Guide for Transnational Access

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www.aquaexcel.eu

Contents

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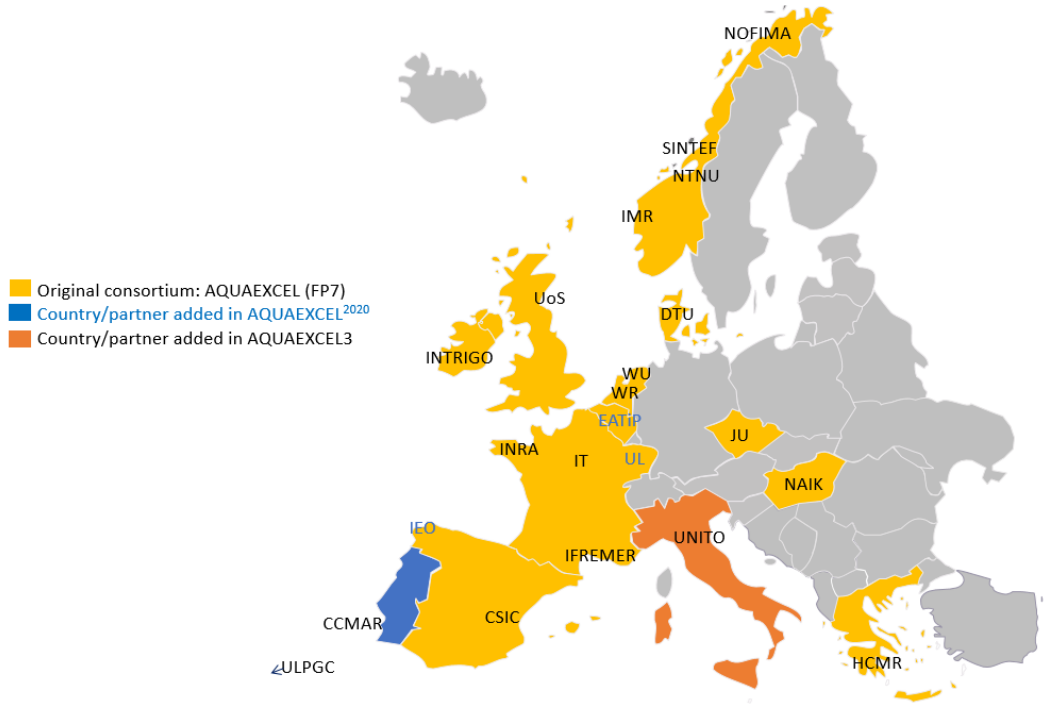
1 Introducing the AQUAEXCEL3.0 Consortium of Research Infrastructures

The AQUAEXCEL3.0 project is a key part of the European Commission strategy to support the development of research in the field of aquaculture to address the key priorities of the European Research Area:

- Realising a single labour market for researchers
- Developing world-class research infrastructures
- Strengthening research institutions
- Sharing Knowledge
- Optimising research programmes and priorities
- Opening to the world: international cooperation in Science & Technology

The project promotes collaboration between research groups and research infrastructures in a way that will help to optimise research programmes and priorities and strengthen the institutions. It should lead to higher quality research outputs and better sharing and exploitation of results.

AQUAEXCEL3.0 gathers partners who are leaders in the domains they are involved in within the project and have multidisciplinary interest and expertise. They offer an unprecedented set of aquaculture research infrastructures covering all important species, rearing systems and environments (see Table 1 below).



AQUAEXCEL makes available 40 Research Installations provided by 22 partner organisations across Europe.

Competences combined in AQUAEXCEL3.0 range from biological sciences (genetics, nutrition, physiology, pathology) to technology (rearing systems, engineering, information and communication technologies) and integrative expertise such as system modelling and design.

The partners expertise not only covers the range of the necessary academic scientific fields but also the many species that need to be considered to propose integrated aquaculture research infrastructures, as well as the access to specific environments (freshwater and marine, cold and warm water) and scales (small, medium and industrial scale):

- established freshwater and seawater finfish (salmon, trout, sea bass, sea bream, carp, cod, turbot),
- candidate "new" species (bluefin tuna, Atlantic bonito, four seriola species, wreckfish, meagre, shi drum, common dentex, Senegalese sole, tench, perch, European catfish, 11 sturgeon species, pike, pikeperch, burbot, whitefish, African catfish, tilapia...),
- cleaner fish for sustainable salmon farming (ballan wrasse, lump sucker),
- mollusks (flat and cupped oyster, mussel, clam, octopus, cuttlefish)
- macroalgae (*Saccharina latissima, Alaria esculenta, Laminaria digitata, Palmaria palmata, Porphyra sp., Chondrus crispus* and *Ulva lactuca*).

AQUAEXCEL3.0 partners provide a unique set of world-class infrastructures, providing researchers with excellent facilities and support to set up the highest quality experimental protocols:

- **Disease challenge facilities** for all main pathogens that cause significant losses in the EU fish and shellfish sector, including bacteria (Aeromonas, Vibrio), viruses (VHSV, ISAV, IPNV, IHNV, KHV, SVCV, Nodavirus, OSHV-1) and parasites (sea lice, Sparicotyle, Enteromyxum, etc.) for Mediterranean species (ULPGC-MBS, CSIC-EXP),cold-water fish species (IMR, UoS, INRA-IERP), temperate water fish (NAIK), and the all-purpose, high containment facilities of European Reference Laboratories for fish, crustacean (DTU) and bivalves (IFREMER) diseases.
- Facilities with the **highest level of environment control** to study the biology of fish: IMR, NTNU and NOFIMA for salmon, ballan wrasse and lumpfish and cod, CSIC and IFREMER for Mediterranean species, UL and JU for temperate freshwater species.
- Specialized units for **fish nutrition** studies: UoS for salmon and cod, INRA StPée, UNITO and WU for freshwater salmonids, JU for temperate freshwater fishes and CCMAR, ULPGC-FITU and CSIC for Mediterranean species, WU for tilapia.
- Specialized units for **fish behaviour** studies: IMR-Matre for salmon and cod, IFREMER and CSIC for Mediterranean species, IEO-ICRA and MAP for bluefin tuna.
- **Hatcheries and larval rearing** units: NTNU for cold-water marine species, NOFIMA for salmon and lump fish, HCMR-Aqualabs for most Mediterranean species, JU and UL for temperate freshwater species, IEO-ICRA and MAP for bluefin tuna, IEO-AquaCOV for turbot, Black spot seabream and wreckfish.
- A complete **genetic toolbox**
- Collections of ***fish lines***: INRA for trout, IMR for salmon and cod, IFREMER for sea bass, JU, WU and NAIK for carp, UoS for tilapia.

- Facilities for ***mollusc genetics***: mussels at CSIC and oysters at Ifremer.
- Genomic and ***high throughput sequencing*** facilities (HCMR, UoS).
- ***Genome editing*** on trout with CRISPR/Cas9 methodology (INRA).
- Provision of ***specific family crosses***: IMR for salmon and cod, ULPGC-WWSSU for sea bream, INRA for trout, Ifremer for sea bass, NAIK, JU and WU for carp.
- A unique capacity to develop and optimize **aquaculture technology and systems**
- Recirculated systems in NOFIMA-NCRA, WU and WR, with possibility (unique) to replicate systems.
- Facilities for engineering: larval tank systems (NTNU), large scale exposed facilities (SINTEF).
- Integrated Multitrophic Aquaculture (IMTA) at IFREMER, SINTEF and DTU, which represents a key research direction for environmentally sustainable aquaculture, as well as facilities for waste converters that can be used in fish feeds (insects in UNITO, marine worms in IEO-PAU).
- **Medium to large scale facilities** for growing of salmon (NOFIMA, SINTEF, IMR), Mediterranean species (HCMR) and temperate-warm freshwater fishes (JU, NAIK-OEPS).
- **Multi-disciplinary research**, across multiple species and environments in Stirling University, the leading international centre in aquaculture research and the largest of its kind in the world.
- **Highly specialized units with world-class expertise** in particular fields at WU (metabolic chambers), NTNU (zooplankton and larval cultivation) and WR (swim carousel to study swimming physiology and temperature preference chamber).
- **e-infrastructure solutions**, developed in FP7-AQUAEXCEL, providing remote access to WU, SINTEF, NTNU (http://aquaexcel.wikidot.com/).

Table 1: Consortium main expertise

Infrastructure	Systems						Environments				Expertises								Main species
	Broodstock/lines	Hatchery	Flow-through tanks	RAS tanks	Cages	Ponds	Sea water	Freshwater	Cold water	Warm water	Nutrition	Genetics	Physiology	Behaviour/welfare	Pathology/immunology	New species	NGS/genomics	Technology/systems	
INRAE	x		x	x				x	x		x	x	x	x	x		x		Trout
IMR	x	x	x		x		x	x	x		x	x	x	x	x	x	x	x	salmon, cod
UoS	x	x	x	x			x	x	x	x	x	x	x		x		x		Finfish: salmon, tilapia, trout, lumpfish, wrasse, African catfish and zebrafish. Crustaceans: European lobsters, langoustines and crabs. Bivalves: mussels, pacific and native oysters and scallops.
CSIC			x	x			x			x	x	x	x	x	x	x	x	x	sea bream, sea bass, turbot
HCMR	x				x		x			x	x			x		x	x	x	sea bream, sea bass, meagre
NAIK	x	x				x		x		x	x	x	x	x	x	x		x	carp, pikeperch
IFREMER	x	x	x	x			x			x	x	x		x	x		x	x	sea bass, oysters/bivalves
NOFIMA		x	x	x	x		x	x	x	x	x	x	x	x	x	x		x	salmon, lumpsucker, cod, ballan, wrasse, lumpfish
JU	x	x	x	x		x		x		x		x	x	x	x	x		x	carp, sturgeon, pikeperch
NTNU		x	x	x			x		x		x		x	x		x		x	Salmon, cod, wrasse, lumpsucker
SINTEF Ocean					x		x		x					x		x		x	Salmon, seaweed, cod
ULPGC	x	x		x			x			x	x	x		x	x	x			sea bream meagre, seriola, abalone
WU	x	x	x	x			x	x	x	x	x		x					x	Tilapia, trout, white shrimp

WR	x						x	x	x	x		x	x	x		x	x		Eel, sea bass, sea bream, salmon, trout, turbot, kingfish
UL		x		x				x	x	x			x	x		x			Perch, pikeperch, zebrafish
DTU			x	x			x	x	x	x					x		x		Trout, turbot
CCMAR	x	x	x			x	x			x	x	x	x	x		x	x		Breams (*Sparus aurata, Diplodus sargus, Diplodus cervinus*) sea bass (*Dicentrarchus labrax*) Senegalese sole (*Solea senegalensis*) meagre (*Argyrosomus regius*), Macroalgae (*Ulva sp., Asparagopsis armata*), shellfish (*Crassostrea angulata, Ostrea edulis, Crassostrea gigas*)
IEO	x	x	x	x			x		x	x	x	x	x	x		x		x	Tuna, wreckfish, turbot, octopus, sea bass, sea bream, seriola and polichaetes
UNITO		x	x					x	x		x								Trout, insects

2 Arrangements for Transnational Access

Researchers from any country can apply for access to these Research Infrastructures, although priority (at least 80% of all funded access) will be given to researchers from organisations legally established within an EU Member or Associated State[1]. Applications must be made to use a Research Infrastructure in a different country to that of the lead researcher. Details of the Research Infrastructures available within AQUAEXCEL3.0 are contained in this document. Each Research Infrastructure has a budget based on units of access, which are detailed for each facility in the following pages. Access to the facilities is provided free of charge to users and travel and subsistence expenses will also be paid. In general, it is anticipated that access will be in the form of one or in some cases two scientists travelling to work at one of the Research Infrastructures for a period of between one and three months (maximum number of days is 90).

Applications for Transnational Access may be made by any organisation (including commercial companies), but the conditions of access require the **results of the work to be published and made available to the scientific community** via standard channels.

Applications for Transnational Access should be made in accordance with the guidance published in regular "Calls for Proposals" that are made available on the project website www.aquaexcel.eu. Applicants are also encouraged to directly **contact individual facilities (by means of the facilities managers or TNA facilitators)** to discuss their research plans in advance of submitting an application. Another option is to address the queries to the **Orientation Committee** to obtain a more comprehensive mentoring for TNA applicants.

Applications for Transnational Access will be reviewed by an expert selection panel and an independent ethics adviser. Projects selected for Transnational Access will be expected to demonstrate high scientific quality, make efficient use of resources, and effectively address issues important for the development of European aquaculture – e.g., as expressed through the Strategic Research Agenda of the European Aquaculture Technology and Innovation Platform (www.eatip.eu).

All Transnational Access projects must be carried out between November 2020 and October 2025. Access to the Infrastructures will be promoted through a permanently open call for access with monthly application deadlines. The calls will be promoted quarterly to update and provide information about the infrastructures and the facilities offered and the opportunities and obligations for TNA projects. Please ALWAYS contact the research infrastructure manager directly to enquire about potential availability.

[1] Associated states: Switzerland, Norway, Iceland and Liechtenstein, Israel, Turkey, Croatia, the Former Yugoslav Republic of Macedonia and Serbia, Albania and Montenegro, Bosnia & Herzegovina

3 The Partners and Research Infrastructures

3.1 Institut National de la Recherche Agronomique (INRAE)

3.1.1 Introduction

In this project, INRAE, the main institute for agronomic research in France puts forward four installations for TNA. 1) PEIMA is the main salmonid experimental station in France, and one of the largest in Europe, and is dedicated to all kinds of studies on mainly trout genetics and physiology, and interaction between those, 2) INRAE St Pée Infrastructure which is a unique set of installations devoted to nutrition research in freshwater salmonids, 3) INRAE-IERP (Fish Infectiology Platform) is the INRAE experimental facility dedicated to fish infectiology 4) INRAE-LPGP proposes the production of transgenic or genome edited trout (GET service) and a service for germ stem cell grafting (GCGraft service) into recipient embryos a. INRAE has internationally recognized teams in fish physiology, genetics, nutrition and pathology (>400 peer-reviewed papers in the last 5 years) which will be involved in the networking and joint research activities.

3.1.2 INRAE-PEIMA (Experimental Fish Culture station of Monts d'Arrée)

Location: Sizun, FRANCE

Web site address: https://www6.rennes.inrae.fr/peima_eng/ & https://www6.rennes.inrae.fr/peima_eng/BIOLOGICAL-MATERIAL

Contact: Nicolas Larranaga (nicolas.larranaga@inrae.fr)

3.1.2.1 Facilities

PEIMA is the reference experimental unit for research on all stages of the life cycle of salmonids performed within several INRAE departments, mostly in physiology (reproduction, growth, behaviour, adaptation, etc.), genetics and nutrition. It is equipped with:

- Two separate water supplies:
  - River, with a flow rate of 900m^3/h and a temperature varying from 5 to 18°C.
  - Spring, with a maximum flow of 50m^3/h and a constant temperature 11°C ± 1°C.
- A hatchery with a capacity of 3 million eggs instantaneous hatching.
- 156 indoor nursery tanks (250L to 400L) for testing the early stages.
- 156 outdoor tanks (2 m^3). 70 tanks have individual oxygen control and 42 have photoperiod control.

- An outdoor semi-industrial RAS composed of 10 breeding tanks of 7 m^3 each. This RAS is linked to a hydroponic compartment consisted of two lagoons of 28 m^2 each and two media-based (gravel) beds of 14 m^2 each. It's equipped with a suspended solids treatment compartment. A fraction of the effluents, the highly charged backwash water of the drum filter is stored in a reservoir and periodically pumped to a radial flow settler for the later recovery of solids into polyester filter bag, due to an intermediate polymeric flocculation step.
- A platform of 26 circular tanks of 28m^3 used for broodstock maintenance.
- A behavioural study room with 32 tanks of 500 litres and 16 video cameras.
- Control of feed intake and feeding rhythms: a set of 48 tanks is equipped with self-feeders to monitor feeding rhythms and control feed distribution over the daily cycle and (iii) evaluate the amount of feed distributed.
- A wet laboratory for sampling and measurement of live fish equipped with a high throughput phenotyping platform.
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- An experimental processing/smoking unit with individual data acquisition on morphometry, yields, physiological & quality traits, and processing of samples for sensory evaluation.
- An indoor RAS platform composed whit 3 independent rooms. In each room the environmental factors (gas, temperature, light) can be managed. Each tank is equipped with faecal collectors, so accurate knowledge on feed intake by fish is gathered over long periods.

Each room could be linked to an aquaponic cold greenhouse composed of 27 parcels. Each parcel can be coupled or decoupled with the different rooms of the RAS.

- PEIMA also has a world unique collection of farmed trout with selection and maintenance of trout lines with original characteristics like growth, sex-ratio, fat content, spawning date, adaptation to plant-based diets, disease resistance, including 20 isogenic lines of rainbow trout. Specifically, the available biological material includes:
    - 5 strains of rainbow trout (*Oncorhynchus mykiss*) distinguished by their dates of egg-laying, of which one species is Golden (dominant albinism)
    - 2 strains of rainbow trout diverging in muscle-fat content (7th generation of selection)
    - 3 strains of brown trout (*Salmo trutta*), of which 1 has been selected for the speed of growth (9th generation of selection under way)
    - 1 strain selected for its ability to ingest plant-based feed (3rd generation of selection under way)
    - 20 strains of homozygous rainbow trout
    - 1 strain of YY males and 1 line of neo-males (XX).
- They are all available for TNA, under a collaboration agreement in the case of isogenic lines.
- A cold-water aquaponics unit may also be made available.

Ten full-time permanent technical staff work on site, highly skilled in fish protocols in genetics, physiology (reproduction, growth), welfare and nutrition.

3.1.2.2 Services currently offered by the infrastructure

PEIMA provides an experimental platform for freshwater studies throughout the whole life cycle of salmonids. All experimental animals are from well characterized genetic lines, including highly variable populations with different spawning dates, isogenic clonal lines and lines selected for specific traits (growth, muscle fat, dominant albinism). Production of triploid and/or mono-sex fish is available on request. Usual protocols are in all fields of physiology, genetics and nutrition, interactions between those, and their effects on product quality.

INRAE-PEIMA is currently used as a research infrastructure by several remote laboratories from INRAE (physiology, genetics, nutrition) and other French institutes and universities. It has also hosted many experiments from private companies.

In addition to the above, technical support for daily experimental work and technical help for samplings will be provided to all users. For specific needs, INRAE scientists using the infrastructures (genetics, nutrition, physiology, pathology) will assist users for experimental design and data interpretation.

3.1.2.3 Modality of access

INRAE-PEIMA will carry out experiments for potential users and provide physical access to its facilities during crucial periods of the running experiments. As the standard procedures and the general maintenance will be carried out by trained and experienced staff, each user is expected to stay 10 days, typically 5 days at the beginning of the experiment to finalize the technical protocol details and start the experiment and 5 days at the end of the experiment for final measurements and sampling.

PEIMA offers access to carry out fish trials with all tank types and water qualities available at the premises. Access will comprise the use of tanks including maintenance, water supply, daily feeding and husbandry of fish, manipulation, and sampling of fish. Access to all dry laboratory facilities and other infrastructural,

logistical, technical, and scientific support to external users is offered, as well as accommodation and office access with PC and international phone, fax and internet communications.

PEIMA provides standardized experimental protocols, documentation of results, and appropriate sampling and conservation of samples. Provision of experimental fish will exclusively be done using the collection of fish lines (rainbow trout, brown trout) available on site. Provision of specific genetic settings (different lines and crosses, triploids, mono-sex) should be agreed in advance. Use of rainbow trout isogenic lines is subject to prior agreement on research topics and IP rights.

3.1.2.4 Unit of Access

The unit of access is defined as 1 tank week: equalling the occupation of 1 standard fish holding unit (2 m^3) for 7 days. Occupation of small (250 l) or large (> 2000 l) tanks will be assigned a fraction or a multiple, respectively, of the standard tank unit. One trial is expected to comprise 128 tank-weeks on average (i.e., 16 tanks for 8 weeks). There are 500 units of access are allocated over the life of the project. Included in the units of access are monitoring of water quality parameters (flow, temperature, O_2, CO_2, pH), sanitary costs if needed (veterinary and treatment), sanitary safety, oxygen, etc...

3.1.3 INRAE-STPEE (Fish nutrition farms and platform)

Location: Saint Pée sur Nivelle, FRANCE

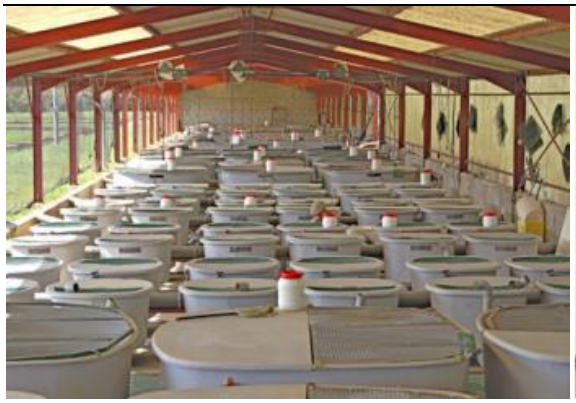
Web site address: http://www6.bordeaux-aquitaine.inrae.fr/st_pee

Contact: Stephane Panserat (stephane.panserat@inrae.fr)

3.1.3.1 Facilities

INRAE-STPEE facilities include three platforms, two full scale experimental fish farms with flow through raceways supplied with water at constant water temperature (8 and 17°C) and one specialised, original dedicated facility for fish nutrition research under controlled re-circulated water systems that allows feeding behaviour studies and digestibility measurements. INRAE-STPEE facilities thus enables fish nutrition research work all through the life cycle from larvae to broodstock.

Platform 1: The Experimental fish farm at Donzacq has a complete feed manufacturing plant with a twin-screw extruder. There are also wet lab facilities for in vivo work as well as samplings. The water supply is from natural springs at a constant 17°C with oxygenation and gas desaturation. The farm has large (160 cubic meters) and small scale (5000 and 200L) flow through raceways and individual tanks of different sizes: 20 small tanks of 50L for hatchlings, 48 1m² tanks, 18 2m² tanks, the latter with computer-controlled feeders.




Platform 2: At the experimental fish farm at Lees Athas, a constant water temperature of 7°C enables nutrition studies on cold water salmonids. The facility comprises of a hatchery for up to 400 groups of eggs; a UV-treated thermoregulated system to produce eggs and fry; 84 self-cleaning tanks for growing juvenile salmonids, of special interest for studies on nutrient-genotype interactions, 16 tanks of 200L, 32 tanks of 500L; 6 concrete out-door circular ponds of 12 to 20m^3 for studies with broodstock nutrition, 8 raceways of 12 to 20m^3 for studies with broodstock nutrition.

Platform 3: Specialised facilities

- Control of feed intake and feeding rhythms: A set of 2 independent recirculated systems each with 12 tanks, each of which is equipped with self-feeders specially developed by the research team (Boujard et al., 1992) to (i) monitor feeding rhythms, (ii) control feed distribution over the daily cycle and (iii) evaluate the amount of feed distributed. Each tank is equipped with faecal collectors, so accurate knowledge on feed intake by fish is gathered over long periods. The setup also enables feed choice experiments.

- Digestibility: In a recirculated temperature-controlled system, the system consists of 3 series of 6 cylindric-conical tanks connected with a continuous automatic faeces collector. The set up originally developed by the research unit (Choubert et al. 1982) has been recognised by EIFAC as the most valid method for in vivo studies on digestibility measurements with fish. This makes possible evaluation of apparent digestibility coefficients (ADC) of both diets and feed ingredients, and the estimation of suspended matter loss of dietary origin. A Quality-control system has been developed for ensuring the validity of standardised protocols and methods.

3.1.3.2 Services currently offered by the infrastructure

INRAE-STPEE can undertake all types of nutrition research experiments on freshwater salmonids. It has been actively used in experiments from different EU projects (PEPPA, RAFOA, GUTINTEGRITY, FINEFISH, AQUAMAX, PROMICROBE, ARRAINA, AQUAEXCEL^{2020}).

An added strength to the experimental infrastructure is the proximity of research laboratories (UMR INRAE-UPPA NuMeA) having all the necessary analytical equipment for nutrition related work: proximate and chemical composition analyses, bomb calorimeter, UV-visible spectrophotometers, HPLC, GC, cell culture facilities, histology and image analysis, molecular biology and genomics (real time PCR, phosphorimager). The laboratory provides a healthy environment for scientific interaction and exchange.

In addition to the above, technical support for daily experimental work and technical help for samplings will be provided to all users. INRAE scientists will assist users for experimental design and data interpretation.

3.1.3.3 Modality of access

INRAE-STPEE will carry out nutrition experiments on any life-stage of freshwater salmonids, either in open-flow farms at constant temperature (platforms 1 &2) or in controlled specialized units (3). A combination of platforms 1&2 for different temperatures and 1&3 for feeding behaviour, digestibility measurement and feeding trial can also be used. The usual trial duration is 3 months in order to allow sufficient growth of the fish. The access will comprise the use of tanks including maintenance, water supply, daily feeding and husbandry of fish; manipulation, and sampling of fish. Access to all dry laboratory facilities and other infrastructural, logistical, technical and scientific support to external users is offered, as well as office access with PC and international phone, fax and internet communications. Experienced staff will carry out the standard procedures and the general maintenance; however, the external user will be strongly integrated in all processes, recordings, evaluations, preparation and dissemination of results.

INRAE-STPEE will provide advice on experimental design and methodology, documentation of results for all experiments conducted during the project, and appropriate sampling and conservation of samples. Specific feeds can be produced for the experiments using the feed manufacturing plant. Provision of experimental fish can be done using the fish lines available on site. Provision of specific genetic settings (different (isogenic or selected) lines and their crosses) should be agreed in advance.

3.1.3.4 Unit of Access

Unit of Access: The unit of access is defined as 1 tank/week; equalling the occupation of 1 standard fish holding unit per week. One trial is expected to comprise 16 tanks on average (i.e. to test 3 factors and one control in quadruplicate, during twelve weeks).

3.1.4 INRAE-IERP (Fish Infectiology Platform)

Location: Jouy-en-Josas, FRANCE

Web site address: https://www6.jouy.inrae.fr/ierp/

Contact: Bernard CAYRON (bernard.cayron@inrae.fr) Dimitri RIGAUDEAU (dimitri.rigaudeau@inrae.fr)

3.1.4.1 Facilities

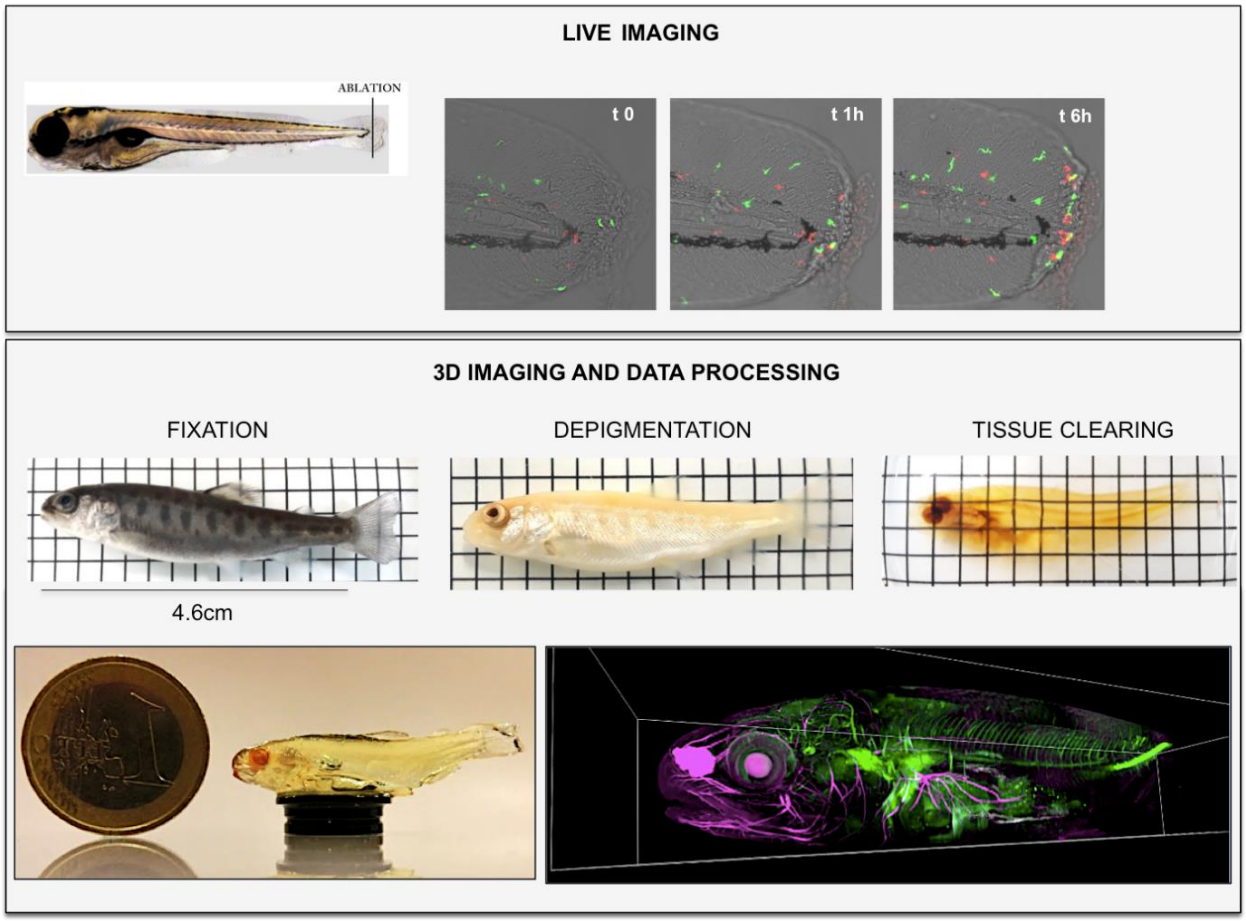
INRAE-IERP is the INRAE experimental facility dedicated to fish infectiology. It supports a number of long-term research studies on fish pathology, immunology, implementation of vaccines and genetic resistance/susceptibility to diseases.

EOPS fish (rainbow trout and carp) is produced in the 'clean' area, for usage in infectious challenges. Trout are from controlled genetic origin, i.e. a standard population (INRAE reference strain) and isogenic lines from INRAE-PEIMA (collaboration agreement) with contrasted resistance to a range of pathogens. IERP has access to stable inbred carp families from WU.

The fish installation (1000m²) consists in rooms for breeding pathogen free fishes with 4 RAS, 344 incubators or 86 aquaria, 18 tanks of 200l. The infectiology part (BSL2) has 104 aquariums in recycled or flow-through water, 14 tanks of 300 l in recycling or in lost water. Several animal genetic origin, age, route of inoculation, water quality, etc. are available.

Within the IERP, the phenotyping platform by *in vivo* imaging and tissue clearing, aims to provide standard and customized phenotyping services dedicated to the study of infectiology and inflammatory diseases. INRAE researchers and more broadly the national and international scientific community benefit from cutting-edge imaging equipment ideally located in confined environment to conduct live imaging of pathogen infections and host responses of the fish species available in the infrastructure. Our services include (https://www6.inrae.fr/zp2/Home-page)

- fish and rodent infectiology under controlled conditions monitored by bioluminescence and/or photonic imaging methods,
- *in vivo* screening of therapeutic candidates,
- innovative anatomopathology analyses based on 3D Imaging of whole organisms (combining advanced in toto immunohistochemistry, tissue clearing, deep imaging and data processing).

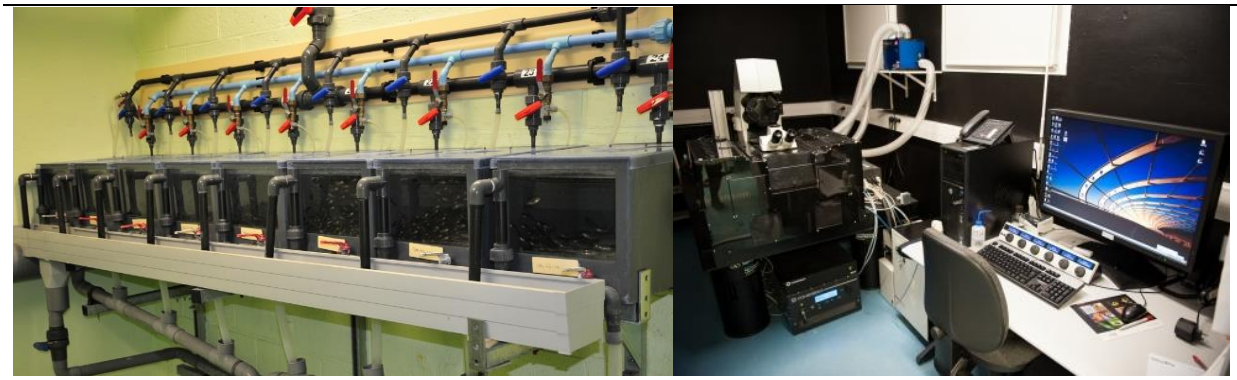


Live imaging of inflammation. Dynamic of leukocyte recruitment (green macrophages, red neutrophils) was recorded by confocal imaging at the tail cut post-ablation of zebrafish tail fin. **Tissue clearing and 3D imaging of rainbow trout**. Trout (4g) were fixed and immunlabelled to reveal the axonal network in the whole body. Light sheet imaging of the whole specimen allows the reconstruction in 3D of biological systems in trout and carp and open unprecedented perspectives to develop anatomopathology analyses in 3D.

3.1.4.2 Services currently offered by the infrastructure

The experimental facility produces and supplies specific animals (population, families, isogenic lines) of rainbow trout and carp with specific sanitary status and realizes experimental infections using injection or immersion. Pathogenic agents studied include most classical and emerging viruses and bacteria (trout: VHSV, IHNV, ISAV, Alpha virus SDV and SPDV, *Flavobacterium psychrophilum*; carp: SVCV). Experiments are performed with the expertise of INRA labs Molecular Virology and Immunology (VIM) and Animal Genetics and Integrative Biology (GABI). The facility was part of the Emerg'in infrastructure (https://www.emergin.fr/emergin_eng/)

Technical support for daily experimental work and technical help for samplings will be provided to all users. For specific needs, INRAE scientists using the infrastructures (genetics, nutrition, physiology, pathology) will assist users for experimental design and data interpretation.



3.1.4.3 Modality of access

Each user is expected to stay 5 weeks at the infrastructure with the provision of 1 circuit (12 aquariums of 15l or one tank of 300l) with appropriate fish (max 600 fish of 5 g, tagged if requested). Procedures will include inoculation with pathogen, recording of mortalities and termination of experiment by euthanasia, with subsequent necropsy, sample collection (blood, fins), decontamination and biosafety. Advanced sampling and monitoring and use of isogenic lines should be agreed in advance.

Access includes advice on experimental design, fish lines supply, daily maintenance and measurements, routine sampling and biometric measurements, conservation of samples, provision of monitoring data, access to an office with internet communication.

3.1.4.4 Unit of Access

Units of access are circuit/week. There are a total of 20 units of access available and an expectation that each trial will use 5.

3.1.5 INRAE-LPGP (Fish physiology and Genomics Facility)

Location: Rennes, FRANCE

Web site address: https://www6.rennes.inrae.fr/lpgp_eng/

Contact: Amélie Patinote (amelie.patinote@inrae.fr); Jean-Charles Gabillard (jean-Charles.gabillard@inrae.fr)

3.1.5.1 Facilities

The LPGP fish facility is an indoor structure based on recirculation systems which allows to control all the rearing parameters. The LPGP fish facility has the required level of biological safety for rearing genome-edited fish (trout, zebrafish, medaka, pike ...) over a complete life cycle.

It is equipped with:

- 20 independent recirculating water systems in 10 rooms (500m^2).
- a quarantine room.
- a behavioural study room with camera on each tank.
- more than 100 large tanks for trout and 1,000 small tanks for model species.
- room dedicated to eggs microinjection for production of transgenic or genome edited fish.

Four full-time permanent technical staff work on site, highly skilled in fish protocols in genome edition, physiology (reproduction, growth), and welfare.

3.1.5.2 Services currently offered by the infrastructure

The LPGP fish facility offers an array of services:

• INRAE LPGP proposes the production of transgenic or genome edited trout (GET service) that includes egg injection, genotyping and fish rearing up to reproductive stage. INRAE LPGP will train the users to genotyping and microinjection.

• The possibility to perform germ cell grafting (GCGraft service) into recipient embryos and the rearing of the surrogate fish up to maturation.

3.1.5.3 Modality of access

INRAE-LPGP fish facility will carry out experiments for potential users and provide physical access to it facility during crucial periods of the running experiments. As the standard procedures and the general maintenance will be carried out by trained and experienced staff, each user is expected to stay 5 days, for sampling and phenotyping of mutated trout (GET service) or grafted trout (GCGraft service).

LPGP offers access to carry out fish trials with all tank types and water qualities available at the premises. Access will comprise the use of tanks including maintenance, water supply, daily feeding and husbandry of fish, manipulation, and sampling of fish. Access to all dry laboratory facilities and other infrastructural, logistical, technical, and scientific support to external users is offered, as well as accommodation and office access with PC and international phone, fax and internet communications. LPGP provides standardized experimental protocols, documentation of results, and appropriate sampling and conservation of samples.

3.1.5.4 Unit of Access

The unit of access is defined as one tank/week. One typical access consists of 52 units of access (one tank for one years). One unit of access includes the injection of 400 trout eggs, genotyping and rearing until one year (F0). There are 104 units of access are allocated over the life of the project. Included in the units of access are monitoring of water quality parameters (flow, temperature, O_2, CO_2, pH), sanitary costs if needed (veterinary and treatment), sanitary safety, oxygen, etc.

3.2 Institute of Marine Research (IMR)

3.2.1 Introduction

The Institute of Marine Research is the largest marine institute in Norway and covers marine living resources, marine environment and aquaculture. The main task is to provide advice to Norwegian authorities on aquaculture and the ecosystems of the Barents Sea, the Norwegian Sea, the North Sea and the Norwegian coastal zone. The aim of research and management advice provided by IMR is to ensure that Norway's marine resources and aquaculture industry are managed and develop within a sustainable frame. IMR are making available the landbased (CELL) facilities within Matre Aquaculture Research Station in Matredal.

IMR Matre Aquaculture Research Station has access to cultured and wild stocks of salmonids like Atlantic salmon, rainbow trout (only cultured fish), and Atlantic cod. In all these species, experiments can also be designed with full-sib and half-sib groups. The available Atlantic salmon stocks include wild salmon from several Norwegian rivers, and wild cod stocks. The facilities have been used for species varying from salmonids to halibut, cod, herring and horse mackerel, and has also been approved for a variety of other species (e.g. mackerel, capelin, hake, sand eel, saithe, sea bass, sea bream and krill).

AQUAEXCEL3.0 visitors will be invited to work in conjunction with one of IMR's eighteen research groups and if appropriate with existing research programs. Our experience is that a close integration of visitors is stimulating and lead to development of mutual ideas and networks. The researchers that work in aquaculture related topics produce more than 100 peer-review papers every year and create a stimulating scientific environment. IMR will designate a contact person and together with the liaison officer and personnel from the technical and biological support groups make sure that the visitors will be given the same support as the local researchers. This support includes full access to e-mail, internet, office facilities, computing library and chemical lab facilities. We can assist visiting scientists with accommodation nearby.

IMR Matre Aquaculture Research Station has been a necessary part of the activities in several national projects and EU projects like PUBERTIMING, GUTINTEGRITY, WEALTH, FASTFISH, AKVAMAX, SALMOTRIP and LIFECYCLE and the scientists are involved in collaborative research with colleagues from within the EU and from North America, and we have frequent visits of guest scientists. Each year, trainees spend 1-3 months training periods at our research facilities. The trainees are funded by EU programs such as Erasmus, as well as from development cooperation countries (e.g. South Africa, Cuba, Thailand and Indonesia), or from the industry. Several important scientific achievements have been obtained by the users of the infrastructure. The studies leading to a seasonal independent production of salmon smolts and photoperiod control of growth and sexual maturation in Atlantic salmon and cod must be highlighted.

Sedin Zunic is the street artist behind the graffiti.

3.2.2 IMR-CELL land-based facilities

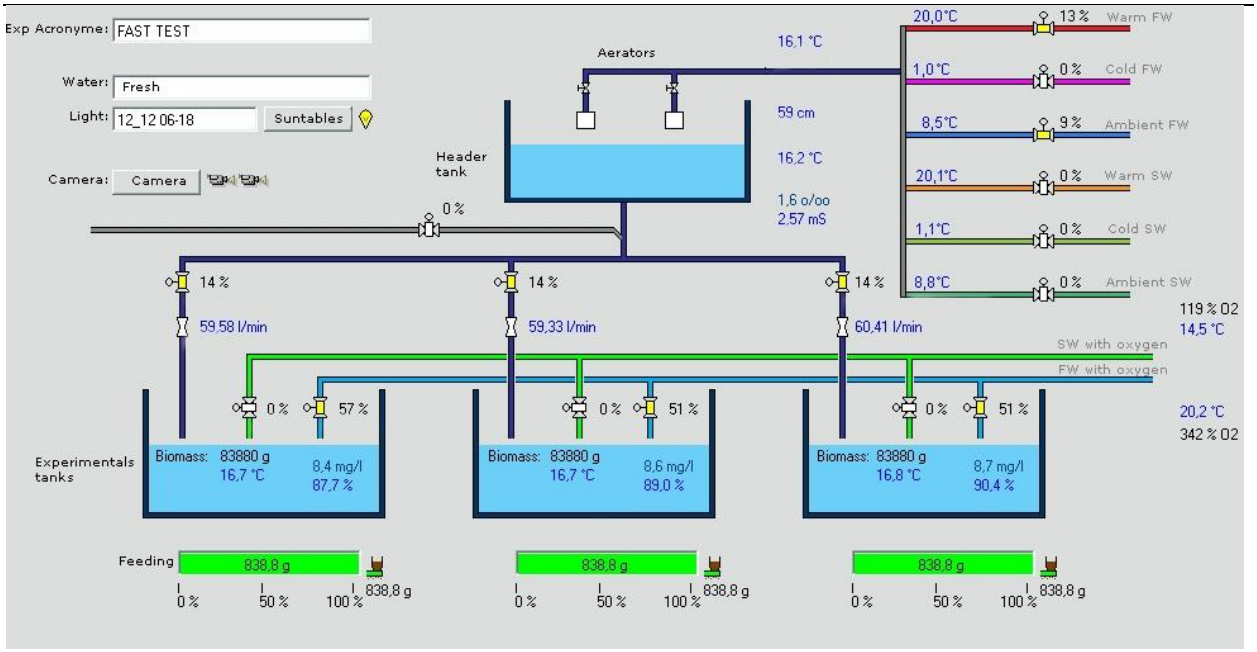
Location: Matredal Western Norway, 80 minutes drive North of Bergen

Web site address: www.imr.no

Contact: Station Manager PhD Ragnar Nortvedt (ragnar.nortvedt@hi.no)

3.2.2.1 Facilities

The land based facilities at IMR Matre Aquaculture Research Station have tanks with automatic feeding, photoperiod, salinity (0-35 ppt), temperature (1-20°C all year round), O_2 and CO_2 control. This environmental lab installation (CELL) is excellent for studies on fish welfare, growth, reproduction, and flesh quality, involving experimental parameters like diet, ration and photoperiod, in salinities ranging from pure freshwater to full salinity seawater and fish sizes from first feeding fry up to 2 kg. The tanks have waste feed collectors and some tanks have video cameras. These environmental labs can be followed and controlled over the web (through a vpn client). The facility comprises 80 tanks with 100 cm diameter. The experimental parameters are controlled by computers and can be regulated to preset values, or set to follow daily or seasonal cycles. The water quality is monitored by alarm systems (24-7), calling up the guard if needed. Meta-data from the water monitoring system are available for all the researchers.



A printout of the screen showing one of the computer controlled environmental laboratories (CELL). From the original six water qualities (up right), the water is mixed to the wanted water quality (in this case 16°C freshwater) in the header tank. From the header tank the water is distributed to the experimental tanks. In this experiment, oxygenated water is added to keep the oxygen level at 90%. The fish is reared under a 12:12 photoperiod and have been given 100% of their daily ration. Oxygen level can also be controlled by regulating the water flow and CO_2 can be added.

3.2.2.2 Services currently offered by the infrastructure

Fish behaviour and welfare is highlighted as one of major aquaculture research areas at IMR Matre Aquaculture Research Station. The major goals of this research area are to identify environmental standards that secure animal welfare, to create basic knowledge on relationships between the culture environment and the animals coping ability, to identify welfare indicators and methods to assess welfare and to develop and evaluate production strategies and technology that secure animal welfare and efficient production.

Growth and reproductive physiology is a research area where IMR Matre Aquaculture Research Station is considered to be in the international front. The main goals of this work are to increase the knowledge about the environmental, physiological and molecular regulation of puberty, broodfish and egg quality, sex differentiation and muscle and skeletal development (including malformations). The CELL facilities at Matre are excellent for holding all stages of fish (including large broodstock), under natural and artificial photoperiod and temperature regimes. Studies of reproductive strategies in important fisheries species and how these are influenced by environmental factors and pollution is also possible.

Feeds, feeding and flesh quality is a research area which has been developed in close cooperation with the industry. To increase the knowledge of how the feed influence the health, welfare and flesh quality are the main goal in this research area. The work has mainly been concentrated around micronutrient demands or pigmentation in salmonids and to evaluate potential alternative marine feed resources. The facilities at Matre make it possible to do these studies in small scale and also under full industrial scale.

Biological mechanisms: The research facilities are excellent for aquaculture related studies, but are also designed to support research on biological and environmental studies related to wild stocks and fisheries. The temperature and CO_2 control makes the facilities excellent for studies on climate related studies.

3.2.2.3 Modality of access

Because of the sophisticated design of this facility, the research activities are virtually independent of season and are only limited by the fact that some life stages are only available 'in season'.

From 2003 all the available facilities at IMR have been included in the institute's main database. As a consequence, the facility description and availability can be accessed through the institute's intranet. Today requests/proposals are registered by the scientists in this web-based system. IMR has also appointed a committee that meet every three months to evaluate the different requests and assign the different resources and experimental facilities to the proposed research activities. In cases where several requests for the same facility overlap in time the committee can give priority or suggest moving research activities in time. IMR will make sure that AQUAEXCEL3.0 visitors will be given the same priority as our internal users and if the visitor wants it, a high degree of independence to the normal research activities at the infrastructure.

Visitor planning to perform experiments in the IMR Matre Aquaculture Research Station CELL facility will provide an experimental plan for their work which will enable planning of activities in relation to other activities.

3.2.2.4 Unit of Access

Access to one tank during one week. A typical project at the Matre cell installation under AQUAEXCEL3.0 will have access to up to 16 tanks which normally are organized in an experiment with four treatments and four replicates. A normal experimental period will be 3 months and the visiting scientist will normally come to Matre for the first and last two weeks to start and finish the activity, respectively. In the period when the visiting scientist is not at the facility the experiment will be followed by the technicians at Matre, in close contact with the visiting scientist. The visiting scientist can follow the experiment on internet.

3.3 University of Stirling (UoS)

3.3.1 Introduction

Competences: The Institute of Aquaculture is a division of the University of Stirling, within the Faculty of Natural Sciences, and its mission is to carry out research and teaching in sustainable aquaculture. It carries out research in most areas of aquaculture related science, including health and welfare, nutrition, reproduction and genetics, aquaculture development and environmental management.

3.3.2 UoS-IoA (Institute of Aquaculture)

Location: Institute of Aquaculture (University of Stirling campus, Scotland, UK),
Niall Bromage Freshwater Research Unit (Stirling, Scotland, UK), Marine Environmental Research Laboratory (Machrihanish, Argyll, Scotland, UK). These sites are closely integrated, and their activities are entirely complementary. Fish are frequently moved between sites for experimental and management purposes and laboratory facilities at the Institute of Aquaculture site are used for all analysis of experimental material.

Web site address: https://aquaexcel.stir.ac.uk

Contact: Amaya Albalat (amaya.albalat@stir.ac.uk)

3.3.2.1 Facilities

The Institute of Aquaculture provides extensive laboratory and experimental facilities capable of supporting research in most fields of aquaculture science. Our facilities are closely integrated, increasing the potential for interdisciplinary research to support the development of sustainable aquaculture. The Institute's strength lies in the combination of first-class laboratory facilities with staff internationally recognised for their research, and all types of fish-keeping facilities, both marine and freshwater, cold and warmwater. Fish keeping facilities include:

MERL is the Institute's marine site at Machrihanish near Campbelltown on the Kintyre peninsula (Fig. 1). This versatile facility pumps and filters seawater 24 hours a day and hosts a wide range of academic and contract research, including pharmaceutical development for salmonid aquaculture to Good Laboratory Practice (GLP) standard. We have a total of 151 flow-through and recirculation tanks ranging from 0.1m^3 - 13m^3 and equipped with environmental monitoring and a liquid oxygen supply. Seawater can be filtered, sterilised and temperature controlled. Several experimental systems of up to 30 identical tanks are available for replicate trials. Bespoke systems can be built to meet requirements for size, water quality, feeding, lighting and other variables. We run a range of studies including fish nutrition and performance, selective breeding, triploidy and environmental control technologies, but most commercial work on site takes advantage of our well-established challenge models and facilities for sea lice and amoebic gill disease (AGD). Such challenge facilities allow us to offer therapeutant development services, to GLP if required.

Fig. 1. Aerial view and examples of tanks available at MERL (Institute of Aquaculture)

The Stirling campus offers a warm water research facility (Fig. 2). The warm water facility contains genetically defined Nile tilapia (*Oreochromis niloticus*), African catfish (*Clarias gariepinus*) and Zebrafish (*Danio rerio*) strains held in 10 self-contained warm-water recirculation systems. Cameras are also available for behavioural monitoring and custom-made tanks for behavioural tests are available. Ethovision software is also available for fish tracking and analysis.

Fig. 2. Tilapia and camera set-up for behavioural studies from the warm water research facility. This facility is located at the University of Stirling main campus.

Close to the Stirling campus, there is **the Niall Bromage Freshwater Research Unit located at Buckieburn** (Fig. 3). Here there is a total of 42 flow-through holding units of various volumes, ranging from 0.8m^3 to large 25m^3. Each of these systems can be run in distinct groups, from one unit to twenty, and can be monitored and data logged daily for various water quality parameters (temperature and oxygen). Additional oxygenation is available using a high capacity oxygen injection system. The unit has a dedicated sterile room for live fish work as well as a laboratory for further detailed analysis. This feature allows greater flexibility in the timeframes for research experiments, allowing increased capacity to deliver a range of projects. The facility also has full temperature-controlled RAS made up of 24x700L tanks. Each tank has an automatic feeder, DO / Temperature probe as well as a feed recovery system to collect any uneaten feed, d as well as full solunar lighting for out of season work or photoperiod manipulation. A dedicated, on-site RAS incubation unit / hatchery with the capacity to hold 250,000 salmonids eggs separately in 24 trays is fully temperature controlled to provide exact conditions.

Fig. 3. Facilities available at the Niall Bromage Freshwater Research Unit located at Buckieburn, Institute of Aquaculture.

Experimental studies at these fish keeping facilities are supported by **extensive laboratory and analytical facilities** (Fig. 4). A total of 1254m^2 of laboratory space is available and distributed between 3 main research areas: Aquaculture Breeding & Nutrition, Aquaculture Health and Aquaculture Environment. Available resources include fluorescent and confocal microscopy, histology, culture facilities for viruses and bacteria, preparation of test vaccines including recombinants, monoclonal antibody screening, serology, *in-situ* hybridization, image analysis, state of the art molecular labs routinely used for genotyping and gene expression and associated bioinformatics. Other analytical facilities include High Performance Liquid Chromatography (HPLC), gas and thin-layer chromatography (GC, TLC), GC mass spectrometry (GC-MS), LC-MS/MS, MALDI-ToF MS, high resolution densitometry, feed preparation, CHSNc analysis, flow cytometry and Inductively Coupled Plasma Mass Spectrometry (ICP-MS).


Fig. 4. Cell culture and molecular laboratory (qPCR) facilities at the Institute of Aquaculture.

The range of equipment available, together with experienced support staff, allows visitors using fish keeping facilities to gain maximum advantage whilst at the Institute.

3.3.2.2 Services currently offered by the infrastructure

The Institute offers access to all laboratory, aquarium-and ancillary facilities to visitors, with full technical and administrative support. The range and quality of research undertaken at the Institute, together with a large cohort of dynamic researchers, provides a very supportive and stimulating environment for visiting researchers.

In collaboration with visiting scientists, Institute staff have a strong track record, knowledge and skills across a range of research areas. These include:

- Development of diagnostic tools and genetic probes against fish pathogens
- Welfare indicators for fish
- Fish behavioural studies
- Fish, crustacean and mollusc physiology
- Development and testing of novel chemotherapeutants against sea-lice
- Selective improvement programmes based on genetic markers
- Transcriptomics/proteomics/lipidomics
- Bioinformatics
- Microbiome studies
- Development of isogenic lines of fish species
- Evaluation of the mechanisms underlying the control of reproduction and smoltification in salmonids and cod and their application in aquaculture
- Optimisation of polyunsaturated fatty acid nutrition of marine fish larval feeds and antioxidant protection
- Fish oil and fish meal substitutions using alternative and novel materials in salmonid diets.

3.3.2.3 Modality of access

Users will propose their own research projects and will be supported in carrying them out independently if they wish. The senior scientists at the Institute of Aquaculture will, in discussion with applicants and AquaExel facilitators, determine whether the available facilities are appropriate and available for the planned research. If appropriate facilities are available the most suitable time for the visit will be determined given the needs of the visiting researcher, the project itself, other demands on the facilities and staff and the degree of support required.

Each user will receive access to all necessary live animals, equipment and consumables to complete their research project, as agreed in their project proposal. In addition, users will be provided with any necessary technical assistance, training and advice on methodologies, experimental design and data analysis. Users will have access to full office facilities and will be able to access the University of Stirling central IT and library facilities. Users may also be able to access remote facilities, including commercial aquaculture sites, research vessels, or other laboratories.

Every effort will be made to accommodate visits at times suitable for applicants and when facilities, experimental animals and staff are available. In most cases we have found that visiting scientists wish to undertake joint research with Institute of Aquaculture staff and that this collaboration will often continue beyond Transnational Access Programme, thus further developing networks of European researchers in aquaculture. In our experience, the majority of visitors to the Institute have carried out research which has led to substantial publications in peer-reviewed journals.

Institute of Aquaculture hosts a large number of visiting researchers and is therefore experienced in providing support and assistance particularly to younger researchers. All visiting scientists are associated with a senior member of staff who assists them in developing their research and dealing with administrative matters. As necessary, other staff will be allocated to help with general scientific matters and laboratory and aquarium work. Specialist technical assistance is available in all areas, including aquaria. In general, visitors will be invited to work in one of the three active groups that cover most aspects of research devoted to developing a sustainable aquaculture sector globally. Depending on the nature of the study, we can offer multidisciplinary research collaboration opportunities (https://www.stir.ac.uk/research/research-themes/) that are unavailable in many other Institutions.

Visitors are encouraged to present seminars on their research and to participate in the Institute's ongoing program.

3.3.2.4 Unit of access

Unit of Access is defined as one person per week, this giving access to the 150 tanks (size from 1-10m^2) at the Machrihanish Marine Environmental Research Laboratory and the Institute of Aquaculture to carry out laboratory and aquarium-based studies on all sizes of fish from fry to broodstock and/or to the 216m^2 of tank space at the freshwater Buckieburn Experimental Facility to carry out genetics, reproduction and nutritional studies on salmonids. Most institute and university facilities are available on a 7-day week basis, although some procedures may need to be restricted for safety reasons.

A typical project is 7 weeks for one person. Experience has shown that visits, especially under the previous infrastructure programs, last from 2-13 weeks with an average length of 7 weeks. Visits have often taken place across a range of Institute of Aquaculture facilities, but it is anticipated that a research group will not host more than two visitors at any one time.

3.4 Consejo Superior de Investigaciones Científicas - Instituto de Acuicultura Torre de la sal (CSIC)

3.4.1 Introduction

The infrastructure offered by CSIC is made up of two types of installations (IATS-EXP, IATS-ANA) located in the campus of the Instituto de Acuicultura de Torre de la Sal (IATS) (Castellón, Spain. IATS offers the use of experimental tanks (EXP) and the use of analytical labs (ANA).

The users will be able to develop a research project using highly qualified facilities and having access to a research environment which has proven to be highly productive in the previous AQUAEXCEL and AQUAEXCEL^{2020} projects. Users will have the opportunity to consult, have advice and interchange ideas with experts on most of the disciplines in Aquaculture, with notable excellence in marine fish parasites, fish pathology, fish immunology, nutrigenomics, genomics, biochemistry, cellular and molecular biology to study and control fish reproduction, food intake and growth, Artemia and fish larviculture.

Expected output/deliverables for infrastructures users: water parameters, biometrical data of fish, feeding and growth data, mortality records after challenges, metabolic scoring of exercised and free-swimming fish, serum and tissue samples for individual genotyping, analysis of differential gene expression, DNA methylation patterns, gut microbiota, histo-pathological scoring, pathological diagnoses, and immunological, biochemical and metabolic profiling. The presentation of results in conferences and scientific publications resulting from the projects are highly envisaged.

Support offered under this proposal: Users will be trained by highly qualified and experienced technical and scientific personnel on methodologies, experimental design and data analysis. Information about safety and security rules and procedures will be provided. The support would vary depending on the type of project and the actual degree of autonomy of the user. Users will be integrated in a research group and expected to collaborate in all the research process including report and article writing and publishing. The visiting scientist will receive a workplace including internet access, and receive support in finding accommodation. TNA visitors will have the possibility of conducting research experiments related to Aquaculture that may also include Aquatic Sciences, biotechnology, biomedicine, toxicology, genomics or molecular biology. During the stage, users will have online access to the full text journals and databases through internet, as CSIC is subscribed to the "Web of Science" and to most of the relevant scientific editorials. All this will mean scientists will have more opportunities to discuss the information available and to produce high quality scientific publications.

3.4.2 CSIC-IATS-EXP (Instituto de Acuicultura Torre de la Sal / experimental tanks)

Location: Ribera de Cabanes, Castellón, SPAIN.

Web site address: www.iats.csic.es

Contact: Josep Calduch-Giner (j.calduch@csic.es)

3.4.2.1 Facilities

IATS-EXP: includes research holding tanks located in different units at IATS, with a total surface of 2,100 m^2. About 250 tanks, with different shapes and capacities (from 3,000 l to 30 l), together with the associated wet labs and sampling rooms are offered. These installations are adequate for conducting experiments in most of the disciplines involved in aquaculture research: Health and welfare (parasite and bacterial challenges), physiology and energy metabolism (hypoxia priming and pre-conditioning, swimming exercise tests), reproduction, nutrition and growth, live prey and larval rearing. Water quality (salinity, temperature, filtration, etc.) and light conditions (photoperiod, intensity, etc.) vary depending on the type of projects and specific tanks in use. The open sea flow provides 90,000 m^3/h and water temperature ranges naturally from 11 to 28ºC. Tanks with recirculation and heat/cooling systems are

available in some units. Biosensor technology, based on the use of AEFishBIT datalogger developed in AQUAEXCEL[2020], is also available for individual and poorly invasive monitoring of respiratory frequency and jerk acceleration in juvenile and adult fish. Experimental studies can be conducted with a great variety of species: gilthead sea bream, European sea bass, sole, turbot, mussel, clam and Artemia, with access to one of the largest Artemia Cysts collection available in Europe.

View of the 4 buildings (A-D) which compose installation IATS-EXP within the campus of the Instituto de Acuicultura Torre de la Sal.

3.4.2.2 Modality of access

On average each user or user group is expected to stay 2 weeks at the infrastructure distributed at the convenience of the user. A typical user will have to designate a contact person for the setup of the project. This previous contact is essential to know the specific and detailed services required for the project, and to integrate it into the scheduling of the research groups and other external users which use the infrastructure. A typical project will have 1 user and an average duration of 12 weeks.

Users will receive access to all necessary live animals, equipment and consumables to complete their research project, as agreed in their project proposal. In addition, users will be provided with any necessary technical assistance, training and advice on methodologies, experimental design and data analysis. Users will be integrated in a research group and expected to collaborate in all the research process including report and article writing and publishing. The visiting scientist will receive a workplace including internet access and receive support in finding living accommodation.

The access offered will include assessment by technical and scientific personnel and will depend on the type of project. Users will be welcomed and introduced by the officer liaison and will be integrated in the scientific group related to the subject of the project. The support would vary depending on the actual degree of autonomy of the user in respect to efficiency and security aspects. Users will have the opportunity to consult, have advice and interchange ideas with scientific staff with expertise on most of the disciplines in Aquaculture to, with notable excellence in marine fish nutrition and pathology, larviculture and nutritional enrichment of live preys, Artemia biology, fish immunology and biochemistry, and cellular and molecular biology to study and control fish reproduction, food intake and growth from early life stages to completion of production cycles. Thus, users will have the opportunity of learning how

to run a project under the best experimental conditions and to apply this knowledge to their own infrastructures back to their countries. This support and scientific environment is currently provided to external users working in collaborative projects and international grants. IATS researchers have expertise in training and outreach to students.

During the stage at IATS, users will have access to the full text journals and databases through internet, with the same rights as internal users. This will imply quick and efficient way of acquiring bibliographic information, as IATS is nowadays subscribed to the "web of knowledge" and to most of the relevant scientific editorials. All this will mean that scientist will have more opportunities to discuss the information available and to produce high quality scientific publications.

3.4.2.3 Unit of access

Unit of access is defined as person-weeks - the number of weeks each person in a project is using a set of experimental tanks and associated lab units. One typical access consists of 12 units of access. This modality of access includes the preparatory work of the experiment including acclimatization period of fish and technical support for the samplings. It will not include the shipment of samples obtained during the project. Remote access to some tanks parameters during the experimental time for some of the installations while away is also available.

3.4.3 CSIC-IATS-ANA (Instituto de Acuicultura Torre de la Sal/Analytical Labs)

Location: Ribera de Cabanes, Castellón, SPAIN.

Web site address: www.iats.csic.es

Contact: Josep Calduch-Giner (j.calduch@csic.es)

3.4.3.1 Facilities

IATS-ANA: includes associated services and 9 analytical laboratories located in IATS. They have all the scientific appliances and devices to conduct most of the techniques and analyses involved in research in aquaculture: microscopy, histology, histochemistry, ISH, immunoassays, gas and liquid chromatography, PCR and RT-PCR and other molecular techniques for gene expression analysis, epigenetic mapping, in vitro cell and eukaryotic culture, isotopic assays, micromanipulation, etc. These methodologies are applied in the fields of: genetic marker analysis of molluscs and fish, fish ehalth and welfare, fish nutrition and growth, marine larviculture, ecotoxicology, fish reproduction, fish neuroendocrinology and energetic metabolism, biotechnology, and environmental and organism monitoring. Large scientific equipment includes: liquid chromatographs (FPLC, HPLC), gas chromatographs (GC, GC-MS), spectrophotometers, fluorimeters, plate readers (absorbance, fluorescence, luminiscence), densitometer, gel and membrane image analysers, real-time PCRs, protein and nucleic acid electrophoresis (1D-2D) equipment, ultracentrifuges, freeze-dyer, ultrasonics, autoclaves and sterilization units, inverted microscopes with micromanipulation and microinjection units, swim metabolic chambers and - 80ºC freezers.


Left: Detail of an analytical laboratory in installation IATS-ANA, Right: Detailed view of the holding tanks in building C of installation IATS-EXP.

3.4.3.2 Modality of access

On average each user or user group is expected to stay 4 weeks at the infrastructure. The user will have to designate a contact person and define precisely which techniques are to be applied in the project. This access can be combined with access to IATS-EXP or to other experimental facilities offered by other partners of the project.

Users will receive access to all necessary equipment and consumables to complete their research project, as agreed in their project proposal. In addition, users will be trained by highly qualified and experienced technical and scientific personnel on methodologies, experimental design and data analysis. Users will be integrated in a research group and expected to collaborate in all the research process including report and article writing and publishing. The visiting scientist will receive a workplace including internet access, and receive support in finding living accommodation.

Users will have the opportunity to consult, have advice and interchange ideas with scientific staff with expertise on most of the disciplines in Aquaculture to, with notable excellence in marine fish nutrition and pathology, larviculture and nutritional enrichment of live preys, Artemia biology, fish immunology and biochemistry, and cellular and molecular biology to study and control fish reproduction, food intake and growth from early life stages to completion of production cycles. Thus, users will have the opportunity of learning how to run a project under the best experimental conditions and to apply this knowledge to their own infrastructures back to their countries. This support and scientific environment is currently provided to external users working in collaborative projects and international grants. IATS researchers have expertise in training and outreach to students.

Access to equipment and consumables will be as agreed in the project proposal. Access to transcriptomic and genomic databases also when agreed.

3.4.3.3 Unit of access

The unit of access is defined as weeks per person and it is defined as the number of weeks each person in a project is using a set of analytical laboratories for the analyses of samples. One typical access consists of 4 units of access (1 user and stay of 4 weeks). This includes the previous holding space of the samples to be analyzed (if necessary) and the scientific and technical support. It will not include the shipment of samples.

3.5 Hellenic Centre for Marine Research (HCMR)

3.5.1 Introduction

HCMR -the main advisory body on aquaculture and fisheries in Greece- will participate in the project with the Institute of Marine Biology, Biotechnology and Aquaculture (IMBBC). IMBBC aims to carry out basic and applied research on 1) aquaculture technology, reproduction, rearing, nutrition, welfare, pathology and fish quality 2) diversity of marine and freshwater life, phylogeography and genomics of marine species, development of genomic approaches in fish aquaculture, bioinformatics and interactions of organisms with their environment. IMBBC has a long-standing experience in converting accumulated knowledge to aquaculture technologies applicable to the private sector, development of genetic tools for parentage assignment, production of genetic maps and QTL analyses of aquaculture species.

Material resources: Specialized laboratories (nutrition, physiology, pathology, water quality and ethology) support any experimental study. Aqualabs are more specialized on hatchery technology, where systems with automated feeding and monitoring of environmental parameters will be applied. In Souda cages are devoted to on-growing experiments and monitoring of feeding behaviour in larger specimen of new warm-water species.

3.5.2 HCMR-Aqualabs

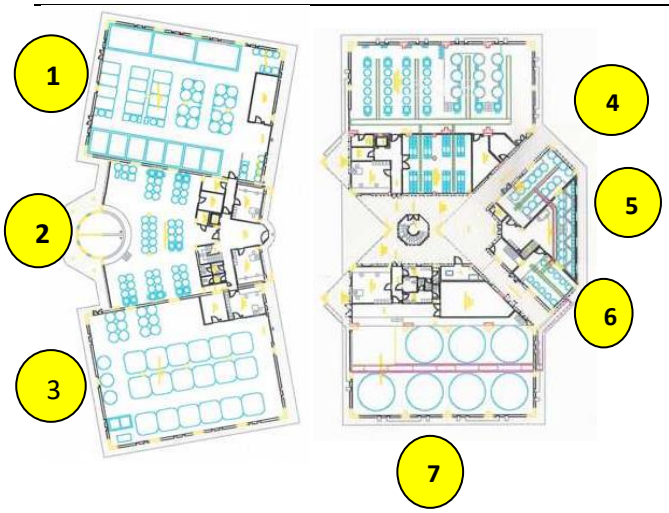
Location: Heraklion-Chania, GREECE

Web site address: www.imbbc.hcmr.gr

Contact: Stavros Chatzifotis (stavros@hcmr.gr)

3.5.2.1 Facilities

The Institute of Marine Biology, Biotechnology and Aquaculture (IMBBC) in Crete provides access to a modern infrastructure enabling multidisciplinary research on all life stages (breeders, eggs, larvae, juveniles, market size) of sea bass and sea bream and of 16 species of 11 genus (*D. dentex, P. pagrus, D. sargus, P. erythrinus, D. puntazzo, U. scirosa A. regius, S. umbra, S. dumerili, P. americanus* and *E. marginatus*) emphasizing on the fast growing species greater amberjack and meagre. It also provides access to associated food chain technologies (microalgae, rotifers, artemia). Aqualabs are located at Gournes 17 km from Heraklion.



Plans of Aqualabs

(without offices and labs on 2nd floor)
total surface 3600 m^2

1- Brood stock zone (200 of 500m^2)
2- Behaviour zone (386 m^2)
3- Nursery zone (100 of 500 m^2)
4- Intensive hatchery (477 m^2)
5- Food chain zone (100 of 178 m^2)
6 - Photobioreactors (187 m^2)
7 - Mesocosm zone (200 of 480m^2)

from which **1700** m^2 of experimental zones and labs for Access

- In the broodstock zone, specimens of 18 different species have been able to spawn and produce viable eggs. There is a possibility of controlled temperature and photoperiod, as well as induced spawning by use of implants, which is a frontline technique used at our facilities.
- In the behaviour zone, 50-500 L tanks are used in a flow-through system with an option for recirculation and temperature control (15-27°C) and recently 250-L cylindroconical tanks have been added for digestibility studies in fish nutrition.
- In the intensive hatchery, 500-L tanks are used connected to 1m^3 biofilters and these systems are applied for the rearing of marine fish larvae in high stocking densities of larvae (50-200 larvae per L). Temperature and photoperiod are controlled and feeding with microalgae, rotifers, and *Artemia* can be adjusted through a computerized system, which is in the frontier of this type of technology for automated feeding of fish larvae.
- In the live food zone, microalgae are produced in 1500-L photobioreactors in high density cultures (200-300 millions cells per mL). These photobioreactors use natural light condition, and thereby take advantage if high light irradiance and favourable light conditions in Crete and are a product of constant development in the area of microalgae production during the last 15 years. Rotifers and *Artemia* are produced in industrial scale with automated feeding, controlled temperature by experienced personnel.
- Six mesocosmos unit are housed of 40m^3 where rearing of larvae takes place with high survival rates even of most “difficult” species.

In Souda Bay the concession of floating cages provides access to 100 m^2 of pilot scale 3x3x3 m cages or 1x1x1.5 m cages for experimentations on production. Excellent for simulation of real cage aquaculture, this zone is managed by 3 technicians providing daily maintenance and feeding. The zone for access is located in Souda Bay (130 Km from Aqualabs, close to city of Chania).

Souda bay cages.

Aqualabs-Souda bay has been a necessary part of national research projects as well as large European research projects in the area of aquaculture such as FINEFISH, FASTFISH, SEACASE, SELFDOTT, FISHBOOST, DIVERSIFY.

3.5.2.2 Services currently offered by the infrastructure

At Gournes, the two floors infrastructure named Aqualabs (see plan) is organised as a vertical integrated hatchery (19 people staff) with pilot scale and small scale experimental rearing facilities well equipped with specialised wet and dry laboratories and more classic infrastructures (offices, library, 50 places meeting room, etc). The 7 main zones of experimental Access (1700 m^2) integrate the up-to date technology in fish larviculture and computerised management and are managed each by a scientist. The ability to work with early life stages of so many different species (18 different species) is unique worldwide. Nutritional experiments can be performed in 35 tanks of 500 litter capacity. The tanks are connected to a recirculation system with the ability of thermoregulation and photoperiod control. A biochemical laboratory equipped with HPLC, HPTLC, GC, Dumas nitrogen analyser, automated fiber analyzer and bomb calorimeter is offered for chemical analysis of samples. The installation in Souda is unique in the Mediterranean as it offers a variety of high quality experimental facilities for study of early fish life and produces ± 2.000.000/year fry species thus making them always available for experimental purposes.

3.5.2.3 Modality of access

The Aqualabs-Souda infrastructure is a leading institution in the research for the development of new fish species for the Mediterranean aquaculture through participation to European research projects and collaborations with the industry. Round the year there is a constant flow of visitors for research and education purposes. The infrastructure pursues research and innovation in:

a) Hatchery technology and larviculture (early life biology and ethology).
b) Biology and control of larvae-fish development (morphology, osteology) and development of digestive and visual systems employing histological techniques.
c) Determination of nutrient and energy requirements and optimization of feeding, use of alternative sources of nutrients.
d) Fish behaviour and applications in rearing populations (schooling, self-feeding, learning, sorting devices, welfare) using automated feeding systems, self-feeders, data loggers, video recording and analysis.

e) Production management in cages during grow-out in relation to feeding, behaviour and management.

The following laboratory facilities will be used of support of researchers using the access areas:

- Microscopy (fluorescence, inverted microscope, phase contrast) and stereoscopy equipped for photography, camera and image analysis.
- Physico-chemical analysis of water with electronic devices or photometer.
- Microbiology (cooled incubator, laminar flow, deep freezer, cooled centrifuge, colony counter).
- Biochemistry and nutrition (Dumas, Soxhlet extractor, Hydrolysis unit, fibertec, muffle furnace, oven, GC for fatty acid analysis, bomb carolimeter, HPTLC, LC).
- Fish Physiology (ELISA, RIA enzymatic methods), haematology, endocrinology, speed vac.
- Histology (rotary tissue processor 12 stations (histokinette), embedding station, microtome, slide warmer plate, portable bench, top fume hood, staining system).
- Fish behaviour, ethology, biorythms and welfare with electronic self-feeders linked to computerised data collector, tagging systems of fish (fish eagle) and cameras.
- Computers for processing, analysis and presentation of data as well as redaction of reports.

Visitor planning to perform experiments in the Aqualabs-Souda bay facilities will provide an experimental plan for their work, in collaboration with Aqualabs-Souda bay researchers in the project. This will enable planning of activities in relation to other Aqualabs-Souda bay activities. The visitors will, once they arrive,

have the same access to the facility, equipment and technical support as any of the HCMR researchers already working in the facility. The users of the AQUAEXCEL3.0 infrastructure will be provided access to internet, desk, and will be offered the possibility to work with the different groups of activities in the Institute of Aquaculture.

3.5.2.4 Unit of access

One week represents the access of installation. The unit of access represents the use of 12 500-L tanks or 1 mesocosm 40000-L tank or 6 intensive hatchery 500-L tanks, fish, personnel, use of other supporting equipment and consumables (e.g. industrial feed or live feed) for one week. In the installation of Aqualabs-Souda projects will be run with an average duration of 3 months. Depending on the nature of research, and although the experiments may take longer, users may spend two weeks at our institution.

After presenting a detailed description of the experimental process and requirements, users may either monitor the experiment or actively participate with hands on work, if required. Host scientists will assist visitors during their experimental work and experienced technical personnel will carry out the routine procedures.

3.5.3 HCMR-Genomics-Bioinformatics

Location: Heraklion, GREECE

Web site address: http://www.imbbc.hcmr.gr

Contact: Costas Tsigenopoulos (tsigeno@hcmr.gr)

3.5.3.1 Facilities

The HCMR-Genomics/Bioinformatics facility has modern equipment, essential for the design and elaboration of research projects in the fields of population genetics, molecular ecology, phylogeography, genetic improvement and genomics of Mediterranean aquaculture fish, and it is able to perform any necessary genetic analysis under the context of the proposed activity. The installations include Next Generation high-throughput genetic analysers [a MiSeq (Illumina) and two Oxford Nanopore (MinION and MinION-Mk1C) sequencing devices], a capillary sequence analyzer ABI 3730xl (for DNA sequencing and genotyping)(https://imbbc.hcmr.gr/infrastructures/facilitiesimbbc/dna-sequencing-platform/), an arsenal of gradient and real-time PCR machines (including two Magnetic Induction Cycler qPCRs), a QIAcube (Qiagen) and in general equipment which facilitates and ensures the appropriate conditions for the isolation and the qualitative and quantitative study of the genetic profile of an organism at the level of DNA, RNA and proteins.

(https://imbbc.hcmr.gr/infrastructures/facilitiesimbbc/genetics-molecular-biotechnology-lab/).

The High-Performance Computing (HPC) facility of IMBBC/HCMR was launched in 2009 to address computational challenges over a range of scientific fields in marine biology, with a focus on non-model taxa. The bioinformatics platform (*Zorba*) currently consists of 328 cores and 2.3 TB total memory. Job submission takes place to the four available computing partitions, or queues, and at its current state achieves a peak performance of 8.3 trillion double-precision floating-point operations per second (8.3 Tflops). On top of these, a total 7.5 TB is distributed to all servers for the storage of environment and system files.

(https://imbbc.hcmr.gr/infrastructures/facilitiesimbbc/high-performance-computing/).

3.5.3.2 Services currently offered by the infrastructure

The HCMR- Genomics-Bioinformatics infrastructure is a leading institution in the research for fish species for the Mediterranean aquaculture through participation to European research projects and collaborations with the industry. Round the year there is a constant flow of visitors for research and education purposes. The infrastructure pursuits research and innovation in a) phylogenetics, systematics and population genetics, b) the *de novo* genome analysis, transcriptome sequencing, and analysis of microbial diversity (metagenomics), and c) the development of molecular markers, parentage assignment analyses, construction of genetic maps for target species and potentially also QTL analyses.

3.5.3.3 Modality of access

The research activities of the institute (IMBBC) focus in diversity of marine and freshwater life, phylogeography and genomics of marine species, development of genomic approaches in fish aquaculture, bioinformatics and interactions of organisms with their environment. IMBBC has a long-standing experience in marker development, use of molecular genetic tools to assess population structure of natural and cultivated stocks, parentage assignment and production of genetic maps (including candidate genes and neutral markers) of species important to the aquaculture industry. The Institute was responsible for the introduction into Greece of the use of molecular genetic markers to i) address questions of population structure of natural marine stocks and ii) assist genetic improvement in aquaculture. Recently, the team has played a significant role in the introduction of genomic approaches in aquaculture practices and is actively contributing to practical applications of the produced results in commercial farms.

Data analysis opportunities in the HCMR- Genomics-Bioinformatics infrastructure: The bioinformatics personnel of the institute have experience in data analysis and pipeline development of various 'omics' fields like:

• Genomics (prokaryote and eukaryote): genome assembly, structural and functional annotation, comparative genomics (synteny, non-coding DNA, regulatory elements, genetic marker discovery), phylogenomics (orthology discovery, multiple alignment, phylogenetic reconstruction)

• Transcriptomics: Experimental design, sequencing, data pre-processing, assembly (de novo & reference-based), structural and functional annotation, genetic variant mining (SNPs and microsatellites), differential gene expression, non-coding RNA (microRNA gene and target prediction)

• Meta-genomics (microbial communities) Amplicon sequencing and analysis, taxonomy, biodiversity

• Population Genomics: SNP discovery through Genotyping by Sequencing methods (e.g. ddRAD-Sequencing) and population genomics pipelines

• Quantitative Genomics: QTL mapping, linkage maps, GWAS

• Bioinformatics expertise: pipeline/workflow design, database design and optimization, software development, software optimization (e.g. parallelization), web design, cluster development and management.

3.5.3.4 Unit of access

One week represents the access of installation. The unit of access represents the use of molecular laboratory or data analysis facilities, personnel, use of other supporting equipment and consumables (e.g. commercial kits) for one week. In the installation of Genomics-Bioinformatics, projects will be run with an average duration of 2-4 weeks. Depending on the nature of research, and although the experiments may take longer, users may spend two weeks at our institution.

After presenting a detailed description of the experimental process and requirements, users may either monitor the experiment or actively participate with hands on work, if required. Host scientists will assist visitors during their experimental work and experienced technical personnel will carry out the routine procedures.

3.6 Hungarian University of Agriculture and Life Sciences (MATE), Research Center for Fisheries and Aquaculture (HAKI)

3.6.1 Introduction

HAKI offers possibilities to work in research areas as immunology, nutrition, technology, reproduction and genetics, water quality. All users will have full access to HAKI services and infrastructures. The respective researchers and technicians will be assigned to support work in infrastructures and laboratories. Assistance will be provided to users in finding accommodation and transportation in the institute's close neighbourhood.

At our installations, we mainly deal with common carp, European catfish, sterlet, and pikeperch, which are commonly propagated in- and out-of-season. From the other domesticated and wild broodstocks in our gen-banks and wintering ponds, we possess African catfish, paddlefish, grass carp, Russian and Siberian sturgeon, pike, asp, perch, and Volga pikeperch which can be used for a seasonal egg, larvae, and juvenile production in case such material would be demanded by the user. Due to the diversity of our work, our experimental systems are set in such a way to be feasible for the work on various species and classes of fish.

HAKI offers two experimental installations, recirculation, and a pond system.

3.6.2 MATE HAKI-OEPS (Outdoor experimental pond system)

Location: Szarvas, HUNGARY

Web site address: https://haki.naik.hu

Contact: Uroš Ljubobratović (Ljubobratovic.Uros@uni-mate.hu)

3.6.2.1 Facilities

OEPS installation consists of earthen ponds, and units with the following distribution are on offer for TNA:

9 ponds of 3500 m^2
15 ponds of 1700 m^2
8 ponds of 500 m^2

and in largest ponds we offer installation of cages of the following sizes:

17 x 4 m^2 (15mm mesh size)
42 x 4 m^2 (30mm mesh size)
23 x 9 m^2 (30mm mesh size)
6 x 18 m^2 (30mm mesh size).

The ponds can be filled up with water and drained individually. The water is supplied to the ponds from the natural open surface waters (Szarvas-Békésszentandrás oxbow lake). The ponds have an electrical supply for artificial aeration and are also equipped with aerators.

Fig. 1. HAKI OEPS installation.

The OEPS is operated by a professional staff (six persons). The pond system is suitable for experiments with different purposes (i.e. feeding tests, testing different rearing technology, management, and technological elements; ecosystem modeling, etc.).

3.6.2.2 Services currently offered by the infrastructure

This installation is suitable for outdoor trials in various rearing systems, from extensive to super-intensive, enabling a wide range of possible trials on the applicability of different feed additives; nutrient dynamics in pond ecosystems; integrated fish production systems i.e. combination of ponds and cages; nutrient remediation experiments in wetlands and ponds.

3.6.2.3 Modality of access

On average each user or user group is expected to stay 30 days at the infrastructure. Access to the infrastructure is expected to last 4-12 weeks depending on the nature of the trial. There are two types of accesses which are usually carried out at our infrastructure. Either the lead researcher is present throughout the whole access, or the lead researcher is present at the beginning and the end of the trial while the daily routines, monitoring, and data collections are done by our staff and supervised by either an internal expert or another researcher involved in the study at the time of proposal preparation. We are highly recommending to the potential users to communicate with us at least two months before the proposal writing so we could offer our assistance and integrate the plan into our agenda.

All users will be allowed full access to the institute's experimental, laboratory, and office facilities necessary to perform the work described. Likewise, users will be assigned relevant researchers and technicians for assistance in all methodological issues and material needs connected to the trials. Fish material in terms of species and class will be properly prepared for the trials.

The operation of the experimental system will be integrated with a professional team for sampling (i.e. water, sediment, plankton, fish, etc.) and in situ measurements (i.e. oxygen, conductivity, pH, turbidity, temperature, etc.) and with professional analytical laboratories (equipped – among others - with water, TOC analyzer, atomic absorption, and ICP spectrometry) for water, sediment, soil, tissue, plant, etc. analysis, as well.

The researchers of the institute will share their knowledge (on fish genetics, immunology, nutrition, aquaculture production, wastewaters, irrigation, and aquatic ecosystems) and practical experiences with the guest and also can help to organize the logistics if necessary.

3.6.2.4 Unit of Access

The unit of access is defined as 1 ha/week. One typical access consists of 20 units of access for OEPS installation.

3.6.3 MATE HAKI-RECIRK

Location: Szarvas, HUNGARY

Web site address: https://haki.naik.hu

Contact: Uroš Ljubobratović (Ljubobratovic.Uros@uni-mate.hu)

3.6.3.1 Facilities

RECIRK installation is composed of 5 independent recirculation systems:

1. “Ballonos” - larviculture system for percids and cyprinids composed of twelve 250L cylindro-conical tanks and equipped with twelve 2L egg incubation Zug jars;

2. “Valyus” - larviculture system for sturgeons and catfishes composed of eight 250L raceway type tanks equipped with six 8L egg incubation Zug jars;

3. “18-as” - juvenile rearing system composed of three identical and separated systems each composed of six 1000L tanks each supplied with swirl separator, each system suitable for independent temperature in the range 15-25 °C;

4. “Karanteen” - quarantine system composed of three 4 m^3 raceway tanks suitable for seasonal and out-of-season reproduction trials;

5. “SDC” - disease challenge system is used for challenge tests with bacteria (*Aeromonas hydrophila*) flexible in terms of tank size and number.

Larvae and juvenile rearing systems are equipped with automatic feeding systems.

Fig. 2. RECIRK larval nursing system “valyus” applicable for sturgeons and catfishes.

3.6.3.2 Services currently offered by the infrastructure

Our recirculation systems are suitable for the trials on the breeders, eggs, larvae, and juveniles in almost all freshwater European species. The disease challenge system is used for challenge tests with bacteria (Aeromonas hydrophila) either for independent studies or for the challenge tests on the fish previously subjected to experiments in other systems. Our researchers and technicians of the group for aquaculture technologies are skilled in the needed technological solutions for propagation and rearing in almost all freshwater aquaculture species offering a wide range of trials on larvae and juveniles. Researchers and technicians of the department for fish biology are well experienced in trials on fish genetics, fish welfare, and fish nutrition. The RECIRK installation is directly operated by a professional staff (six persons).

Fig. 3. RECIRK “18-as” system composed of three identical independent RAS units.

3.6.3.3 Modality of access

On average each user or user group is expected to stay 30 days at the infrastructure. Access to the infrastructure is expected to last 4-12 weeks depending on the nature of the trial. There are two types of accesses which are usually carried out at our infrastructure. Either the lead researcher is present throughout the whole access, or the lead researcher is present at the beginning and the end of the trial while the daily routines, monitoring, and data collections are done by our staff and supervised by either an internal expert or another researcher involved in the study at the time of proposal preparation. We are highly recommending to the potential users to communicate with us at least two months before the proposal writing so we could offer our assistance and integrate the plan into our agenda.

All users will be allowed full access to the institute's experimental, laboratory, and office facilities necessary to perform the work described. Likewise, users will be assigned relevant researchers and technicians for assistance in all methodological issues and material needs connected to the trials. Fish material in terms of species and class will be properly prepared for the trials.

The operation of the experimental system will be integrated with a professional team for sampling (i.e. water, sediment, plankton, fish, etc.) and in situ measurements (i.e. oxygen, conductivity, pH, turbidity, temperature, etc.) and with professional analytical laboratories (equipped – among others - with water, TOC analyzer, atomic absorption, and ICP spectrometry) for water, sediment, soil, tissue, plant, etc. analysis, as well.

The researchers of the institute will share their knowledge (on fish genetics, immunology, nutrition, aquaculture production, wastewaters, irrigation, and aquatic ecosystems) and practical experiences with the guest and also can help to organize the logistics if necessary.

3.6.3.4 Unit of Access

The unit of access is defined as one system/week for RECIRK. One typical access consists of 15 units of access for RECIRK.

3.7 Institut Francais de Recherche pour l'Exploitation de la Mer (IFREMER)

3.7.1 Introduction

Ifremer is the largest French institution involved in marine research (1500 people) through research centers and stations in mainland and overseas. In Palavas, the research station is devoted to fish domestication, health and welfare. In Brest, the aquaculture department has an international expertise in fish larval physiology, ontogeny and lipid metabolism of the digestive functions in sea bass, turbot and sea bream.

In Palavas, the infrastructure comprises identical tanks (1 cubic meter each) shared in 2 rooms in flow through or in recirculated system with a high control of water quality and associated laboratories.

3.7.2 IFR-PEARS (Palavas Experimental Aquaculture Research Station)

Location: Palavas les Flots, South FRANCE

Web site address: www.ifremer.fr

Contact: Marie-Laure Begout (mlbegout@ifremer.fr)

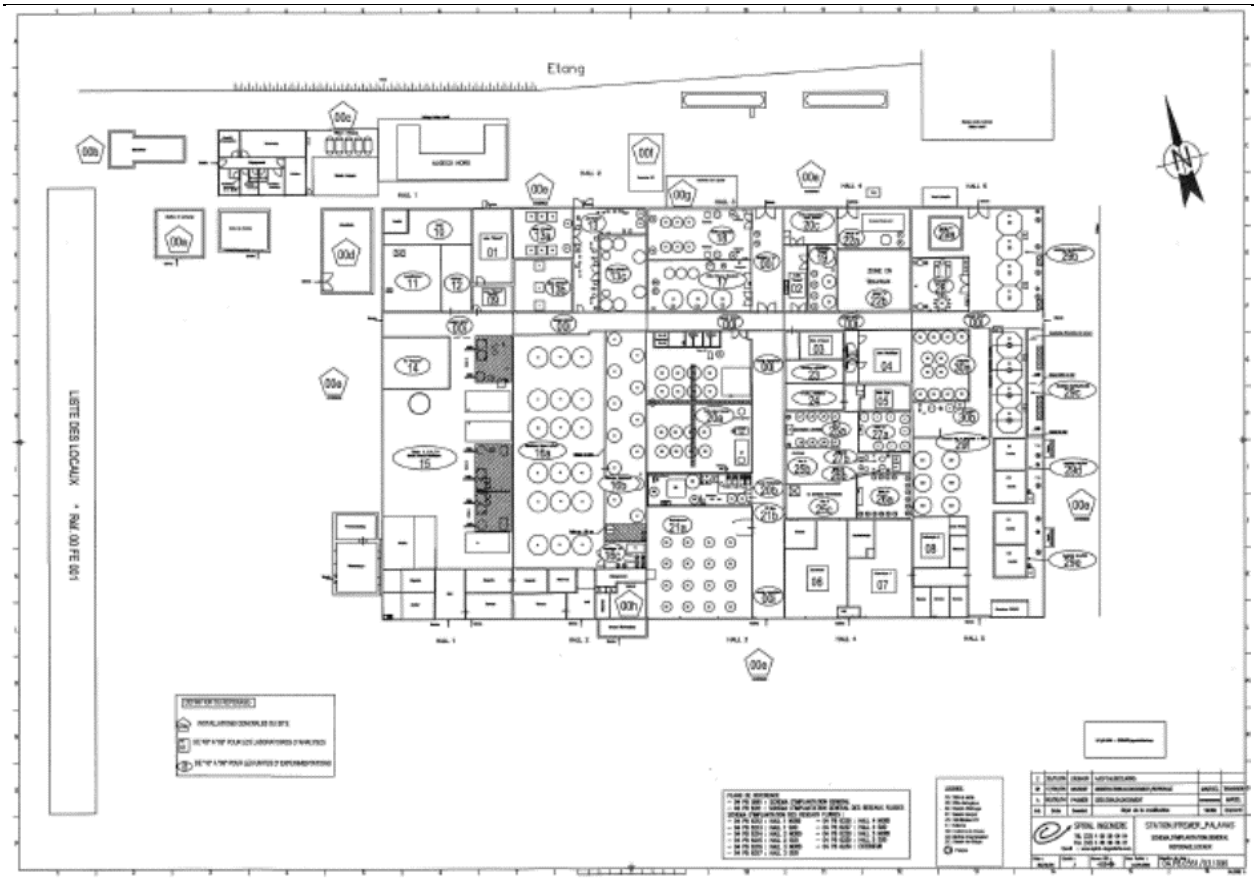
3.7.2.1 Facilities

for research on fish performance, all suited for experiments with new or established species in larval, juvenile or growout phase. The 3 units are:

1-MES: Marine Ecotolerance Section. It includes 2 sets of 16 tanks of 1m^3 each, running with seawater in flow-through or recirculated water. Tanks are fitted with efficient feeders and particulate traps allowing a high level of the control of feed intake and uneaten feed, especially when fish are fed at satiation.

2-FLA: From Larvae to Adult Fish. This part allows to grow fish from egg to commercial size by offering a comprehensive and homogeneous sub-infrastructure for any type of long-term experiment in genetics and genomics. This installation includes one isolated room with 8 tanks of 0.5m^3 each, one isolated room of 9 tanks of 0.5m^3 each, one room with 16 tanks of 1.5 m^3 each and another separate room with 6 tanks of 5 m^3 each. Seawater is recirculated. For both MES and FLA installations, light intensity is possibly regulated from 0 to 500 lux with artificial dawn and dusk. Seawater is filtered at 30µ to 60µ, UV sterilized, degassed in a packed column, regulated at constant temperature ranging from 13 to 25°C and can be enriched with oxygen.

3-IMTA: Integrated Multi-Trophic Aquaculture (4 sets of 3 tanks of 1.5 m^3 each, connected to outdoor experimental lagoon). This part of the infrastructure is going to be constructed and should be operational from late 2015.The zone will allow the evaluation of purification capacity for different species of fish effluents ("inorganic and organic extractors").



Schematic layout of PEARS.

3.7.2.2 Services currently offered by the infrastructure

seawater fish at different stages of development (larvae, fingerlings, juvenile, grow-out). The specific IMTA systems offers the possibility to evaluate the nutrient recycling in multi-trophic system. Characterization and quantification of nutrient fluxes can be realized in experiments combining different biological compartments (fish + algae + filter or deposit feeders) in various scales tanks in Recirculated Aquaculture Systems (RAS) or flow-through system. IFREMER staff will advise the TNA users in the experimental set-up including system preparation, fish supplying and acclimatization. During the experiments, it will continue to support the TNA user, including daily care, sampling and (temporal) storage of samples. In addition, when appropriate, legal permits to work with experimental animals will have to be obtained by a certified IFREMER scientist prior to the experiment. In addition, close collaborations within the frame of other international projects frequently allow guests to work in the facilities of IFREMER.

3.7.2.3 Modality of access under this proposal

On average each user or user group is expected to stay 56 days at the infrastructure. The performance units are suitable for long-term experiments (depending on species and proposition of the TNA user), based on fish performance under different culture conditions, as described above. The TNA user will have the daily responsibility of the experiment, coordination of the sampling and data analyses.

The TNA guest will obtain all data from the experiment; daily measurements of water quality, system performance and fish performance. In addition, the (final) sampling will enable the user to perform analyses on the obtained tissues, plasma, etc. The results can be published in a joined paper between the

TNA user and involved IFREMER staff. When appropriate, the obtained knowledge can be implemented in the facilities of the TNA user.

The TNA user will be supported by the technical and supporting staff, and a responsible scientist will be appointed as first contact person. The support will ensure that the regulations of IFREMER and national animal protection laws are followed, and that the experimental design, the work protocol, execution of the experiment and data acquisition will meet IFREMER criteria. In addition, the administrative staff will assist in finding accommodation and transportation.

TNA users will get access to the relevant scientific literature, databases and IFREMER labs. The location in Palavas les-Flots has highly qualified staff in all fields that are relevant for the execution of the TNAs.

3.7.2.4 Unit of access

The unit of access is m^3/week. One typical access consists of 312 units of access. A typical TNA experiment uses 16 experimental tanks (1.5m^3) for a total period of 13 weeks (4 preparation, 8 experiment (as 56 days), 1 cleaning), resulting in 312 unit of access by project. The actual number of system weeks of a particular TNA thus depends on the experimental design.

A unit of access typically includes assistance with tasks that cannot be performed by the TNA user, or by the TNA user alone. This includes:

• Preparation of the work; set-up of the systems, acclimatization of filters and the fish, protocols, legal permission to work with live animals,

• Daily work on the experiment itself according to the protocol; check on the systems and fish, work on the experiment, the use of collection of data, backstopping during weekends, alarm service,

• Sampling for the experiment: samples of water and fish, according to the protocol,

• Analyses of data when this is part of the TNA.

3.7.3 IFR-PMMLT (La Tremblade Experimental Aquaculture Research Station)

Location: La Tremblade, FRANCE

Web site address: www.ifremer.fr

Contact: Christophe Stavrakakis (christophe.stavrakakis@ifremer.fr), head of research unit

Frédéric Girardin (frederic.girardin@ifremer.fr), manager of the experimental platform

3.7.3.1 Facilities

PMMLT offers 1200m^2 experimental facilities dedicated to aquaculture research. They are intended to produce experimental families of bivalve molluscs (hollow oysters, flat oysters, mussels and...) and to carry out experiments on animals in farming.

- evolution and understanding of the determinisms of resistance of marine molluscs to pathogens (viruses, bacteria, protozoa)
- understanding the genomic plasticity of marine shellfish
- evolution and understanding of pathogen virulence

The Tears platform has undertaken a process to consolidate its experimental aquaculture research system in order to guarantee the safety of its research families but also to protect the environment by managing and securing its discharges and confining animals according to the anticipated risk.

The 3 units are:

1-The secure platform section

390 tanks of different volumes (8 to 800 l) distributed in nine rooms allowing the production of biological material and the conservation of strains of interest. Each room will be equipped with 50% of its capacity in closed circuits and a possibility to regulate each tank at the thermal level Seawater is filtered at 1µ to 60µ, UV sterilized, degassed in a packed column. Four seawater distribution networks are designed to work between 8°C and 25°C.

Seven (7) distinct types of hatchery operations can be distinguished in the hatchery with different purposes:

- quarantine
- maturation
- larval breeding
- micro-nursery
- Strain conservatory
- Production of forage phytoplankton
- Three experimental rooms

2- Unsecured platform section

130 experimental tanks (130l to 12m^3), one experimental onshore concession (10 tidal marsh) with an area of 13400 yard^2 and five offshore concessions (5000 yard^2).

A phytoplankton production area with a capacity of 20m^3.

3- secure laboratory section

- Three laboratories in the secure platform area, allowing work to be carried out on biometrics, cytogenetics, cytometry, sample collection, ...
- An experimental infection laboratory (L2) with seven remote rooms (acclimatization, experimental infection (4), laboratory and a laundry room, the effluents are secured by a waterproof tank.
- Physio-pathology laboratories are secured by a waterproof tank.

3.7.3.2 Services currently offered by the infrastructure

The experimental platform allows all experiments on marine shellfish to be carried out.
It is designed to enable the production of biological materials for experimental purpose unit from reproduction to Strain conservatory phase.
The proposed work is on several themes: animal zootechny, physiology, pathology and genetics.

IFREMER staff will advise the TNA users in the experimental set-up including system preparation, shellfish supplying and acclimatization. During the experiments, it will continue to support the TNA user, including daily care, sampling and (temporal) storage of samples. In addition, when appropriate, legal permits to work with experimental animals will have to be obtained by a certified IFREMER scientist prior to the experiment.
During FP7-AQUAEXCEL, two foreign TNA guests used this infrastructure for their research to fully use the number of proposed accesses. In addition, close collaborations within the frame of other international projects frequently allow guests to work in the facilities of IFREMER.

3.7.3.3 Modality of access under this proposal

Location of work: La Tremblade, France (PMMLT)

Duration of work: Depending on the user's choice of section, the duration of use will be different.

For the sections of the secure/unsecured platform: each user must stay a minimum of 56 days with a minimum presence of five days at the beginning of the experiment in order to finalize the protocol and start the experiment, the same duration must be effective at the end of the experiment.

For the secure laboratory section: each user must stay a minimum of 5 days with a minimum presence of one day at the beginning of the experiment in order to finalize the protocol and start the experiment, the same duration must be effective at the end of the experiment.

The TNA user will be responsible for the daily experience, coordination and analysis of the data following the different protocols given at the beginning of the experiment.

3.7.3.4 Unit of Access

For the sections of the secure/unsecured (tank) platform: **Tank/week**.

One typical access consists of 238 units of access.

For example to produce experimental ten families of bivalve molluscs (T6): A typical TNA experiment uses 17 experimental tanks (3 to 150l) for a total period of 14 weeks excluding broodstock maturation (1 preparation, 12 experiment (as 84 days), 1 cleaning), resulting in 238 units of access by project.

The actual number of system weeks of a particular TNA thus depends on the experimental design.

For the sections of the unsecured platform (experimental onshore and offshore concession): Oyster Mesh Bags /week.

For the secure laboratory section (physiology, pathology and genetics): **days/laboratory**

A minimum access consists of 5 units (5 days) of access. One day of preparation, three days of experimentation and one day of cleaning.

Specify what is included in one unit of access: A unit of access typically includes assistance with tasks that cannot be performed by the TNA user, or by the TNA user alone. This includes:

- Preparation of the work; set-up of the systems, acclimatization of filters and shellfish, protocols, legal permission to work with live animals,
- Daily work on the experiment itself according to the protocol; check on the systems and shellfish, work on the experiment, the use of collection of data, backstopping during weekends, alarm service,
- Sampling for the experiment: samples of water and shellfish, according to the protocol.

3.7.4 IFR-PMMB (Mollusc Experimental Platform of Bouin)

Location: Bouin, FRANCE

Web site address: www.ifremer.fr

Contact: Christophe Stavrakakis (christophe.stavrakakis@ifremer.fr), head of research unit

Virginie Le Razavet (virginie.le.razavet@ifremer.fr), manager of the experimental platform.

3.7.4.1 Facilities

PMMB offers one 2000 m^2 infrastructure located on the Bourgneuf bay, which independent units for research on shellfish, including experiments from the larval level to the adult size.

The 3 units are:

1- ENA: Experimental Nursery Area: it includes 2 raceways of 7 m^3 with 13 slieves positions each (potentially 26 shellfish families), running with settled seawater disinfected with UV rays and degassed in a pack column. Shellfish spat is continuously fed with *Skeletonema marinoï* microalgae. The unit is provided with ambient water temperature.

2- EBA: Experimental Breeding Area for ecotoxicology: 1 experimental room of 15 m^2 and 1 microalgae production room supplied with controlled water quality (sand filtration at 30 µm, cartridge filter at 0.2-5 µm, UV disinfection and temperature regulation) and all facilities (air, tap water, CO2, …). Each room can be equipped with tanks for experimental breedings with different capacities (from 5 liters to 800 liters). Effluents of this area can be treated by a high performance medium lamp UV device or

can be retained in a specific tank of 5 m^3. All rooms are air-conditioned, and unit can be provided by regulated temperature.

3- WER: Water treatment Experimental Room: this room of 40 m^2 can accept water treatment devices supplied continuously with controled seawater quality (see previous section). Treated water can be tested then with experimental breedings. This room is supplied with all facilities too.

3.7.4.2 Services currently offered by the infrastructure

The system is suitable to complete any kind of experiments in ecotoxicology, etc. These experiments can set up breedings from the larval stage to the adult size. ENA is equipped with a continuous measurement device of water quality parameters (pH, O_2, turbidity and salinity). EBA is the experimental unit for research on all stages of the life cycle of shellfish. For the 3 units, different analytical devices are available to characterize biological cells as microalgae (spectrophotometer, fluorimeter), shellfish larvae and gametes (flow cytometry) and bacteria / viruses (microbiological analyses on petri dishes).

Ifremer staff will advise the TNA users in the experimental set-up including system preparation, shellfish supplying and acclimatization. During the experiments, it will continue to support the TNA user, including daily care, sampling and (temporal) storage of samples. In addition, when appropriate, some of ifremer's the staff possesses legal permits to experiment on animals.

The EBA unit can receive experiment on contaminant effects, it's equipped with a specific retention device for effluent.

3.7.4.3 Modality of access under this proposal

Location of work: Bouin, France (PMMB)

Duration of work: On average each user or user group is expected to stay 42 days at the infrastructure.

The performance units are suitable for long-term experiments (depending on proposition of the TNA user), based on shellfish performance under different culture conditions. The TNA user will have the daily responsibility of the experiment, coordination of the sampling and data analyses.

The performance units are suitable for long-term experiments (depending on species and proposition of the TNA user), based on fish performance under different culture conditions, as described above. The TNA user will have the daily responsibility of the experiment, coordination of the sampling and data analyses.

3.7.4.4 Unit of Access

Unit of access: 1 m^2/week

The actual number of system weeks of a particular TNA thus depends on the experimental design.

A typical TNA experiment uses experimental tanks (from 50 to 800 l) by experimental room (14 to 30 m^2) for a total period of 9 weeks (2 preparation, 6 experiment (as 42 days), 1 cleaning), resulting in 100 unit of access by project. The actual number of system weeks of a particular TNA thus depends on the experimental design.

Specify what is included in one unit of access:

A unit of access typically includes assistance with tasks that cannot be performed by the TNA user, or by the TNA user alone. This includes:

- Preparation of the work; set-up of the systems, acclimatization of the shellfish, protocols, legal permission to work with live animals,
- Daily work on the experiment itself according to the protocol; check on the systems and shellfish (mortality record), work on the experiment, the use of collection of data, backstopping during weekends, alarm service,
- Sampling for the experiment: samples of water and shellfish, according to the protocol,
- Analyses of data when this is part of the TNA,
- Providing of ifremer hatchery spats.

3.8 The Norwegian Institute of Food, Fisheries and Aquaculture Research (NOFIMA)

3.8.1 Introduction

Nofima is working in R&D for the aquaculture, fisheries and food industry, and provide research at an international level. Nofima has three research divisions; Aquaculture Division, Division for Fisheries Industry and Market, Division for Food and Science.

Nofima is located at Ås, Stavanger, Bergen, Sunndalsøra, and Tromsø. For this project, the NOFIMA Centre for Recirculation in Aquaculture (NCRA) and NOFIMA Cleaner Fish Experimental Unit (CFU) are supplemented with additional facilities for research on salmon. The facilities at Sunndalsøra therefore include indoor tanks with salmon, wrasse and lumpsucker on RAS and flow through.

3.8.2 NOFIMA NRSA (Research station for Sustainable Aquaculture)

Location: Sunndalsøra, NORWAY

Web site address: https://nofima.no/en/research-facilities/sunndalsora-aquaculture-research-station/

Contact: Per Brunsvik (per.brunsvik@nofima.no)

3.8.2.1 Facilities

NRSA have facilities for aquaculture experiments with freshwater (ground water) and seawater (filtrated to 20 microns and UV-treated), in flow through and RAS. Fish species used in research are: salmon, lumpfish and ballan wrasse. There are tanks available from the size of start feeding up to fish size around 2 kg. Fish tanks have variation from 20 to 10.000 liters. The station has research facilities for nutrition, formulated feeds, physiology, breeding and recirculation studies.
The station has six different buildings: 3 buildings will be available for TNA experiments:

Building 4 NOFIMA, Salmon department has 81 x 500 l tanks, 24 x 1200 liter tanks, 32 x 200 l tanks all with feed Collection, 44 200 l tanks without feed collection. Several hatching units. The department has a possibility for temperature control, both warm and cold for both fresh and seawater. The department will be upgraded by June 2021.

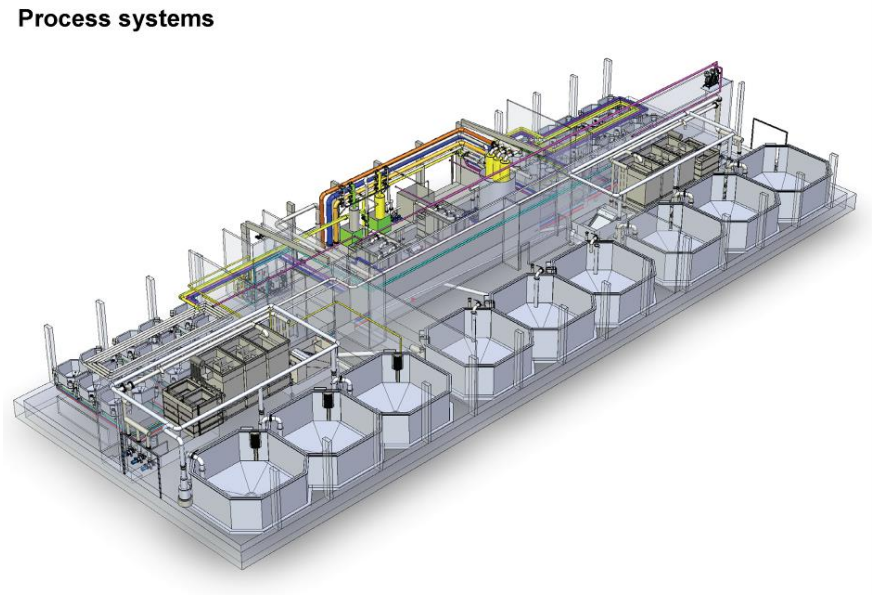
Building 5 Cleaner Fish Experimental Unit (CFU) has license for holding ballan wrasse and lumpsucker. The tanks (6 x 3000l; for broodstock, 15 and 24 units a 100 l for start feeding in 2 compartments, 12 x 250l units, and 12x 300l units, a hatching unit for eggs from both lumpsucker and ballan wrasse. The department can be used for broodstock nutrition, environment manipulation and experiments using dry feed for juvenile cleaner fish. The research aims at production of cleaner fish by aquaculture, as opposed to wild catch.

Building 6 NOFIMA Centre for Recirculation Aquaculture (NCRA) features 4 RAS-systems, 100 m^3 (9 pcs), 3 m^3 (30 pcs) and 0.5 m^3 (18 pcs) tanks in 6 experimental sections with individual light regimes. The facility provides both RAS and flow-through (FT) with freshwater (ground water) and seawater (microscreen and UV-filtered). NCRA carries out research on recirculation on a broad basis, and experiments in the areas of fish nutrition, technology, physiology and welfare. High degree of control and monitoring is possible using modern e-infrastructure developed in previous AQUAEXCELs.

3.8.2.2 Services currently offered by the infrastructure

Users will be able to work with salmon from eggs to 2000 grams with on flow through and RAS water on a wide range of topics, and on Broodstock, egg quality and nutrition on cleaner fish.

NOFIMA Research station for Sustainable Aquaculture principal activities are: a) Nutrition, feed and feeding, b) Breeding and genetics, c) New species, d) Quality, e) Preventive health measures, and f) Production technology and the environment.



Process research systems at NRSA. Only ground floor (1750 m^2) is shown.

3.8.2.3 Modality of access

Visitors and partners that come to NRSA and want to perform trials in the facility will meet a scientific environment with highly qualified personnel. The visitors will collaborate with leading scientists within physiology, nutrition, water quality and welfare. The technical support at the research station is of highest quality since they are trained and educated to perform trials in a scientific manner. Nofima Sunndalsøra is frequently receiving national and international visiting scientists that perform trials and exchange scientific ideas. The visitors will be carefully followed up and be included in the daily scientific work. NRSA can also provide offices, meeting rooms, and access to housing.

3.8.2.4 Unit of Access

The unit of access at NRSA is defined as one tank/week; equalling the occupation of one standard tank for seven days. For instance, 108 tank/weeks can imply an experiment using 12 tanks (e.g. a 2x2 factorial experiment in triplicate tanks) for 9 weeks. Nofima uses actual cost method; it is an accurate and updated method to calculate the cost associated with the TNA.

3.9 University of South Bohemia in Ceske Budejovice (JU), Faculty of Fisheries and Protection of Waters (FFPW)

3.9.1 Introduction

The Faculty of Fisheries and Protection of Waters (FFPW) consists of the Research Institute of Fish Culture and Hydrobiology in Vodnany (RIFCH), the Institute of Aquaculture and Protection of Waters (IAPW) in Ceske Budejovice, the Institute of Complex Systems (ICS) in Nove Hrady and the International Environmental Educational, Advisory and Information Centre of Protection Vodnany (IEEAIC).

The RIFCH is focused on scientific and especially applied research, education and activities in the fields of fisheries and protection of waters. The RIFCH utilizes a small fishpond farm, river fishing preserve, specialized laboratories, aquarium rooms, two experimental facilities for research into reproduction, genetics and the breeding of fish, and the intensive breeding of fish and crayfish, including recirculation systems with water filtration. The IAPW provides research, educational and consulting services focusing on pond aquaculture, nutrition and feeding of fish in ponds and intensive culture of fish. The ICS deals with the study of complex systems in natural and social sciences, with technical and other applications of research results.

3.9.2 JU- ICS (Institute of Complex Systems)

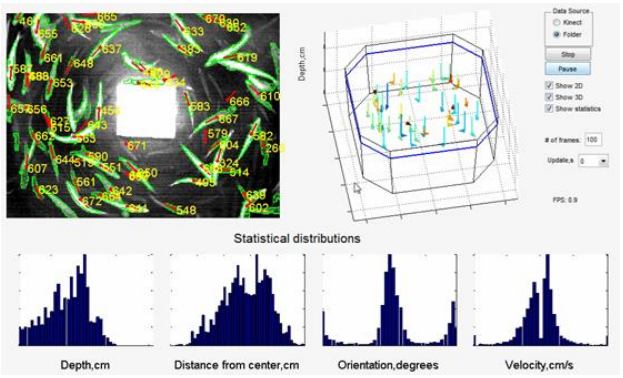
Location: Nové Hrady, CZECH REPUBLIC

Web site address: https://www.frov.jcu.cz/cz/veda-a-vyzkum/projekty/aqua-excel

Contact: Petr Císař (cisar@frov.jcu.cz)

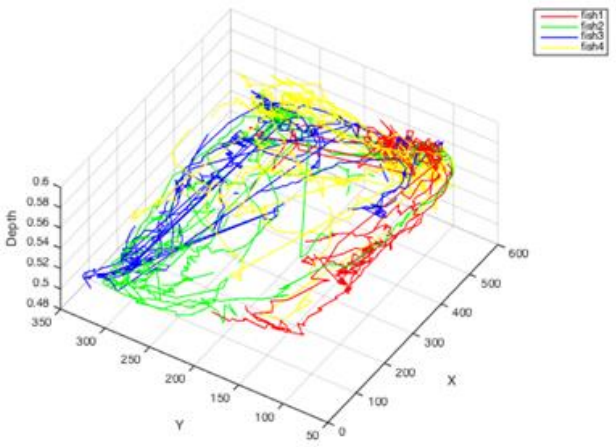
3.9.2.1 Facilities

The Institute of complex systems (ICS) is a part of the University of South Bohemia, Faculty of Fisheries and Protection of Waters. The institute is active in the research field of systems biology with focus on complex systems (cell, fish, crayfish, fish school). The institute consists of 2 laboratories (focused on data measurement, processing and analysis) and one working place (focused on cell culturing methods and biocompatibility). The institute builds on the mathematical, physical, chemical and cybernetic background and applies the knowledge in the biology. Several state-of- art methods were developed by the institute: methods for data filtration (LC-MS data), data description and analysis based information theory (clustering of image content). The institute operates computing cluster which can be used for the data processing of large multidimensional datasets. The expertise from the simple image processing tasks to complex data analysis problems can be solved. The main focus is the monitoring systems for fish behaviour in small aquarium and fish tanks and analysis of fish behaviour and appearance changes using image processing methods.



3.9.2.2 *Services currently offered by the infrastructure*

Any kind of image processing data can be realized in the area of objects detection and analysis (colour, shape, quantity) with the support in design of systems for visual inspection. The example of realized expertise: crayfish movement detection, fish detection in tanks, pellets detection in tanks, fish and sea horse coloration analysis, cells interior analysis, cells detection. Behaviour analysis services – We offer the analysis of behaviour (movement) of aquatic organisms or objects in the tanks of small aquariums. The statics about the behaviour (speed, space distribution, direction) over the time can be produced.



The services can be realized in the form of consultations of the specific research problem or data processing and analysis or combination of both.

3.9.2.3 *Modality of access*

The access will comprise the use of the facilities with regard to experiments and access to the laboratory equipment. Usually, trained and experienced engineer- and technical staff will carry out the standard procedures and the general maintenance. The external user will be strongly integrated in all processes, sampling, data recording, due analyses and assessment, and preparation and dissemination of results. The Facility will provide suitable supervision and guidance for potential unexperienced users to properly carry out the work. Scientific support will include advice on experimental design and methodology, documentation of results for all experiments conducted in the project and appropriate sampling and storage of samples. The technical and management staff will be helpful with the overall project´s implementation.

3.9.2.4 *Unit of Access*

One unit of access for ICS is defined as 1 week. Typical duration of the project is 2 weeks for 1 researcher. The unit of access consists from the analysis of the research problem or dataset following with the proposal of the best solution supported with the testing of different methods for data processing and analysis.

3.9.3 JU- IAPW (Institute of Aquaculture and Protection of Waters)

Location: České Budějovice, CZECH REPUBLIC

Web site address: https://www.frov.jcu.cz/cz/veda-a-vyzkum/projekty/aqua-excel

Contact: Jan Mráz (jmraz@frov.jcu.cz)

3.9.3.1 Facilities

The Institute of Aquaculture and Protection of Waters (IAPW) is composed of two analytical labs, four aquarium rooms and processing plant. The analytical part consists of two fully equipped labs (fume hoods, freezers, fridges, centrifuges, balances, etc.) with instruments for proximate analyses (Soxhlet, muffle oven etc.), sensory analyses (sensory panel, texture meter, photometer), lipid, volatiles and oxidation analyses (GC with FID and head space auto sampler, HP TLC, ultra microbalance, spectrophotometer), lipidomics (MALDI-TOF), vitamin and protein analyses (UPLC, spectrophotometer), elemental analyses (CHNS-O elemental analyzer), microscopy analyses (a broad array of stereomicroscopes) and microbiological analyses (stomacher, incubators). The aquarium rooms have 10 independent RAS systems installed composed of 3 or 4 modules enabling division of the systems in smaller units. All the RAS are equipped with drum mechanical filtration, biological filtration with floating elements, UVC ozone generator, aeration, heating, cooling and feeding system. Monitoring of water quality could be done on-line (temperature, O_2, pH), by multimeters, CO_2 meter, flowmeter, and spectrophotometer. Rearing tanks enables sedimentation and quantification of sediments. Available are aquariums and tanks of different volumes: 30l (14), 60l (72), 165l (36), 300l (24), 390l (24), 700l (9) and 1000l (10). The processing plant enables the processing of fish into a wide range of products.

See more details on individual parts of the IAPW:

- Aquarium rooms with RAS systems
- Fish processing plant
- Aquaponic hall

3.9.3.2 Services currently offered by the infrastructure

The IAPW offers a wide range of analytical services related to fish and feed quality, fish nutrition and early ontogenesis of fish as well as feeding trials, culture of new fish species etc. The laboratory developed a patented technology to produce carp with increased content of omega 3 fatty acids. Another key area is technology of intensive aquaculture and early ontogeny of economically important or protected species and species of interest to sport fishing.

3.9.3.3 Modality of access

The access will comprise the use of the facilities regarding experiments and access to the laboratory equipment. Usually, trained, and experienced engineer- and technical staff will carry out the standard procedures and the general maintenance. The external user will be strongly integrated in all processes, sampling, data recording, due analyses and assessment, and preparation and dissemination of results. Facility will provide suitable supervision and guidance for potential unexperienced users to properly carry out the work. Scientific support will include advice on experimental design and methodology, documentation of results for all experiments conducted in the project and appropriate sampling and storage of samples. The technical and management staff will be helpful with the overall project´s implementation.

3.9.3.4 Unit of Access

One unit of access for the IAPW is defined as 1 week. Typical duration of the project is 2 weeks for 1 researcher.

3.9.4 JU-IFA (Intensive Freshwater Aquaculture Units)

Location: Vodňany, CZECH REPUBLIC

Web site address: https://www.frov.jcu.cz/cz/veda-a-vyzkum/projekty/aqua-excel

Contact: Tomáš Policar (policar@frov.jcu.cz)

3.9.4.1 Facilities

The Intensive Freshwater Aquaculture Units (IFA) includes:

1) Two experimental rooms for controlled larval and juvenile culture can be used for different experiments with optimization of nutrition, environment conditions (temperature, light, oxygen, pH), fish density, polyculture stock, frequency of feed application, and the daily feeding rate using an automatic self-feeder from the Imetronic company, etc. to study the effect of the mentioned parameters/conditions on the efficiency of larval and juvenile culture in different high-valuable fish species such as pikeperch, perch, largemouth bass, grayling, Danube salmon, African catfish, etc. Each system is equipped with modern experimental RAS including all technical components with a total water volume of 6 m^3 and 9 experimental tanks (each with 350 litres).

2) One fish culture chamber for controlled environmental stimulation (temperature, light regime, and feeding regime) **of out-of-season or normal season reproduction in different fish species broodstock** is equipped with modern RAS including experimental tanks (4 and 6 tanks with each volume 1.2 m^3 and 350 litres, respectively), mechanical and biological filtration, degassing, oxygen saturation and ozone water treatment saturation.

3) Large scale RAS hall for intensive aquaculture of ongrowing or grow-out stock of different species includes two separated RAS, each system with a total water volume of 30 m^3 and controlled temperature, light, pH and oxygen conditions and the possibility to use ozone treatment for water sterilization. Each RAS system has 10 experimental tanks with an average volume of 1.2 m^3 and can be used for different large-scale experiments related to the optimization of intensive aquaculture (for example: nutrition, environmental conditions, water quality, fish density, stock etc.) in ongrowing or grow-out stock of

different species (for example: pikeperch, perch, largemouth bass, grayling, Danube salmon, African catfish etc.).

4) Laboratory of mass rotifer production can be used for controlled mass production of freshwater (*Brachionus calyciflorus*) or marine rotifers (*Brachionus plicatilis*). This laboratory is equipped with a batch or a continuous RAS production system from the Pentair company and an experimental aquarium system where different nutrition aspects of the first exogenous feeding can be tested in a larval culture of different fish species such as pikeperch, burbot, tench or some ornamental or marine fish species.

5) Haematological and biochemical laboratory is equipped with complete facilities for the analytical analyses of chemical, biochemical, haematological parameters (ultracentrifuge, double-beam spectrophotometer SPECORD 210, plate-reader with fluorescent and luminescent module Infinite M200PRO (TECAN), VETTEST 8008 analyser, analyser of blood gases Radiometer ABL90 Flex, real-time PCR, PCR thermocycler, NanoDrop). This installation can be used for different biochemical and hematological analyses from different aquaculture, physiological and toxicological studies.

6) Histological laboratory is equipped with the tissue processor Histomaster 2052/1.5, modular tissue embedding center - Leica EG1150, semi-automatic rotary Microtome, automatic slide staining system - TISSUE-TEK® DRS™ 2000, SEKURA, contrast and fluorescence microscopy. Also, this installation can be used for different tissue analyses from different aquaculture, physiological and toxicological studies.

7) Hatchery for broodstock management, egg incubation, and hatching of larvae is equipped with tanks and other facilities which can be used for broodstock management and reproduction. Also, this hatchery can be used for egg incubation and larval hatching in different types of jars or incubators. The hatchery can use the water supply from the flow-through or recirculating system. In this way, the water temperature during egg incubation can be easily controlled.

8) Pond culture system includes a maximum of 9 experimental ponds with a total area of 0.16 or 0.08 ha, which is supported by water from the river Blanice, that can be used for the optimization of larval, juvenile, or marketable mono- or poly- culture of different fish species.

3.9.4.2 Services currently offered by the infrastructure

This installation offers fish culture under RAS and pond conditions related to larval, juvenile, ongrowing, grow-out and broodstock stages, technical support and routine biological examinations for exact and precise experiments related to environmental stimulation of gametogenesis and final reproduction in broodstock, fish nutrition and feeding, optimization of fish husbandry, optimization of cultured conditions during all phases. Laboratories are enabled to assess the effects of xenobiotic on biochemical, chemical, haematological indices and histopathology in fish and crustaceans. Service/support of this installation will observe changes in the tissues of fish and crayfish exposed to tested substances on the level of gene expression and thus help us assess possible negative effects of these substances on the exposed organisms with high sensitivity.

3.9.4.3 Modality of access

The access will comprise the use of the facilities with regard to experiments and access to the laboratory equipment. Usually, trained and experienced engineer- and technical staff will carry out the standard procedures and the general maintenance. The external user will be strongly integrated in all processes, sampling, data recording, due analyses and assessment, and preparation and dissemination of results. Facility will provide suitable supervision and guidance for potential unexperienced users to properly carry out the work. Scientific support will include advice on experimental design and methodology, documentation of results for all experiments conducted in the project and appropriate sampling and storage of samples. The technical and management staff will be helpful with the overall project´s implementation.

3.9.4.4 Unit of Access

One unit of access is defined as 1 week. Typical duration of the project is 4-20 units for IFA installation.

On average each user or user group is expected to stay 14 days at the IFA. It is offered specific training and performance of experiments related to fish handling and nutrition in intensive farming of high-value fish, their reproduction including stripping of gametes, evaluation of sperm or egg quality, preparation of experimental food, assessment of larval and juvenile quality, optimization of culture in larvae, juveniles and other stages, evaluation of the physiological status of fish, behaviour observation, determination of survival and deformities, biometric of fish etc.; preparatory work-related experiment and set-up of experimental design, preparatory work in the laboratory – treatment of samples, equipment calibration and measurement on the analytic instrument.

3.9.5 JU- GRC (Laboratory of Fish Genetics and Reproduction and Hatchery)

Location: Vodňany, CZECH REPUBLIC

Web site address: https://www.frov.jcu.cz/cz/veda-a-vyzkum/projekty/aqua-excel

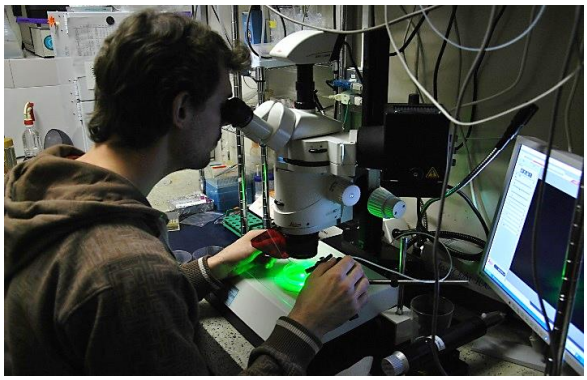
Contact: Vojtěch Kašpar (vkaspar@frov.jcu.cz)

3.9.5.1 Facilities

The Laboratory of Fish Genetics and Reproduction and Hatchery (GRC) – modern and multipurpose fish hatchery (with possibility of farming early fish stages, indoor tanks for preparation of broodstock for controlled reproduction, experimental fish rearing in special troughs and for work with young brood fish) with total area of 220 m^2. Tap water used for egg incubation and fry nursing, two recirculation systems are cleaned through biofilters and sterilized by ozonizer and UV radiation. Water levels, water temperatures and oxygen saturation with control of preparation of technological flowthrough or recirculated water are monitored in the entire system with the use of technological reporting by means of GSM technology. Twelve circular tanks (6m^3 in total) and four rectangular basins (12m^3 in total) operated by two separated recirculation aquaculture systems (RAS) are used for rearing the yearlings. Two RAS (2 x 8m^3) are ready for experimental preparation of broodstock for controlled reproduction. Laboratory of Reproductive Physiology, well equipped with microscopy and equipment for analysis of fish spermatozoa motility, cell and blastomere cryopreservation and micromanipulation and Laboratory of Molecular, Cellular and Quantitative Genetics, well equipped with aquaria rooms, microscopic and imaging systems, fluorescence microscopy and LSM Fluoview confocal microscopy, Partec flow cytometry, multichannel flow cytometry, DNA specific laboratory (e.g., PCR, gel electrophoresis and DNA sequencers - automated sequencing, semiconductor sequencing).

3.9.5.2 Services currently offered by the infrastructure

Reproduction related experiments - broodstock management and preparation for semi-artificial or induced reproduction, work with fish gametes, study of fish sperm motility, cryoconservation of fish gametes, flow-cytometry, light or fluorescence microscopy, image analysis, micromanipulations, transplantations of germ cells, genetic analyses (sequencing, fragment analysis, semiconductor sequencing).



3.9.5.3 Modality of access

The access will comprise the use of the facilities with regard to experiments and access to the laboratory equipment. Usually, trained and experienced engineer- and technical staff will carry out the standard procedures and the general maintenance. The external user will be strongly integrated in all processes, sampling, data recording, due analyses and assessment, and preparation and dissemination of results. Facility will provide suitable supervision and guidance for potential unexperienced users to properly carry out the work. Scientific support will include advice on experimental design and methodology, documentation of results for all experiments conducted in the project and appropriate sampling and storage of samples. The technical and management staff will be helpful with the overall project´s implementation.

3.9.5.4 Unit of Access

One unit of access for GRC is defined as 1 week. Typical duration of the project is 2 weeks for 1 researcher. The GRC unit of access consists of the preparatory work, reproduction of fish, incubation of fertilized fish eggs or work with fertilized gametes, micromanipulations and analyses of micromanipulations, cryoconservation of fish sperm, micromanipulations and transplantations of germ cells, juvenile breeding of hatched embryos or analysis of obtained samples in genetic labs.

3.10 Norwegian University of Science and Technology (NTNU)

3.10.1 Knowledge for a sustainable ocean

NTNU is the largest university in Norway, with about 40.000 students and it has the national responsibility for graduate engineering education. “NTNU Oceans” is one of NTNU's four strategic research areas, which all addresses complex challenges of great importance for society through interdisciplinary cooperation (https://www.ntnu.edu/research/strategicareas).

NTNU Oceans has as an overarching vison to help solve the big sustainability challenges in the ocean space. Our main goals are to support science, communication, and innovation within key areas of technology, natural science, social science, humanities and art, and facilitate interdisciplinary activity at the borders between these areas. Our research efforts are combined to create new multidisciplinary solutions supporting a sustainable production of marine living resources, energy and minerals.

Through its research and outreach activities (i.e. Ocean Week), NTNU Oceans contributes to Norway's role as a maritime nation. **Sustainable use of ocean resources – seafood and marine bio-resources** is one of six marine multidisciplinary research areas, and is centered on

- Salmon farming, with a special focus on the environmental factors
- Aquaculture technology
- Improved utilization of "new" bio-marine living resources.

3.10.2 NTNU Centre for fisheries and aquaculture: Sealab

Location: Trondheim, NORWAY

Web site address: www.ntnu.no/marine/sealab

Contact: Martin Føre (martin.fore@ntnu.no)

NTNU Sealab provides a joint multidisciplinary platform for aquaculture and marine science research and education. It assembles researchers and students in the field of aquaculture biology and technology, fisheries, processing of marine resources, marine engineering, coastal community development and marine toxicology. NTNUs special aquaculture competence is related to several biological aspects of fish, zooplankton, and micro-/macro-algae, open ocean cage systems, land-based recycling systems (RAS), and hatchery technology and logistics.

NTNU Center for Fisheries and Research is situated in the ground and first floor of this building, and SINTEF Ocean is one of the nearest neighbors. The NTNU Research Vessel "Gunnerus" in front.

3.10.2.1 Facilities

The Center for Aquaculture and Fisheries (NTNU Sealab) has hatchery and recycling aquaculture systems, in addition to several smaller temperature regulated experimental rooms, all with access to freshwater and seawater. The NTNU experimental aquaculture infrastructure may combine collaboration within cybernetics and fish farming expertise to generate new knowledge in a wide range of fields, from fish physiology, nutrition, welfare/stress, and development studies, to climate change responses, ecotoxicology, and bacterial community experiments.

NTNU Sealab has licenses for conducting experiments on many fish species, most commonly used are cold-water species such as Atlantic salmon, trout, lumpfish, ballan wrasse, cod, and Atlantic halibut.

At NTNU Sealab, the laboratories are used for research and training of students in biology, engineering, and microbiology at PhD, MSc and bachelor levels. The NTNU "International Master Programme in Ocean Resources" and the bachelor programme "Aquaculture Engineering" are the main aquaculture study programmes.

NTNU Sealab houses laboratories for experiments on cultivation of both marine and freshwater organisms under controlled conditions. NTNU Sealab infrastructure provides access to experimental and analytical laboratories:

CODTECH larviculture laboratory - The automated start-feeding system consists of 16 self-cleaning rearing tanks (100-200 L). It is especially designed for controlled experiments with marine fish larvae and planktonic organisms, with systems for production of live feed organisms and microalgae. The CODTECH laboratory is suitable for experiments on a wide range of freshwater and marine species. Environmental variables, such as temperature, light, dissolved oxygen, and carbon dioxide are monitored and controlled electronically. There are automated systems for feeding live prey and formulated feed.

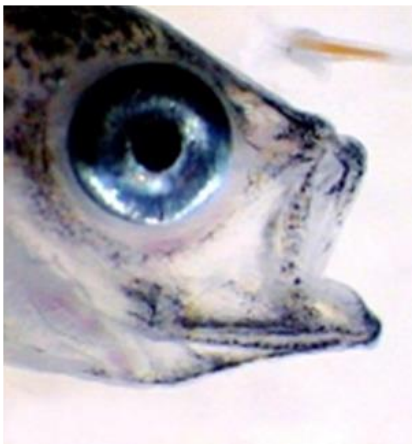
In-house cultures of live prey organisms (rotifers, Artemia, copepods) and microalgae provide a good basis for nutritional and developmental studies of marine fish during larval and fingerling life stages. The installations thus provide a unique degree of flexibility and automation, which can guarantee optimal cultivation conditions on a continuous basis. Incoming water undergoes a microbial maturation process whereas effluents are submitted to an advanced disinfection procedure. The latter makes the facilities particularly attractive for experiments with different bacterial communities and possible contaminants. This combination makes the facility one of the most advanced cultivation hatchery units in Europe.

The CODTECH larval rearing laboratory is especially designed for experiments with fish larvae, plankton organisms, and fish juveniles. The tanks are "self-cleaning", with fully controlled light, temperature, and water flow. Automated feeding is used for both live prey and formulated diets. There are 16 self-cleaning rearing tanks (á 100-200 L) available in this laboratory.

Plankton laboratory - NTNU Sealab is partner in EMBRC, and our National Center for Plankton Technology (Plankton lab) offers nine experimental laboratories (á 10 – 30 m^2) for plankton experiments (zooplankton

and algae), and live prey cultivation. The NTNU laboratory houses world unique cultures of marine copepods, and is well equipped for indoor, controlled algal experiments.





Recirculation laboratory (RAS) - The recirculation system (RAS) laboratory consists of three independent recirculation aquaculture systems each holding six tanks (in total 18 tanks á 380 litre), fully equipped for different types of fish experiments in fresh or brackish water, with automated systems for controlled feeding and environmental parameters.


The RAS-laboratory is designed for fish cultivation experiments with controlled temperature and light conditions.

Analytical laboratories (biochemistry and histology) - The analytical laboratories are equipped with a wide variety of instruments, such as spectrophotometer and spectrofluorometer (both including temperature control and a microplate reader), GLC and HPLC instruments for e.g lipid and protein composition, etc, a coulter counter and an algae incubator. At the histology/morphology laboratory there are fluorescence and light microscopes with computer-assisted stereological software for making volumetric calculations from histological sections, as well as equipment for tissue embedding, sectioning, staining, and tissue analyses.

Routinely operated are also various physiological equipment, such as Ussing chambers for assessing intestinal integrity, clinical blood autoanalyzer, and mitochondrial respiration (OXPHOS).

3.10.2.2 Services currently offered by the infrastructure

NTNUs CODTECH lab provides a stimulating and integrated environment for basic and applied research in marine aquaculture, such as e.g. fish functional development and growth, fish nutrition, stress physiology, and environmentally related issues.

The cross-disciplinary research group at NTNU with expertise in marine biology and technology, control systems, physiology, microbiology has long experience in innovating and improving aquaculture technology related to the cultivation of salmonids and marine fish species. In the previous AQUAEXCEL projects, the CODTECH lab was "fully booked", with several experiments related to cultivation of fish larvae and micro-algae, i.e. demonstrating the high potential and economic relevance of using microalgae products based on Pavlova in hatcheries. Currently, the facility is accessed by about 60 users/year, of which about 10 % are from outside Norway.

The NTNU aquaculture research group has a long and broad experience in developing biological knowledge and technology for intensive larval rearing of coldwater species, with numerous national and international research projects, and major international involvement in R&D. The group has a high competence in innovating and improving start feeding techniques related to the cultivation of marine cold water and tropical fish larvae. The group has long experience with salmonid rearing, physiology and nutrition, as well as salmonid ecology. A major expertise has been built up on the establishment of a stable tank environment, reduction of opportunistic bacteria, and the stimulation of a balanced microflora, both in the fish gut and in live prey organisms. Specific attention has been given to the function of probiotic bacteria in intensive aquaculture. During recent years, the facility has also contributed significantly to the development of methods for cultivation of continuous lines of copepods (*Calanus finmarchicus* and *Acartia tonsa*). These organisms are considered as important alternative larval feed sources in mariculture, as well as being increasingly used as model species for environmental and toxicological studies.

Marine fish require different types of live prey during the first stages of their life. NTNU has the capacity and experience to produce different types of live feed, depending on the species cultivated and the specific needs of the experiments: microalgae, rotifers, artemia and copepods. These prey organisms can also be enriched in various ways, to provide fish larvae with requested nutritional contents according to experimental design.

3.10.2.3 Modality of access

Location of work: Trondheim, Norway

Duration of work: On average, each user or user group may stay up to three months at the infrastructure (max 90 days). Initial planning of the experiment will happen well in advance, either by e-mail or through a meeting. Upon arrival, a user(group) will typically do preparatory work in the lab about 1 week before arrival of experimental organisms, and subsequent experiments are conducted. Analysis of samples may be done during or after the experimental period. Specific tools and instruments needed for individual measurements and analysis can be made available if within budget limits.

Unit of access: The unit of access is defined as one month of experimental/analytical laboratory use. One typical access can consist of 3 units of access.

Specify what is included in one unit of access: All include advice on experimental design, fish and plankton/live prey supply, purchase of fish feed, daily maintenance and measurements, routine sampling, conservation of samples, provision of monitoring data, access to office space and internet. This involves equipping the facility and making the necessary preparations before arrival, the training of users in using the control systems and ICT tools prior to, and technical assistance during the experiment. The purchase of fish material, (live and/or formulated) feed or algae is included. Any specific, experiment related components that are not readily available at Sealab need to be purchased by the users themselves. For analytical labs, assistance for sample preparation, and processing of data. User training will be provided if needed.

Method used to declare access costs: Actual costs (analytical accounting system)

Expected output/deliverables for users: Access to unique experimental research laboratories with experienced staff, interaction with researchers, and possible joint research collaborations.

As soon as a proposal for access is approved by the evaluation panel, the group leader will be contacted and be appointed a contact person at the infrastructure. This person will be responsible for the preparation of the planned experiments. Typically, the group leader will be invited to a meeting for a first discussion on experimental set-up, in advance of the start of the project. Details to be clarified with the facility provider are the number of tanks, species, quantity of eggs, larvae, or larger fish, instruments and analytical labs needed. In addition to the contact person, researchers and/or students working in similar field of research may join the group. This will stimulate the interaction between external and internal users of the facilities, resulting in an expansion of the existing collaborative network and eventually in joint publications. In addition, they will be given the possibility to access analytical laboratories. A project may typically last about 7 weeks, including preparations and performance of the experiments. Upon request, guest researchers and students can join different educational elements that are part of the International Master of Marine Coastal Development.

Monitoring and controlling equipment is designed in-house, and therefore, state-of-the-art expertise will also available to external users. During the transnational access project, support will be offered on a scientific, technical and logistic level:

In addition to the above, technical support for daily experimental work and technical help for samplings will be provided to all users. In case of specific needs, NTNU scientists using the infrastructures (larval development, nutrition, physiology, pathology) will assist users for experimental design and data interpretation.

Scientific support: The scientific staff involved in the ongoing interdisciplinary research and education activities consists of professors, post-doctoral researchers and PhD-students from several departments and faculties. The presence of experts and broad knowledge in first feeding experiments and cultivation of planktonic organisms, fish physiology, larval development and nutrition, microbiology, functional genomics, biotechnology, marine cybernetics, robotics, control systems and ICT tools in intensive

aquaculture systems, provides a stimulating research area for external researchers and students visiting the facilities at Sealab.

Technical support: Dedicated technical staff for operation of 18 tanks, instruments, monitoring and sampling gear, adjustment of experimental systems, temperature, water quality, water exchange rate according to experimental design. Supply of live prey organisms, microalgae, and laboratory assistance to perform standard analyses of samples.

Logistic support: All users will be offered an office space, and will be connected to the wireless communication area of NTNU. They will also have the opportunity to use technical workshops, digital meeting rooms and library services. The university's Office of International Relations offers professional services to all guest researchers. Accommodation is offered within the city of Trondheim by NTNU.

3.10.2.4 Unit of Access

The unit of access is defined as one month of experimental/analytical laboratory use. One typical access can consist of 3 units of access.

3.11 SINTEF Ocean AS (SINTEF)

3.11.1 Introduction

SINTEF is Scandinavia's largest independent research organisation. The research institute is strongly involved in the development of European aquaculture. Bridge-building between biological and engineering sciences is important for the institute to serve a more complex, advanced, future aquaculture industry with knowledge. It develops, organises and operates the large-scale infrastructure specialised for serving RTDI on technology used in sea based aquaculture (within a licence of production of 2340 t salmon and a seaweed production site).

SINTEF offers two unique installations: 1) ACE Facility for large scale testing of solutions for seabased aquaculture: 4 industrial-scale salmon farm sites with up to 15 circular net pens (157m in circumference and 30m deep) culturing Atlantic salmon, equipped with a range of environmental sensors; and 2) Norwegian Seaweed Technology Center (NSTC) composed of NSTC-Sealab (laboratory/hatchery for macroalgae cultivation) and NSTC-Seafarm (two field sites at the coast). The center has licence for cultivating 7 different macroalgae species.

3.11.2 SINTEF ACE

Location: Farm sites along the Norwegian coast close to Trondheim, NORWAY

Web site address: www.sintef.no/en/projects/2021/aquaexcel3

Contact: Nina Bloecher (nina.bloecher@sintef.no)

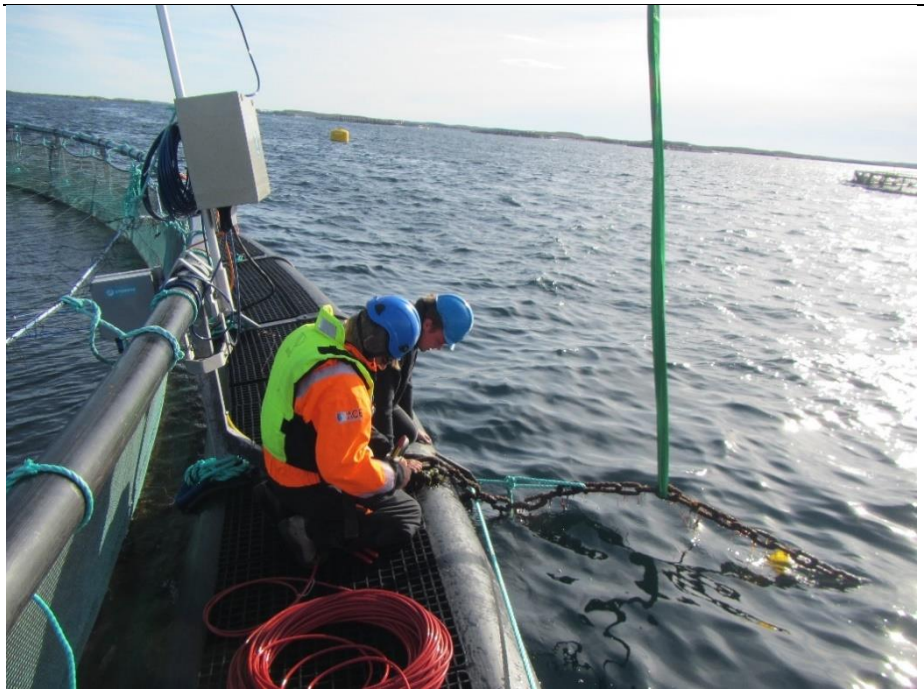
3.11.2.1 Facilities

SINTEF ACE is an industry scale infrastructure developed for testing and verification of improved and new technical and operational solutions in sea-based aquaculture. SINTEF has research licenses for industry scale production of Atlantic salmon, and this allows offering a combination of industry scale facilities for salmon farming, flexible technology test sites at different exposure levels, and state-of-the-art monitoring

and communication equipment. The primary focus is on equipment and operations for the on-growing stages of salmon at exposed sea sites. The infrastructure will promote engineering developments for a more sustainable marine aquaculture production, also including the possibility to study the interaction between technology and biology. The infrastructure consists of salmon farming sites in four geographical locations along the coast of Mid-Norway. This allows for experiments with different degrees of exposure, and different production cycles (time of year for deployment of fish)

The feed barge with control centre on one of the sites is shown in the picture below:

SINTEF ACE is integrated in the SINTEF e-Infrastructure for secure and controlled access to laboratory facilities (SINTEF SeaLab). This includes support for data capture, storage, and analysis of environmental and operational data. The e-Infrastructure also provides live video and on-line access to sensors and actuators, thus enabling remote configuration, monitoring and operation of equipment. Additional support tools, computing clusters and database servers as well as graphical processing equipment and displays are installed at SINTEF SeaLab in Trondheim. The picture below shows deployment of load shackles for measuring tension in anchoring systems. Data series are transferred via broadband connections to SINTEF SeaLab.



3.11.2.2 Services currently offered by the infrastructure

The current services are focused on industry scale salmon farming and on facilities for testing sea-based aquaculture technology. Technical personnel, scientists and equipment are available on site depending on the project requirements. All operational and project specific data from SINTEF ACE are stored at SINTEF SeaLab and are made available through the e-Infrastructure. On-line remote access to SINTEF ACE contributes to more efficient use of resources during design, setup and monitoring of experiments, and also for analysis and dissemination of results.

Depending on the project requirements, four sites in different stages of the production cycles and different degrees of exposure (waves, currents) are available. The fish used in each cycle will have a documented genetic background, and low variance in treatment and handling. The sites/cages are equipped with sensors that continuously measurements and document environmental conditions. Operational data (type of feed, feeding rates, sea lice treatments, biomass growth estimates etc) are also available. Infrastructure for efficient installation of project related equipment is available on every cage, including communication interfaces for remote monitoring and data transfer via SINTEF SeaLab. Reference measurements are supplied by an environmental monitoring buoy, also accessible through SINTEF SeaLab. Other available equipment includes:

- Remote controlled units: ROV, UAS/RPAS
- Structural sensors: accelerometer, load shackles, depth sensors
- Biomass sensors: echolocators (single beam), sonar (split beam), camera
- Environment sensors: oxygen, temperature, salinity, current, waves, wind, chlorophyll

3.11.2.3 Modality of access

The modality of access is flexible, ranging from on-site visits on the farming sites, to remote access to data from other consortium infrastructures (via logon to SINTEF SeaLab). The experimental set-up has to be discussed and planned in advance with the facility provider, e.g. number of cages, sensor equipment, size and quantity of fish present, and quantity of fish samples. The e-Infrastructure communication

network is divided into several VLAN's (Virtual Local Area Networks). Access to the relevant VLAN and the resources on that VLAN is given on a per user basis (password protected). All connections to external data acquisition equipment (e.g. sensors, video cameras) are routed to a VLAN dedicated to this purpose, thus limiting the risk for unauthorized access to other resources.

Scientific and technical support will be available both for visits to SINTEF ACE and for remote access through SINTEF SeaLab. This includes boat transport between shore and farming sites, necessary safety equipment and clothing for operations at sea. On-site installation of project related equipment will be conducted by the technical support staff to minimize the risk for personnel and operations. Documented time series of environmental and operational data will be available through SINTEF SeaLab on a site/cage basis, along with environmental reference data for the coastal area. A limited number of fish samples are analysed on a monthly basis, these samples can also be used for project related special analysis. Scientific and technical support includes appropriate sampling and conservation of samples. In addition to live video feeds from SINTEF ACE, meeting rooms with video conferencing will be available, enabling visiting scientists to communicate with colleagues and other research groups during experiments.

3.11.2.4 Unit of Access

The unit of access is defined as one week, equalling the occupation of the SINTEF ACE facility during 5 days of 7.5 hours each for up to 2 persons.

3.11.3 SINTEF-NSTC (Norwegian Seaweed Technology Center)

Location: Laboratory in Trondheim and two farm sites along the Norwegian coast close to Trondheim, NORWAY

Web site address: www.sintef.no/en/projects/2021/aquaexcel3

Contact: Silje Forbord (silje.forbord@sintef.no)

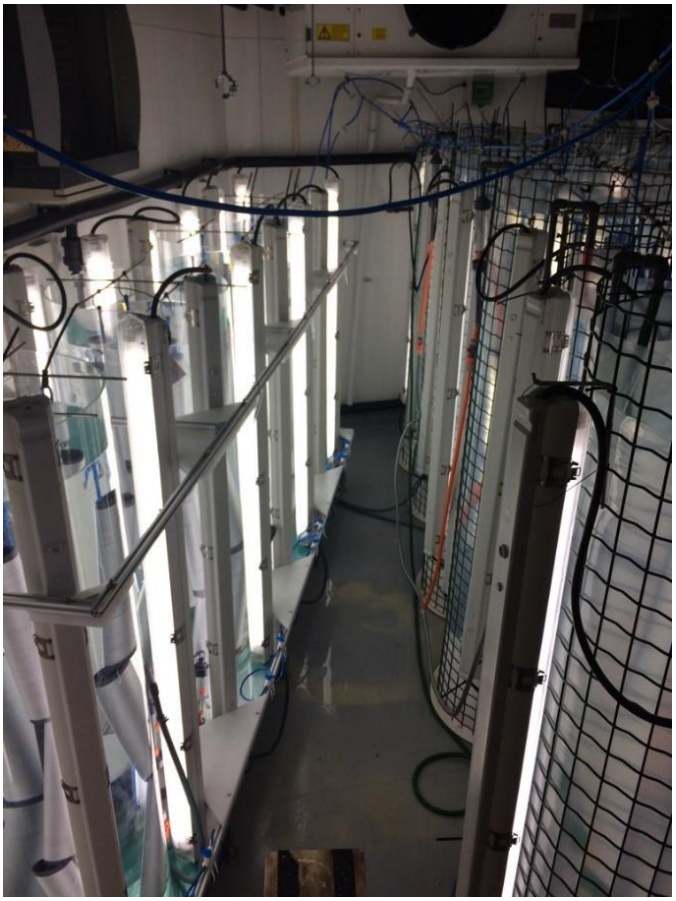
3.11.3.1 Facilities

Norwegian Seaweed Technology Center (NSTC) is a knowledge platform for technology development within industrial cultivation, harvesting, processing and application of seaweed in Norway. The center has licence for cultivating 7 different macroalgae species; *Saccharina latissima, Alaria esculenta, Laminaria digitata, Palmaria palmata, Porphyra* sp.*, Chondrus crispus* and *Ulva lactuca.* NSTC is composed of NSTC-Sealab and NSTC-Seafarm.

NSTC-Sealab is a laboratory for macroalgae cultivation in Trondheim, comprising: 1) Climate room with light control for vegetative cultivation or sorus induction, 2) Climate cabinet used for gametophyte cultivation, 3) Seedling's cultivation rigs in climate rooms (see picture below) with light control and equipment for seeding of substrates and mechanical transfer of seeded twine to carrier ropes. The laboratory is supplied with filtered, UV-treated 8-12°C seawater from a 70m depth intake from the Trondheimsfjord providing nutrient rich conditions year-round.

The NSTC-Sealab is well equipped for cultivation trials with different stages of the life cycles of the licensed species, which have been selected because of a commercial interest. The lab is well suited for research on seaweed hatchery challenges and vegetative cultivation of red and green species. The

research environment has a strong focus on upscaling of the methods developed in this infrastructure and is continuously working to improve and possibly automatise different operations.



NSTC-Seafarm consists of two field sites at the coast, one at the island Hitra characterised by being partly sheltered against waves but with strong currents, and one site for cultivation of macroalgae integrated with the two 5000t salmon farms at SINTEF ACE locations at Frøya and characterised by an exposed/semi-exposed location in open sea with strong water currents. The latter allows for cultivation of macroalgae close to the salmon farm to exploit its nutrient rich effluents (integrated multitrophic aquaculture (IMTA), see picture below). The sites have mooring suitable for fastening of longlines and for seeded cultivation substrates such as seeded droppers, continuous lines, nets or sheets. The water quality is good for cultivation of kelp and red algae regarding nutrients, light and temperature.

3.11.3.2 Support offered

Assistance will be offered to users by experienced scientists and technicians for experimental design of macroalgae cultivation trials. Technical support for daily experimental work and technical help for samplings will be provided to the users, including logistic support (vessel) for field work. Follow-up of the experiments between start-up and termination, i.e. when the users not are present, will be done if required.

3.11.3.3 Access modalities

The duration of work is flexible, depending on the project requirements. Use of the NSTC-Seafarm requires production of seedlings in the NSTC-Sealab. At NSTC-Sealab a typical trial will run for 4-6 weeks where the user stays the first and last week. The field sites in NSTC-Seafarm are suited for cultivation trials that can last for several weeks or months, and in such case, it is anticipated that the user will be physically present at least two times: at start-up and during running or termination of the trial.

3.11.3.4 Unit of Access

The unit of access is defined as one week, equalling the occupation of the infrastructure for 5 days, each of 7.5 hours for up to 2 persons.

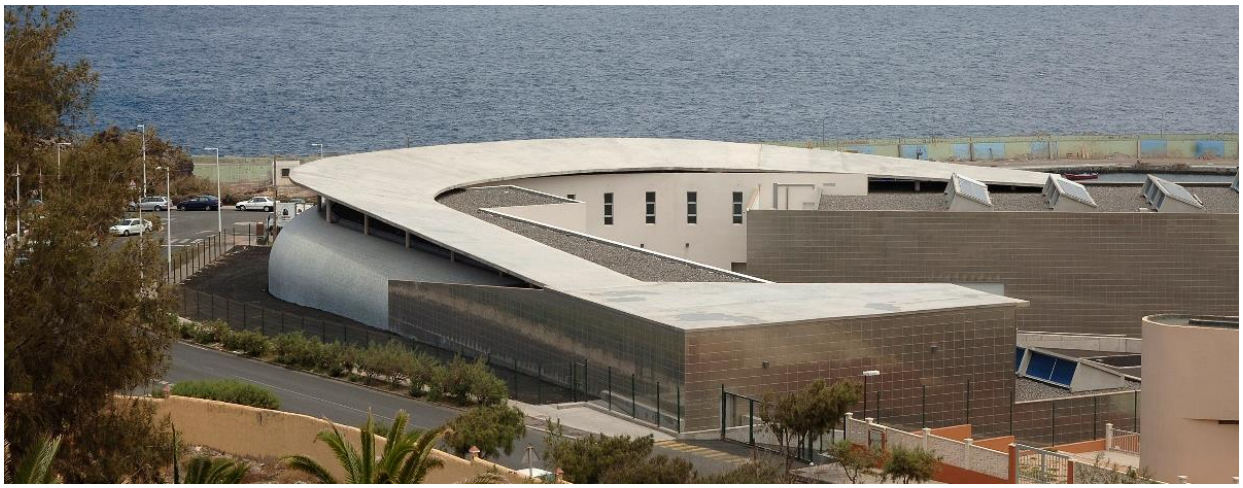
3.12 Universidad de Las Palmas de Gran Canaria (ULPGC)

3.12.1 Introduction

GIA (Grupo de Investigación en Acuicultura) is a Joint Research Unit of the University of Las Palmas de Gran Canaria (ULPGC), with a 30 years experience in fish aquaculture RTD, mainly nutrition, pathology, new species and genetics. One of its main achievements has been the clarification of the biological mechanisms involved in the regulation of the functioning of several tissues by means of dietary nutrients, using histological and immune-histological studies. Besides, GIA has developed physical tagging systems and selection schemes in sparid species and microarrays, and molecular markers for genealogies and health studies (microsatellites, TNF, IL11, GR, HSP70, HSP90, Δ5 and Δ6 desaturases).

ULPGC aquaculture infrastructure is located at the Marine Science & Technology Park (PCTM) which includes 3 installations:

- *Warm Water Species Selection Unit (WWSSU),* with a completely equipped laboratory of Molecular Biology and Quantitative Genetics techniques.
- *Marine BioAssays Station (MBS),* with three RAS and Fish Pathology, Anatomo-pathology and Microbiology Laboratories.
- *Feed Ingredients and Additives Testing Unit (FITU),* with labs for nutrition (GLCs, HPLCs and GLCs/HPLC-MS), analysis, feed production, digestibility and wet labs with computer-controlled photoperiod and feeding for either larvae (including automated start feeding), juveniles or broodstock of marine fish species, both commercial or new species for aquaculture.



3.12.2 ULPGC- WWSSU (Warm Water Species Selection Unit)

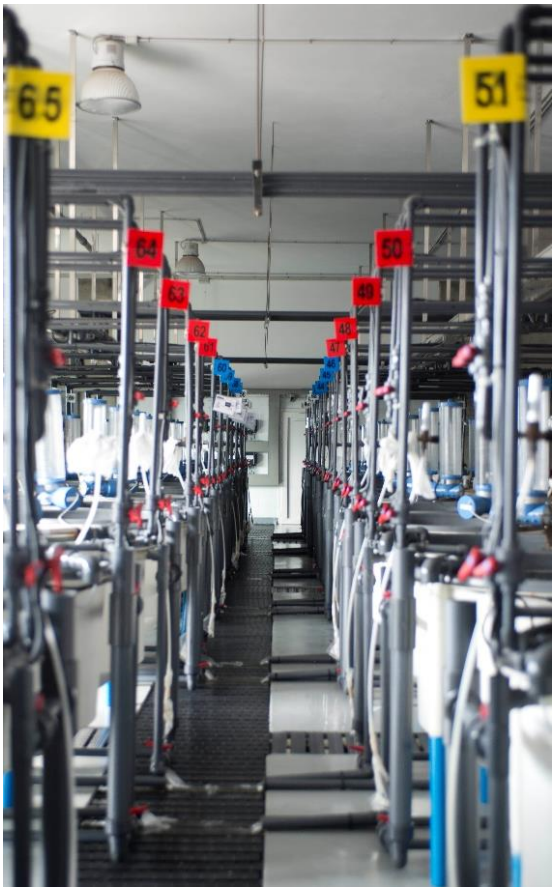
Location: Las Palmas, SPAIN

Web site address: www.giaqua.org

Contact: Rafael Ginés (rafael.gines@ulpg.es).

3.12.2.1 Facilities

The facility includes a breeding and a selected family rearing station and offers an infrastructure for genetic experiments like crossbreeding, inbreeding, epigenetic crosses or selection programs for families of, at least, 48 half sibs or 96 full sibs, or more when mass spawning is used. Fish culture is possible from larvae until adults. This installation is complemented with different labs for molecular and quantitative genetics, morphology lab based on image processing for detecting deformities among physical features, and meat and fish quality analysis. It comprises 69 circular tanks of 1000 litres and 12 tanks of 30000 litres of capacity (as average) prepared to obtain spawning from tagged pairs or groups of marine warm water fish broodstocks, by controlled photoperiod and temperature or hormone induction, respectively. Besides, 144 tanks of 500 litres allow larval and juvenile rearing until they are ready to be tagged. These tanks have a capacity to culture of fish from full and half sib families. It also includes a completely equipped laboratory for Molecular Biology and Quantitative Genetics techniques (manual and automatic sequencers, gel documentation systems, 5 color gene expression equipment, quality quantifier of nucleic acids, design and planning of breeding schemes, development of individual identification systems for physical and molecular reconstruction of genealogy, estimation of genetic parameters and evaluation of players, etc..), where we have reported, for the most important species in Mediterranean aquaculture (gilthead seabream), physical and genetic tagging systems for estimates of genetic parameters under industrial conditions. Furthermore, it benefits other research lines in animal breeding of other species with similar biological characteristics (sparids), which are important for the diversification of Mediterranean aquaculture. The facility is included in the Marine Scientific and Technological Park of the ULPGC and has access to other large aquaculture infrastructures and laboratories.



3.12.2.2 Services currently offered by the infrastructure

This infrastructure provides the possibility to establish a breeding program with its subsequent genetic progress and increased profits, both for commercially well-established species and for new species for aquaculture. Services include genetic advice, construction of genealogies, estimation of genetic parameters and selection of breeders. It also has a self-selection scheme in which users can provide elite breeders or measure the genotype-environment interaction, which is interesting in species such as sea bream produced in very diverse environments. This infrastructure contains control and monitoring of biological, chemical and physical parameters like oxygen, temperature, water flow, feeding or behaviour.

Several successful EU and national projects have been conducted of the facility, whereas a new hall will be ready for April 2010. At present, the Unit is the coordinator and National Reference Center for Development of a genetic improvement program in gilthead seabream (PROGENSA from JACUMAR-2008; INNOTECSS from INIA-2014), giving also service to commercial hatcheries.

3.12.2.3 Modality of access

Users can also have access to individuals from the different lines in order to conduct trials in their own laboratories. Fish are shipped by airplane in cube-containers by GIA researchers which have a wide experience and success in this process. The number of trials per year will depend on the numbers of families demanded and the requests by the different partners.

The access will comprise the use of tanks including maintenance, water supply, daily feeding and husbandry of fish; manipulation, and sampling of fish. Also access to all dry laboratory facilities and other infrastructure, logistical, technical and scientific support to external users is offered on request. Scientific support will include advice on experimental design and methodology, documentation of results for all experiments conducted during the project, and appropriate methods for sampling and conservation of samples.

3.12.2.4 Unit of Access

The unit of access is defined as 1 tank/week, equalling the occupation of 1 tank of 1m^3 for 7 days. Occupation of small (500 L) tanks will be assigned a fraction or a multiple, respectively, of the standard tank unit. One project is expected to comprise 45 tanks on average during twelve weeks.

3.12.3 ULPGC- MBS (Marine Bio-Assays Station)

Location: Las Palmas, SPAIN

Web site address: www.giaqua.org

Contact: Daniel Montero Vítores (daniel.montero@ulpgc.es)

3.12.3.1 Facilities

The MBS is located in the Marine Scientific and Technological Park of the ULPGC and the ULPGC itself and comprises three main RAS units completely equipped to separately challenge with up to three different pathogens at the same time in all phases of fish life cycle including broodstock, larvae and juveniles of marine fish species. Each of them is provided with automatic and programmable control of flow, oxygen concentration, temperature, salinity and feeders and is designed to content up to 48 circular tanks of 500 litres. Therefore, 6 treatments in triplicates can be run at the same time in each RAS unit, but up to 48 tanks can be used if all units are included in the same experiment. The design of the recirculatory units is versatile, which allows a great amount of testing conditions and assays in vivo with any pathogen. It also has a support laboratory in situ, as well as access to the Fish Pathology Laboratory of the Institute of Sustainable Aquaculture and Marine Ecosystems (EOCAQUA) and the Microbiology Laboratory, both at the ULPGC, with microbiology and anatomo-pathology techniques ready for all fish and mollusc tissues (including anterior kidney, brain, muscle and bone, among others). These characteristics make the MBS the most versatile and controlled research station in Europe to challenge marine fish with virus, bacteria or parasites, at the same time. This kind of studies have been conducted by GIA and the Fish Pathology Lab for the last 15 years, fish health and welfare being a main research line of this group. The MBS is a reference centre for disease prevention in the Canary Islands and adjacent African countries.

3.12.3.2 Services currently offered by the infrastructure

In marine fish, facilities to provide pathogen-free animals with which to develop large-scale experiments are scarce. In this sense, the MBS supplies pathogen-free animals, which are highly demanded by experimental and industrial laboratories, offering services on pathogen challenge for researchers, feed producers and pharmaceutical companies, developing vaccines, immune stimulants and therapeutic products. The service includes standardised models for several pathogens and infection by intramuscular or intra peritoneal injection, cohabitation, immersion and rectum canulation as well as the development of combined experiments in nutrition and disease. All experiments are supported by biochemical, enzymatic histological and microbiological analysis.

3.12.3.3 Modality of access

One project is expected to comprise 18 tanks on average for eight weeks. Users are given access to this infrastructure for an average of 8 weeks for in vivo infection experiments. The number of trials per year will depend on the numbers of treatments demanded and the requests by the different partners.

The access will comprise the use of marine fish of both, commercially important and new species for Aquaculture, different types of pathogens, tank maintenance, water supply, daily feeding and husbandry of fish; manipulation, and sampling of fish. Also access to all dry laboratory facilities and other infrastructure, logistical, technical and scientific support to external users is offered on request. Scientific support will include advice on experimental design and methodology, documentation of results for all experiments conducted during the project, and appropriate methods for sampling and conservation of samples.

3.12.3.4 Unit of Access

The unit of access is defined as 1 tank/week equalling the occupation of one standard tank for seven days.

3.12.4 ULPGC-FITU (Feed Ingredients and Additives Testing Unit)

Location: Las Palmas, SPAIN

Web site address: www.giaqua.org

Contact: Daniel Montero Vítores (daniel.montero@ulpgc.es)

3.12.4.1 Facilities

The infrastructure includes an ingredient processing laboratory, a feed production hall, two series of 15 digestibility tanks (200 and 500 litres) and three wet labs with 170 tanks of 100, 200, 500 and 1000 litres, as well as two lines for commercial scale testing, provided with computer controlled automatic, auto-demand or manual feeding and waste feed collectors (feed intake control), to test diets and ingredients for either larvae (including automated start feeding), juveniles or broodstock of marine fish species, both commercial or new species for aquaculture. Photoperiod control is also available in 100, 200 and 500 litres tanks. It also has access to a complete nutrition laboratory equipped with 3 GLCs, GC-MS, 3 HPLCs, Densitometer, Iatroscan, Khjeldahl, ovens, muffles, etc., where all lipid, protein, aminoacids, fatty acids, lipid classes, vitamins, pigments, toxines, dioxines, PCBs and certain minerals from ingredients, feeds, live preys, seaweeds, moluscs, fish, turtles and marine mammals are daily analysed. Several successful EU and national projects have been conducted in this facility which has been completely renewed one year ago allowing complete automatisation and control for research on larval, juvenile and broodstock nutrition including nutritional requirements determination, alternative nutrient sources search, development of feeding tables and feeding methods, etc. The facility is included in the Marine Scientific and Technological Park of the ULPGC and has access to other large aquaculture infrastructures and laboratories, such as in vitro cell studies.

3.12.4.2 Services currently offered by the infrastructure

The facility allows determination of ingredient and feed quality, as well as nutritional studies, in relation to growth, nutritional status, health, welfare and juvenile and flesh quality of fish and mollusc. Up to now the facility has been used in cooperation with researchers from more than 20 countries that came for student, post-doc or sabbatical stages. Besides, it has given service to more than a dozen of local, national and multi-national companies, working at present for 4 of them. There is a very high demand for the use of these facilities that cannot completely being covered by the present facilities and hence a new plant is being build that will be ready for the end of 2010. Two patents, commercial feed formulas for aquaculture

species, several new ingredients for two pharmacological companies, more than 25 PhD thesis and 30 Master thesis, 9 EU projects and about 350 scientific papers have been produced in this facility.

3.12.4.3 Modality of access

One project is expected to comprise 15 tanks on average for twelve weeks. The duration will depend on the life cycle stage (from first feeding larvae to broodstock).

The access will comprise the use of tanks including maintenance, water supply, daily feeding and husbandry of fish; manipulation, and sampling of fish. Also access to all dry laboratory facilities and other infrastructure, logistical, technical and scientific support to external users is offered on request. Scientific support will include advice on experimental design and methodology, documentation of results for all experiments conducted during the project, and appropriate methods for sampling and conservation of samples.

3.12.4.4 Unit of Access

The unit of access is defined as 1 tank/week equalling the occupation of one standard tank for seven days.

3.13 University of Wageningen (WU)

3.13.1 Introduction

WU-AFI (Aquaculture and Fisheries) belongs the Department of Animal Sciences of WU. It lectures in the MSc Aquaculture and Fisheries and organizes intensive courses/workshops on recirculation aquaculture system (RAS) technology. WU-AFI has 40 years record of research on the interaction and modulation of fish and rearing environment in intensive farming systems, such as RAS. It developed expertise in: (1) growth, nutrient and energy metabolism using metabolic chambers and (2) the engineering and operation of RAS systems (since the 80's) and is now worldwide recognized as one of the leading experts in that area.

Aquaculture scientists visiting this facility can benefit from Wageningen Aquaculture Research Facility, a 1800m^2 aquatic indoor recirculation systems-based research facility (approximately 65 RAS and 560 holding tanks). The facility contains: (a) the Metabolic Research Unit, which offers a research environment for studies on nutrient and energy balances and metabolism in fish (both over a production cycle and for within-day variations, and (b) the Recirculation Facility consisting of sets of identical lab scale and pilot scale RAS to replicate treatments on system level. Both installations are stand-alone research installations which are each located in a separate room offering a research environment on organism level (WU-MRU) and production system level (WU-RAS). Marine and freshwater pilot scale RAS can be extended with several water treatment units (e.g. a single sludge denitrification reactor or a Geotube®system).

WU carries out research in Fish Nutrition, Fish Production Systems and Fish Health and Immunology. Animal experiments in Fish Nutrition and Fish Production Systems are conducted in fresh water or salt water species. For research on Fish Health and Immunology genetically well-defined carp and zebra fish inbred lines are used which can be combined with the use of a standardised blood parasite (Trypanosome) infection model. The research on Fish Nutrition and Fish Health and Immunology is performed in the metabolic research chambers (WU-MRU).

Expected output/deliverables for users: Publications describing the effect of animal, nutritional and environmental factors on responses of fish (output WU-MRU) and on system responses (output WU-RAS). Fish responses are: e.g. feed efficiency, feeding behaviour (latency and feeding time), digestibility, immunological, heat production (energy and nitrogen balance), and behaviour are among the measurements performed. In addition, these measurements may be combined with blood parameters and anything you can measure at slaughter. System responses are: e.g. water quality, water treatment performance and environmental performance (system waste discharge).

3.13.2 WU-MRU (The metabolic Research Unit)

Location: Wageningen, THE NETHERLANDS

Web site address: www.afi.wur.nl

Contact: Roel Maas (roel.maas@wur.nl)

3.13.2.1 Facilities

The WU-research infrastructures are in the 1800m^2 WU - Aquatic Research Facility (CARUS-ARF) on the campus of Wageningen University. The WU-Metabolic Research Unit (WU-MRU) consists of 12 metabolic chambers (chamber is the experimental unit). For publications, PhD-theses and posters related to the WU-MRU see: https://www.wur.nl/en/project/AQUAEXCEL3.0.htm; https://library.wur.nl/WebQuery/wurpubs/444707

The WU-MRU is used to study how nutritional, animal and environmental factors affect responses of fish (organism level, WU-MRU). The WU-MRU consists of twelve metabolic chambers (200L each) linked to a recirculation system with a total water volume of ± 7m^3. The recirculation system is equipped with an independent water quality (pH, salinity, temperature) measurement and control system. The metabolic unit is placed in a room with adjustable photoperiod. It has on-line measurement of actual and cumulative water flow per metabolic chamber, oxygen, temperature, pH, conductivity (µS), salinity, CO_2 production/consumption, TAN, urea, NO_2-N, NO_3-N, dissolved protein, and PO_4-P in the rearing water, using an auto-analyzer (Type San autoanalyzer adapted with flow through cuvettes, Skalar, Breda, The Netherlands). The twelve metabolic chambers can be equipped with a mobile feeding registration system. Mobile faecal collection units (12 sedimentation funnels) can be used to study the digestibility of feed nutrients. Mobile webcams (N=16) and imaging analysis software are available to record and analyse behavioural data. The metabolic research unit is equipped with a data acquisition system in which all data can be stored and made available in excel spreadsheets for later analysis. The unit can be connected to two identical RAS differing in water quality (pH, salinity, water exchange rate, nitrate level) to study the effects of these factors on the response of fish.


The metabolic research unit is commonly used for studies on nutrient and energy balance studies in fish (both over a production cycle and for within-day variations) and for studies on the adaptive physiology of fish. The WU-MRU: (1) can be supplied with four water flows differing in oxygen or carbon dioxide concentration each flow supplying 3 metabolic chambers; (2) can be used to determine O_2 consumption and CO_2 production by fish, (3) has a high accuracy and stability for the online water flow measurement across the metabolism chambers, (4) is equipped with a webcam per chamber for behavioural studies, (5) enables researchers to perform experiments for both freshwater and marine organisms (salinity can be varied from 0 to 35ppt) and for cool and warm water fish (water temperature can be controlled between 15 and 30 °C), (6) allows the determination of within days variation in O_2-consumption (from water), CO_2-production (in water), TAN, urea, orthophosphate, temperature and pH trough online water quality measurement.


3.13.2.2 Services currently offered by the infrastructure

The metabolic research unit offers a research environment for studies on nutrient and energy balances and metabolism in fish (both over a production cycle and for within-day variations). The research questions in the metabolic research unit relate to how animal factors (genetics, phenotypic differences, and health status), nutritional factors and environmental factors (temperature, oxygen concentration, carbon dioxide concentration, stocking density, sex ratio and housing conditions) affect responses of animals.

However, over the past 5 years, research has focused on adaptive physiological responses of fish to various husbandry conditions, such as the changes in feed intake behaviour and nutrient utilisation when ambient oxygen conditions are pre-set at different levels (tilapia) or carbon dioxide levels are pre-set at different levels (seabass). Studies were combined with changes in feed composition (substitution of animal by plant proteins, and different levels of non-starch polysaccharides, affecting the viscosity of the chyme and other intestinal ecological parameters), chronic (density; light conditions) and acute (netting) stress conditions, etcetera. Measured responses in the metabolic research unit strongly depend on the research questions involved, but generally, feed efficiency, feeding behaviour (latency and feeding time), digestibility, heat production and behaviour are among the measurements performed. In addition, these measurements may be combined with blood parameters and anything you can measure at slaughter.

Lab analysis of immune responses such as real-time PCR analysis of expressed genes, ELISA-based analysis of antibody or cytokine production, flow cytometric analysis of changes in leukocyte cell populations and analysis of proximate composition of fish, feed, faeces and sludge are routinely performed. An auto analyser is available for online measurements of TAN, urea, NO_2-N, NO_3-N, dissolved protein, CO_2 and PO_4-P in the rearing water. The WU-MRU is equipped with remote access sensors measuring oxygen, pH, temperature, conductivity and water flow rate. Sixteen (16) remote access cameras are available for recording of fish behaviour.

Visiting scientists and PhD's have carried out research in the metabolic research unit. Studies in the WU-MRU were partly conducted through EU funded research (for example: AquaExcel-FP7 and the WEALTH project (SSP8-CT-2003-501984) investigating the metabolic effects of rearing European seabass in extreme high densities, and at high CO_2, low O_2 levels in RAS).

3.13.2.3 Modality of access

A project will typically last 3 months, whereby the users spend part of the 3 months' time (the maximum stay at the infrastructure is 90 days) for preparation of the final work protocol, discussion with the local WU scientists and supporting staff, and discussion of the results. The effective use of the infrastructure for experimentation during each project will be 8 weeks. Within AQUAEXCEL3.0, the WU-MRU infrastructure will receive four projects of 3 months each during the project duration, thus 4*8=32 weeks of infrastructure use. When a proposal is selected, a host-supervisor will be identified and allocated from the senior staff of WU. The visiting user group is expected to discuss details of the proposed research with this senior staff member who acts as an immediate local partner for the proposed research. The study will be further executed as a joint collaborative research project between the Aquaculture and Fisheries group (AFI) of Wageningen University and the project user group. This guarantees that the study is administratively registered as a Wageningen University Task, which facilitates the further administrative implementation.

The host unit (WU) will start all logistic and administrative procedures and supports the execution of the work by providing supporting staff (lab technicians, administrative support, fish care taking staff etc.) and scientific embedding and backing. The visiting scientists are expected to stay at least 8 weeks at WU and execute part of the experiment themselves: four weeks at the start of the experiment and four weeks at the end of the experiment (to be discussed with the host supervisor). In the meantime the practical work will be done by the infrastructure personnel.

The Aquaculture and Fisheries Group of WU will assist in the outline of the work protocol, submit the application for approval of the Ethical committee, and provide scientific backup on methods and results interpretation and act as co-author for eventual publication of the results.

WU technicians will support the proper execution of the experiments, keep track of the (mandatory) welfare logbook, purchase of fingerlings and feeds required, and act as liaison to the staff of the Aquatic Research facility (CARUS-ARF). Staff of the research facility will provide support in feeding the animals and preparing the infrastructure before/after its use in the project.

The visiting scientist will receive a workplace, including a WUR internet account for the duration of their stay, receive support in finding living accommodation and be registered as visiting scientist. The latter enables the formal support of all WU administration, e.g., finances, book-keeping, secretarial support etcetera. The e-infrastructure developed for the WU-MRU in FP7-AQUAEXCEL offers the visiting scientists through remote access (graphical presentation and downloading of (actual) sensor data time series and live video per metabolic chamber) to follow part of the experiment at home or allows colleague scientists at home to follow the experiments and discuss the experimental conditions through (Skype/Teams) video conferencing with their colleague and/or scientists/technicians in Wageningen.

The support offered is a standard support given to visiting scientists and PhD's by WU.

3.13.2.4 Unit of Access

The unit of access is defined as one week access to 12 metabolic chambers.

3.13.3 WU-RAS (The Six Recirculating Aquaculture Systems)

Location: Wageningen, THE NETHERLANDS

Web site address: www.afi.wur.nl

Contact: Roel Maas (roel.maas@wur.nl)

3.13.3.1 Facilities

The WU-Six Replicated Recirculating Aquaculture Systems (WU-RAS) consisting of 6 replicated (identical) lab scale Recirculating Aquaculture Systems (WU-RAS) (system is the experimental unit). For description of the WU-RAS see dissertation Meriac (2014).

http://library.wur.nl/WebQuery/wurpubs/456252
http://www.sciencedirect.com/science/article/pii/S004484861300611X

The WU-RAS is used to measure how nutritional, animal, environmental and management factors (including RAS configuration) affect water quality, water treatment unit performance, waste production and waste discharge (system level, WU-RAS). Fish species used in research include: rainbow trout, Atlantic salmon, Nile tilapia, European eel, African catfish, Inbred and outbred lines of common carp, seabass, turbot, sole and Yellowtail Kingfish. The WU-RAS: (1) can be used with a drum filter or settling unit; (2) can be extended with a single sludge denitrification reactor (4 reactors available); (3) can be used to test different biofilters (trickling vs. moving bed, different biofilter media, etc.) (4) enables researchers to

perform experiments for both freshwater and marine fish (salinity can be varied from 0 to 35ppt) and; (5) for cool and warm water fish (water temperature can be controlled between 12 and 32°C).

3.13.3.2 Services currently offered by the infrastructure

Fish Production Systems research is performed in 6 replicated RAS. An auto analyser is available for online measurements of TAN, urea, NO_2-N, NO_3-N, dissolved protein, CO_2 and PO_4-P in the rearing water of the RAS. The 6 replicate RAS can be equipped with remote access cameras. Laboratory analysis of immune responses such as real-time PCR analysis of expressed genes, ELISA-based analysis of antibody or cytokine production, flow cytometric analysis of changes in leukocyte cell populations and analysis of proximate composition of fish, feed, faeces and sludge are routinely performed.

3.13.3.3 Modality of access

A project will typically last 3 months, whereby the users spend part of the 3 months' time (the maximum stay at the infrastructure is 90 days) for preparation of the final work protocol, discussion with the local WU scientists and supporting staff, and discussion of the results. The effective use of the infrastructure for experimentation during each project will be 8 weeks. Within AQUAEXCEL3.0, the WU-RAS infrastructure will receive two projects of 3 months each during the project duration thus 2*8=16 weeks of infrastructure use. When a proposal is selected, a host-supervisor will be identified and allocated from the senior staff of WU. The visiting user group is expected to discuss details of the proposed research with this senior staff member who acts as an immediate local partner for the proposed research. The study will be further executed as a joint collaborative research project between the Aquaculture and Fisheries group (AFI) of Wageningen University and the project user group. This guarantees that the study is administratively registered as a Wageningen University Task, which facilitates the further administrative implementation.

The host unit (WU) will start all logistic and administrative procedures and supports the execution of the work by providing supporting staff (lab technicians, administrative support, fish care taking staff etc.) and scientific embedding and backing. The visiting scientists are expected to stay at least 8 weeks at WU and execute part of the experiment themselves: four weeks at the start of the experiment and four weeks at the end of the experiment (to be discussed with the host supervisor). In the meantime the practical work will be done by the infrastructure personnel.

The Aquaculture and Fisheries Group of WU will assist in the outline of the work protocol, submit the application for approval of the Ethical committee, and provide scientific backup on methods and results interpretation and act as co-author for eventual publication of the results.

WU technicians will support the proper execution of the experiments, keep track of the (mandatory) Welfare logbook, purchase of fingerlings and feeds required, and act as liaison to the staff of the Aquatic Research facility (CARUS-ARF). Staff of the research facility will provide support in feeding the animals and preparing the infrastructure before/after its use in the project.

The visiting scientist will receive a workplace, including a WUR internet account for the duration of their stay, receive support in finding living accommodation and be registered as visiting scientist. The latter enables the formal support of all WU administration, e.g., finances, book-keeping, secretarial support etcetera.

The support offered is a standard support given to visiting scientists and PhD's by WU.

3.13.3.4 Unit of Access

The unit of access is defined as one week access to 6 replicated RAS.

3.14 1.1 Wageningen Livestock Research (WR-WLR)

3.14.1 Introduction

Wageningen UR Livestock Research (WR-WLR) is the Netherlands research institute established to provide the scientific support that is essential for developing the knowledge needed for sustainable and

profitable livestock and aquaculture farming. The aquaculture research is integrated in the departments of the institute according expertise levels, and holds in its portfolio a wide range of fresh water and marine species and culture technologies.

WR offers an infrastructure which includes independent units for research on fish performance, all suited for long and short term experiments with new or established species in larval, juvenile or grow-out phase; a swim carousel and swim tunnels, and a number of different independent RAS, with various options on the number and size of the tanks, depending on the proposition of the TNA user. All RAS are temperature controlled and suitable for fresh water and seawater, and equipped with mechanical and bio-filtration units. Filter modules can be exchanged to meet the specific needs of the end-user, such as UV-disinfection, ozone treatment, up-flow filtration, de-nitrification etc. The facilities offer the ability to test in identical and truly independent RAS at system level effects of nutritional, environmental, and management factors, as well as genomics and sensor implementation on system and fish performance.

The swim carousel and swim tunnels are tools to define optimal hydraulic conditions, and exercise and swimming protocols. The carousel has a compartment for resting and a compartment for swimming, where the controlled water speed induces swimming activity of the fish. The carousel is connected to a trickling and drum filter, and can run on both fresh and seawater.

3.14.2 WR RAS-Fish performance

Location: Wageningen, THE NETHERLANDS

Web site address: http://www.WLR.nl

Contact: Wout Abbink (wout.abbink@wur.nl)

3.14.2.1 Facilities

The Recirculation and fish performance offers two sets of research infrastructure:

1. Pilot scale RAS either for cold, warm, fresh or marine studies; up to 3 m^3 and 1.5 kg feed per day; to replicate treatments on system level.

2. Swim performance installations. A 3600 L swim carousel with a motor driven propeller reaching speeds up to 1.2 m/s, and four 120 L Blazka type swim-tunnels which can be applied for simulated migrations, exercise training and critical swimming speed tests.

3.14.2.2 Services currently offered by the infrastructure

The fish performance facilities offer to aquaculture researchers the:

- Ability to test in identical and truly independent RAS at system level (system as experimental unit) effects of nutrition, environment, management, breeding, welfare, sensor implementation.
- A tool for simulated migrations, exercise training and critical swimming speed tests.

3.14.2.3 Modality of access

Users will be given access to the facilities based on the common procedures of WLR. The necessary local arrangements will be taken by the technical staff, e.g. system set-up, adaptation of biofilms and water quality, adaptation of the required experimental animals etcetera. In case the proposed experiment falls under the code of conduct and regulation for usage of experimental animals, the approval of related experimental commissions has to be granted a priori the experiment can be started. The experiment needs to be supervised by a certified researcher of WLR. Users will have access by directly staying at the facilities and being integrated in the scientific atmosphere at WLR. The TNA guest will be supported by local staff, such as the directly involved technical staff dealing with the direction of the scientist to conduct the experiment. A local responsible scientist will collaborate with the TNA guest to ensure that the regulation of WLR and national animal protection laws are followed. TNA guests will be granted with internet access to the scientific literature and databases of WLR and other e-infrastructure and labs. Experienced research staff will safeguard the success of the experiments by support during the design phase, the generation of a work protocol and the related animal experimental code of conduct, execution of the experiment and data acquisition.

3.14.2.4 Unit of Access

The unit of access is defined as 1 system-week; equalling the occupation of 1 system for 7 days. The duration of the trial is greatly dependent on the proposition of the TNA user; the number of systems to be used (and thus to be prepared in advance), the type of trial, and the type of system used (carousel, swim-tunnel or RAS).

3.15 University of Lorraine (UL)

3.15.1 Introduction

The URAFPA-team DAC (domestication in Inland Aquaculture) is a lab from the University of Lorraine. Its mission is to perform research in the field of diversification in aquaculture, with focus on the domestication of new relevant species for the development of European fish production. It carries out

experiments on the reproduction function and fish welfare in particular on the environmental control of gametogenesis, broodstock endocrinology, gamete quality, embryo behaviour and comparison of biological traits linked to reproduction. The lab has particular research interests in the biology of percid fishes.

3.15.2 UL-EPA (Experimental Platform in Aquaculture)

Location: Vandoeuvre les Nancy, FRANCE

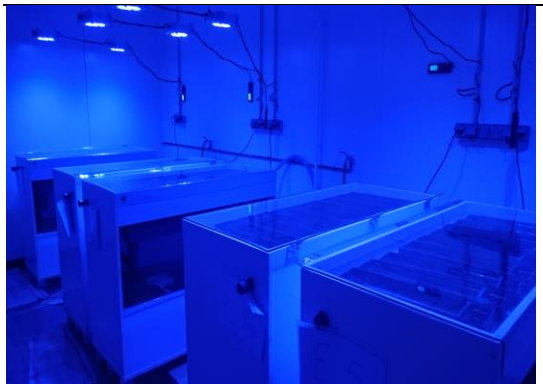
Web site address: www.urafpa.fr

Contact: (1) Sylvain Milla (Sylvain.Milla@univ-lorraine.fr); (2) Alain Pasquet (Alain.Pasquet@univ-lorraine.fr)

3.15.1.1 Facilities

The EPA of UL (800m²) is a new and modern indoor infrastructure dedicated to research on freshwater fish culture with facilities adapted to the different fish developmental stages (eggs, larvae, juveniles and breeders). The EPA is composed of two RAS for eggs incubation, two RAS for larval rearing (5 tanks of 700 L each) and 16 individual, autonomous and identical RAS (tanks of 2m^3, see picture) for juveniles and breeders, completed by a specific area (6 RAS of 1700 L each) for fish acclimatization step. These facilities are located in isotherm boxes to allow a very precise regulation and management of environmental factors (water temperature, photoperiod, light intensity, dawn and dusk simulation …). In relation to water management, the EPA is able to rear all freshwater species, from cold water species like salmonids to warm water species like tropical species. The water temperature can vary between 4 and 30°C whatever the season.

The EPA also contains a hatching room with five independent hatcheries (see the picture below) and a behaviour room to study social interactions (e.g. cannibalism), predatory behaviour, using a temperature/light intensity control. The behavior room is equipped with cameras (X3) for movies monitoring with low light intensity (<5 lux), and devices for behavioural tests (e.g. arena and labyrinths, see below). The EPA also contains two zebrafish rearing systems, each one enclosing 50 aquariums with automatic control of the environmental factors (e.g. temperature, photoperiod).



The experimental studies performed in EPA are accompanied with analytical laboratories. This area is dedicated to carry out physiological, cellular and molecular analysis and it is equipped with apparatus to perform microscopy, cells and organotypic culture, western blot and in-situ hybridization, gel electrophoresis, ELISA, enzymatic assays, microassays, HPLC, PCR…

3.15.1.2 Services currently offered by the infrastructure

Domestication of new species is investigated in Europe to diversify fish production. During the first steps of the domestication, fish performances are highly variable, fish features can be compared to a complex "black box" and the fish performances depend on multifactorial determinisms resulting from the effects of environmental, nutritional and "populational" factors. The accurate and fine control of the environmental conditions is fundamental to achieve a repeatable induction of the reproductive cycle, gonadal maturation, stimulation of the final stages and the optimal embryo-larvae development. Controlling the whole reproductive cycle is one of the key bottlenecks for fish diversification and the domestication of new species is one of the major promising topic for ongoing and future research in aquaculture.

In the EPA infrastructure, the number of identical experimental units (for example 16 RAS for juveniles and breeders) and their independent environmental control allow the application of multifactorial experimental design such as fractional or complete factorial design in order to study in parallel multiple factors and their interactions by reducing the number of experimental units. This infrastructure is thus mainly used for experiments which aims at optimizing the external rearing factors (e.g. temperature, photoperiod, luminosity), to understand their influence on the fish biology and on the zootechnical performances. The EPA of UL will allow such multifactorial studies on freshwater fish species in the framework of initial approach (screening) or more advanced approach (optimization of protocols). For example, that could be used for the development of protocols for larval rearing or growth, or for the control of reproductive cycle to achieve out-of-season spawning, or for the improvement of fish welfare.

3.15.1.3 *Modality of access*

In all, 3 projects are expected to be achieved in UL facilities. For each project, the visitors will benefit from these facilities to perform all experimental works on freshwater fish species in relation with modulation of external factors. They will first describe their research goals and, if suitable, they will be supported in performing the experiments in the EPA of UL. The field of research will concern larvae development, welfare, reproductive and growth performances, reproductive physiology and the use of molecular tools to assess the progress of gametogenesis and embryogenesis. According to the scientific goals, each visiting user will be linked to a local group of researchers depending on the technical and scientific skills.

Together, they will schedule the experiments by finding out the most appropriate experimental period. The equipment necessary will be determined, purchased and prepared in advance.

Before the experiment, the users will be provided access with all the fish, equipment and consumables to carry out their research projects. They will also benefit from advices for collecting good data (optimization of experimental parameters, design of experiments, calibration of sampling) and for highlighting information from the data using appropriate statistical analysis. Two animal keepers will be available to follow the progress of the experiments, to help for monitoring the zootechnical performances and the water quality and for organ sampling. One research engineer will supervise the schedule, organization and quality of the experiments (quality certification of EPA with the highest standard of UL). Partners will benefit from a rigorous archiving and recording data to improve the safety of the experiments. Users will have full access to computing and offices, and will also receive all the services offer by the university. A report enclosing the description of the experiment and the scientific data obtained will be written after each experiment. The users will be encouraged to present their results during local seminars.

3.15.1.4 Unit of access

On average each user or user group is expected to stay twice between 4 and 8 weeks (2 trials) in the infrastructure with thus a typical/average duration of 12 weeks per project.

The unit of access is defined as 1 RAS.week. For eggs (hatchery), one trial is expected to range between 4 and 16 units (i.e. 1 RAS during 4 weeks; 2 RAS during 8 weeks) and a maximum of 16 units per project is authorized. For larvae, one trial is expected to range between 4 and 16 units (i.e. 1 RAS during 4 weeks; 2 RAS during 8 weeks) and a maximum of 16 units per project is authorized. For juveniles and breeders, one trial is expected to range between 24 and 128 units (i.e. 6 RAS during 4 weeks; 16 RAS during 8 weeks) and a maximum of 150 units per project is authorized. For zebrafish, one system of 50 aquariums equals to 5 RAS.

Access typically consists of: discussions on the experiment, definitive time schedule, acclimatization period, sampling procedures, zootechnical and analytical measures, modalities of storing samples, statistical analysis.

3.16 DTU National Institute of Aquatic Resources (DTU Aqua)

3.16.1 Introduction

DTU Aqua has about 325 employees (full-time equivalents). The institute is organized into 10 scientific sections, which carry out the research, educational and advisory activities. DTU Aqua has employees at DTU's campus in Lyngby and in Silkeborg, Hirtshals and Nykøbing Mors in Jutland as well as on board the research vessel Dana. DTU-AAH in Lyngby is the scientific section devoted for Fish and Shellfish Diseases while DTU-DSC is part of the Coastal Ecology section and located in Nykøbing Mors at the Danish Shellfish Centre. DTU-DSC is devoted to Sustainable Resource Utilization of lower trophic level organisms.

3.16.2 DTU Aqua Fish and Shellfish diseases

Location: Lyngby, DENMARK

Web site address: www.aqua.dtu.dk

Contact: Argelia Cuenca (arcun@aqua.dtu.dk)

3.16.2.1 Facilities

DTU AQUA, Unit for Fish and Shellfish Diseases is located in Lyngby, Copenhagen, Denmark. Beside fully equipped laboratory facilities, it includes, 1. A contained experimental unit capable of conducting infection and challenge trials with all known fish pathogens and bioengineered organisms under both fresh- and salt water conditions, 2. A quarantine unit for purchased fish, vaccination trials and trials with non-infectious reagents, 3. A specialized facility for housing crustaceans and 4. A closed facility for supply of experimental specific pathogen free (SPF) rainbow trout. The facilities can operate at various temperatures and salinities. This guarantees that well-controlled laboratory and tank trials can be conducted with a wide range of fish pathogens on most fresh water fish species and some saltwater fish species. The highly contained facilities enable us to conduct experiments with exotic and highly infectious pathogens. The Unit for Fish and Shellfish Diseases is accredited according to ISO 17025. The service team has in-depth experience in the handling, management and care of fish at all stages. The laboratory is the European Union Reference Laboratory for Fish and Crusteacean Diseases and the OIE Reference Laboratory for VHS and is leading within research and diagnostics on listed viral fish diseases.

The facility comprises approx. 100 experimental tanks of various sizes. Both flow-through and recirculation systems can be made available in the tanks. DTU AAH has a broad experience with bacterial and viral pathogens. In trial protocols for bacterial and viral pathogens, fish are exposed to test agents by intraperitoneal or intramuscular injection, through cohabitation or by bath/immersion.

Standardized infection models for fish rhabdoviruses are available. Pharmacological assessments are also offered. Some of the major scientific achievements include:

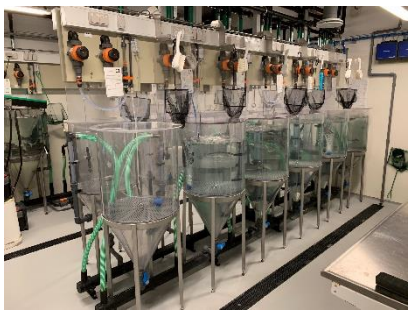
• Determination and kinetics of the humoral response in fish towards viral and bacterial diseases with related studies in immunology.

• The pathogenicity testing of a large number of isolates of VHSV have explained and changed the view of VHS and its epidemiology dramatically.

• Several new putative emerging fish pathogens have been tested for their infectivity, with results contributing to revision of EU legislation.

A significant part of the studies have been conducted by scientists from most of the world during research visits to our facilities. In the FP7 infrastructure project NADIR, and the Horizon project Aquaexcel^{2020} access were given to research groups from Italy, Spain, Turkey, Ireland and Norway, respectively. Access comprises both tank and laboratory facilities as well as all technical support needed for conducting TNA research projects.

3.16.2.2 *Services currently offered by the infrastructure*



DTU AAH offers access to carry out in vivo fish trials with infectious pathogens in various tank types and water qualities (only fish < ½ kg). The access will comprise the use of tanks including maintenance, water supply, daily feeding and husbandry of fish; manipulation, and sampling of fish. On request, access to all dry laboratory facilities and other infrastructural, logistical, technical and scientific support is offered to external TNA users.

Scientific support will include advice on experimental design and methodology, documentation of results for all experiments conducted during the project, and appropriate sampling and conservation of samples.

Fish are feed and inspected minimum 2 times a day. Under infection trials, inspection frequency is increased according to clinical symptoms. Moribund fish are euthanized, sampled, labelled and stored. Included in the unit, is also access to work in lab, e.g. molecular and immunochemical examination of fish tissues, antigen propagation, histopathology etc. The work is conducted under quality assurance conditions (ISO 17025) and under close supervision of technical and scientific personnel at DTU. Expected output/deliverables for users: Feed-back to DTU AAH members as a short presentation of results in seminar form with discussion. The feedback provided from the user should include inputs for improvement for future TNAs. Final agreement to finalize the TNA project will be provided. The agreement will include testing, delivering of samples and presentation of scientific data in form of peer review papers and presentations at national and international meetings.

3.16.2.3 *Modality of access*

Access is given to the whole facility and is conducted in a close collaboration with scientists and technical personnel of the facility. Preparation and planning is done in a consortium with other users in order to cross benefit the trials and laboratory activities.

Applicants will be required to provide detailed information about ethical issues (benefits that justify the use of animals, main adverse effects for the animals as well as steps taken to ensure that the amount of suffering to the animals is minimized and definition of humane endpoints for the trial). Hereafter DTU AAH will decide whether the proposed trial is possible to conduct at the facility. If accepted a detailed research protocol and timeframe are developed in collaboration with a contact person at DTU AAH prior to the stay.

On average each user or user group is expected to stay 30 days at the infrastructure. Prior to the actual start of access, all formalities regarding tank set up, pretreatment of fish and decision about pathogens to be used, and which analyses to be used, should be in place, so that these things are in place prior to the arrival of the TNA user, and the trial can start immediately upon arrival.

The stay at DTU AAH will include introduction to the facilities both wet laboratory facilities and laboratories, including information about biosafety measures in the high-containment facilities. Furthermore, IT-facilities and establishment of office facilities will be introduced. There will be a meeting with the veterinarian holding the Animal Experiments License for the trial and meetings with other potential collaborators at the Institute, including scientists, technicians and animal facility staff members. The user will be introduced to/trained in the relevant laboratory work necessary for the trial, e.g. cell

culture, virus isolation, virus identification by immunochemical and/or molecular techniques, The trial will be carried out according to the agreed protocols in close collaboration with the contact person at DTU AAH.

3.16.2.4 Unit of access

One unit of access is equivalent to one day of access to 35 small 10-l tanks or to 10 medium 180-l tanks, to 4 large 1000 l tanks or to ½ day access to laboratory facilities. Preparation, project planning, reporting etc is included in the overall access. One typical access consists of 40 units of access. The availability of relevant fish must be coordinated before the stay takes place. Fish (up to 1000) of a given size and conditions are present in and acclimatized to the tanks. Water supply (fresh, brackish or saltwater) and temperatures will be adjusted according to the agreed plan.

3.16.3 DTU-DSC: Danish Shellfish Center (Shellfish and macroalgae production)

Location: Nykøbing Mors, DENMARK

Web site address: https://www.aqua.dtu.dk - https://coast.dtu.dk/english/about

Contact: Camille Saurel (csau@aqua.dtu.dk), head of research group and manager of the experimental platform.

3.16.3.1 Facilities

DTU-DSC offers 3800 m^2 of building and lands, and off coast long-line culture units dedicated to low trophic aquaculture including shellfish, crustacean, microalgae and macroalgae production.

The inland infrastructure consists of standard equipped laboratories and stand-alone hatchery units for research on shellfish and macroalgae, from larvae/spore to adult stage, as well as producing microalgae for shellfish production.

By mid-2021 our infrastructure will be upgraded including new 750m^2 hatchery and 400m^2 nursery buildings. Current laboratories (275 m^2) include microscopes, autoclave, water quality instruments etc.., while the new laboratory (50 m^2) will include autoclave, laminar flow workstation, climate chambers, etc.

There are 4 units:

1) Bivalve hatchery + micronursery

- Current. Both recirculation and flow through systems. Adjustable feed supply rate via individual peristaltic pumps per tanks.
    - Experimental room 1 (130 m^2) for flat oyster production is supplied with 1 µm filtered UV treated seawater temperature controlled. The room includes 4 x 200L and 9 x 30L

broodstock tanks; 10 x 15L conical ultra-high density rearing system larvae tanks and 10 x 100L downwelling settlement sieve tanks and 20 x 100L micronursery sieve tanks.
    - Experimental room 2 for bivalve or crustacean production (124 m^2) is supplied with 1 µm filtered UV treated seawater temperature controlled. The room includes 10 x 100L sieves tanks, and modular tank options (50-1000L) depending on needs for larvae, settlement and micronursery.
    - Experimental room 3 for microalgae production (30 m^2), based on maximum production of 50 x 50L batch culture bags. Currently 4 microalgae strains are available all year round. System supplied with 0.2 µm filtered UV treated seawater.

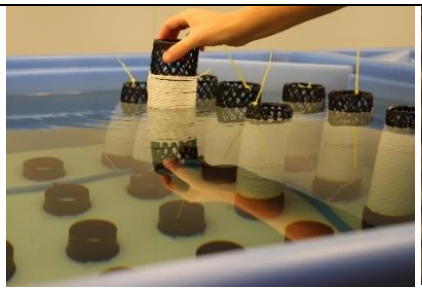


- 2021. New Hatchery – secure area. Both recirculation and flow through systems. All room supplied with min 1 µm filtered UV treated seawater, controlled water and room temperature.
    - Quarantine (50 m^2) with wastewater treatment UV + 0.2µm filtration
    - Flat oyster hatchery room (187 m^2) will include 12 x 100L and 12 x 30L broodstock tanks, 40 x 15L larval tanks, 40 x 50L settlement and modular micro nursery tanks (trays, sieves…).
    - Experimental room (86 m^2) with modular tanks adapted to all kind of bivalve experimentation
    - Microalgae production room (82 m^2)

2) Macroalgae hatchery

- Current. Climate room with constant temperature (15 m^2).
    - Only batch systems of water (no recirculation and flow through). Water filtration down to 5 µm. Adjustable light (irradiance and day length).
    - The setup is not fixed and changes according to ongoing research trials.
        - Tank setups include conical 5, 30 or 120 l tanks with bottom aeration for oxygen and flow.
        - 200 or 600 l batch tanks for e.g. broodstock conditioning and seaweed nursery.
        - Different scale trays setups are used for seeding (30 or 400 l).
        - Small-scale setups (flasks, beakers, small aquariums etc.) for cultures and experiments with microstages of different seaweed species.
- 2021. New hatchery - 53 m^2 climate room.
    - Both batch, recirculation, and flow-through systems will be available at various experimental and production scales.
    - The hatchery will be supplied with 1 µm filtered UV treated seawater with the option of different water temperatures.
    - The infrastructure is still in the planning phase, but will consist of a range of fixed and flexible setups at various scales to cover activities of both research and production






3) Nursery unit

- Current. Set of 12 raceways x 10 upwelling 80L tanks (120 tanks) with unfiltered seawater.

- 2021. Current building will include with unfiltered or 1µm filtered seawater + new 400m^2 building with filtered seawater at 60 µm. Tank configuration as required for experiments.

4) grow-out unit

Two longline farms of 5 and 15ha. The large unit can hold 16 x 3 x 100m longlines. Spat collectors or socked mussels can be hanged at different density, as well as grow-out system for flat oysters (e.g. lanterns, trays, cages) and seaweed.

A small platform in the DSC harbor is also available for easy access grow-out experiments.



3.16.3.2 Services currently offered by the infrastructure

At DTU Aqua DSC experiments with all stages of the native flat oyster has resulted in a unique stable production of >1M spat/year attracting international PhD students and MSc students to carry out research. DTU Aqua-DSC can provide facilities for basic research on aquaculture of known aquaculture species like flat oysters, mussels (e.g. in the OYSTERECOVER and CERES projects), macroalgae (e.g. different ecotypes of *Saccharina latissima* and *Palmaria palmata)* as well as more exotic species like ascidians and lobster. DSC facilities also provide real scale production for applied research (REPROSEED,

BONUS-OPTIMUS) and knowledge transfer on longline culture practice. Collaboration with the industry allows use of latest technologies, and research results to be used by business. Experiments can include breeding, larval stage up to adult size. Physiological rates (respiration, clearance, growth etc.) under different environmental conditions, as well as water quality can be measured (pH, O_2, salinity, turbidity, Nitrate, Phosphate). Other analytical devices are available such as spectrophotometer, fluorometer, flow-cytometer with camera.

3.16.3.3 Modality of access

Location of work: Nykøbing Mors

Duration of work: On average each user or user group is expected to stay 5 - 84 days at the infrastructure. DTU-DSC proposes training/description of culture practice where 1 week to 3 weeks are expected. Users will be integrated in the daily routine and able to participate to all stages of production in hatchery or in the field for grow-out. For research experiments, stays are expected to be 12 weeks due to the life cycle of the produced animals. Most of accesses have to match the production season. There are 3 training accesses for macroalgae, microalgae, oyster productions in hatchery, and 1 training access for mussel longline culture (spat collectors, technologies, harvesting/socking) and grow-out production (oyster and macroalgae).

3.16.3.4 Unit of Access

Unit of access: The unit of access is defined as one training day with access to the lab/hatchery or 1.5-2 days for experiments in the hatchery facilities. One typical training access consists of 5 units of access while one typical experimental access consists of 40 units.

Specify what is included in one unit of access:

Training unit of access includes access to hatchery, teaching/tutoring by technicians and academics, follow and experience daily routines with technicians.

Experiment units include advice on experimental design, setup, collection of live animals for the experiments, or larvae/spat provided by DSC. Preparatory work, acclimatization of the shellfish, macroalgae, protocols. Support for daily maintenance, use of facilities, sampling for the experiment, analyses, and use of equipment. DTU-DSC also offer support during weekends.

3.17 Algarve Centre of Marine Sciences (CCMAR)

3.17.1 Introduction

The infrastructure is composed of two installations at CCMAR (Algarve Centre for Marine Sciences, Faro, Portugal) and the linked third party IPMA-EPPO (Portuguese Institute for Sea and Atmosphere, I. P., Olhão, Portugal). The two installations are complementary and located within a short distance (12 km) of each other.

CCMAR is a non-profit research organization located in the Gambelas Campus of the University of Algarve. The Ramalhete Marine Station is a facility dedicated to experimentation with marine organisms, including fish (seabass, seabream, sole), macroalgae, and bivalves. It is located in the Ria Formosa National Park, a unique coastal mesotidal lagoon, separated from the ocean by a system of

barrier islands and inlets. It can offer tailored experimental setups with indoor/outdoor tanks of various sizes and controlled environment. A variety of experiments with larvae, and juveniles of several fish species such as nutrition, behavior, general and specific physiology including acidification can be performed. Research laboratories and technology platforms are located in the Gambelas Campus of the University of Algarve. A bioinformatics computational cluster offers software for genome assembly and transcriptomics studies. Complementary services include molecular biology (sequencing and proteomics) and analytical and structural chemistry. Transport between the Gambelas Campus and Ramalhete Marine Station is available during working days.

The Portuguese Institute for Sea and Atmosphere, I.P. (IPMA) is the state laboratory for Ocean and Atmospheric research. The IPMA-EPPO Aquaculture Research Station facility is dedicated to aquaculture research and technological development at pre-industrial scale. EPPO has an area of about 7 ha, including hatchery (1500 m^2) fully equipped for research and experimental production, support building (600 m^2), different analytical laboratories, unit for seafood packing, area for pre-fattening (for earth pond and sea cages production) and 17 earthen ponds. EPPO holds breeders of marine fish species, microalgae, sea urchin. IPMA offers access to tanks for different stages of meagre, sole, sea urchin and macroalgae, integrated multitrophic aquaculture systems.

The infrastructure receives approximately 100 external users per year. Approximately 15 projects are run on the station annually and more than 50 projects use the laboratories and platforms. Among recent scientific achievements, the development of sea cucumber aquaculture, the demonstration of fish olfactory impairment under ocean acidification conditions, sequenced genomes of sea bass, sea bream and sardine, development of novel fish feeds.

Users carrying out procedures with live fish must hold a Felasa animal experimentation certification and a project license from the Directorate General for Food and Veterinary (DGAV) to be requested in advance. A typical access consists of planning (generally initiated remotely), the setting up and the monitoring of experiments. Longer experiments may be setup by the service provider and the visit consists of monitoring and finalizing experiments, collection of samples, storage and preparation for transport. Some samples may be locally analyzed in the laboratories and technical platforms. Technical and scientific support will be assigned to the visitors according to the specific objectives of the TNA. Visitors will be provided their own desk and lab space. During their visit they will have full independence and will receive, as required, logistical, technical or scientific support through the liaison officer and other staff. Local accommodation can be booked by CCMAR. Costs related to shipment of samples may be covered by the TA and will be evaluated on a case-by-case basis. Paperwork and shipment costs of special materials, reagents or equipment will be responsibility of the users. There is a weekly seminar program, complemented by visitor and invitation conferences. Visitors will be given access to the general services: administrative services, internet access, accommodation, documentation and communication, and access to laboratories.

Pre-flight cancellation insurance and full health/work/travel insurance covering pre-existing medical conditions, world-wide travel assistance and emergency air transportation services covering the full period of access from departure to return are required. This is a private cost not covered by the TNA.

3.17.2 CCMAR - Ramalhete Experimental Station

Location: Faro, PORTUGAL

Web site address: www.ccmar.ualg.pt

Contact: Liaison officer - Ana Amaral (ccmarcts@ualg.pt)

3.17.2.1 Facilities

The **Ramalhete Experimental Station** allows a variety of experiments with larvae and juveniles of several fish species such as nutrition, behavior, and physiology, including acidification studies. It consists of 500 m^2 of indoor tanks, isolated rooms for studies that require environmental control or for behavioural studies, wet and dry laboratories. A 900 m^2 outdoor area is used for larger volume tanks and other needs. The station has been used mostly for projects related to fish (seabass, seabream, sole) and macroalgae.

3.17.2.2 Services currently offered by the infrastructure

The **Ramalhete Experimental Station** offers access to projects requiring tanks of different capacities: 100 L (n=24); 500 L (n=20); 1000 L (n=22); 3000 L (3); 9000 L (5). Tanks are set flow-through supplied with filtered natural sea water. Indoor and outdoor systems of tanks are setup for CO_2 experiments simulating oceanic acidification scenarios. Tanks and space can be adapted to fulfill specific experimental needs as temperature control, photoperiod, light intensity, or salinity. Species available include sole (*Sole senegalensis*), seabream (*Sparus aurata*) and seabass (*Dicentrachus labrax*).

3.17.2.3 Modality of access

A user group will have access to the services offered under this TNA: 1) access to experimental facilities - tanks and supporting laboratories – and organisms (fish, molluscs and macroalgae) at Ramalhete (CCMAR, Faro). Users carrying out procedures with live animals must hold a Felasa animal experimentation certification and a project license from the Directorate General for Food and Veterinary (DGAV) to be requested in advance.

Support will be provided in the first instance through the Liaison Officer who will take care of introduction to local rules and permits needed, ensure integration of visitors and projects into the scheduling of the infrastructure, and will help with access to facilities.

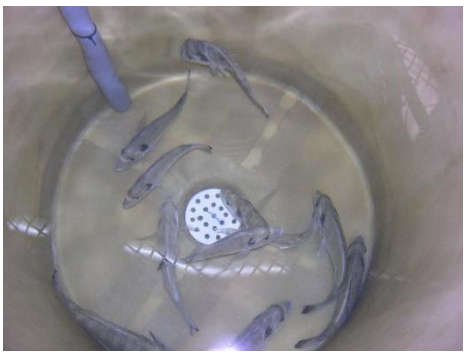
Users will be able to carry out their projects according to pre-arranged planning and they can do at least some of the analysis *in situ*. As a rule, user access the facilities with complete independence from local research groups. Only if requested, users can benefit from interaction with a local group to benefit from their expertise. Users are expected to provide a seminar and a report of the visit.

Paperwork and shipment costs of special materials, reagents or equipment will be the responsibility of the users. Costs related to shipment of samples may be covered to some extent and will be evaluated on a one-by-one basis.

Pre-flight cancellation insurance and full health/work/travel insurance covering pre-existing medical conditions, and including world-wide travel assistance and emergency air transportation services, are required covering the full period of access from departure to return. This is a private cost not covered by CCMAR.

3.17.2.4 Units of access

Access typical consists in finalizing the planning (generally initiated remotely), the setting up and the monitoring of experiments. Longer experiments may be setup by service provider and the visit will be for monitoring and finalizing experiments, preparation of storage or other materials, collection of samples for various purposes, storage in appropriate media. Some samples may need to be initially locally analyzed in laboratories and platforms. Technical and scientific support will be assigned to the visitors according to the specific objectives of the TA.



Costs are declared by a combination of units of access and actual costs. The unit of access at Ramalhete Marine Station, is defined as tank.week (e.g. 20 units of access are 20 tanks during one week or 10 tanks during two weeks).

3.17.3 CCMAR - Labs and Platforms

Location: Faro, Portugal

Web site address: www.ccmar.ualg.pt

Contact: Liaison officer - Ana Amaral (ccmarcts@ualg.pt)

3.17.3.1 Facilities

CCMAR laboratories and platforms (Gambelas Campus) are well equipped with state-of-the-art instruments (mass spectrometry, nuclear

magnetic resonance, confocal and light-sheet microscopy, electrophysiology, cell culture) for biological research at all levels, from biochemistry to molecular biology, bioinformatics, nutrition, physiology, behaviour and ecology.

3.17.3.2 Services currently offered by the infrastructure

The **CCMAR laboratories and platforms** offer access to technology platforms and support services: molecular biology (incl. sequencing and proteomics), analytical chemistry (mass spectrometry coupled to gas chromatography and HPLC, nuclear magnetic resonance spectrometry), imaging (fluorescence confocal and light sheet microscopy), cell culture and bioinformatics (CETA computational infrastructure).

3.17.3.3 Modality of access

A user group will have access to the services offered under this TNA: access to labs and platforms.

Support will be provided in the first instance through the Liaison Officer who will take care of introduction to local rules and permits needed, ensure integration of visitors and projects into the scheduling of the infrastructure, and will help with access to facilities.

Users will be able to carry out their projects according to pre-arranged plan. As a rule, user access the facilities with complete independence from local research groups. Only if requested, users can benefit from interaction with a local group to benefit from their expertise. Users are expected to give a seminar and a report of the visit.

Paperwork and shipment costs of special materials, reagents or equipment will be the responsibility of the users. Costs related to shipment of samples may be covered to some extent and will be evaluated on a one-by-one basis.

Pre-flight cancellation insurance and full health/work/travel insurance covering pre-existing medical conditions, and including world-wide travel assistance and emergency air transportation services, are required covering the full period of access from departure to return. This is a private cost not covered by CCMAR.

3.17.3.4 Units of access

Access typical consists of sample preparation and analysis. Technical and scientific support will be assigned to the visitors according to the specific objectives of the TNA. Costs are declared by a combination of units of access and actual costs. The unit of access for CCMAR laboratories and platforms is person.day (e.g. 20 units of access are 2 persons during 10 days).

3.17.4 IPMA Aquaculture Research Station (EPPO)

Location: Olhão, PORTUGAL

Web site address: https://www.ipma.pt/pt/pescas/eppo/

Contact: Pedro Pousão-Ferreira (pedro.pousao@ipma.pt)

Fig. 1. Aerial view of IPMA's aquaculture research station facility, located in Olhão Portugal.

3.17.4.1 Facilities

EPPO occupies 7 ha in the Ria Formosa Natural Park. At EPPO research is focused on broodstock management, marine fish larvae rearing, fish feeding and nutrition, fish physiology and pathology. This facility holds more than ten species of breeders of fish and invertebrates (e.g., meagre, sole, sea-urchin). This facility has more than 260 tanks (indoor and outdoor) and 17 earthen ponds used with different production systems (monoculture, polyculture and integrated multitrophic aquaculture). Photoperiod can be controlled, and water monitoring of physico-chemical parameters is automatic. Wet and dry laboratories for biochemistry, fish pathology and molecular biology offer the possibility of integrated and multidisciplinary research.

Fig. 2. Experimental rearing system of 200 L, in the larval acclimated room (left side), overview with larval (1.5 m^3) and juveniles (9 m^3) tanks in the main floor of hatchery (right side).

3.17.4.2 Services currently offered by the infrastructure

EPPO offers access to several experimental circuits, with tanks with different volumes (from 20 L to 1000 L), different shapes, and water circulation modes, in a controlled environment enabling the development of a variety of experiments with selected life cycle stages of several marine species. Tanks and space can be adapted to fulfil specific experimental needs such as temperature control, photoperiod, light intensity, or salinity. Access to experimental organisms and life stages, such as meagre (*Argyrosomus regius*), sole *(Sole senegalensis*), seabream (*Sparus aurata*), seabass (*Dicentrachus labrax*), sea urchin (*Parenchentrachus lividus*) and macroalgae (*Ulva* sp.*)* depends on time of the year. EPPO has a team of researchers with a multidisciplinary background and technicians with expertise to rear different marine aquatic organism species at different stages of the biological cycle for technical and scientific support. Complementary services (i.e., costs will have to be covered by the user) include biochemical analysis (digestive physiology, oxidative stress, blood biochemistry, welfare biomarkers, protein metabolism), fish pathology (bacteria and parasite identification, antibiograms, challenge trials), molecular biology (gene expression analysis of growth, oxidative stress and welfare biomarkers, molecular identification of selected bacteria and parasites).

3.17.4.3 Modality of access

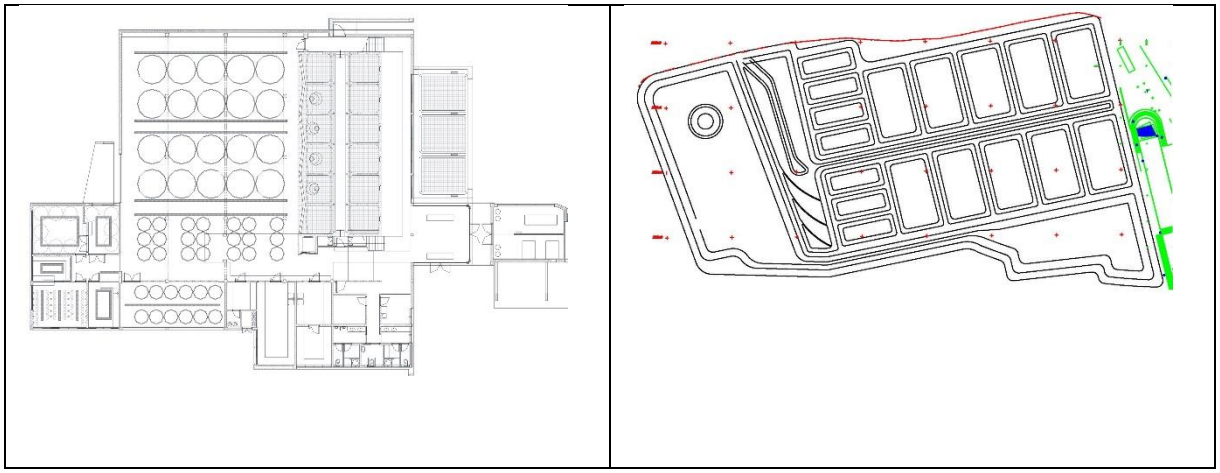
A user group will have access to the services offered under this TNA: access to experimental facilities tanks, supporting laboratories and organisms (fishes, molluscs and macroalgae).

Users will be able to carry out their projects according to previous experimental planning, e.g. feeding behaviour, nutrition, growth and physiology, health. Access will comprise the use of tanks including maintenance, water supply, daily feeding and husbandry, manipulation, and sampling. Access to all dry laboratory facilities and other infrastructural, logistical, technical scientific support, as well as access to

internet. Users will be provided with technical assistance, training and advice on methodologies, experimental design, and data analysis. Users are expected to provide a seminar and a report. Paperwork and shipment costs of special materials, reagents or equipment will be responsibility of the users.

3.17.4.4 Unit of Access

Access typical consists in finalizing the planning (generally initiated remotely), the setting up and the monitoring of experiments. Longer experiments may be setup by service provider and the visit will be for monitoring and finalizing experiments, preparation of storage or other materials, collection of samples for various purposes, storage in appropriate media. Technical and scientific support will be assigned to the visitors according to the specific objectives of the TA. The unit of access at EPPO, is defined as tank/week. As an example, 20 units of access are 20 tanks for one week or 10 tanks for two weeks.



3.18 Instituto Español de Oceanografía (IEO)

3.18.1 Introduction

In this project, IEO puts forward three installations for TNA. The facilities includes the Marine aquaculture facilities of Murcia (IEO-ICAR-MAP), Vigo (IEO-AquaCOV) and Santander (IEO-PAU). All three experimental aquaculture facilities are fully equipped. These facilities include several areas, such as breeding, hatchery, nursery, phyto and zooplankton cultures and pre- and on growing. There are also several available on-site biological laboratories: wet labs, genetic, histology, nutrition, chemistry, and biochemistry as well as rooms for feeding preparation. Murcia facilities are devoted to developing techniques for bluefin tuna (*Thunnus thynnus*) reproduction in captivity and juvenile production of bluefin tuna, as well as breeding and juvenile production of other Mediterranean fish species. In Vigo, the IEO-AquaCOV's general research lines have been focused on the optimization of animal husbandry of marine species of commercial interest and the rearing of new species. EIO-PAU unit in Santander has a wide expertise in rearing polychaetes.

The involved IEO teams (Vigo, Murcia and Santander) hold expertise to carry out scientific research in:

1) Rearing protocols for new and consolidated species for aquaculture such as Atlantic bluefin tuna, wreckfish, European hake, greater amberjack, sparids, flatfish and cephalopods, 2) reproductive performance and physiology, nutritional requirements of cultured marine species, 3) health and welfare,

immune system and vaccine development and 4) genetic analysis for selective breeding of aquaculture stocks.

3.18.2 IEO-ICAR-MAP

Location: Puerto de Mazarrón (Murcia), SPAIN

Web site address: http://www.icar.ieo.es

Contact: Aurelio Ortega García (aurelio.ortega@ieo.es)

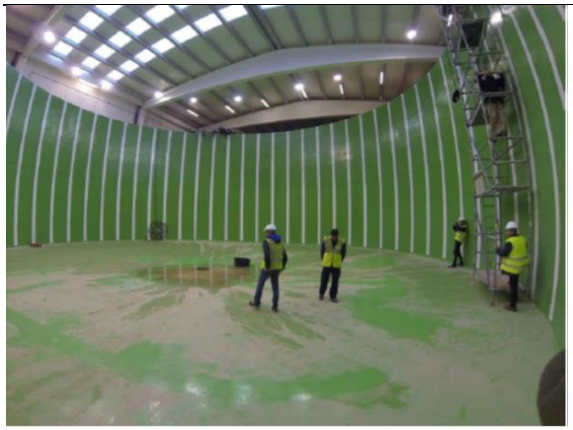
3.18.2.1 Facilities

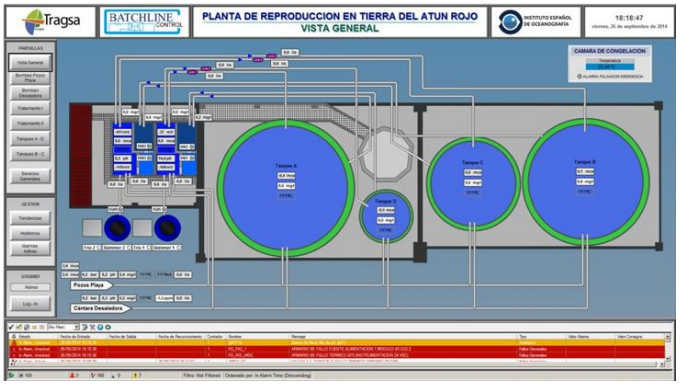
The Research Infrastructure consist of marine aquaculture facilities located in the Region of Murcia devoted to culture Mediterranean species, mainly Atlantic bluefin tuna, *Thunnus thynnus, (*ABFT*)* but also another Mediterranean species like sea bass, sea bream, yellowtail and another Scombrids and Scienidae. The Research Infrastructure has facilities to reproduction, incubation, larval rearing and weaning and ongrowing distributed in two closed but different buildings. They include more than 200 culture units, between 150 l and 3.500 m^3 each, with a total volume of 9.000 m^3. It provides automatic systems for controlling biological and physic-chemical parameters, as well as monitoring and control systems for feeding, nutrition and fish behaviour by means of self-feeders and video cameras. Some of these tanks are in different RAS systems, temperature controlled and equipped with mechanical and bio-filtration units, as well as UV-disinfection and skimmer and ozone treatment.

1. Facility for controlling the reproduction of the bluefin tuna (building 1)

It consists of a building of 2,660 m^2, corresponding 1,960 m^2 to the area including the tanks, 300 m^2 to the laboratory area and offices and 400 m^2 for water recycling and treatment area. The facility count on four big tanks: 2 broodstock tanks (20-22m Ø and 9-10 m depth -2,600 and 3,500 m^3-) containing 70 ABFT broodfish and 2 juveniles tanks (14 m Ø, 6 m depth -900 m^3 - and and 8 m Ø, 3 m depth -150 m^3-) The juvenile tanks are devoted to the quarantine, adaptation and ongrowing of new fish, and under demand could be filled with some cages to preongrowing trials.

The laboratory and offices area includes a storage room, a cold and freezer room, two laboratories and four small offices. The treatment and recycling water area has two full independent systems including physical and biological filtration, thermal treatment (heating or cooling), chemical filtration with ozone and skimmers, U.V. sterilization and oxygen injection. All the facility is fully equipped with automatic video cameras, activity control of all the devices (pumps, blower, valves, oxygen and ozone machines, UVA equipment, heating and chilling machines, skimmers, etc.) and sensors of temperature, pH, oxygen, redox potential, measurement of U.V. radiation, photoperiod, flowmeters, water level, etc., which are continuously registering and reporting activities in order to guarantee the correct operation of the systems and to monitor the tuna behavior.





2. Marine aquaculture Plant: Facilities for incubation, larval rearing, weaning and ongrowing (building 2)

These facilities extend over a total surface of 8,000 m^2 with a building of 3,500 m^2. It includes more than 200 culture units, between 150 l and 100 m^3 each, with a total volume of 1,300 m^3. It provides automatic systems for controlling biological and physic-chemical parameters, as well as monitoring and control systems for feeding, nutrition and fish behavior by means of self-feeders and video cameras.

- Office area of 700 m^2

- Laboratories: Wet laboratory, Laboratories for histology, nutrition, chemistry and biochemistry, lyophilized and sample treatments, Image and video laboratory, Room for feeding preparation and Genetics laboratory

- Water inlet system including different RAS.

- Oxygen and air delivery systems

- Cold and freeze rooms at 2ºC (18 m^2) and at –20ºC (27 m^2).

- Sea water heating and cooling systems

- Power generator of kVA of electrical power.

- Phytoplankton production unit (*Tetraselmis, Nannochloropsis, Isochrysis* and *Rhodomonas*)

- Small isotherm room (60 m^2) for phytoplankton strains conservation and starting cultures

- Two greenhouses (150 m^2) for massive phytoplankton production in photobioreactors and bags

- Isotherm room for rotifer production and enrichment (29m^2) with 8 (1.5 m^3) and 5 (500 liters) cylindrical tanks.

- Unit for *Artemia* hatching and enrichment. Isotherm room (24 m^2) with 10 cylinder-conical (160 l) tanks for *Artemia* hatching and enrichment.

- Unit for copepods (*Acartia tonsa*) production with 4 (5 m^3) broodstock tanks and 8 (1.5 m^3) tanks for hatching and growing Nauplius.

- Incubation room (22 m^2) provided with 12 (500-1000 l) cylinder-conical tanks and a small incubation unit provided with 24 (10 l) cylinder-conical tanks.

- Three water recycled units for larval rearing with 60 cylindrical tanks (150 to 1500 l.)

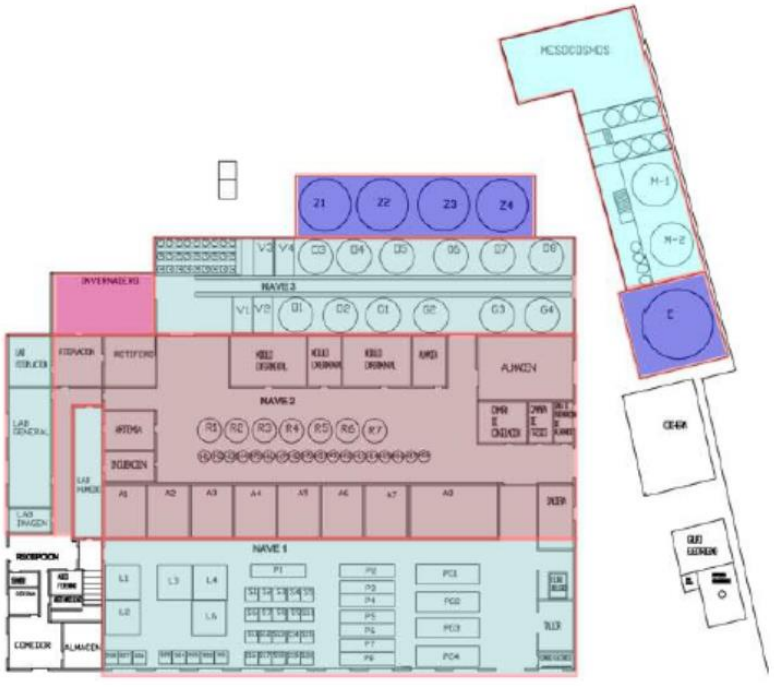
- Larval rearing area with 7 (5 m^3), 18 (1,4m^3) and 2 greater (45 m^3) cylindrical tanks

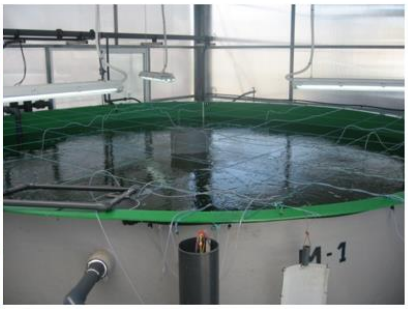
- Two experimental isotherm rooms with a total of 40 (170 l) cylindrical tanks.

- Broodstock area with 7 (45 m^3) square-based tanks and 2 (90 m^3) and 4 (6m^3) rectangular-based tank. This area is mainly devoted to produce yolk sac larvae to supply the tuna larvae needs

- Weaning and pre-ongrowing area with 4 (50 m^3), 4 (20 m^3) and 18 (10 m^3) cylindrical tanks and 40 square-based tanks (2-12 m^3)

- Room to pathology challenges: A small room with 200 l. tanks fully isolated to carry out challenges with pathogens.





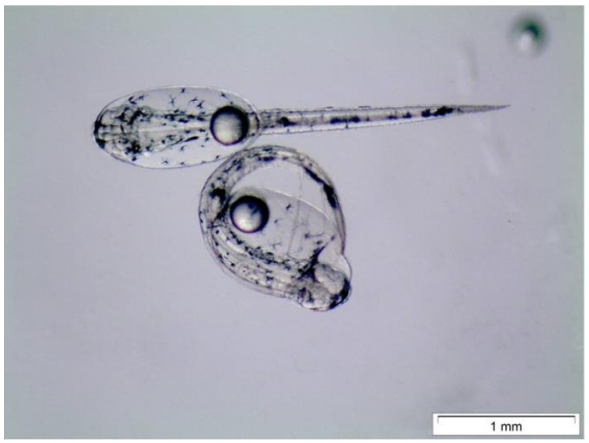
3.18.2.2 Services currently offered by the infrastructure

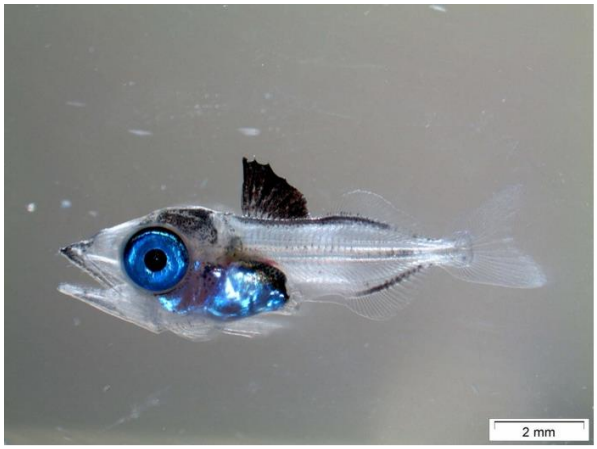
IEO-ICAR MAP is aimed to develop techniques for juvenile production of bluefin tuna, as well as breeding and juvenile production of other Mediterranean fish species. It is currently used as a research infrastructure by IEO scientific staff and other Spanish and international institutes and universities. It has also hosted many experiments from private companies.

Technical support for daily experimental work and technical help for samplings will be provided to all users. For specific needs, IEO scientists using the infrastructures will assist users for experimental design and data interpretation.

Main services are related to:

- Tuna farming
- Species diversification
- Nutrition and food
- Recirculation systems (RAS) development
- Animal health and welfare
- Technical larval culture
- Sampling
- Formation and training of technicians on bluefin tuna rearing.





3.18.2.3 Modality of access

IEO-ICAR MAP will carry out experiments for potential users and provide physical access to its facilities during crucial periods of the running experiments. As the standard procedures and the general maintenance will be carried out by trained and experienced staff, each user is expected to stay 10 days, typically 5 days at the beginning of the experiment to finalize the technical protocol details and start the experiment and 5 days at the end of the experiment for final measurements and sampling.

Access will comprise the use of tanks including maintenance, water supply, daily feeding and husbandry of fish; manipulation, and sampling of fish. Access to all dry laboratory facilities and other infrastructural, logistical, technical and scientific support to external users is offered, as well as access to internet, desk, fax and printing service, copy machine, etc. Users will be provided with any necessary technical assistance, training and advice on methodologies, experimental design and data analysis.

IEO-ICAR MAP provides standardized experimental protocols, documentation of results, and appropriate sampling and conservation of samples.

3.18.2.4 Unit of Access

The unit of access is one week (5 days) per person. The typical access consists of 5-10 units. Unit of access is defined as one week during which a user is given access to IEO-MAP facilities to use a set of experimental tanks or biological labs (1 great tank in building 1 or a set of several incubation, larval rearing or preongrowing tanks in building 2). The unit of access will include the preparatory work of the experiment, live preys if needed and the technical support during the project.

There are 40 units of access allocated to IEO-ICAR MAP over the life of the project.

3.18.3 IEO-AquaCOV

Location: Vigo, SPAIN

Web site address: http://www.ieo.es/en/web/ieo/plantas-de-cultivo

Contact: Montse Pérez (montse.perez@ieo.es)

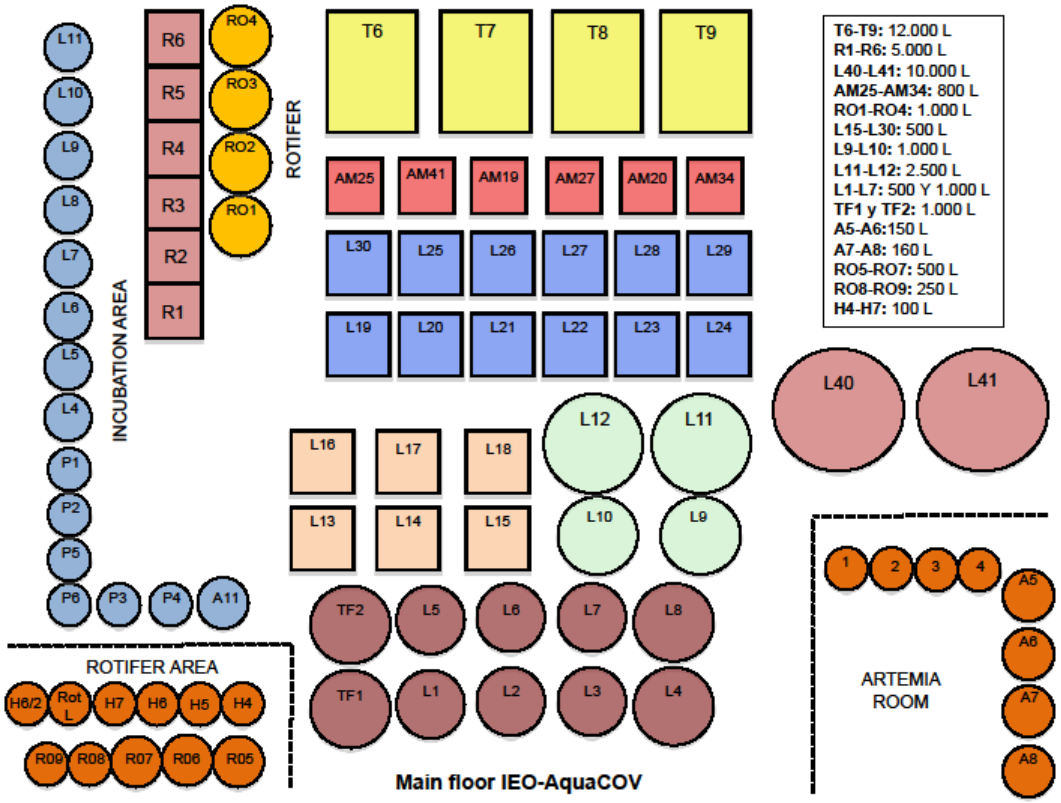
3.18.3.1 Facilities

IEO-AquaCOV's general research lines have been focused on the optimization of animal husbandry of marine species of commercial interest, such as fish (turbot *Psetta maximus*, black-spot sea bream *Pagellus bogaraveo* and molluscs (*Octopus vulgaris*), as well as in the development of the culture of new species such as wreckfish *Polyprion americanus*.

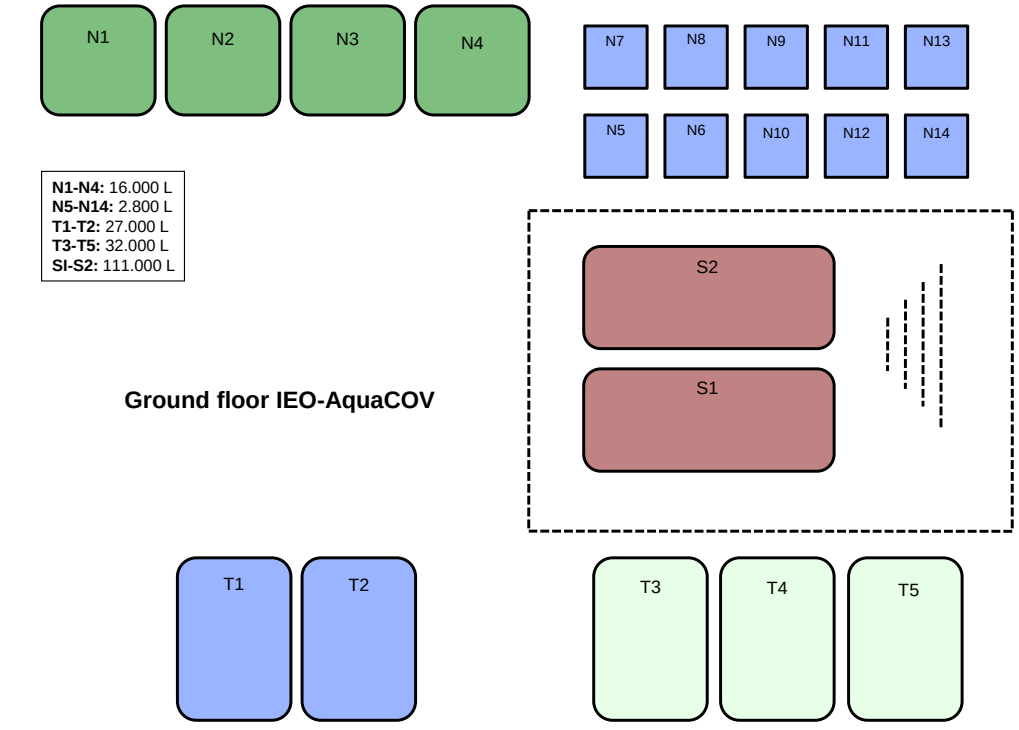
Diversification in aquaculture and animal husbandry are two fundamental elements in research at IEO-AquaCOV, as well as more specific aspects such as genetic and environmental factors in turbot and wreckfish sex determination, physiology and quality of triploid turbot, use of alternative diets in sea bream ongrowing, reproductive physiology of Senegalese sole, nutrition and molecular biology of the octopus, and mass production of phytoplankton in photobiorreactors. Genetic applied to aquaculture is an important issue strongly connected with all research lines all together working as a multidisciplinary team.

IEO-AquaCOV has an area of 1,950 m^2 comprising offices, labs and hatchery (tanks between 100 l -10,000 l) and ongrowing facilities (tanks between 1,000 l - 90,000 l) with a total volume of 550 m^3. The Marine Aquaculture Group from IEO-AquaCOV is a multidisciplinary team that currently consists of 4 Scientists, 2 Technicians R + D + i and 3 Assistants R & D & i.

Main floor IEO-AquaCOV:



Ground floor IEO-AquaCOV:



3.18.3.2 Services currently offered by the infrastructure

AquaCOV have dealt with genetics applied to aquaculture (molecular markers development, identification of species, traceability, genetic improvement, kinship analysis), use of alternative diets, reproductive physiology, nutrition and production of phytoplankton in PBRs. Each year on average 7 international research teams use our facilities.

IEO-AquaCOV is currently used as a research infrastructure by IEO scientific staff and other Spanish institutes and universities. It has also hosted many experiments from private companies.

3.18.3.3 Modality of access

Each visiting scientist will be linked to a local research group with expertise in the same or closest possible research field. Visitors planning to perform experiments in the IEO- AquaCOV facilities will provide an experimental plan for their work in collaboration with IEO researchers in the project.

As the standard procedures and the general maintenance will be carried out by trained and experienced staff, each user is expected to stay 10 days, typically 5 days at the beginning of the experiment to finalize the technical protocol details and start the experiment and 5 days at the end of the experiment for final measurements and sampling.

Access will comprise the use of tanks including maintenance, water supply, daily feeding and husbandry of fish; manipulation, and sampling of fish. Access to all dry laboratory facilities and other infrastructural, logistical, technical and scientific support to external users is offered, as well as access to internet, desk, fax and printing service, copy machine, etc. Users will be provided with any necessary technical assistance, training and advice on methodologies, experimental design and data analysis.

IEO-AquaCOV provides standardized experimental protocols, documentation of results, and appropriate sampling and conservation of samples.

3.18.3.4 Unit of Access

The unit of access is one week (7 days) per person. The typical access consists of 10 units. Unit of access is defined as one week during which a user is given access to IEO-MAP facilities to use a set of experimental tanks or biological labs. The unit of access will include the preparatory work of the experiment and the technical support during the project.

There are 20 units of access allocated to IEO-AquaCOV over the life of the project.

3.18.4 IEO-PAU

Location: Location: Santander, SPAIN

Web site address: http://www.ieo.es/santander

Contact: Inmaculada Rasines (inma.rasines@ieo.es)

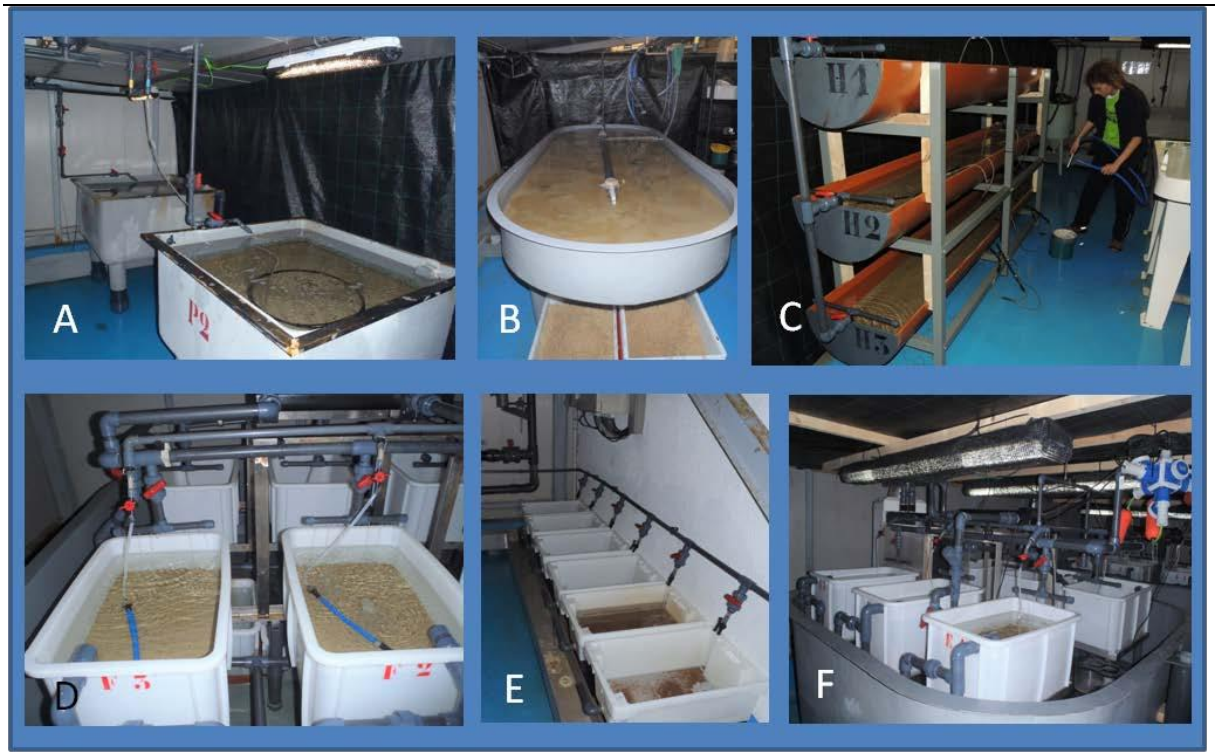
Hediste diversicolor (juvenile)

3.18.4.1 Facilities

IEO-PAU is an experimental unit for research on aquaculture of polychaetes located in the Santander Marine Aquaculture Plant (SMAP), a facility mainly devoted to flatfish aquaculture research. SMAP consists of a 3118 m^2 building, 2400 m^2 correspond to a wet area including the tanks, and 718 m^2 to dry and wet labs and offices. The facility has a seawater pumping system that produces a flow rate of up to 350 m^3/h and a water heating and temperature control system, it also includes food preparation room, refrigerators (4°C), freezers (-20 °C and -80 °C) and cryopreservation equipment.

PAU unit is an isolated culture room of 142 m^2 provided with air supply, filtered seawater, freshwater, temperature water control and photoperiod control. This facility include more than 24 m^2 of substrate for hosting worms in different types of tanks and farming systems: Nine tanks of 1 m^2 (Fig. A), one 3 m^2 raceway (Fig. B), three channels (1.5 m^2 / channel) superimposed (Fig. C), two sets with 6 culture trays of 0.18 m^2 (Fig. D), four RAS systems, each with 6 culture trays of 0.18 m^2 (Fig. F) and 8 shallow trays for larval culture of 0.16 m^2 (Fig. E), also sets of containers of 0.01m^2 are available. These types of tanks, which can be set with different sand layer/water column heights, allow the management and maintenance of the IEO-PAU polychaete stock and pilot and small-scale experimentation.

This facility has equipment for physicochemical control of water quality, biometric evaluation, and image analysis.



3.18.4.2 Services currently offered by the infrastructure

IEO-PAU allows experimentation in on all stages of polychaetes lifecycle (larva, juveniles and breeders), testing different zootechnical conditions and different sources of food, especially organic waste from various origins. Batches of *Hediste diversicolor* produced in captivity for several generations are available for experimental work. The research team can offer their expertise in management methods such as daily maintenance, transfer of individuals between different culture systems, samplings or harvesting adapted to the polychaete´s characteristics. So, technical assistance for sampling will be provided to all users.

3.18.4.3 Modality of access

IEO-PAU will carry out experiments for potential users and provide physical access to its facilities during crucial periods of the running experiments. As the standard procedures and the general maintenance will be carried out by trained and experienced staff, each user is expected to stay 10 days, typically 5 days at the beginning of the experiment to finalize the technical protocol details and start the experiment and 5 days at the end of the experiment for final measurements and sampling. Access will comprise the use of tanks including maintenance, water supply, daily feeding and husbandry, manipulation and sampling of polychaetes. Access to all dry laboratory facilities and other infrastructural, logistical, technical and scientific support to external users is offered, as well as access to internet, desk, fax and printing service, copy machine, etc. Users will be provided with any necessary technical assistance, training and advice on methodologies, experimental design and data analysis.

IEO-PAU provides standardized experimental protocols, documentation of results, and appropriate sampling and conservation of samples.

3.18.4.4 Unit of Access

The unit of access is one week (5 days) per person. The typical access consists of 10 units. Unit of access is defined as one week during which a user is given access to IEO-PAU facilities to use a set of experimental tanks or biological labs. The unit of access will include the preparatory work of the experiment and the technical support during the project.
There are 20 units of access allocated to IEO-PAU over the life of the project.

3.19 University of Torino (UNITO), Department of Agricultural, Forest and Food Sciences (DISAFA)

3.19.1 Introduction

The Department of Agricultural, Forest and Food Sciences (DISAFA) performs research to deliver knowledge and innovation, and provide evidence-based sustainable solutions to current and future challenges. DISAFA has a strong experience on animal husbandry and animal nutrition as well as on product quality.

In particular, in the fish nutrition sector, DISAFA researchers have a particular experience on the use of alternative protein sources (insect, poultry by-products and vegetable meals) and lipid sources in aquafeed and their effects on growth, digestibility, product quality, intestinal health, microbiota and metabolic responses of freshwater fish species.

Other expertise are related to the methods of fish slaughtering as well the effect of stocking densities on welfare of fish reared under organic aquaculture rules.

DISAFA offers two installations: 1) DISAFA-AQUA - fish nutrition platform, and 2) DISAFA-INSECTS - Insect rearing farm.

3.19.2 UNITO-DISAFA – AQUA (Fish nutrition farm)

Location: Carmagnola, ITALY

Web site address:
www.disafa.unito.it/do/home.pl/View?doc=/ricerca/centri_sperimentali/centro_di_agrozootecnia_tetto_frati.html

Contact: Laura Gasco (laura.gasco@unito.it)

3.19.2.1 Facilities

The DISAFA-AQUA is the experimental farm for aquaculture trials. The farms is mainly dedicated to rainbow trout (Oncorhynchus mykiss) nutritional trials (whole life cycle) but other freshwater species can also be reared (i.e sturgeons – *Acipeser baerii*, *A. trasmontanus*, *A. gueldenstaedtii*).

It offers three independent growing systems and one digestibility system. All systems are available for TNA.

Growing tanks system: includes twelve (3000L) indoor, twenty-one (100L) and twenty-four (400L) outdoor tanks. For all tanks, the water is provided by an artesian well water (constant temperature of 13 ± 1 °C all over the year) supplied in flow-through open system.

Digestibility system: two series of six cylindro-conical tanks (240L - flow-through open system) with automatic faeces collector (Choubert et al. 1982), recognized by EIFAC as the most valid method for in vivo evaluation of apparent digestibility coefficients (ADC) of diets and ingredients, and the estimation of suspended matter loss of dietary origin.

Two full-time permanent technical staff work on site. DISAFA-AQUA is located in Carmagnola, 25 km from Turin.

3.19.2.2 Services currently offered by the infrastructure

DISAFA-AQUA allows experimentation in on all stages from eggs to large trout but also growing trials using sturgeons. It hosts all UNITO research teams working on farmed salmonids (which can bring scientific support to visiting scientists) but also other research organizations or universities in Italy and Europe.

In addition to the above services, research laboratories are available at DISAFA headquarter (Grugliasco - about 25 km far from the experimental infrastructure). These laboratories have all the necessary analytical equipment for nutrition related work. In particular, laboratory facilities are equipped for proximate, chemical composition, mineral, HPLC, GC, histology and microbioma analyses to be carried out on feed and biological fish samples.

Another important aspect that could be evaluated at DISAFA-AQUA is how the feed influence the flesh quality when using potential alternative feedstuff. At the experimental farm a laboratory equipped with a vacuum machine, a bench colorimeter, a portable pH meter, a refrigerated chamber, and a -80°C fridge for sampling and storage of chilled and frozen samples is available to perform shelf-life trials. Moreover, at DISAFA headquarter other flesh quality parameters (texture, TPA and cooking losses) could be assessed in order to complete the panel of quality analysis. Sensory analyses can be performed using untrained panelist and results can be coupled with results of electronic nose.

3.19.2.3 Modality of access

Each user is expected to stay 10 days, typically 5 days at the beginning of the experiment to finalize the technical protocol details and start the experiment and 5 days at the end of the experiment for final measurements and sampling. The TNA access includes the use of tanks and the trial follow-up (daily feeding and husbandry of fish; manipulation, and sampling of fish). The whole trial is performed under the supervision of scientific staff and implemented by skilled technical staff. Scientific support will include advice on experimental design and methodology, documentation of results for all experiments conducted in the project and appropriate sampling and storage of samples.

TNA user will be strongly integrated in all processes, from trial set up to trial ongoing, sampling, data recording, due analyses and assessment, and preparation and dissemination of results.

3.19.2.4 Unit of Access

One unit of access for the DISAFA-AQUA is defined as one tank/week. One typical access consists of 144 units of access (12 tanks for 12 weeks: i.e. three (or four factors), in quadruplicate (or triplicate) during 12 weeks).

One unit of access includes: advice on experimental design, use of tanks (including fish supply and daily maintenance) and measurements, routine sampling and biometric measurements, conservation of samples, access to an office with internet communication. Fish feeds (not extruded) can be produced using the feed plant. Specific raw material should be provided by user.

3.19.3 UNITO-DISAFA-INSECTS (Insect rearing farm)

Location: Carmagnola, ITALY

Web site address:
www.disafa.unito.it/do/home.pl/View?doc=/ricerca/centri_sperimentali/centro_di_agrozootecnia_tetto_frati.html

Contact: Laura Gasco (laura.gasco@unito.it)

3.19.3.1 Facilities

DISAFA-INSECTS is the experimental facility for insect trials. The facility consists in 2 separated sectors: one for *Hermetia illucens* and one for *Tenebrio molitor*.

The *Hermetia illucens* sector is divided into (i) Reproduction room with controlled environmental conditions (Light, T°, RH) where the adult colony is maintained and eggs production performed. (ii) Hatching and weaning climatic chamber (2*1*2.5 m), where eggs hatch and the first 5-6 days of insect larvae growth is performed. The climatic chamber has controlled environmental conditions (T° and RH) that can be changed according to trial protocols. (iii) Larvae growing climatic chamber (2.9*6.5*2.9 m): where 6 days-old larvae are grown till the prepupae (o pupae) stage. The growing chamber has controlled environmental conditions (T°, ventilation, light) that can be set according to trial protocols.

The Tenebrio molitor sector consists in one room with controlled environmental conditions where both reproduction and growth are performed.

All sectors are available for TNA users.

DISAFA-INSECTS is located in Carmagnola, 25 km from Turin.

3.19.3.2 Services currently offered by the infrastructure

DISAFA-INSECTS is a unique experimental facility able to conduct trials using different rearing substrates for both *Hermetia illucens* and *Tenebrio molitor*, which are two of the most promising species for aquaculture feeds.

At the end of the rearing process, performed on different protocols, trout digestibility trials can be performed to assess nutrients digestibility of the insect meals produced.

In addition to the above, technical support for daily experimental work and technical help for samplings will be provided to all users. In case of specific needs, DISAFA scientists using the infrastructures can assist users for experimental design and data interpretation.

In the period when the visiting scientist is not at the facility the experiment will be followed by the technicians at DISAFA in close interaction with the visiting scientist. The visiting scientist can be updated about the experiment through skype calls or live web chat.

3.19.3.3 Modality of access

Depending on the insect species, each user is expected to stay:

• about 20 days, typically the average length of a full growing trial with *Hermetia illucens*;

• about 10 days, with *Tenebrio molitor*, typically 5 at the beginning of the experiment to finalize the technical protocol details and 5 days at the end of the experiment for final measurements and sampling.

The access includes the use of the facilities and the support of trained and experienced researchers. Skilled technical staff will carry out the day-to-day trial ongoing.

TNA user will be strongly integrated in all processes, from trial set up to trial ongoing, sampling, data recording, due analyses and assessment, and preparation and dissemination of results.

3.19.3.4 Unit of Access

One unit of access for the DISAFA-INSECTS is defined as one container-substrate and a typical access consists of 18 units of access (6 containers per 3 substrates).

One unit of access includes: insect larvae supply, substrate preparation, daily maintenance and measurements, routine sampling and biometric measurements, conservation of samples, access to an office with internet communication, larvae freeze-drying and analyses. Specific substrates should be provided by user.