should be encouraged and continued.

A tailored and targeted dissemination strategy has made **AQUAEXCEL** well known in the aquaculture community. A selection of publications including our project newsletters



AQUAEXCEL interactive online aquaculture RI map



Industry focused workshop, Aquaculture Europe conference 2014, San Sebastián, Spain

and **AQUAEXCEL** Key Achievements booklets were complemented by an industry focused workshop at the Aquaculture Europe conference 2014 in San Sebastián, which gathered over 140 participants from the whole aquaculture sector.

At the scientific level, our work on remote access now allows researchers to access their on-site experiments at **AQUAEXCEL** facilities such as IMARES, Nofima, NTNU, SINTEF, and WU-Aquaculture and Fisheries Group, from their living rooms. A study on how e-infrastructure affects the design, outcome, cost and collaboration in an experiment has also been carried out. In addition, **AQUAEXCEL**'s work on upscaling has now confirmed that yes - even in fish tanks and in bio filters - size matters! Such studies are a useful link between research and industry and show how the scale of an experiment can influence its validity in industrial conditions; and also propose explanatory factors that can help extrapolate small scale experiments to industry size application.

AQUAEXCEL also provided the scope to integrate knowledge on measuring more precise phenotypes of individual fish by combining experimental approaches on fish, genomics and bioinformatics. Very interesting results on the importance of mitochondrial pathways in stress response were produced, and scoring methods developed.

A significant effort was also committed to produce isogenic fish lines for major species like salmon, sea bass and carp; a priceless experimental resource for reproducibility of results and genetic studies. The road has been tough, and we have not yet reached the end of the story; with the first isogenic salmon about to hatch in 2015, while the prospects are good to obtain isogenic carp and sea bass within the next two years.

AQUAEXCEL's final meeting was held from 4-6 February 2015 in Spain. On this occasion, the project's results were shared and discussed with partners as well as with TNA researchers and scientists from other projects. It was the perfect opportunity to analyse **AQUAEXCEL**'s impact on the individual, organisational, and scientific level, and to see how the project has contributed to the evolution of European RIs and our approach to aquaculture science.

An enlarged **AQUAEXCEL** consortium has submitted a new project to the EC. The final decision on its funding should be known shortly and we look forward to hopefully continuing this aquaculture challenge towards 2020.

*Best Wishes,
Marc*



Final partner's meeting, Benicàssim, Spain, Feb 2015



AQUAEXCEL's partners at the project's final annual meeting

AQUAEXCEL Annual Meeting 2015, Benicàssim, Castellón, Spain

The fourth and final Annual Meeting of **AQUAEXCEL** took place in Benicàssim, Spain, from 4-6 February 2015, and was kindly hosted by Consejo Superior de Investigaciones Científicas (CSIC). CSIC is the largest public institution dedicated to research in Spain and the third largest in Europe, comprising more than 125 centres and institutes.

Almost sixty participants including partners, TNA researchers, and special guests attended the meeting.

AQUAEXCEL results presented at the meeting included guidelines on the use of common standards, protocols and ontologies developed during the project; suggestions for actions to further integrate European aquaculture RIs; the presentation of a variety of new tagging tools suitable for use on larvae and juvenile sea bass and gilthead sea bream; technical solutions and testing protocols for the standardised implementation of the **AQUAEXCEL** e-infrastructure; a new Bioinformatic tool ("Fish and Chips") adapted to enable meta-analysis of fish microarray data; new pathway focused PCR-arrays for phenotyping nutritional and environmental stress in gilthead sea bream; effects of different sized experimental tanks and cages on performance indicators of Atlantic salmon and sea bass; phenotypic analysis of gynogenetic and androgenetic individuals in salmon, carp and sea bass; and insights into the creation of isogenic fish lines.

An afternoon was dedicated to the **AQUAEXCEL** TNA programme, including a special session with the TNA Selection Panel, which provided the opportunity for partners to discuss and share feedback on the success of the programme. The **AQUAEXCEL** TNA programme enabled research groups to utilise the facilities of participating aquaculture RIs to undertake experimental trials on a selection of commercially important aquaculture fish

species and system types. Several users of the TNA Calls for Access also presented their research results at the meeting, which included studies examining the effects of different dietary interventions, such as the substitution of fish oil with alternative ingredients (hazelnut oil, insect meal) or arginine supplementation, on health and growth performance.

There was a special session entitled "Ethics in **AQUAEXCEL**: lessons learned and how to improve" with **AQUAEXCEL**'s ethics advisor Prof Felicity Huntingford.

As the meeting concluded **AQUAEXCEL**'s four year contribution to the European aquaculture sector the consortium considered options for future collaboration, strategic planning, and sustainability; to ensure the legacy of the project and the continued impact of the results achieved. The **AQUAEXCEL** researchers are eager to continue to contribute to the growth of the European aquaculture sector through their industry applicable research and to propose new solutions to feeding the growing human population in a sustainable and healthy manner.

On the final day of the meeting, participants visited the CSIC Instituto de Acuicultura "Torre de la Sal" (IATS) facilities, which were part of the TNA infrastructures. Research conducted at this facility includes investigations into the reproduction and health and pathology of aquatic organisms.



AQUAEXCEL TNA Selection Panel

Infrastructure mapping, strategic planning and sustainability



Alexandra Neyts, NTNU

Alexandra Neyts, NTNU, is the leader of AQUAEXCEL's Work Package 2 which is concerned with Infrastructure mapping, strategic planning and sustainability. Here she explains the objectives of the work package and some of the interesting findings of the work being undertaken.

1. What were the main aims of your team's activities?

This networking activity aims to consolidate the aquaculture RIs in Europe. The aquaculture research community is highly diversified, with expertise in a wide range of biological and technological disciplines. The existing pool of facilities shows an even larger variety as they have to suit experimental research for the main types of commercial fish species and related fresh or seawater resources, for production on land, at sea or in ponds. An important mission of **AQUAEXCEL** is to strengthen the ties between existing infrastructures in Europe. This was done through building up the online RI map, linking the infrastructure properties to the research goals set out by European Aquaculture Technology and Innovation Platform (EATiP), finding the gaps in research, and by providing a strategy for more sustained RI collaboration.

2. How has being involved in AQUAEXCEL shaped your opinion on the potential impact of collaborative research?

For the first time ever, a group of Europe's leading RIs collaborated in one single project. **AQUAEXCEL** gathered scientists working on a large variety of topics, all relevant for the necessary development of the aquaculture industry in Europe. This created a highly dynamic and cross-disciplinary atmosphere of collaboration, which may very well lead to the start of new projects that involve new types of partners with complementary assets. This is a necessary development if we wish to contribute to tackling the complex challenges the aquaculture sector is facing. TNA has largely contributed to the creation of new partnerships between users and providers of the facilities. These types of collaborations add new value to research as they stimulate knowledge transfer across disciplines, regions and aquaculture sub-sectors. This paves the way for novel opportunities and approaches for bringing new knowledge into the aquaculture sector. Collaboration, for example, between fish physiologists working with different types of species and ICT specialists, allows companies to better monitor fish behaviour, providing prospects for fish welfare improvement initiatives.

3. What challenges have you encountered?

The heterogeneity of the consortium might sometimes be challenging, as experimental research at one facility might be of a very different kind compared to another facility. Hence, the research priorities, experimental methods, and the type of data collected will also largely vary. **AQUAEXCEL** provides a good platform for the different partners to meet, which would not necessarily happen otherwise. This networking role is important to stimulate exchange of knowledge!

AQUAEXCEL has been an ambitious project, under which a wide range of activities have been carried out. As many of the partners were not familiar with TNA activities at the start of the project, it has taken some extra time to implement the necessary measures to fully carry out this activity.

4. WP2 created the interactive online map of RIs. Why is this map important to the European aquaculture sector?

The **AQUAEXCEL** online RI map clearly shows the diversity in the European aquaculture research area today. Its functionality allows anyone to search for facilities and research groups that correspond to his/her interest, be it as a potential user of the RI or partner in international collaborative projects. It is also a good way to promote facilities, and to highlight their properties and research opportunities. Because of its interactive user interface, the map permits facility owners to modify or add their entries at any time, keeping the information provided up-to-date. The online map is also a useful tool to guide policy and decision makers in their strategies for RIs in Europe.

5. What do you think should be the strategic aims of European aquaculture RIs going forward?

As mentioned earlier, the aquaculture RIs in Europe represent a wide variety of tools and expertise, which are difficult for the research community to fully grasp. Stronger links between RIs across national and research area boundaries could stimulate the formulation of common strategies, standards and experimental methodologies and the efficient use of research facilities. This again would benefit the individual researcher and the aquaculture sector as a whole. At present, collaboration is often hampered by a lack of funding, which was identified as the most critical obstructive factor by the majority of RIs. A collaborative RI project is therefore to be preferred, in the short term, in order to continue the coordinated actions and to build upon many of the initiatives already undertaken as part of **AQUAEXCEL**. A stronger integration with the EATiP should also provide the aquaculture RI community with a valuable tool to support further integration in the time to come. The **AQUAEXCEL** partners are also enthusiastic about the possibility of creating an ERIC. However, for a young consortium such as **AQUAEXCEL**, a significant effort is still required to prepare for this kind of process.

AQUAEXCEL Model for Sustained Research Infrastructure Collaboration

AQUAEXCEL has analysed and recommended some future possibilities for a sustained and coordinated collaboration of aquaculture RIs in Europe in a new report entitled “Model for sustained research infrastructure collaboration”. In order to arrive at a recommendation, five different organisation models were evaluated vis-a-vis their appropriateness as a first step towards an integrated European aquaculture RI using a Strengths, Weaknesses, Opportunities and Threats (SWOT) methodology.

The report builds upon existing initiatives completed within the project in the areas of infrastructure mapping, strategic planning and sustainability. These include the **AQUAEXCEL** online RI map, a report on regulatory collaboration frameworks for RIs, and other research and actions which aim to enable a stronger integration between key European aquaculture RIs.

The new report complements previous research carried out by the project, where the priorities for collaboration between RIs as perceived by the **AQUAEXCEL** members were mapped, analysed and prioritised. Based on these collaboration priorities and the particularities of aquaculture research, a selection of organisation models for structured RI collaboration were presented, namely:

- ✓ **Project based collaboration**
- ✓ **Memorandum of Understanding (MoU) between participating RI providers**
- ✓ **EATIP RI network**
- ✓ **European RI Consortium (ERIC)**
- ✓ **Internationally acting not-for-profit association**

The report found that all five analysed models stimulate collaboration among existing RIs in some way – with varying intensity and/or perpetuity. There is no “one model fits all” option. A given situation, with external influences, existing RI landscape, and maturity of collaboration, will have a strong influence on the suitability of each model and its feasibility. During the analysis, it was noted that there are Strengths, Weaknesses, Opportunities and Threats that are common to any collaborative infrastructure initiative, regardless of the model.

Project-based collaboration was evaluated to be the most suitable model for continued collaboration in the short term. There are several reasons for this but outstanding among its strengths as a model is the fact that it accommodates all the priority areas identified by **AQUAEXCEL** partners, namely:



- ✓ **Transnational Access**
- ✓ **Collaborative research**
- ✓ **Staff exchange**
- ✓ **Joint development of common standards & methods**

It is also a model which is adequately and securely resourced through external funding. The fact that this model has a robust structure and clear roles and responsibilities governed by a detailed contract was also perceived as advantageous.

The formation of an ERIC was considered the most viable model for consolidating aquaculture RIs, sustaining their development, and maximising their impact in the long term. The European Strategy Forum on Research Infrastructures (ESFRI) Roadmap identifies RIs of pan-European interest corresponding to the long term needs of the European research communities, covering all scientific areas. However, regrettably, the European aquaculture sector is not currently represented on this roadmap. The report concludes that this should now become a strategic aim for the sector in order to secure the place of European aquaculture RIs in the long term.

Ascertaining the will and commitment of prospective member states in forming an ERIC for the advancement of aquaculture research in Europe was recommended as the next step forward. Indeed, the consortium has already taken steps to initiate this process as AQUAEXCEL partners have recently established an RI Working Group under the auspices of EATiP. This has created the first single European contact point for infrastructure issues in the aquaculture sector which represents the views of both facility providers and users.

The report will be of interest to existing aquaculture RIs of international value in the European Research Area, and the stakeholders, both public and private, that depend on them for their research, training and testing activities. The full report can be viewed and downloaded here: http://aquaexcel.eu/images/Deliverables_2014/aquaexcel_d2.6_final.pdf

Transnational Access (TNA) Programme

On a regular basis, AQUAEXCEL invited proposals from European research groups for scientific research that utilised the facilities of any of the participating aquaculture RIs. These facilities were made available to the research community for TNA with the support of the European Union 7th Framework Programme for Research and Technological Development (Infrastructures). Here, several researchers who have accessed the programme describe their work and experiences using TNA to further their research.



Andrea Boanini

Name: Andrea Boanini

Institute: Dip. di Scienze delle Produzioni Agroalimentari e dell'Ambiente, UNIFI, Italy

TNA project: Microalgae-Boost

Current position: PhD student

Aquaculture RI accessed: IMR Cell (Matre Research Station, Matredal, Norway)

What type of research were you carrying out?

Our investigation is focused on the presumptive prebiotic properties of microalgae. We aim to study their impact on the gut microbiota of farmed salmon and their potential exploitation as natural feed additives. In our research, two species of phytoplankton are investigated alone (prebiotic) and in combination with probiotic bacteria to study the symbiotic effect.

In a broad sense, the general aim of this work is promoting

a more natural approach in the disease control of farmed salmon, enhancing their physiological state. In this context, microalgae have high potential, because they have a large spectrum of action and are eco-friendly.

Has AQUAEXCEL's call to access been beneficial for your project? If so, please outline why.



Experimental facility at IMR Cell

AQUAEXCEL provided a great opportunity for me to access a reference centre for salmonid aquaculture. The staff at IMR Cell

gave me the scientific and technical support to carry out my project. In fact, Prof Rolf Erik Olsen is an expert in the application of prebiotics in salmon aquaculture. Moreover, the technicians are highly qualified and very efficient. The intellectual environment was exciting and all the accommodation they provided was really comfortable.



Chris Bridges

Names: Chris Bridges and Gwendolin Göttler

Institute: Heinrich Heine University Düsseldorf, Germany

TNA project: Effects of ocean acidification and warming (OAW) on adult reproductive capacity and adult welfare in cod (*Gadus morhua*) (BIOACID)

Aquaculture RI accessed: Norwegian Cod Breeding Center, Nofima (NCBC)

What type of research were you carrying out?

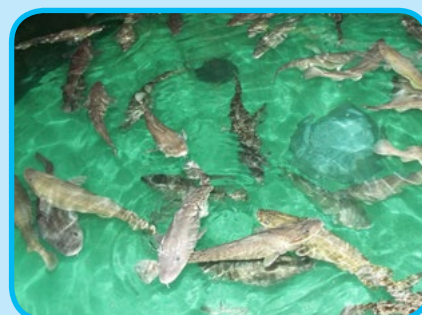


Gwendolin Göttler

The main objective of our project is to examine the influence of ocean acidification on reproduction in adult cod. In future ocean acidification scenarios, all life stages will be exposed to higher CO₂ levels. We are looking at responses of fecundity and gonad development in the stages before examining egg

and larval survival from such parents. Modern parentage studies are being used together with hybrid production to test the rationale of "transgeneration effects and adaptation".

Has AQUAEXCEL's call to access been beneficial for your project? If so, please outline why.



Cod broodstock in CO₂ incubation tank in NCBC

The **AQUAEXCEL** project gave us the support to work outside Germany, which would have been almost impossible without this help. The opportunity to work in the NCBC was eminently important for our work.

NCBC is undoubtedly one of the best facilities to work with cod worldwide with highly skilled staff and infrastructures perfectly tailored to our particular needs.



Francesca Tulli

Name: Francesca Tulli, PhD

Institute: Department of Food Science, Università degli Studi di Udine, Italy

TNA project: Genetics for LC-PUFA increase

Current position: Senior Researcher

Aquaculture RI accessed: UR1067 NuMeA Nutrition, Métabolisme Aquaculture, INRA Saint-Pée-sur-Nivelle (INRA – ST PEE)

What type of research were you carrying out?

The research was set up to study the possible correlation of a polymorphism in the fatty acid desaturase 2 gene and the ability of rainbow trout to utilise dietary n-3 long-chain PUFA precursors, as D6-desaturase is the rate-limiting enzyme in the production of EPA and DHA from α -linolenic acid. After the genomic characterisation, fish have been fed a fish meal and oil deprived experimental extruded diet for ten weeks and the D6 expression and activity indicators and rainbow trout muscle LC-PUFA composition will be evaluated. The results could, by using marker-assisted selection, allow an improvement in the utilisation of dietary vegetable oils and meals, rich in n-3 precursors, while providing human

consumers a healthier fish product with a high content in LC-PUFA, namely EPA and DHA.

Has AQUAEXCEL's call to access been beneficial for your project? If so, please outline why.

The AQUAEXCEL call has been very useful because it has allowed us to benefit from optimal culture conditions to carry out the experimental trial. Special thanks to the INRA staff who kindly and warmly assisted during the experience. The project is still ongoing and the on-field phase has just ended, but the energy and the enthusiasm for further work is still very high. The exchange with our colleagues was intense and useful and I undoubtedly hope this experience is another step to continue further collaborations in R&D projects and other research activities.



AQUAEXCEL team at INRA facilities



Giovanni Piccolo

Name: Giovanni Piccolo

Institute: Department of Veterinary Medicine and Animal Production - University of Naples Federico II

TNA project: Evaluation of apparent digestibility coefficients of insect meal based diets in European sea bass (*Dicentrarchus labrax*)

Current position: Lead Researcher

Aquaculture RI accessed: Hellenic Centre for Marine Research - Institute of Aquaculture (HCMR Aqualabs), Crete, Greece

What type of research were you carrying out?

This study focused on the determination of Apparent Digestibility Coefficients of energy and nutrients in European sea bass diets containing *Tenebrio molitor* (TM) larvae meal and two digestive enzymes.

Our research is part of a wider series of studies aiming to investigate the possible use of insects as alternative sources of proteins for cultured fish and it represents the continuation of previous research, coordinated by Dr Laura Gasco (Department of Agricultural, Forest and Food Sciences - University of Turin, Italy), carried out with support from the

AQUAEXCEL project at HCMR Aqualabs in Crete.

Has AQUAEXCEL's call to access been beneficial for your project? If so, please outline why.

Some research has been carried out on the potential use of insects as feed for fish but there is an urgent need for additional research to enhance the existing framework. The AQUAEXCEL call has been very useful because it has allowed us to benefit from the invaluable expertise of Dr Stavros Chatzifotis and the modern and well equipped facilities of HCMR Aqualabs. Furthermore, it gave us the opportunity to come into contact with other European research groups, which improved the quality of our research.



Tenebrio molitor larvae meal and an experimental diet



Marco Alexandre Cerqueira

Name: Marco Alexandre Cerqueira

Institute: Centre of Marine Sciences of University of Algarve, Portugal

TNA project: Using temperature choice in a dynamic environment to assess animal personality both within and between genetically distinct Tilapia populations

Current position: PhD student

Aquaculture RI accessed: University of Stirling, Institute of Aquaculture (UoS, IoA), United Kingdom

What type of research were you carrying out?

This research is in the scope of my PhD and aimed to explore the possibility that thermal preference is an indicator of animal personality. The development of a simple, inexpensive, non-invasive and non-lethal screening method would enable

us to gain more information on both animal personality and welfare within a population, which would be valuable for refining fish production in the industry.

Has AQUAEXCEL's call to access been beneficial for your project? If so, please outline why.

AQUAEXCEL was undoubtedly beneficial for the development of this research and for my PhD project. It gave me the opportunity to develop a ground-breaking study with direct relevance to aquaculture and enabled me to gain experience that spans across the biological sciences, which is invaluable at my career stage. Thanks to this opportunity I gained knowledge about a species with a significant body of related research over the past 30 years and I was supported by in-house expertise which added value both on a personal and professional basis.

The results obtained could open doors for future research and collaboration with this RI in the field of sustainability, welfare, health, and disease resistance of farmed fish.



Paloma Morán

Name: Paloma Morán

Institute: Universidad de Vigo, Spain

TNA project: Study of sex ratios in brown trout during early life stages

Current position: Professor in Genetics

Aquaculture RI accessed: PEIMA INRA (La Pisciculture Expérimentale INRA des Monts d'Arrée), France

What type of research were you carrying out?

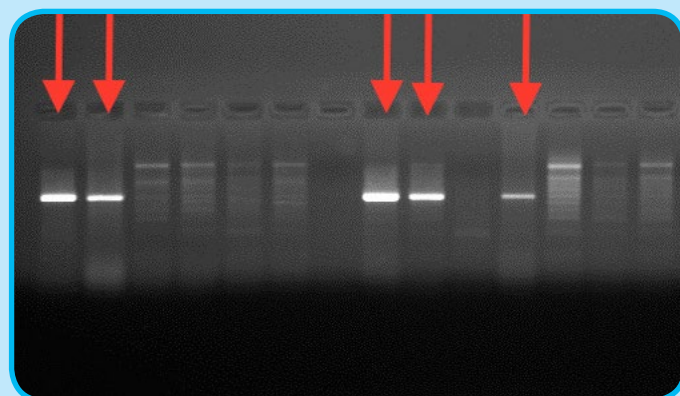
My study is concerned with the investigation of sex ratios in trout. In this species sex ratio is most often considered to be balanced (0.5) however different rates of males and females are common when sex ratio is studied in adult populations. There is very little data on sex ratios of juvenile trout because up to 2013 no genetic markers were available, and therefore assessing sex composition was not always possible in early stages. The discovery of sdY (sexually dimorphic on the Y chromosome) as the master sex-determining gene in rainbow trout (Yano et al. 2012) and in other salmonid species has allowed for the development of an efficient and easy molecular sexing technique, the partial polymerase chain reaction (PCR) amplification of the sdY gene, and solving sex ratio at any stage is now possible (Yano et al. 2013, Quémeré et al 2014).

My experiment involves 1:1 crosses between three different

trout strains. In total 45 crosses were done and we have been following their development until yolk-sac reabsorption. Once the hatchery experiment is finished we will start with lab analysis to test the following hypothesis: sex ratio in brown trout is 1:1 during the early life-stages. We hope the results of this experiment will be valuable to fish managers.

Has AQUAEXCEL's call to access been beneficial for your project? If so, please outline why.

AQUAEXCEL gave me the opportunity to carry out this experiment in optimal conditions. I tried to do a similar experiment before but there was not enough room at the local hatchery, and because it is far from the university, it was difficult to control crosses and mortalities. This call has been very beneficial for my research interest.



PCR experiment for sex identification. First line is the molecular marker; the next lines represent different individuals. The ones with a band (arrows) are males. The ones without bands are females.



Maria Rita Azeredo

Name: Maria Rita Azeredo

Institute: Interdisciplinary Centre of Marine and Environmental Research, CIIMAR, Portugal

TNA project: Effect of arginine-supplemented diets in sea bass (*Dicentrarchus labrax*) in terms of protection against vibriosis

Current position: PhD student

Aquaculture RI accessed: Instituto de Acuicultura Torre de la Sal - Consejo Superior de Investigaciones Científicas (IATS-CSIC)

What type of research were you carrying out?

Improving fish health and welfare is a priority during mass production of finfish in aquaculture. Alternative solutions to the use of antibiotics and other chemicals ought to be developed, and functional feeds are an emergent tool. Several amino acids are involved in key steps of the inflammatory response. Arginine plays important roles such as being the precursor of polyamines and nitric oxide, and is therefore involved in cell proliferation and innate immune response, respectively. Our study was focused on the effect of arginine dietary supplementation on the disease resistance of European sea bass (*Dicentrarchus labrax*).

Has AQUAEXCEL's call to access been beneficial for your project? If so, please outline why.

The AQUAEXCEL Transnational Access programme was more than beneficial since it gave me the opportunity to carry out an essential study for my PhD thesis. The execution of this study required amounts of fish and the use of infrastructures that would otherwise have been impossible to obtain.



Juvenile sea bass after treatment with *V. anguillarum*

The experiment was undertaken in collaboration with two well-recognised research groups in IATS-CSIC: the Fish Pathology (Dr Ariadna Sitjá Bobadilla) and the Nutrigenomics and Fish Growth Endocrinology

(Dr Jaume Pérez-Sánchez) groups. While working with them, I had the chance to discuss and improve ideas, working methodologies and results interpretation. The Nutrigenomics and Fish Growth Endocrinology group has recently developed a bioinformatic molecular tool that allows the study of functional regulation of fish transcriptomes, including the European sea bass. This tool made possible the expression analysis of a high number of immune-related genes. We hope this was just the important starting point of a constructive and promising research line.



Peyman Mosberian

Name: Peyman Mosberian

Institute: Norwegian University of Life Sciences, Norway

TNA project: Interaction effect of dietary soybean meal inclusion and water dissolved oxygen levels on fish metabolism and gut homeostasis

Current position: PhD student

Aquaculture RI accessed: Wageningen University Metabolic Research Unit (WU-MRU),

Wageningen, the Netherlands

What type of research were you carrying out?

The aim of this project was to evaluate the interaction effect of dietary soybean meal inclusion and water dissolved oxygen level on the intestinal permeability and energy/nutrient metabolism of rainbow trout. The overall outcomes of this project will address areas of sustainability of fish feed production and aquatic health and welfare.

Has AQUAEXCEL's call to access been beneficial for your project? If so, please outline why.

Yes. This experiment was important for my PhD project. The WU-MRU allowed me to have access to excellent facilities to perform advanced experiments with highly controlled environmental conditions, in combination with on line fish metabolism measurements.



Experimental facility at WU-MRU



Türker Bodur

Name: Türker Bodur

Institute: Akdeniz University, Fisheries Faculty, Department of Aquaculture, Antalya, Turkey

TNA project: New Herbal Anaesthetics for Fish

Current position: Specialist

Aquaculture RI accessed: University of Las Palmas de Gran Canaria, Warm Water Species Selection Unit

What type of research were you carrying out?

Three different herbal extracts were used to anaesthetise European sea bass (*Dicentrarchus labrax*) and meagre (*Argyrosomus regius*) juveniles in this project. The project had two experiments. In the first experiment, we checked the suitable dosage of new anaesthetics for fish species. In the second experiment, we checked the stress effect of new anaesthetics on species. We sampled blood from the fish at four time intervals (0h, 2h, 6h and 24h) after the fish were anaesthetised. Stress gene expression will also be analysed from anterior kidney, liver and gill tissues.

Has AQUAEXCEL's call to access been beneficial for your project? If so, please outline why.

Transnational Access to ULPGC was definitely beneficial for me. I had the chance to see the operating research infrastructures and worked with very good experienced staff. Designing the stress experiment and sampling and evaluating the results with experienced people made everything especially easy. We have already discussed possible new projects for future collaboration between ULPGC and Akdeniz University. I'm very happy to know new people through the "EXCELlent" project AQUAEXCEL and I am already looking forward to hopefully having new opportunities for future research under AQUAEXCEL 2020.



The team from ULPGC for sampling of stress analysis

AQUAEXCEL's TNA Programme by Numbers

Proposals Funded

Total Project Proposals: 136

Projects Funded: 97 (71%)

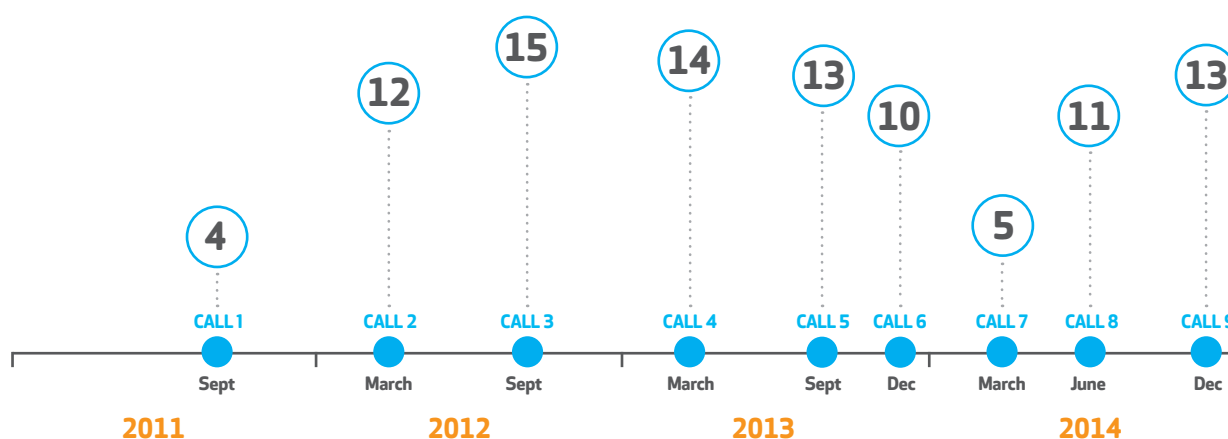
Project Proposals from non-AQUAEXCEL Institutes: 112

Projects Funded: 79 (70%)

Project Proposals from AQUAEXCEL Partner Institutes: 24

Projects Funded: 18 (75%)

Projects Funded Per Call



AQUAEXCEL Training Course Feedback

Over the course of the project, **AQUAEXCEL** organised four pioneering technical training courses that focus on different aspects of aquaculture experimentation. These courses were the only ones of their kind putting emerging aquaculture infrastructure centres of excellence at the forefront. Participation in these courses represented a unique opportunity for researchers and technicians in this field as course attendance is free, thanks to EC FP7 funding. Here some course participants tell us about their experience with the final **AQUAEXCEL** training course.

Course: Efficient Design of Fish Larval Experiments Utilising New Monitoring and Control Systems

Course provider: Norwegian University of Science and Technology (NTNU).

Location: Norwegian University of Science and Technology (NTNU) and SINTEF Sealab, Trondheim, Norway

Date: 19 - 22 May 2014



Sinem Zeytin

Your name: Sinem Zeytin

Your position: PhD student

Your institute: GMA - Association for marine aquaculture Ltd., Büsum & Christian-Albrechts-Universität zu Kiel, Germany

I am a current PhD student at University of Kiel, and working at the GMA in Büsum, Germany. I have been actively involved in a research project working on the investigation of the larval digestive physiology, and aiming to discover ontogenetic and nutritional deficiencies in the first feeding phase.

What were your reasons for applying for this course?

For my investigations, I take care of the rearing of the fish larvae, including the production of live food organisms. I need to be careful, and most of all, a very good observer. As a fisheries engineer, during my studies and work I have come to fully appreciate the important role of the hatchery technology, as well as the monitoring systems, in experiments. Thus, this course caught my attention since it was within the framework of experimental methods in first feeding experiments and new instrumentation with integrated control systems.

What was your overall impression of the course?

The overall course organisation, reading selection, assignments and activities were very well organised and balanced both practically and theoretically. The instructors were very knowledgeable and experienced in the subject area.

What part of the course did you enjoy the most?

The practical sessions were really useful since we had such a diverse group. In addition, having the opportunity to visit



On the way to the offshore salmon cages during the visit to the ACE industrial scale RI in Frøya, Norway

the fish farm and the fish processing plant was amazing. It gave me a broader understanding of monitoring and control systems. The friendly atmosphere helped us to be more active during the course and to learn from each other.

What do you feel is the most useful thing you have learned on the course and why?

For me the most valuable aspect of the course was the instrumentation and control systems in experimental design, since I would like to implement this in my experiments. Seeing the potential of the new technology and networking with Norwegian industry representatives was also very useful to combine the knowledge we have gained.



Visit to Salmar processing plant (Innovamar), Kverva, Norway



Kevin Torben Stiller

Your name: Kevin Torben Stiller

Your position: PhD student

Your institute: FTZ of Kiel University (Marine Measuring Technique)/GMA Büsum, Germany

My PhD thesis is dealing with the development of a respirometer system and sensors adapted for CO₂, pH, temperature, O₂ and NH₃ measurements in

aquatic environments. My contribution to the project is application-oriented. I use a purpose built system for my research in the field of respiration, assimilation and housing conditions of aquatic organisms, particularly fish, and I also verify and improve probes and analysers for respirometer measurements.

I have done an online controlled CO₂ gassing trial with turbot to investigate the effect of chronic hypercapnia (a condition of abnormally elevated CO₂ levels) on this marine species and a metabolic fuel use study with rainbow trout under challenging oxygen environments at different temperatures. These experiments were performed using new monitoring and control systems, so the topic of this course fit perfectly with my recent work.

What was your overall impression of the course?

At the NTNU CodTechLab the working conditions were great and the work with the liquid feeding robot was impressive. The organisers were extremely nice and ensured that we had a great time together. We had interesting lectures on the broad range of technologies applied in fish experiments. I particularly enjoyed the input of Ep Eding from the University of Wageningen as course tutor.

What part of the course did you enjoy the most?

I enjoyed networking and discussing with others about problems with aquaculture technology. It was interesting to see how the Norwegian colleagues work and how they have built their facilities at the NTNU.

The field trip was excellent. When visiting the large scale salmon research facility I was amazed by the utilisation of technology in Norway for salmon production.

What do you feel is the most useful thing you have learned on the course and why?

The most important thing for me was to see how other scientists work with adapted technology and how they exploit the possibilities of their purpose built facilities. I was happy to see that this does not differ too much from what we're doing.

Final Reflections from AQUAEXCEL's Partners



Alexandra Neyts

Alexandra Neyts – Work Package 2

For the first time, aquaculture RIs from different countries, covering a wide range of research disciplines and facility properties, are collaborating on a large scale! The online RI-map is a nice tool to show this diversity and makes it possible for any user to find the RI that corresponds to his/her interests.



Marieke Reuver

Marieke Reuver - Work Package 5

AQUAEXCEL focused its research so that it really addresses the needs of the aquaculture industry in Europe, has applications in industry, and so, measurable impact. There was real enthusiasm to reach beyond the world of science and academia and to reach audiences who could really use these results and apply them.



Bendik Fyhn Terjesen

Bendik Fyhn Terjesen – Work Package 8

WP8 has been a loud wake-up call that the conditions we provide for the experimental fish have great impact on research results. The size of experimental units matters, both at the organismal level, for the fish, and at the technology level, in biofilters.



Marc Vandeputte

Marc Vandeputte - AQUAEXCEL Project Coordinator

We are now at the end of the project, and this is the perfect time for analysing AQUAEXCEL's impact on the individual, organisational, and scientific level, and to see how the project has contributed to the evolution of European RIs and our approach to aquaculture science.

One of the major features of this project is its real multi-disciplinary approach, which broadens the landscape of the participating researchers. Certainly, we have started creating a community of aquaculture researchers, which has widened through new connections gained by TNA.