Guide for Transnational Access

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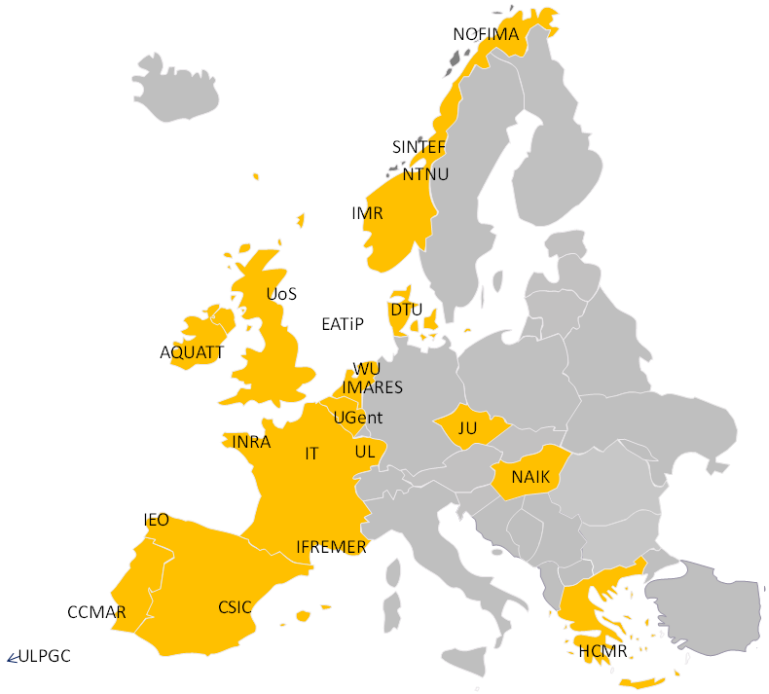
1 Introducing the AQUAEXCEL^{2020} Consortium of Research Infrastructures

The AQUAEXCEL^{2020} 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.

AQUAEXCEL^{2020} gathers partners who are leaders in the domains they are involved in within the project, and have multidisciplinary interest and expertise. They offer as a whole an unprecedented set of aquaculture research infrastructures covering all important species, rearing systems and environments (see Table 1 below).



AQUAEXCEL makes available 39 Research Installations provided by 19 partner organisations across Europe

Competences combined in AQUAEXCEL[2020] 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):

- Coldwater marine species (salmon, cod) in Norway and in the UK
- Temperate marine species (turbot, sole) in the Netherlands and France
- Coldwater freshwater species (trout) in France and the UK
- Mediterranean marine species (sea bass, sea bream) in Greece, Spain and France
- Temperate/warm freshwater species (common carp, sturgeon and many others) in Czech republic and Hungary
- Tropical species in recirculated systems (tilapia, catfish, shrimp) in the Netherlands, UK and Hungary

AQUAEXCEL2020 partners provide a unique set of world-class infrastructures, providing researchers with excellent facilities and support to set up the highest quality experimental protocols:

- The combined facilities of INRA are the largest research infrastructure for freshwater salmonids in the EU, with a collection of trout lines that has no equivalent at the world level (base populations, selected lines, isogenic lines)
- The facilities offered by IMR and Nofima in Norway are the best facilities to study the biology of Atlantic salmon and cod, the major species in Northern Europe, for which they leaders at the world level
- NTNU and SINTEF will give access to world class facilities for research, development and testing of aquaculture technology and engineering
- For recirculated systems, which are essential to develop for environment-friendly aquaculture, DLO-IMARES, WU and Nofima offer facilities specifically designed for the optimisation of such systems at several scales, allowing replication of systems – a very rare feature
- Mediterranean species are covered by a unique set of facilities, offering controlled rearing conditions (Ifremer Palavas, CSIC, ULPGC), cages (HCMR), larval rearing (Ifremer Brest), disease challenge testing (ULPGC), specialized facilities integrated with laboratories (HCMR, CSIC) and broodstock lines of sea bass (Ifremer) and sea bream (ULPGC)
- The two largest research stations for pond-reared temperate species in the EU (HAKI and VURH) will offer an outstanding combination of hatcheries, recirculated systems and ponds, with world level reference collections of common carp broodstock lines and sturgeons
- Multi-disciplinary research, across species and environments is offered by the University of Stirling, the leading international centre in aquaculture research and the largest of its kind in the world.

- Highly specialized units to study key aspects of fish biology, with unique set-ups at the world level, are available at WU (remote access to metabolic chambers with total control on water quality and fish behaviour) and Ugent (axenic culture of live prey and larval fish)

Table 1: Consortium main expertise

Infrastructure	Systems						Environments				Expertise								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/diseases	New species	NGS/genomics	Technology/systems	
INRA	x		x					x	x		x	x	x				x		Trout
IMR	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		salmon, cod, tilapia
CSIC			x	x			x			x	x		x		x		x		sea bream, sea bass, turbot
HCMR	x				x		x			x	x			x		x	x	x	sparids, sea bass
NAIK	x	x				x		x		x	x	x	x		x	x		x	carp, pikeperch
IFREMER	x	x	x	x			x			x	x	x		x				x	sea bass
NOFIMA			x	x	x		x	x	x		x	x	x	x		x	x	x	salmon, cod
JU	x	x		x		x		x		x		x	x			x			carp, sturgeon
NTNU		x	x	x			x		x		x		x	x		x		x	Salmon, cod, wrasse, lumpsucker
SINTEF		x	x	x	x		x	x	x		x			x				x	Salmon, cod
ULPGC	x	x		x			x			x	x	x			x	x			sea bream meagre, seriola
WU	x	x	x	x			x	x	x	x	x		x	x				x	tilapia, trout, carp, catfish, turbot, sole
UGent		x					x			x	x				x		x	x	Artemia
DLO-IMARES			x	x			x	x	x	x	x		x	x		x		x	Turbot, sole, eel, pikeperch
UL		x		x				x	x	x			x	x		x			Perch, pikeperch
DTU			x	x			x	x	x	x					x		x		Trout, turbot
CCMAR	x	x	x			x	x			x		x	x	x		x			Sole
IEO	x	x	x	x			x			x	x	x	x	x		x		x	Tuna, wreckfish, hake

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 AQUAEXCEL[2020] 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.

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.aquaexcel2020.eu). Applicants are also encouraged to directly contact individual facilities to discuss their research plans in advance of submitting an application.

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 Agendas of the European Aquaculture Technology and Innovation Platform (www.eatip.eu).

All Transnational Access projects must be carried out between October 2015 and October 2020. It is anticipated that individual Research Infrastructures will only be included in the three-monthly calls when units of access available. Please 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 (INRA)

3.1.1 Introduction

In this project, INRA, the main institute for agronomic research in France puts forward three 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) INRA St Pée Infrastructure which is a unique set of installations devoted to nutrition research in freshwater salmonids, 3) INRA-IERP (Fish Infectiology Platform) is the INRA experimental facility dedicated to fish infectiology. INRA 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 INRA-PEIMA

Name of the infrastructure: INRA-PEIMA (Pisciculture Expérimentale INRA des Monts d'Arrée)

Location: Sizun, FRANCE

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

Contact: Laurent Labbé (laurent.labbe@rennes.inra.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 INRA 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

- A recirculated water platform (10 tanks of 6 m^3) equipped with fecal-trap, with a filtration system (drum filter 30µ, UV) and a biological filter. This platform can operate in total or partial recirculation of water source or river.
- 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
- A wet laboratory for sampling and measurement of live fish
- An experimental processing/smoking unit with individual data acquisition on morphometry, yields, physiological & quality traits, and processing of samples for sensory evaluation.
- 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 fresh water 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 monosex 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.

INRA-PEIMA is currently used as a research infrastructure by several remote laboratories from INRA (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, INRA scientists using the infrastructures (genetics, nutrition, physiology, pathology) will assist users for experimental design and data interpretation.

3.1.2.3 Modality of access

INRA-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, monosex) 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, O2, CO2, pH), sanitary costs if needed (veterinary and treatment), sanitary safety, oxygen, etc...

3.1.3 INRA St Pée

Name of the infrastructure: INRA-STPEE

Location: Saint Pée sur Nivelle, FRANCE

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

Contact: Inge Geurden (inge.geurden@st-pee.inra.fr)

3.1.3.1 Facilities

INRA-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. INRA-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 for the production of 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 20m3 for studies with broodstock nutrition, 8 raceways of 12 to 20m^3 for studies with broodstock nutrition.

Platform 3: Specialised facilities

3.1 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.

3.2 Digestibility: In a recirculated temperature-controlled system, the system consists of 3 series of 6 cylindro-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

INRA-STPEE can undertake all types of nutrition research experiments on freshwater salmonids. It has been actively used in experiments from EU projects from the 5th to the 7th FP (PEPPA, RAFOA, GUTINTEGRITY, FINEFISH, AQUAMAX, PROMICROBE, ARRAINA).

An added strength to the experimental infrastructure is the proximity of research laboratories 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. INRA scientists will assist users for experimental design and data interpretation.

3.1.3.3 Modality of access

INRA-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.

INRA-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 INRA-IERP

Name of the infrastructure: INRA-IERP (Fish Infectiology Platform)

Location: Jouy-en-Josas, FRANCE

Web site address: http://www6.inra.fr/experimentation_sante_animale/Les-unites-experimentales

Contact: Bernard CAYRON (bernard.cayron@jouy.inra.fr)

3.1.4.1 Facilities

INRA-IERP is the INRA 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 (INRA reference strain) and isogenic lines from INRA-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 has 104 aquariums in recycled or flow-through water, 14 tanks of 300 l in recycling or in lost water. A number of animal genetic origin, age, route of inoculation, water quality, etc. are available.

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 FP7 I3 project NADIR.

Technical support for daily experimental work and technical help for samplings will be provided to all users. For specific needs, INRA 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 tanks 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.

3.2 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 both landbased (ELI) and cage-based (CEL) facilities in Matredal and disease research facilities (BDL) in Bergen.

IMR Matre 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 has 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).

AQUAEXCEL^{2020} 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 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 month 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.

3.2.2 IMR Matre - ELI

Name of the infrastructure: IMR Matre ELI

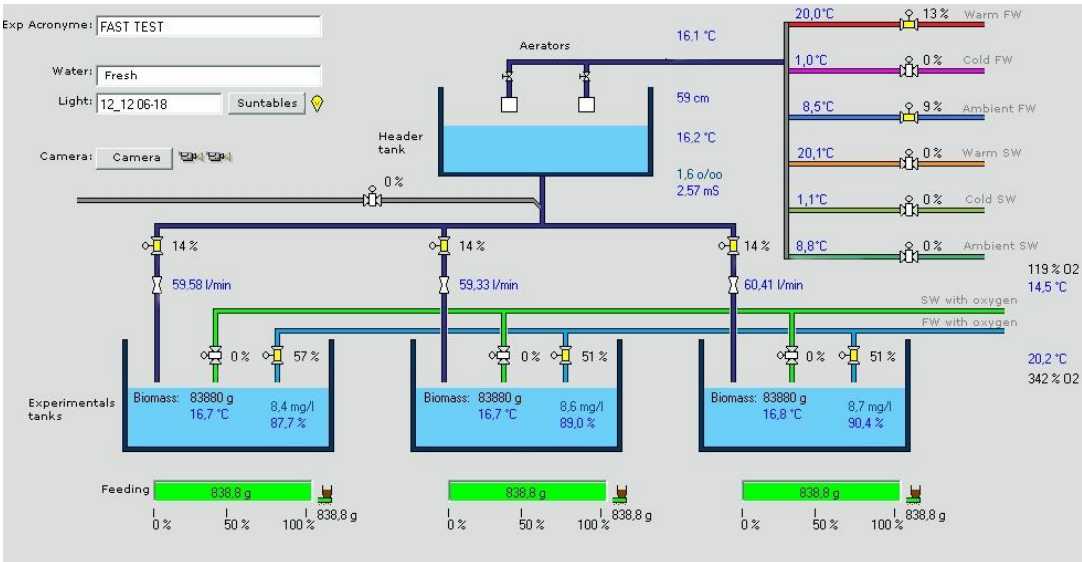
Location: Matredal Western Norway, 80 minutes drive north of Bergen

Web site address: www.imr.no

Contact: Øivind Torslett (oivindto@imr.no)

3.2.2.1 Facilities

The land based facilities at IMR Matre 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 (ELI) is excellent for studies on fish welfare, growth, reproduction, and flesh quality, involving experimental parameters like diet, ration and photoperiod, in salinities ranging from full 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 100cm diameter. The experimental parameters are controlled by computers and can be regulated to preset values, or set to follow daily or seasonal cycles.



A printout of the screen showing one of the computer controlled environmental laboratories (ELI). 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. The major goals of this research area is 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 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 facilities at Matre (ELI and CEL) 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 influences 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 against 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 has 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 AQUAEXCEL2020 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 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 AQUAEXCEL[2020] 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.

3.2.3 IMR Matre CEL

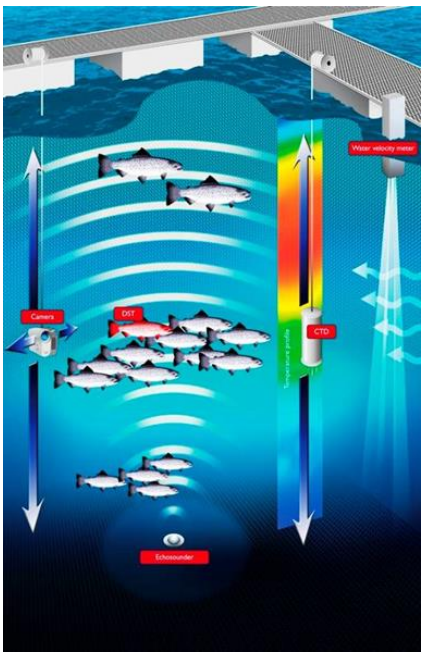
Name of the infrastructure: IMR Matre CEL

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

Web site address: www.imr.no

Contact: Øivind Torslett (oivindto@imr.no)

3.2.3.1 Facilities



IMR Matre also includes the Cage Environment Laboratory (CEL) which consists of 12x12m cages fully equipped with automatic computerized feeding. The Cage Environment Laboratory (CEL) is a specialised facility for behaviour and environmental studies. The equipment of this cage lab includes video cameras, echo sounders, continuous logging of T, S, O_2 and light intensity in all cages. On-farm studies of behaviour is a powerful tool to understand the needs and improve the welfare of caged fish. The Cage Environment Laboratory at Matre Research Station provides a unique international research platform for high-resolution studies of behavioural and physiological responses of free-swimming fish in a dynamic environment. The overall aim is improved management advice and farming protocols.

This cage facility is also excellent for feeding and photoperiod studies and can be used for species like Atlantic salmon, rainbow trout and Atlantic cod.

Schematic presentation of the Cage Environmental Laboratory. Echo sounders positioned under the cages observes swimming depth and fish density. Remotely operated cameras observe schooling behavior, social interactions and horizontal distribution. With the use of Data storage tags (DST) the swimming depth and body temperature experience of individual fish can be registered. Winch-mounted CTD's continuously profiles temperature, salinity, oxygen and light within and outside cages, while profiling current meters positioned at surface, measure water velocity with depth.

The CEL has been used to study the environmental preferences of salmon by operating Data Storage Tags into the body cavity of salmon and comparing the temperature and pressure (depth) data with the high resolution environmental data sampling from the monitoring system.

The CEL has also been used to study the feed intake, growth and behaviour of Atlantic salmon in a submerged cage system, and the effect of fish density on behaviour and vertical positioning in a highly stratified environment.

The present scientific activity at the facility is divided into four major research areas: Fish behaviour and welfare, growth and reproductive physiology, feeds, feeding and flesh quality and biological mechanisms.

3.2.3.2 Services currently offered by the infrastructure

See above description for IMR Matre Cell.

3.2.3.3 Modality of access

Visitor planning to perform experiments in the IMR Matre facility will provide an experimental plan for their work which will enable planning of activities in relation to other activities. The access includes support on experimental design and statistics, initiation of the experiment, daily feeding and husbandry and sampling. The access also includes advice on sampling, access to laboratories and advice and support on laboratory analysis. The support also includes full access to e-mail, internet, office facilities, computing library and chemical lab facilities. We can assist visiting scientists with accommodation nearby.

3.2.3.4 Unit of Access

The unit of access is cage.week with a total of 72 units of access available (1 project). A project on the CEL installation will have access to 6 cages (2 groups and 3 replicates) for 12 weeks. CEL cannot be followed live on the internet.

3.2.4 IMR Bergen Disease lab

Name of the infrastructure: IMR-BDL

Location: Bergen, NORWAY

Web site address: www.imr.no

Contact: Øivind Torslett (oivindto@imr.no)

3.2.4.1 Facilities

These facilities have a number of different tanks with a possibility for adjustments of salinity (0-35 ppt) and temperature (1-22°C). They specialized for challenge studies on fish and shellfish diseases and allow for customization of experimental parameters like diet, ration and salinities for fish sizes from first feeding fry up to approx 1-1.5 kg. IMR Bergen has access to the same fish stocks as IMR Matre, and disease studies can be carried out using enzootic agents on endemic species. The

facilities are approved and have been used for a range of species including salmonids, halibut and cod.

3.2.4.2 Services currently offered by the infrastructure

Bergen BDL is used in challenge experiments pharmacological studies (e.g. treatment, treatment effects, and pharmacokinetics).

Research is supported by modern physiological, histological, genomic and molecular analysis and a modern microbiology lab.

3.2.4.3 Modality of access

On average each user or user group is expected to stay at the infrastructure for the first and last two weeks of one experiment to start and finish the activity (totally 3 weeks). In the period when the visiting scientist is not at the facility the experiment will be followed by the technicians in close contact with the visiting scientist

3.2.4.4 Unit of Access

The unit of access is one tank week and a typical access consist of 108 units (9 tanks (3 groups x 3 replicates) for 12 weeks. A total of 108 units of access is available (1 project).

3.3 University of Stirling (UoS)

3.3.1 Introduction

Competences: The Institute of Aquaculture is a department of the University of Stirling 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, and aquaculture development and environmental management. The Institute has particular research interests in the development of isogenic lines and genetically defined families of fish as experimental tools.

3.3.2 Institute of Aquaculture

Name of the infrastructure: Institute of Aquaculture

Location Institute of Aquaculture and Buckieburn Research Facility (Stirling, Scotland), Machrihanish Marine Environmental Research Laboratory (Machrihanish, Argyll, Scotland).

These sites are very 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.

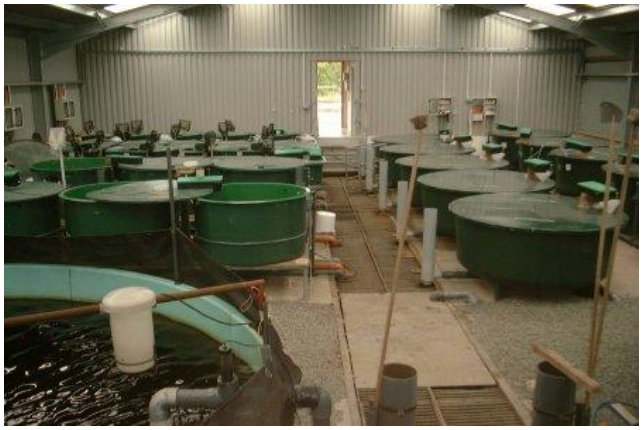
Web site address: www.aqua.stir.ac.uk & www.fishresearch.co.uk

Contact: David Penman (d.j.penman@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:



- Machrihanish Marine Environmental Laboratory is a marine facility containing ca 150 tanks providing 375m^2 experimental area. Tanks vary in size from 1-10m^2 and are suitable for research on all sizes of fish from fry to broodstock. There is a marine fish hatchery with live feed production and an isolation unit capable of experimental studies on EU – host 2 pathogens. Species held on site include salmon, cod and sea bass. There is a filtered sea water supply and temperature and photoperiod controlled systems are available. Machrihanish is suitable for research into fish reproduction, genetics, nutrition, physiology, larval rearing and fish health, including studies on vaccines and fish health.
- The Stirling campus offers a warm water facility containing genetically defined tilapia, catfish and Danio strains held in 20 self-contained warm-water recirculation systems; a self-contained chronobiology facility; and a freshwater disease challenge aquarium with ca. 150 tanks of 10-1600L volume, with temperature and lighting control, which is expressly designed for fish health research with EU list 2 pathogens.
- Close to the Stirling campus there is the freshwater Buckieburn Experimental Facility containing 216m^2 of tank space suitable for genetics, reproductive and nutritional studies on salmonids.

Experimental studies at these fish keeping facilities are supported by extensive laboratory and analytical facilities. A total of 1254m^2 of laboratory space is available allocated between four main research areas: fish health and welfare, genomics and reproduction, nutrition, and aquaculture development and environmental management. Available equipment includes fluorescent, confocal and electron microscopy, histology, culture facilities for viruses and bacteria, preparation of test vaccines including recombinant monoclonal antibody preparation, serology, in-situ hybridization, image analysis, gene cloning and sequencing, gel electrophoresis (including 2D gel), radioimmunoassay,

DNA microassays, large insert gene libraries, bioinformation capability, HPLC, gas and thin-layer chromatography, GC mass spectrometry, amino-acid analysis, high resolution desitometry, feed preparation, CHSNc analysis, AA spectrophotometry, and Coulter counter. There is also access to Illumina MiSeq Next Generation Sequencing.

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, challenge 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 younger, dynamic researchers, provides a very supportive and stimulating environment for visiting researchers. Notable achievements include: development of commercial and trial vaccines against fish pathogens; development of diagnostic reagents, chemotherapeutants and genetic probes against fish pathogens; selective improvement programmes based on genetic and genomic technologies; development of cloned lines of fish; improved polyunsaturated fatty acid nutrition of marine fish larval feeds and antioxidant protection; fish oil substitutions in salmonid diets; and evaluation of the mechanisms underlying the control of sexual maturation in salmonids and marine finfish. In collaboration with visiting scientists, Institute staff has a number of notable achievements across a range of research areas. These include:

- Successful development of commercial and trial vaccines against a number of fish pathogens
- Development of diagnostic reagents and genetic probes against fish pathogens
- Development of welfare indications for fish
- Development of chemotherapeutants
- Modelling of the fate of aquaculture effluents
- Genetic control of biotransformation enzyme systems
- Development of selective improvement programmes based on genetic markers
- Development of isogenic lines of fish species
- Evaluation of the mechanisms underlying the control of reproduction and smolting in salmonids and cod and their application in aquaculture
- Improved polyunsaturated fatty acid nutrition of marine fish larval feeds and antioxidant protection
- Fish oil substitutions in salmonid diets
- Application of GIS modelling for aquaculture development

The Institute plays host to a range of national and international visitors per annum who stay to carry out research for periods ranging from 5-90 days. All TNA from FP7-AQUAEXCEL was utilised.

3.3.2.3 Modality of access

Users will identify their own research projects and will be supported in carrying them out independently if they so wish. The senior scientists within each Institute of Aquaculture research group will, in discussion with applicants, determine whether the available facilities are appropriate 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, 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 full access to computing and office facilities, and will also be able to obtain use of all normal university central facilities. Users may be able to combine access to IOA with access to other infrastructures if this increases complementarity. 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 IHP programs, thus further developing networks of European researchers in aquaculture. In our experience the great majority of IHP visitors to the Institute have carried out research which has led to substantial publications in peer-reviewed journals. In addition visits often lead to further more extensive collaborations with Institute staff, thus promoting closer networking within the European research area.

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 attached to 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 most cases we have found that visiting scientists wish to undertake joint research with Institute staff and that this collaboration will often continue into the future thus promoting closer networking within the European research area. In our experience the great majority of visitors to the Institute have carried out research which has led to publications in international peer-reviewed journals.

The Institute has hosted many visiting scientists and is therefore experienced in providing support and assistance particularly to Early Career researchers. All visiting scientists are attached to a senior member of staff who assists them in developing their research and dealing with administrative matters. In general visitors will be invited to work in one of the five 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 that are unavailable in many other Institutions. With many existing programs in place we can attach visiting scientists to work alongside Institute staff with training skills in the required techniques as well as access to a wider network of collaborators. When the academic support and training, specialist fish holding facilities, defined fish strains, and well equipped modern laboratories focused on specific research themes are combined, the visiting scientist is getting a worldclass research experience moulded to their exact requirements.

Visiting researchers have full on-line access and other office facilities, including telephone, fax and photocopier. Visitors also have access to central university computing and library facilities. Visitors are encouraged to present seminars on their research and to participate in the Institute's ongoing program. Most institute and university facilities are available on a 7 day week basis, although some procedures may need to be restricted for safety reasons.

3.3.2.4 Unit of access

Unit of Access is defined as one person per week meaning giving access to the 150 tanks (size from 1-10m^2) at 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 freshwater Buckieburn Experimental Facility to carry out genetics, reproductive and nutritional studies on salmonids.

A typical project is 7 weeks for one person. Experience has shown that visits under previous the previous Infrastructure programs last from 2-13 weeks with an average length of 7 weeks. Visits have taken place across the whole 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) and a third located at the Instituto de Investigaciones Marinas (IIM-) (Vigo, Spain). IATS and IIM offer the use of experimental tanks (EXP) and IATS also offers 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 FP7-AQUAEXCEL. 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. IIMEXP in particular offers the possibility of infection/stimulation with several pathogens under biosecurity conditions; vaccination trials (live, attenuated and DNA vaccines).

Expected output/deliverables for users for the three installations: water parameters, biometrical data of fish, feeding and growth data, mortality records after challenges, vaccine efficacy records, gene expression studies, fish serum and tissue samples for RNA and cDNA for expression analysis, histological, pathological, biochemical/metabolic, genomic, functional biology studies, etc. The possibility of presenting an abstract for a conference and/or being involved in the writing of an article resulting from the project is highly envisaged.

Support offered under this proposal for the three installations: 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

Name of the infrastructure: Instituto de Acuicultura Torre de la Sal (IATS-EXP)

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: fish pathology (parasite and bacteria challenges), physiology, reproduction, nutrition and growth, live prey and larval rearing. Water quality (salinity, temperature, filtration, etc.) and light quality (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. Experimental studies can be conducted with a great variety of species: gilthead sea bream, European sea bass, sole, turbot, 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, with notable excellence in: Morphological and molecular diagnosis of marine fish parasites; Fish immune response and immunomodulation, Methodologies and skills in biochemistry, immunology, cellular and molecular biology to study and control fish reproduction, food intake and growth; Transgenesis using model species as a tool for gene expression and function; Artemia; Fish larviculture and nutritional enrichment of live preys. 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. More details can be found at the web page of the IATS library (http://www.iats.csic.es/biblioteca). 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

Name of the infrastructure: Instituto de Acuicultura Torre de la Sal (IATS-ANA)

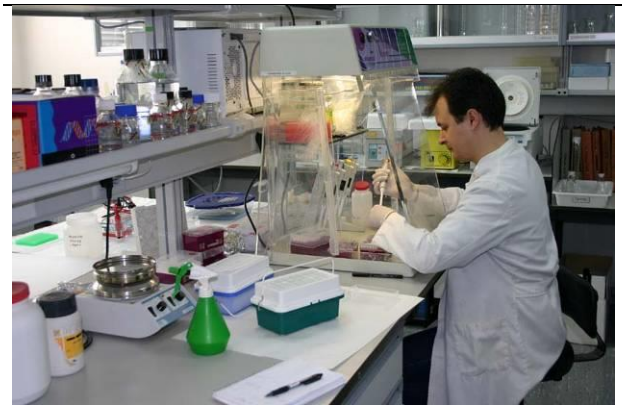
Location: Ribera de Cabanes, Castellón, Spain.

Web site address: www.iats.csic.es

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

3.4.3.1 Facilities

IATS-ANA: includes 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, in vitro cell and eukaryotic culture, isotopic assays, micromanipulation, etc. These methodologies are applied in the fields of: fish pathology, fish immunology, biogeography and biodiversity of Artemia, marine larviculture, live preys, ecotoxicology, fish nutrition and growth endocrinology, fish reproduction, molecular biology, genomics, biotechnology, neuroendocrinology and energy balance. Large scientific equipments include: liquid chromatographs (FPLC, HPLC), gas chromatographs (GC, GC-MS), spectrophotometers, fluorimeters, plate readers (absorbance, fluorescence, luminiscence), densitometer, gel and membrane image analysers (absorbance, fluorescence and quimioluminiscence), 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, 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 IIM-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 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, with notable excellence in: Morphological and molecular diagnosis of marine fish parasites; Fish immune response and immunomodulation, Methodologies and skills in biochemistry, immunology, cellular and molecular biology to study and control fish reproduction, food intake and growth; Transgenesis using model species as a tool for gene expression and function; Artemia; Fish larviculture and nutritional enrichment of live preys. 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.

3.4.4 CSIC IMM-EXP

Name of the infrastructure: Instituto de Investigaciones Marinas (IIM-EXP)

Location: Vigo, Spain.

Web site address: http://patologia.iim.csic.es

Contact: Beatriz Novoa García (virus@iim.csic.es)

3.4.4.1 Facilities

IIM-EXP: include 2 separate aquaria rooms, with temperature, photoperiod and water conditions regulated independently. Room 1 (challenge room), allows challenge of fish (turbot) with bacteria and virus. It is divided into 2 areas: In the inner room temperature can range between 15 and 35 ºC, photoperiod is set up at 12 h light/12 h darkness and aquaria have closed recirculation systems. In the outer room, temperature is set up at 15 ºC and photoperiod as in the interior room. Two types of water quality are provided: a) filtered (50 µm) sea water at 13 ºC-19 ºC); b 23 ºC; c) filtered (10 µm) and UV-sterilized sea water at 15 ºC. Room 2 (stabulation area) at 18-22 ºC, controlled photoperiod and the two same types of sea water. It has flat bottom 500 L-tanks and 10 L-tanks with open water circuit to maintain turbots.

3.4.4.2 Modality of access

On average each user or user group is expected to stay 2 weeks at the infrastructure. A project is estimated to include 2 weeks for infection/stimulation trials up to 12 weeks for vaccination assays. This modality of access includes the preparatory work of the experiment including acclimatization period of fish, the experiment, technical support for the samplings, and basic processing of samples. It will not include the shipment of samples obtained during the project.

3.4.4.3 Unit of access

These are weeks per person. It is defined as 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 between 2 and 12 units of access.

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-Souda

Name of the infrastructures: HCMR-Aqualabs-Souda

Location: Heraklion-Chania, GREECE

Web site address: www.hcmr.gr

Contact: Stavros Chatzifotis (stavros@her.hcmr.gr)

3.5.2.1 Facilities

The Institute of Aquaculture (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 AQUAEXCEL^{2020} 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

Name of the infrastructures: HCMR- Genomics-Bioinformatics

Location: Heraklion, GREECE

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

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 [454 FLX & Junior (Roche) and MiSeq (Illumina)], a capillary sequence analyzer ABI 3730xl (for DNA sequencing and genotyping), an arsenal of gradient and real-time PCR machines, a microarray scanner, a TaqMan OpenArray Genotyping System, 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.

Last, the institute operates a bioinformatics platform (BioCluster) with 13 worker nodes, 300 CPU cores, 2.5 TB RAM, 112 TB high performance storage (Lustre), 18 TB HA global storage (ZFS/NFS) /home, 40 Gbps Infiniband network.

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 National Agricultural Research and Innovation Centre (NAIK), Research Institute for Fisheries, Aquaculture and Irrigation (HAKI)

3.6.1 Introduction

HAKI is implementing a multidisciplinary research work, to provide scientific basis for the development of sustainable aquaculture and agriculture systems, and for the responsible use and protection of aquatic resources. The major fields of research are: aquatic ecology; fish genetics and immunology; fish feeding and nutrition, aquaculture systems and irrigation.

HAKI has a RAS unit, one flow-through system, one experimental pond farms and a system for disease challenge. The recirculation systems have 100 m^3 useful volume. The experimental pond station of HAKI is 5.8 ha, with pond's surfaces between 150 and 3000 m^2.

3.6.2 NAIK OEPS

Name of the infrastructure: Outdoor experimental pond station (OEPS)

Location: Szarvas, Hungary

Web site address: www.haki.hu

Contact: András Rónyai (ronyai@haki.hu)

3.6.2.1 Facilities

The facility consists of earthen ponds with the following distribution:

	area (m^2)
12 experimental pond	1,700
6 experimental pond	3,500
16 experimental pond	400-600
4 experimental pond	300
4 experimental pond	150
4 experimental pond	700
4 wetland pond	3,000

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 electrical supply for the artificial aeration and also equipped with aerators. Also there are possibilities for the experiments in "pond in pond" systems (including either 16 tanks of 10 m^3 each, or 18 cages with 9 m^3) installed in the ponds.

The OEPS is operated by a professional staff (5 persons). The pond system is suitable for experiments with different purposes (i.e. feeding tests, testing different rearing technology, management and technological elements; ecosystem modelling, etc.).

Besides the experimental ponds a constructed wetland system is also operating in the part of the experimental station. The open surface-flow wetland system is equipped with flow metres and electrical system. It is suitable to test wastewater treatment techniques and mechanism. The wetland system includes 4 pond units (among others 2 macrophyta covered ponds with *Typha and Phragmites*).

3.6.2.2 Services currently offered by the infrastructure

The facility is a pilot scale system, built for experimental purposes mainly for feeding and rearing experiments. It enables:

- Research trials on the applicability of different feed additives (immuno-stimulant, vitamins, amino-, and fatty acids, etc) and replacement of fish meal and oil in fish feeding.
- Testing eco-technological elements for water treatment
- Experiments about nutrient dynamics in pond ecosystems
- Development of integrated fish production systems
- Nutrient remediation experiments in wetlands and ponds

It provided research infrastructure for several national and EU funded grant (Eurocarp, Aquamax, SustainAqua etc.). The pond system in the last few years was used approximately 4-5 foreign users per year.

3.6.2.3 Modality of access

The pond system provides facility for the implementation of joint or independent research projects. The ponds operate from March till November, but it could be investigated in winter period on demand. The operation and sampling staff are available, the water and sediment laboratories are able to analyse samples all the year. The user or user group will have a full access to the ponds

belonging to the experimental work they plan. The work plan will be prepared before arriving to the institute to make sure that the users will be fully integrated into the scheduling of experiments. The users will be able to use feeding machines, aerators and all other equipment necessary for pond experiments. The fisherman of the institute will help them with the introduction, feeding and harvesting of the experimental fish. The users will work independently based on their workplan.

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 analyser, atomic absorption and ICP spectrometry) for water, sediment, soil, fish, plant, etc. analysis, as well.

3.6.2.4 Unit of Access

The unit of access is defined as 1 m^2/week; equaling the occupation of 1 m^2 pond surface for 7 days. One trial is expected to comprise 96 000 units of access on average (i.e. 16 pieces of 200 m2 to test 4 factors in quadruplicate, during 30 weeks or 8 pieces of 400 m^2 to test 2 factors in quadruplicate, during 30 weeks or another combination that will suit the external users). The duration of 1 trial in pond installation is estimated for 30 weeks (to utilize full potential of growing season for mass rearing of relatively slower growing freshwater fishes; for common garden experiments etc.) with a stay planned for weeks No. 1, 2, 29 and 30.

3.6.3 NAIK SDC

Name of the infrastructure: Indoor System for fish Disease Challenge (SDC)

Location: NAIK, HAKI, Szarvas, Hungary

Web site address: www.haki.hu

Contact: Galina Jeney (jeneyg@haki.hu)

3.6.3.1 Facilities

The SDC system is used for challenge tests with bacteria (*Aeromonas hydrophila*) Water volume is of 8 m^3. The system requires one month for being fully functional after starting. This system is flexible; fish keeping tanks can be replaced depending on size required. Water can be heated up to 30 °C and cooled. The system is mainly used for challenge and vaccination experiments, which require an experimental space separated from the other recirculation systems, where other experimental works have been carried out. In recent years, this system was used in national and international research projects (Eurocarp, Aquamax, Arraina, BARRA-09).

3.6.3.2 Services currently offered by the infrastructure

The facility is mainly used for challenge tests with bacteria *Aeromonas hydrophila*:

- Challenging (up to 100) half-, and full-sib families of common carp and other fish species to determine the most susceptible or resistant families to *A. hydrophila* bacteria
- Research trials on the effect of different feed additives (immuno-stimulant, vitamins, amino- and fatty acids, etc) and replacement of fish meal and oil in fish feeding on disease resistance

3.6.3.3 Modality of access

The infrastructural background is suitable for carrying out experiments in collaboration with our researchers or alone. In our system experiments can be realised with special needs such as special location or special equipment in the fields of immunology, genetics or nutrition etc. The institute ensures the user infrastructural base for the whole period of experiments e.g. laboratories, office with PC etc. for evaluations. As a result of these activities the new scientific results can be published in national or international journals and conferences. The typical user will prepare a working plan in advance to make sure that the planned research work can be adequately integrated into the schedule of this infrastructure. The typical experimental period vary between 4-12 weeks depending on the type of experiment and using experimental tanks for the research activities. During this period the user or user group will have full and access to the experimental tanks they use and work independently with the support of the institute's staff.

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

3.6.3.4 Unit of Access

The unit of access is defined as 1 m^3/week; equalling the occupation of 1 m^3 standard fish holding unit for 7 days. One trial is expected to comprise all units of access as a suggested minimum (i.e. 26 x 0.25 m^3 tanks for 12 weeks).

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 IFREMER PEARS

Name of the infrastructure: Palavas Experimental Aquaculture Research Station (PEARS)

Location: Palavas les Flots, South FRANCE

Web site address: www.ifremer.fr

Contact: Emmanuel Rezzouk (Emmanuel.Rezzouk@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:

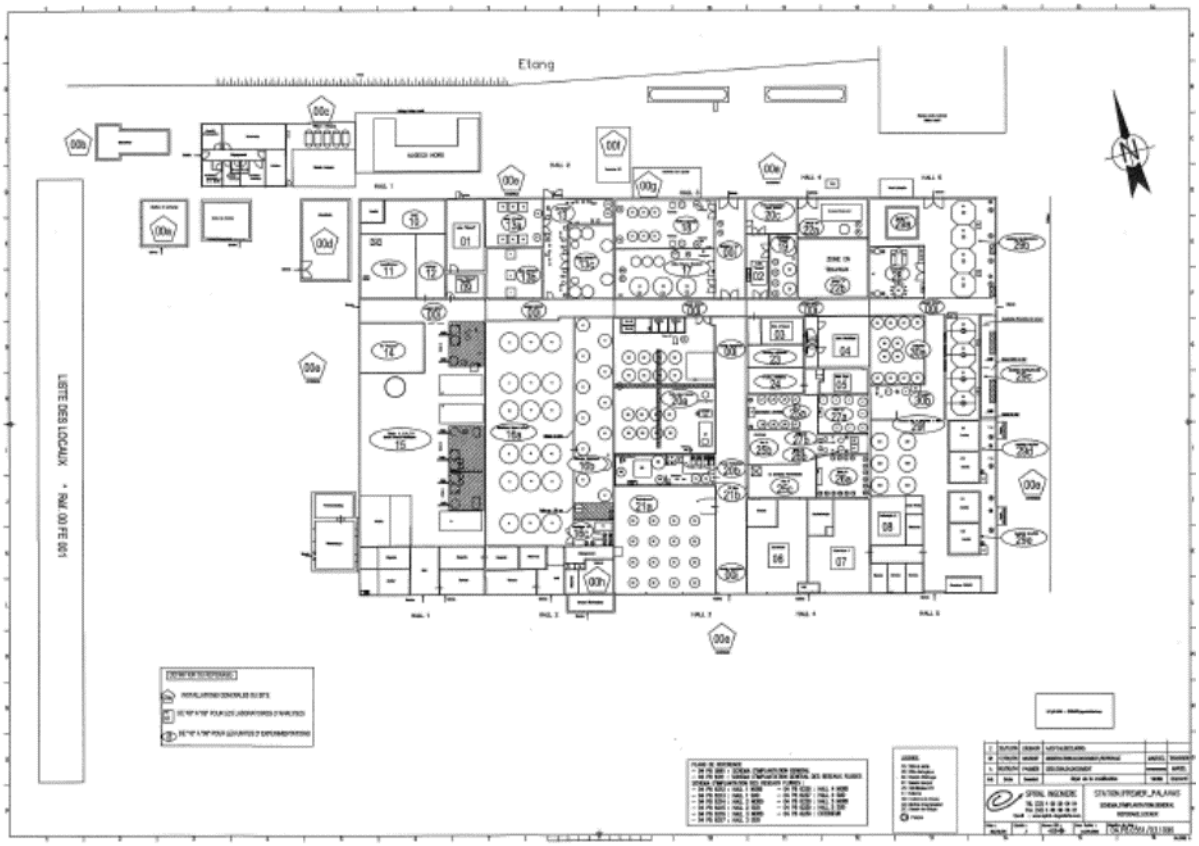
1-MES: Marine Ecotolerance Section. It includes 2 sets of 16 tanks of 1m^3 each,

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. 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.

3.7.2.3 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 (1.5m3) 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.

3.8 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, Averøy and Tromsø. For this project NOFIMA Centre for Recirculation in Aquaculture (NCRA) and NOFIMA Cleaner Fish Experimental Unit (CFU), both at the Research Station for sustainable aquaculture at Sunndalsøra, and the NOFIMA Next Generation Sequencing (NNGS) at Ås will be included. Sunndalsøra has inndor tanks with salmon, wrasse and lumpsucker on RAS and flow through. NNGS carries out research on methodology to characterize microbial communities.

3.8.2 Nofima NCRA

Name of the infrastructure: Nofima Centre for Recirculation in Aquaculture (NCRA)

Location: Sunndalsøra, Norway

Web site address: http://nofima.no/en/research-facilities/nofima-centre-for-recirculation-in-aquaculture/

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

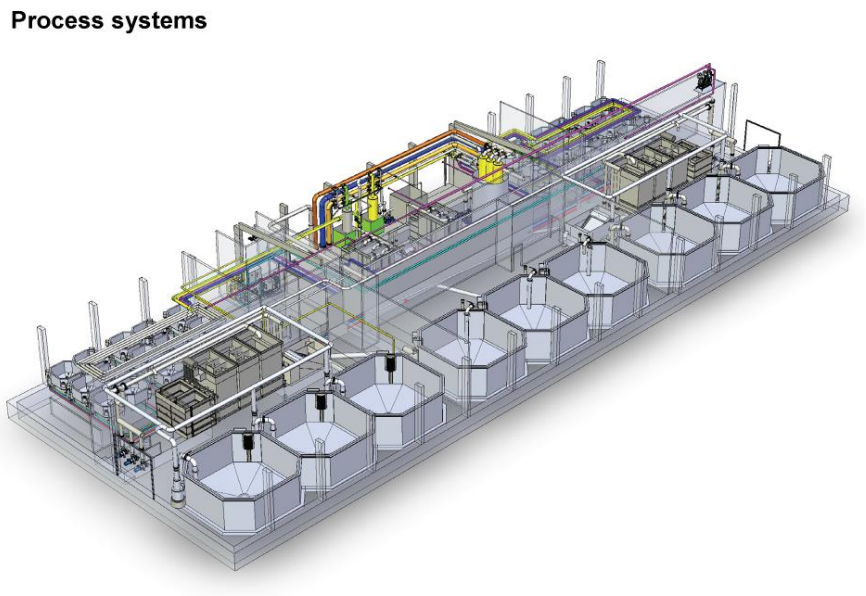
3.8.2.1 Facilities

Recirculating Aquaculture Systems (RAS) can provide good control of the water environment, sensible utilisation of water sources, less discharge of nutrients, and better protection against introduction of external pathogens. However, cold-water RAS for Atlantic salmon and Atlantic cod are little used in Europe, and many questions about water quality thresholds, growth, and fish welfare remains unanswered for this production form.

The Nofima Centre for Recirculation in Aquaculture (NCRA) carries out research on recirculation on a broad basis. Experiments in the areas of fish nutrition, physiology and welfare are central in this facility. This research facility is to the best of our knowledge unique due to:

- NCRA is designed for studies on physiological and nutritional requirements of fish in cold-water RAS
- NCRA is designed for studies across several scales, from small-scale to industrial scale; relevant data for European aquaculture industry can therefore be obtained
- Four research RAS for cold-water species using three-chambered moving bed bioreactors and ozone
- Flexibility of water sources for experiments; seven water qualities, recycled or single-pass, can be assigned to tanks for studies on water quality impact on e.g. fish performance
- Degree of control and monitoring using modern e-infrastructure
- NCRA offers possibilities for studies on innovative energy forms in aquaculture; A sustainable energy source for water and building heating, and possibly cooling, is installed in the form of waste heat water (+80°C) from nearby aluminium production.

The NCRA has a 1750 m² ground area, and a 2nd storey of 550 m². The centre features six experimental sections and has a total culture volume of 1100 m³. The facility has access to both freshwater (3 intake pipes, well and surface water) and seawater (intake from 40 m depth, microscreen and UV-filtered). Cooling water is taken from a nearby hydro power station or heat-pumps in other parts of Nofima Sunndalsøra.



Process research systems at NCRA. Only ground floor (1 750 m²) is shown.

Two experimental sections contain 15 separate 2 m tanks in each, and a third section has 18 pcs of 1 m diameter tanks. During experiments all these 48 tanks can use water from two separate medium-scale recirculating systems (RAS 1 and RAS 2), or two other water qualities in single-pass mode. These water qualities can be randomly assigned to individual tanks and sections. Further, three sections have each three 100 m³ tanks for experiments on a large, near-commercial scale. Two of these sections have separate RASs, while one section operates as single-pass. Feeding is fully

automatic and computer controlled, with tank level feeders in the three experimental sections, while the larger tanks have a pneumatic feeding system with rotor feed distributors. Light regimes in all six sections can be programmed in the case such factors are to be used in experiments.

3.8.2.2 Services currently offered by the infrastructure

The centre thus has four separate RAS, containing tanks with triple outlets (side, centre, and centre particle), which can be varied and thus invites studies on tank water velocity and turnover effects on the fish. Further, the systems contain particle collectors at tank level, ozone treatment, belt micro screens, moving bed bioreactors each with three chambers, counter-current CO_2 degassers with temperature control of the air, and pump sumps. Oxygenation is at tank level, thereby avoiding bias in experiments which can happen if only the main pipes are oxygenated.

The centre is controlled by two programmable logic controllers (PLCs). This enables continuous logging of research data, including pump status, water flow, temperature, oxygen, pH and ORP. The centre also has an autoanalyser for measurement of ammonia, nitrite, nitrate and total inorganic carbon.

The building is purpose-built for the research infrastructure with entrances, and below-ground level areas for easy access to pipe trenches. The centre has a viewing area on the second floor, which enables visitors and students to get an overview without crossing the hygiene barriers. In addition, the second floor has a 200 m² area for moving, sorting and sampling large quantities of experimental fish, and meeting and control room. Each of the six experimental sections and the water treatment room have sluices for contamination control. There are a total of five air ventilation systems, including a separate plant for heating or cooling of the intake air to the CO_2 degassers for all four RAS. In cases where infection is suspected, the ventilation plant may be shut off for individual sections.

This facility is newly constructed, and the numbers of users are therefore limited at the moment, although increases will occur soon. One international user (USA based), and two national users are affiliated with activities occurring in the facility. In addition, two trainees from Chile (PhD level), and a visiting PhD student funded by the Government of Spain, are currently working on Nofima projects in the centre.

This facility is integral to the Nofima Research Station for sustainable aquaculture at Sunndalsøra, which has a large national and international user base and is well known in the field world-wide. Significant break-throughs have been made in fish nutrition, fish welfare and quantitative genetics. In the last years, 9 national research institutes and 22 national aquaculture industry companies have been involved in projects. Internationally, 11 research institutions and 27 industry companies have been involved.

3.8.2.3 Modality of access

Visitor planning to perform experiments in the NCRA facility will provide an experimental plan for their work, preferably in collaboration with Nofima researchers in the project. This will enable planning of activities in relation to other NCRA activities. The visitors will, once they arrive, have the same access to the facility, equipment and technical support as any of the Nofima researchers already working in the facility.

NCRA will offer equipment, technical assistance, and collaboration with researchers to do experiments in many fields on Atlantic salmon, cod, and rainbow trout. Support will be given for the following type of research, but other types of research questions can also be considered: Fish nutrition related to RAS can be studied by using different feeds across several water qualities, to study if e.g. the fish adapt differently to challenging water quality according to nutritional status. Factors such as light-regime, temperature, water velocity, fish density etc. can be superimposed on the experimental designs. Alternatively, two feeds of differing physical qualities can be used in separate RAS, to study impacts on fish performance and welfare due to high or low fragmentation of pellets and faeces in the rearing water. The centre gives exceptional possibilities to study differences in fish performance when reared in either single-pass, RAS or RAS with different hydraulic retention times. Water quality thresholds, e.g. chronic or acute limits for ammonia or nitrite, can be determined in the section with smaller tanks. Most water quality limits for salmonids today have been established in a flow-through environment, but in this facility thresholds in a RAS environment can be found.

Support will also be offered for RAS courses and workshops for students, other researchers, or industry. The two medium scale RAS will give the students hands-on experience in how to establish and maintain optimal water quality. The building contains rooms that can be used for classes, where real time data from the different RAS may be shown.

Visitors and partners that come to NCRA 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. NCRA can also provide offices, meeting rooms, and access to housing.

3.8.2.4 Unit of Access

The unit of access at NCRA 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.

3.8.3 Nofima CFU

Name of the infrastructure: Nofima Cleaner Fish Experimental Unit (CFU)

Location: Sunndalsøra, Norway

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

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

3.8.3.1 Facilities

Cleaner fish experimental unit (CFU) has a license for holding ballan wrasse and lumpsucker. The tanks (3 x 6000l; 3x 3000l 4 x 1500l; 12 x 800l) 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.

3.8.3.2 Services currently offered by the infrastructure

CFU offers experiments on brood stock treatment on available fish, mechanical handling of eggs, growth performance experiments under different environments, feeding routines and standard feed (dry feed).

This facility is integral to the Nofima Research Station for Sustainable Aquaculture, which has a large national and international user base, and is well known in the field worldwide. Significant break-troughs have been made in fish nutrition, fish welfare and quantitative genetics. In the last years, 9 national research institutes and 22 national aquaculture industry companies have been involved in projects. Internationally, 11 research institutions and 27 industry companies have been involved.

3.8.3.3 Modality of access

The CFU offers access to the available facilities including fish material at the station and technical support. It includes associated facilities, water and daily routine maintenance (inspection of fish, automatic feeding, removal of dead fish, and registration of environmental data). CFU further offers equipment, technical assistance, and collaboration with researchers to do experiments in many fields on ballan wrasse and lumpsucker. The visitors will have to consider seasonal status of the fish and availability in cooperation with NOFIMA staff.

Visitor planning to perform experiments in the CFU facility will provide an experimental plan for their work, preferably in collaboration with Nofima researchers in the project. This will enable planning of activities in relation to other CFU activities. The visitors will, once they arrive, have the same access to the facility, equipment and technical support as any of the Nofima researchers already working in the facility.

Visitors and partners that come to CFU 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 Research Station for Sustainable Aquaculture at 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. The facility can also provide offices, meeting rooms, and access to housing.

3.8.3.4 Unit of Access

The unit of access at CFU is defined as one tank/week; equaling the occupation of one standard tank for seven days. Nofima uses actual cost method; it is an accurate and updated method to calculate the cost associated with the TNA.

3.8.4 NOFIMA NNGS-Microbiota

Name of the infrastructure: Next Generation Sequencing of Microbiota (NNGS-Microbiota)

Location: Ås, NORWAY

Web site address: http://nofima.no/en/forskningsomrade/food-safety-and-quality/molecular-analysis/

Contact: Ida Rud (ida.rud@nofima.no)

3.8.4.1 Facilities

NOFIMA Next Generation Sequencing of Microbiota (NNGS-Microbiota) carries out research on methodology to characterize microbial communities using next generation sequencing. The installation covers microbiota analysis of a wide range of different samples from the marine, food and health sector, including samples from RAS installations (NCRA) (biofilter biofilm, water, surfaces, fish skin and intestine) and also cod larvae (NCBC).

3.8.4.2 Services currently offered by the infrastructure

NNGS-Microbiota offers state-of-the-art analyses of microbiota from samples preferentially from the installations at NOFIMA. The methodology involves next-generation sequencing using the Illumina technology with an in-house MiSeq, and data processing using the software Quantitative Insight Into Microbial Ecology (QIIME). NNGS-Microbiota has been successfully used to analyse water and biofilm/biofilter samples from RAS and other aquaculture systems to follow the microbial ecology and their impact on water quality, salmon gut microbiota and fish health. Analytical services include bacterial DNA extraction, 16S rRNA amplicon sequencing (V4) on the MiSeq, followed by data

processing in QIIME. The expected output is diversity and taxonomic plots, including Excel files of all processed data.

3.8.4.3 Modality of access

Each user is expected to stay at the infrastructure following fish experiments at the NOFIMA installations, and on average the user will stay 2 weeks to perform microbiota analysis of one unit of access. The visitors will, once they arrive, have the same access to the facility, equipment and technical support as any of the NOFIMA researchers working in the facility. Degree of independency will depend on the experience of the visitor.

3.8.4.4 Unit of Access

The unit of access includes DNA extraction, pre-sequencing, sequencing and data processing of 40 samples.

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

Name of the infrastructure: Institute of Complex Systems

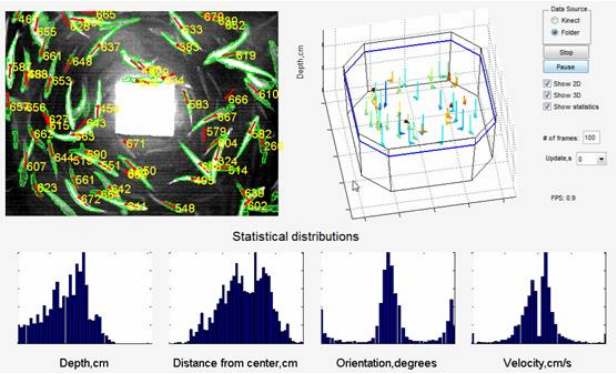
Location: Nové Hrady, Czech Republic

Web site address: http://www.frov.jcu.cz/en

Contact: Jiří Koleček (jkolecek@frov.jcu.cz), Petr Císař (cisar@frov.jcu.cz)

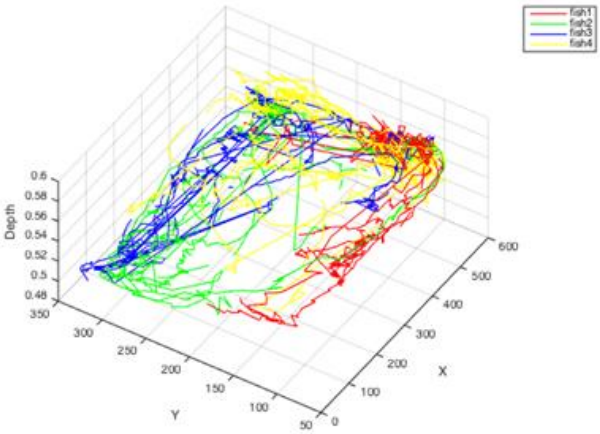
3.9.2.1 Facilities

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

Name of the infrastructure: Institute of Aquaculture and Protection of Waters

Location: České Budějovice, Czech Republic

Web site address: http://www.frov.jcu.cz/en

Contact: Jiří Koleček (jkolecek@frov.jcu.cz), 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.

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 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.

3.9.3.4 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

Name of the infrastructure: Intensive Freshwater Aquaculture Units

Location: Vodňany, Czech Republic

Web site address: http://www.frov.jcu.cz/en

Contact: Jiří Koleček (jkolecek@frov.jcu.cz), Tomáš Policar (policar@frov.jcu.cz)

3.9.4.1 Facilities

The Intensive Freshwater Aquaculture Units (IFA) includes three rooms for controlled environmental stimulation (temperature, light regime) of out-of-season or normal season reproduction. Each system has experimental RAS with total water volume 5 m^3 and 8 experimental tanks (each 350 litres). RAS for fish breeding - two separated RAS, each system with total water volume 20 m^3 and controlled temperature, light and oxygen conditions. Each RAS system has 10 experimental tanks with average volume 1.2 m^3 and can be used for different experiments related to intensive fish culture, feeding, optimization of cultured conditions etc., flow- through system supplied by river water – rectangular tanks (24 x 6 m^3 , 20 x 1,4 m^3) and circular tanks (3,6 m^3), 6 experimental ponds with average area 0.17 ha which can be used as control conditions for RAS or trough water system or for independent experiment related to juvenile and ongrowing culture under pond conditions. Laboratory 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 analyzer, analyzer of blood gases Radiometer ABL90 Flex, real-time PCR, PCR thermocycler, NanoDrop). Histological equipment (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.

3.9.4.2 Services currently offered by the infrastructure

Fish culture under RAS, through water system or ponds conditions, technical support and routine biological examinations for exact and precise experiments related to environmental stimulation of reproduction in fish broodstock, fish nutrition and feeding, optimization of fish husbandry, optimization of cultured conditions during juvenile and ongrowing phase. Laboratories enable to perform assessment of effects of xenobiotic and drugs on biochemical, chemical, hematological indices and histopathology in fish and crustaceans. Service/support of this infrastructure 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 2 weeks for 1 researcher.

On average each user or user group is expected to stay 14 days at the IFA (specific training related to intensive farming of high valuable fish or biological aspects of reproduction and culture of fish, preparatory work related experiment and set-up of experimental design, preparatory work in laboratory – treatment of samples, equipment calibration and measurement on analytic instrument).

3.9.5 JU – GRC

Name of the infrastructure: Laboratory of Fish Genetics and Reproduction and Hatchery

Location: Vodňany, Czech Republic

Web site address: http://www.frov.jcu.cz/en

Contact: Jiří Koleček (jkolecek@frov.jcu.cz), Vojtěch Kašpar (vkaspar@frov.jcu.cz)

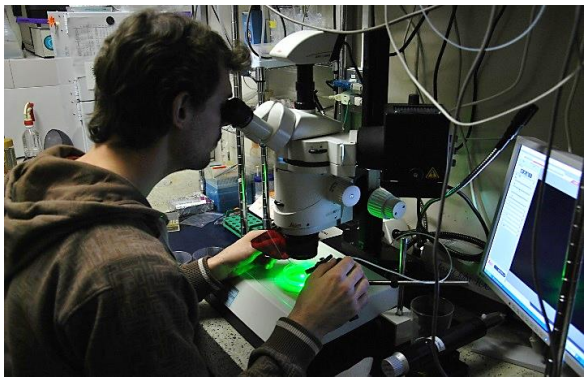
3.9.5.1 Facilities

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 Introduction

NTNU has been given the national responsibility for graduate engineering education. Through prioritizing 'Marine science and technology' as one of six focus areas for research, the university is encouraging the integration of knowledge from a wide range of engineering and bioscience disciplines. NTNUs special competence is related to open ocean cage systems, land based recycling systems, and hatchery technology and logistics.

The Centre for Aquaculture and Fisheries at Sealab was established in 2006 with hatchery and recycling aquaculture systems. Its laboratories are equipped with a wide variety of instruments, such as a spectrophotometer and a spectrofluorometer (both including temperature control and a microplate reader), a Gas Chromatographer, a HPLC, a coulter counter and an algae incubator. At the morphology lab one fluorescence microscope and one light microscope with a computer-assisted stereological toolbox for making 3D-calculations from histological sections, are available.

3.10.2 NTNU CodTech

Name of the infrastructure: NTNU CodTech

Location: Trondheim, Norway

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

Contact: Jan Ove Evjemo (jan.ove.evjemo@bio.ntnu.no)

3.10.2.1 Facilities

The new facilities of Centre of Fisheries and Aquaculture at NTNU were established in 2007 in order to stimulate interdisciplinary research and education in the fields of aquaculture and fisheries. The Centre houses laboratories for the cultivation of both marine and freshwater organisms under controlled conditions.

The automated start-feeding CodTech rig consists of 18 tanks of 160 l each. It is suitable for experiments on a wide range of freshwater and marine species, and the rig is especially designed for controlled experiments with pelagic fish larvae. Continuous 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. Environmental variables, such as temperature, light, dissolved oxygen, carbon dioxide, and nutrient concentration are monitored and controlled electronically. 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. In 2008, the laboratories were upgraded to an experimental facility with automatically controlled feeding, water exchange and light, and online measurements of live feed density. All tanks are equipped with underwater cameras for remote observation. This combination makes the facility one of the most advanced cultivation hatchery units in Europe.

3.10.2.2 Services currently offered by the infrastructure

NTNUs automated start-feeding rig provides a stimulating and integrated environment for applied research in the field of marine aquaculture technology, fish biology and environmentally related issues. It serves as a principal facility for the development of intensive methods for the production of marine fish larvae. There are well established laboratories for experimental studies of fish cultivation, developmental biology, larval rearing and live prey production, and well equipped laboratories for molecular analyses, histology, microbiology, and biochemistry.

The aquaculture research group has been pioneers 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 long experience in innovating and improving start feeding techniques related to the cultivation of marine fish species, in particular cod, halibut and cod, but also for more tropical species such as cobia and Asian sea bass. The group has published more than 400 scientific, refereed publications directly related to larval rearing, and more than 20 PhD- and 100 MSc-students have graduated in the field. A major expertise has been built up on the establishment of a stable tank environment, through the use of microalgae, reduction of opportunistic bacteria, and the stimulation of a balanced microflora, both in the fish gut and in the 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 continous lines of copepods (*Calanus finmarchicus* and *Acartia tonsa*). These organisms are considered to be 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, in order to provide fish larvae with requested nutritional contents according to experimental design.

Since establishment of the laboratory in 2007, a unique cooperation between the aquaculture group from the Department of Biology, Department of Biotechnology, and the Department of Engineering

Cybernetics has resulted in significant contributions in the application of control engineering on the marine larviculture process (especially through the recent large strategic research programme CODTECH, funded by the Norwegian Research Council, 2003-2007). These include automatic live feed monitoring equipment, full appetite controlled feeding, and a model based system for estimating larval density from live feed dynamics. The automated start-feeding rig serves as a showcase for these technologies, and offers an experimental environment where more advanced research both on biological and technological aspects of the rearing process can be performed.

An upgrading of the CodTech facilities, including testing and calibration of its monitoring instruments and control equipment has only recently been finalised. Hence, there is no track record yet of its annual use by external users. Still, the start feeding rig is planned to be used for training of students within engineering, biology and microbiology at PhD and MSc levels. The NTNU "International Master Programme in Marine Coastal Development" offers aquaculture studies, where several students already have used the CodTech facility in their MSc thesis projects. Since the first publications and conference presentations about the CodTech system, several external research groups have expressed interest in collaborating through use of the new technological systems.

3.10.2.3 Modality of access

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 Trondheim to have a first discussion on experimental set-up combined with a visit to the premises, 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 or larvae, 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. All group members will be offered a work space, from where they will have access to all necessary office amenities, such as telephone, internet, copy and printing services. In addition, they will be given the possibility to access laboratory space where the results can be analysed. A project will 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.

We anticipate having 3 projects, with duration of 7 weeks each, adding up to 21 weeks in total. 40 days for the experiment and 1 extra week for preparation/analysis.

The Codtech facilities are organised under the NTNU focus area "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:

Scientific support: With marine larval technology and engineering at the centre of research, a wide range of disciplines is represented. The scientific staff involved in the ongoing interdisciplinary research and education activities consists of professors, post-doctoral and senior researchers 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 systems, temperature, water quality, water exchange rate according to experimental design. Supply of live prey organisms (enriched), microalgae necessary for optimal larval conditions 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, which has 40 furnished and fully equipped apartments and guesthouses allocated for guest researchers.

3.10.2.4 Unit of Access

The unit of access is one week meaning the occupation of the automated start-feeding CodTech rig - which consists of 18 tanks of 160 l each- during five days.

3.10.3 NTNU MCLab

Name of the infrastructure: NTNU McLab

Location: Trondheim, Norway

Web site address: http://www.ntnu.edu/imt/lab/cybernetics

Contact: Sverre Steen (sverre.steen@ntnu.no)

3.10.3.1 Facilities

The marine cybernetics laboratory is a small wave basin (L x B x D = 40m x 6.45m x 1.5m), located in what was originally a storage tank for ship models made of paraffin wax. It is equipped with a wave maker, an advanced wave maker for generating long-crested surface waves, and a current generation system. It is equipped with an advanced towing carriage, with a 6-DoF forced motion apparatus. The lab is also equipped with Qualisys motion capture systems, both above-water and below-water. More details of equipment and capacities are found at http://www.ntnu.edu/imt/lab/cybernetics

The basin is filled with fresh water, with some chlorine for control of algae growth. The basin is not intended for use with living organisms.

As a generic towing tank and wave basin, it is suited for testing of scale-models of many types of ocean structures. Many scale-model tests of aquaculture plants (fish cages mostly) have been tested.

The MC-lab is operated by the Department of Marine Technology https://www.ntnu.edu/imt/

3.10.3.2 Services currently offered by the infrastructure

We offer use of the laboratory, including control room, towing carriage, and use of instrumentation from our stock. If additional instruments are needed, the user will have to bring them or buy them. We also offer assistance by a technician to help setting up the experiment and give instructions on use of lab and instrumentation. Construction of model, test objects and custom test rigs are not part of the access, but the host might assist in having them made, at additional cost.

3.10.3.3 Modality of access

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 Trondheim to have a first discussion on experimental set-up combined with a visit to the premises, in advance of the start of the project. The group leader must provide a plan for the tests, including required instrumentation and description of test objects (models) well ahead of the planned start of the tests.

Scientific support: Department of Marine Technology has a large permanent academic staff, as well as more than 100 PhD and post doc researchers working in the department. Depending on the particular project, the visiting researchers will be set in contact with experts in the relevant fields.

Technical support: We have two engineers, one mechanic and one CAD operator/carpenter working in connection with the hydrodynamic laboratories, where MCLab is one of several test basins. Users will be supported by an experienced engineer.

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, which has 40 furnished and fully equipped apartments and guesthouses allocated for guest researchers.

3.10.3.4 Unit of Access

The unit of access is defined as one week. One typical access consists of 1-2 units of access.

The unit of access includes the effort in offering scientific, technical and logistic support to the users. This involves equipping the facility, technical assistance during preparations before occupying the lab, as well as technical assistance during the tests in the lab. However, it is pointed out that we don't offer continuous presence of technician during the test – the visiting scientists must be able to run the lab and experiment themselves, after having received required instructions and training.

Manufacture of test objects (models) and purpose-built test rigs, as well as instrumentation that need to be acquired for this specific test are not included. All the mentioned items can be arranged by the host institution, but at additional cost.

3.11 SINTEF Fiskeri og havbruk 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, organise and operate the large scale infrastructure specialised for serving RTDI on technology used in sea based aquaculture (within a licence of production of 2340 t salmon).

SINTEF offers two unique installations: 1) SeaLab SSO – Facility for Surveillance, Simulation and Operation (e-infrastructure for R&D within marine disciplines that enables connection of different infrastructures); and 2) ACE Facility for large scale testing of solutions for seabased aquaculture: 2 sites with industrial scaled salmon farms having up to 900.000 salmon kept in 4–6 circle cages (120m/157m in circumference and 12m/15m deep) at each farm, and in addition one environmental buoy and one welfare meter logging environmental conditions at each salmon site.

3.11.2 SINTEF ACE

Name of the infrastructure: SINTEF ACE (SINTEF Aquaculture Engineering)

Location: Trondheim, Norway and industry scale salmon farming sites on the coast of Mid-Norway

Web site address: www.sintef.no/fish

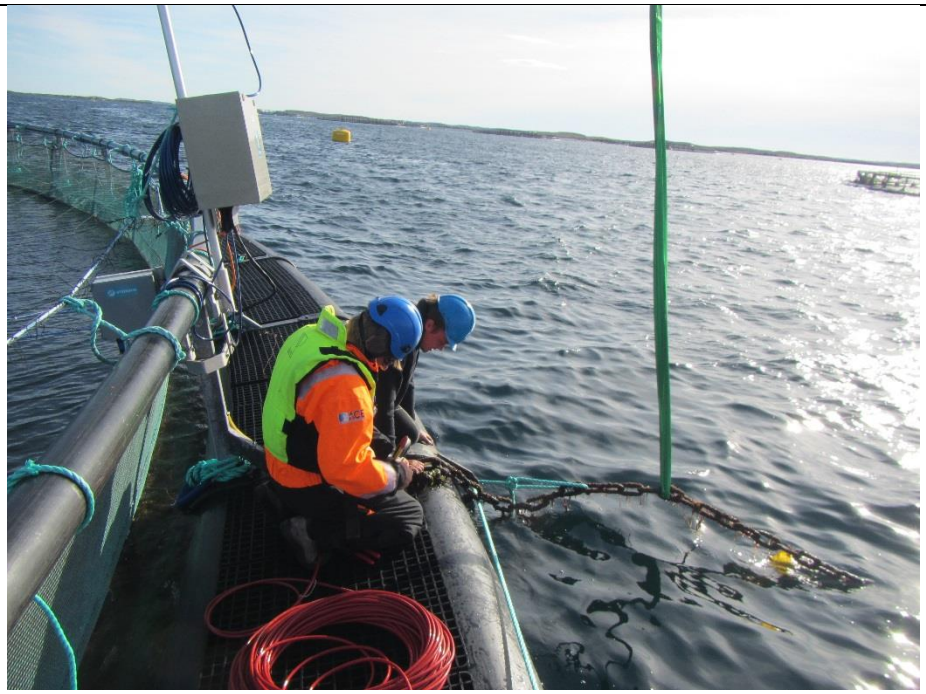
Contact: Gunnar Senneset (gunnar.senneset@sintef.no)

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 salmon production, and this allows the offering of 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 in 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 outside 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

In order to meet industrial requirements, and to facilitate the implementation of scientific results, full-scale test facilities are needed. This will bridge the gap in the development circle between laboratory scale experiments and the application of new scientific knowledge in an industrial production. SINTEF ACE merges knowledge and technology from a wide range of disciplines into a single large-scale environment, adding the necessary operation, management and engineering aspects in order to put the results into a realistic context that is relevant for its application. The need for such services is confirmed by growing interest from education, research and industry. The current services are focused on industry scale salmon farming and on facilities for testing sea-based aquaculture technology. Technical personnel, scientists and equipment is 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. Equipment and personnel is available for sampling of fish, and facilities and support is offered for analysis of samples (lipids, proteins, DNA, microbiology).

3.11.2.3 Modality of access

Depending on the project requirements, four sites in different stages of the production cycles and different degrees of exposure (waves, currents) can be used. The smolt used in each cycle will have a documented genetic background, and low variance in treatment and handling. The sites/cages are equipped with sensors for continuous measurements for documentation of environmental conditions (oxygen, temperature, salinity, currents etc). 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 communications interfaces for remote monitoring and data transfer via SINTEF SeaLab. Reference

measurements are supplied by an environmental monitoring buoy, also accessible through SINTEF SeaLab.

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 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 done 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 will be analyzed 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 each of 7.5 hours for up to 2 persons.

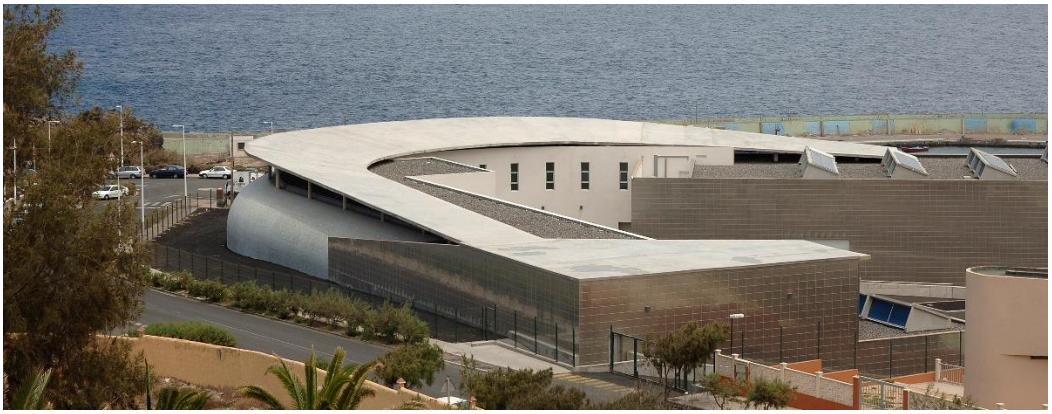
3.12 Universidad de Las Palmas de Gran Canaria (ULPGC)

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

Name of the infrastructure: Warm Water Species Selection Unit (WWSSU)

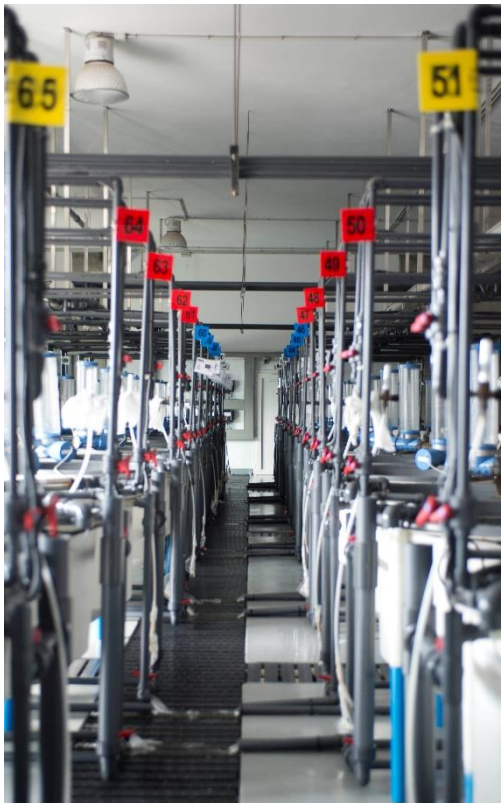
Location: Las Palmas, Spain

Web site address: www.grupoinvestigacionacuicultura.org

Contact: Juan Manuel Afonso Lopéz (juanmanuel.afonso@ulpgc.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

Name of the infrastructure: Marine Bioassays Station (MBS)

Location: Las Palmas, Spain

Web site address: www.grupoinvestigacionacuicultura.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 during 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

Name of the infrastructure: Feed Ingredients-additives Testing Unit (FITU)

Location: Las Palmas, Spain

Web site address: www.grupoinvestigacionacuicultura.org

Contact: Marisol Izquierdo López (marisol.izquierdo@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 during 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 a 30 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 with 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

Name of the infrastructure: The Metabolic Research Unit (WU-MRU)

Location: Wageningen, The Netherlands

Web site address: www.afi.wur.nl

Contact: Menno Ter Veld (Menno.terVeld@wur.nl)

3.13.2.1 Facilities

The WU-research infrastructures are located 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: http://www.wageningenur.nl/en/show/aquaexcel-1.htm

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 or a combination) 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 AQUAEXCEL2020, the WU-MRU infrastructure will receive three projects of 3 months each during the project duration, thus 3*8=24 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) 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

Name of the infrastructure: Six Replicated Recirculating Aquaculture Systems (WU-RAS)

Location: Wageningen, The Netherlands

Web site address: www.afi.wur.nl

Contact: Menno Ter Veld (Menno.terVeld@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 affect water quality, water treatment unit performance, waste production and waste discharge (system level, WU-RAS). Fish species used in research are: rainbow trout, Nile tilapia, European eel, African catfish, Inbred and outbred lines of common carp, seabass, turbot, sole and yellow tail.

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. Sixteen (16) remote access cameras are available for recording of fish behaviour. 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 AQUAEXCEL2020, 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 University of Ghent (UGent)

3.14.1 Introduction

The Laboratory of Aquaculture & Artemia Reference Center (ARC) has been involved in larviculture research since the late 70's. Since the mid 80's research activities extended to fish & shellfish larviculture-related fields a.o. lipid and vitamin requirements, microbial management in larviculture systems, microorganism (bacteria, yeast, micro-algae)-fish larvae interactions, egg and larvae quality, use of enriched Brachionus and Artemia, effects of immunostimulants and other compounds on disease and stress resistance.

3.14.2 UGent ART

Name of the infrastructure: Gene expression in gnotobiotic Artemia (ART)

Location: Gent, Belgium

Website address: http://www.aquaculture.ugent.be/index.htm

Contact: Kristof Dierckens (kristof.dierckens@UGent.be)

3.14.2.1 Facilities

Gnotobiotic systems (set ups without bacteria or with known bacterial communities) are especially interesting, because biases caused by the unknown/variable microbiota in cultures of Artemia are eliminated. There are standard challenge tests with *Vibrio campbellii* (and quorum-sensing mutants), *V. harveyi* and *V. parahaemolyticus*. The set-up can be used to study host-microbial interactions, quorum sensing regulated mechanisms, the effect of microorganisms (probiotic bacteria, yeasts, algae) or feed components (glucan, heat shock proteins, poly-β-hydroxybutyrate) on resistance to challenge, gastro-intestinal morphology and gene expression especially immunology related genes. RT-PCR protocols for 10 immune related genes are available.

The Lab of Aquaculture & Artemia Reference Center is the only aquaculture lab in Europe that has a platform of 10 immune related genes of Artemia available for research.

3.14.2.2 Services currently offered by the infrastructure

The set-up is currently used to study quorum sensing regulation of virulence of Vibrio spp., the effect of microorganisms on the development of the intestinal tract, the application of anti-infective feed components (heat shock proteins, poly-β-hydroxybutyrate (PHB) and PHB-containing bacteria). The system was used in collaborative studies with groups from Belgium (T. Coenye, Ghent University), USA (T. Wood, Texas A&M University), Canada (E. Meighen, McGill University and T. MacRae, Dalhousie University) and India (Indrani Karunasagar, UNESCO MIRCEN for Marine Biotechnology).

This set-up has been used in seven PhD studies and is currently used in 10 aquaculture related PhD studies and by 2 post-doc research fellows and has led to 40 A1-publications.The set-up can be used to study host-microbial interactions, quorum sensing-regulated mechanisms, testing probiotic bacteria, testing the effect of microorganisms (bacteria, yeasts, algae) or feed components (glucan, heat shock proteins, poly-β-hydroxybutyrate) on resistance to challenge, gastro-intestinal

morphology and development of larvae (gastro-intestinal, cranial,...) deformities, gene transcription, immunological essays. It can also be used to verify phenotypic differences in larvae of seabass lines towards a *Vibrio anguillarum* challenge. The set-up can be used to run the experiments and gather samples. Analysis of these samples might need the input of visitor's laboratories, depending on the specific interest.

3.14.2.3 Modality of access

On average each user or user group is expected to stay 60 days at the infrastructure. Access is easy as Artemia is available year-round and can be arranged for on a short term basis. Typically, under local guidance a visitor can acquire the necessary skills to obtain bacteria-free Artemia, gather samples and learn to use the Artemia genome data base in one month and can perform his/her experiments in the following month. The goal and the specific experiment will be discussed with the UGent scientist during the application and during the stay of the user. Analyses of the samples need to happen at the Lab of Aquaculture & Artemia Reference Center.

The user will discuss together with a post-doc level researcher the experiment protocol, treatments and sampling points. The user learns the methods to obtain axenic Artemia and verify axenity from an experienced skilled technician runs the experiment together with a technician under the supervision of the researcher. qPCR is provided of 10 different immune markers to analyze the samples. A report is made together with the researcher for dissemination of the results.

3.14.2.4 Unit of Access

The access will comprise the use of the gnotobiotic Artemia system. A unit of access is defined as one month x 60 vials. One typical access consists of 2 units of access. A typical experiment will have a control + 2 Treatments with or without challenge. This results in 6 treatments at 10 replicates each = 60 vials). However, the user may want to have more treatments in 1 experiment. The set up can be adjusted according to the design of the experiment.

3.15 DLO-Wageningen Livestock Research (DLO-WLR)

3.15.1 Introduction

Wageningen UR Livestock Research (DLO-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 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.

Within Aquaexcel^{2020}, independent units for research on RAS engineering and RAS operation are provided. DLO-WLR has at its deposition independent units for research on fish performance, suited for experiments with all types of species (freshwater and marine) in larval, juvenile or grow-out

phase: a swim carousel and several RAS with various options on the number and size of the tanks, depending on the proposition of the TNA user. All systems are equipped with mechanical and bio-filtration units. In addition filter modules can be exchanged to meet the specific needs of the end-user, such as UV disinfection, ozone treatment, up-flow filtration and denitrification.

3.15.2 DLO-WLR

Name of the infrastructure: Recirculation facilities of DLO-WLR

Location: Wageningen, The Netherlands

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

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

3.15.2.1 Facilities

The Recirculation facilities enable research on RAS engineering and RAS operation. The unit for RAS Research offers two sets of research infrastructure:

1. Six pilot scale RAS either for cold, warm, fresh or marine studies; up to 3 m³ and 1.5 kg feed per day; to replicate treatments on system level

2. A 3600 L swim carousel with a motor driven propeller reaching speeds up to 1.2 m/s which can be applied for simulated migrations, exercise training and critical swimming speed tests.

3.15.2.2 Services currently offered by the infrastructure

The recirculation facility service aquaculture researcher uniquely as they offer the:

- Ability to test in identical and truly independent RAS at system level (system as experimental unit) effects of nutritional factors (nutrient composition, feed technology), environmental factors (pH, O_2, alkalinity, temperature, salinity etcetera) and management factors (stocking density, sex ratio, genotype etc.).
- Choice out of different RAS configurations and tank composition (volumes, flows, tank replicates) based on the experimental objectives (e.g. drum filter filtration or sedimentation; comparison real flow through versus RAS) allowing for the most economical set-up.
- Comparison of flow through with recirculation on pilot scale at different temperatures
- A tool for simulated migrations, exercise training and critical swimming speed tests.

3.15.2.3 Modality of access

Users will be given access to the facilities based on the common procedures of DLO-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 DLO-WLR. Users will have access by directly staying at the facilities and being integrated in the scientific atmosphere at DLO-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 DLO-WLR and national animal protection laws are followed. TNA guests will be granted with internet access to the scientific literature and databases of DLO-WLR and other e-infrastructure and labs. The in RAS experiments 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.

3.15.2.4 Unit of Access

The unit of access is defined as 1 system-week; equalling the occupation of 1 RAS 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 or RAS).

3.16 University of Lorraine (UL)

3.16.1 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 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.

3.16.2 UL (URAFPA-DAC team)

Name of the infrastructures: EPA (Experimental Platform in Aquaculture)

Location: Vandoeuvre les Nancy (France)

Web site address: www.urafpa.fr

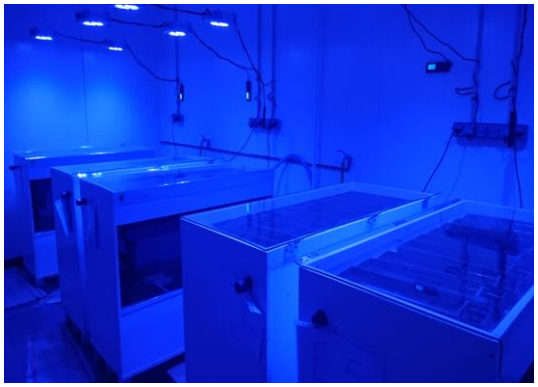
Contact: Pascal Fontaine, Sylvain Milla (p.fontaine@univ-lorraine.fr; Sylvain.Milla@univ-lorraine.fr)

3.16.2.1 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 installation 1 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 installation 2 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 experimental studies performed in both installations 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…

3.16.2.2 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 related to the domestication of new freshwater fish species in relation with the optimization of external factors 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.

3.16.2.3 *Modality of access*

In all, 4 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 PEA of UL. The field of research will concern larvae development, 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 (specific software for multi-factorial 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. To optimize the feasibility of the protocols and ensure the reliability of the results, most of the tasks will be automatized using a computerization of the real-time data monitoring. The data analysis will be performed using a software settled by our computer specialists. 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.

3.16.2.4 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.

Installation 1: 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. Including the variety of RAS available and the 2 trials, 144 RAS.week would be used on average for each project.

Installation 2 (hatchery and behaviour room): The unit of access is defined as 1 camera.week. A maximum of 64 units per project is authorized (e.g 4 cameras during 16 weeks).

For both installations, 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.

3.17 DTU National Veterinary Institute (DTU-VET)

3.17.1 Introduction

DTU VET, Division for Fish Diseases is located in Frederiksberg, Copenhagen, Denmark. Beside fully equipped laboratory facilities, it comprises a contained experimental unit capable of conducting challenge trials with all known fish pathogens and bioengineered organisms under both fresh- and salt water conditions, a quarantine unit, and a semi-closed facility for supply of experimental fish, vaccination trials and trials with non-infectious reagents. 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 Division for Fish Diseases is being operated as 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 Diseases and the OIE Reference Laboratory for VHS and is leading within research and diagnostics on listed viral fish diseases.

3.17.2 DTU-VET

Name of the infrastructures: Laboratory and Fish tank facilities of DTU National Veterinary Institute, Denmark (DTU-VET)

Location: Frederiksberg, Denmark.

Web site address: www.vet.dtu.dk

Contact: Tine Iburg (TIMI@vet.dtu.dk)

3.17.2.1 Facilities

The facility comprises approx. 100 experimental tanks of various sizes. Both flow-through and recirculation systems can be made available in the tanks. DTU VET 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, through cohabitation or by bath/immersion.

Standardised 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 conducting 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, access were given to research groups from Spain, Turkey and Norway, respectively. Access comprise both tank and laboratory facilities as well as all technical support needed for conducting TA research projects

3.17.2.2 Services currently offered by the infrastructure

DTU VET offers to the Infrastructure programme 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 to external users is offered.

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 will be enhanced according to clinical symptoms. Euthanized and dead fish are collected, labelled and stored. In the unit is also included access to work in lab, e.g. molecular and immunochemical examination of fish, antigen propagation, histopathology etc. The work will be 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 VET members as a short presentation of results and raised questions will be asked to each research group. Furthermore, a list of difficulties that may have been encountered during the experiment should be completed. Final agreement on sending samples and finalisation of some data collection and samples agreed upon, and early discussion of dissemination of the scientific results in international journals.

3.17.2.3 *Modality of access*

Access will be given to the whole facility and will be conducted in a close collaboration with scientists and technical personnel of the facility. Preparation and planning will be 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 minimised). Hereafter DTU VET Division for Fish Diseases will decide whether the proposed trial is possible to conduct at the facility. A detailed research protocol and timeframe will be developed in collaboration with Division for Fish Diseases.

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, will be in place, so that these things are in place prior to the arrival of the applicant, and the trial can start immediately upon arrival.

Week n°1: Meeting with staff of the animal facilities, with information about biosafety measures in the high-containment facilities. Introduction to the experimental facilities, including wet laboratory facilities and laboratories. Meetings with other potential collaborators at the Institute, including scientists, technicians and animal facility staff members. Introduction to the IT-facilities and establishment of office facilities. Meeting with the Veterinarian holding the Animal Experiments License. Introduction to relevant laboratory work, e.g. cell culture, virus isolation, virus identification by immunochemical and/or molecular techniques, during participation in selected laboratory activities. Preparation of fish tanks and start of the experiment. Placing of fish in tanks (1000-2000 fish might be included in a trial), infection, collection of samples (always comprehensive in order to avoid unnecessary duplication experiments) according to protocols.

Week n°2: Facilitating the collection of samples during the early phase of infection (preferentially on common working days), this will often already start up during week 1. Clinical observations and registrations. Performance of samples which have to be carried out immediately, e.g. haematological

analyses. Euthanasia of some fish with subsequent necropsy and collection and preparation of tissue samples will usually be required.

Week n°3: Fish experiment to be continued as described for week 2, with sampling and surveillance of the experiment. If appropriate, laboratory analyses will be carried out.

Week n°4: Fish experiment to be continued as described for week 2 and 3, with sampling and surveillance of the experiment. If appropriate, laboratory analyses will be carried out. Most infection trials will be finalised approx 20 day after infection. Experiments are usually finalised by euthanasia of surviving fish, followed by sampling. Completion of laboratory examinations.

3.17.2.4 Unit of access

This is one day access to 35 small 10-l tanks or to 10 medium 180-l tanks or to 4 large 1000 l tanks and include access to all laboratory facilities, preparation, project planning, reporting etc. One typical access consists of 40 units of access It is anticipated that the availability of relevant fish have been 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 is fresh, brackish or saltwater and temperatures adjusted according to plan.

3.18 Centre of Marine Sciences (CCMAR)

3.18.1 Introduction

The Centre of Marine Sciences (CCMAR) is a non-profit organization located on the Gambelas Campus of the University of Algarve, dedicated to R&D in the Marine Sciences.

CCMAR laboratories are well equipped for biological research at various levels, from biochemistry and molecular biology through genetics, physiology, behaviour and ecology. A computational Cluster dedicated to bioinformatics tasks contains software for genome assembly including NGS, transcriptomics, annotation, visualization, sequence alignment, population genetics, phylogenetics. Complementary services include Molecular Biology (Sequencing and proteomics) and analytical Chemistry platforms.

CCMAR Ramalhete Marine station is located inside the Ria Formosa lagoon National Park, a unique coastal mesotidal lagoon, separated from the ocean by a system of barrier islands and inlets, with very high biodiversity and an ideal natural laboratory protected by national and international legislation. The station is a versatile infrastructure with tanks to keep to keep live organisms and large outdoor mesocosms, wet laboratory are available with tanks of various sizes and controlled environment enabling the carrying out of a variety of experiments with larvae and juveniles of several fish species such as nutrition, behavior, general and specific physiology including acidification.

The infrastructure receives approximately 20 international users per year. Approximately 15 projects are run on the station annually and more than 50 projects use the laboratories and platforms. Recent achievements include the identification of a tilapia reproductive pheromone, improved diets for octopus and fish larvae, defining a fish model associated mental retardation in humans caused by thyroid hormone deficiency and Dicentrarchus labrax genome sequence.

3.18.2 CCMAR-Ramalhete Marine Station

Name of the infrastructures: Ramalhete Marine Station

Location: Ria Formosa lagoon Natural Park, Faro, Portugal

Web site address: www.ualg.pt/pt/content/ramalhete

Contact: Liaison officer - Ana Amaral (ccmarcts@ualg.pt); Station Manager - João Reis (ramalhete@ualg.pt)

3.18.2.1 Facilities

The Ramalhete Marine Station is a versatile infrastructure adjacent to one of the main channels of Ria Formosa lagoon, close to Faro international airport, 12km from the city and 9 km from the Gambelas *Campus* of the University of Algarve.

It consists of 4 hectares of a salt pan and marsh system, 300 m2 of indoor tank facilities with installations for phyto- and zooplankton culture, isolated rooms for studies that require environmental control or behaviour, wet and dry laboratories. The 900 m2 outdoor area is used for larger volume tanks. The indoor and outdoor tank facilities at Ramalhete Marine Station allow for the provision of tailored experimental setups in a wide range of conditions. It receives water directly from the Ria Formosa and well-water is used to regulate salinity. Services currently offered by the infrastructure

3.18.2.2 Services currently offered by the infrastructure

CCMAR offers at the Ramalhete marine station, wet lab facilities with tanks of various sizes and controlled environment enabling the carrying out of a variety of experiments with larvae and juveniles of several fish species such as nutrition, behavior, general and specific physiology including acidification. Access is provided basic-routine equipment and consumables, and access to an open office. Costs for non-basic/non-routine chemicals/consumables are not included on the access. Complementary services include Molecular Biology (incl. sequencing and proteomics), Analytical Chemistry platforms and NGS data analysis pipeline but the costs will have to be covered by the user.

Ramalhete Marine Station can provide access to projects requiring tanks of different capacities: 100L (n=24); 500L (n=20); 1000L (n=22); 3000L(3); 9000L(5). All tanks are set in flow-through systems supplied with filtered natural sea water collected in the nearby lagoon channel. A battery of 24 of 100L tanks in a flow-through with three (3) levels of CO_2 for simulating oceanic acidification scenarios can be provided. Tanks and space can be adapted to fulfill specific experimental needs as temperature control, photoperiod, light intensity or salinity.

Access to some fish species can be provided under request, such as sole (*Sole senegalensis*), seabream (*Sparus aurata*) and seabass (*Dicentrachus labrax*). The available sizes are dependent on time of the year.

Transport from CCMAR (Gambelas *Campus* of the University of Algarve) to Ramalhete Marine Station and return CCMAR is available during working days at 9a.m. and 17p.m.

Scientists or technicians directly involved in animal experimentation are required to have recognized personal licenses.

3.18.2.3 *Modality of access*

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 test new methodologies and obtain samples and data from different kinds of experiments, e.g. nutrition, growth and physiology, behaviour. Users are expected to provide a seminar and a report of the visit.

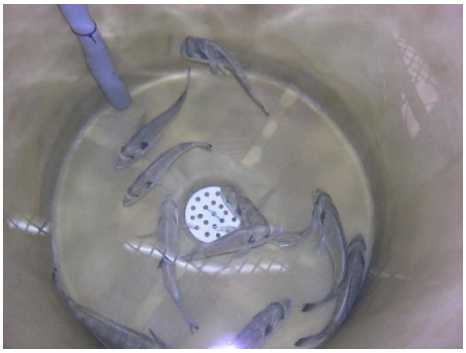
Paperwork and shipment costs of special materials, reagents or equipment will be responsibility of the users. Costs related to shipment of samples may be covered to some extent and will be evaluated on a one by one basis.

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.

3.18.2.4 *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.



The unit of access at Ramalhete Marine Station, is defined as tank.week. As an example, 20 units of access are 20 tanks during one week or 10 tanks during two weeks.

3.19 Instituto Español de Oceanografía (IEO)

3.19.1 Introduction

In this project, IEO puts forward three installations for TNA. The facilities include the Marine Aquaculture facilities of Murcia (IEO-ICRA and IEO-MAP) and Vigo (IEO-AquaCOV), three experimental aquaculture facilities fully equipped. These facilities include several areas, such as breeding, hatchery, nursery, phyto and zooplankton cultures and pre- and ongrowing. 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 develop 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.

The involved IEO teams (Vigo and Murcia) hold expertise to carry out scientific research in: Rearing protocols for new and consolidated species for aquaculture such as Atlantic bluefin tuna, wreckfish, European hake, greater amberjack, sparids, flatfish and cephalopods, reproductive performance and physiology, nutritional requirements of cultured marine species, health and welfare, immune system and vaccine development and genetic analysis for selective breeding of aquaculture stocks.

3.19.2 IEO-ICRA

Name of the infrastructure: IEO-ICRA (The Infrastructure for controlling the reproduction of the bluefin tuna)

Location: Cartagena (Murcia), SPAIN

Web site address: https://www.mu.ieo.es

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

3.19.2.1 Facilities

IEO-ICRA 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 (22 y 20 m Ø y 9 m depth 3,500 and 2,500 m3), and 2 juveniles tanks (14 m Ø, 6 m depth, 900 m^3 - and and 8 m Ø, 3 m depth -150 m^3-) with a total volume of 7,000 m^3. The juvenile tanks are devoted to the quarantine, adaptation and ongrowing of new fish. Each broodstock tank counts on an independent system for the control of the photoperiod and water temperature. 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 cameras and sensors guaranteeing its correct operation and monitoring the tuna behaviour.

3.19.2.2 Services currently offered by the infrastructure

IEO-ICRA is devoted to develop techniques for bluefin tuna reproduction in captivity. This facility is product of a memorandum of understanding signed by the Spanish Ministry of Science and Innovation, the Murcia Regional Community and the IEO, and it is co funded by the regional FEDER funds. First fish were allocated in the tanks in August 2015 and the broodstock will be moved to the facility in spring 2016.

IEO-ICRA is currently used as a research infrastructure by IEO scientific staff and also will be used by other Spanish institutes and universities, as well as 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.

Services

- Handling and management of bluefin tuna eggs.
- Massive production of seabream eggs for feeding bluefin tuna larvae in piscivory phase, from delayed spawning by means of photoperiod and temperature control.
- Assessment for eggs incubation, larval rearing and weaning of bluefin tuna
- Design, application and production of living prey for feeding bluefin tuna larvae: rotifer, Artemia, copepods (Acartia) .
- Prophylactic treatments for eggs and larvae.
- Chemical water analyses (pH, [O2], nitrogen metabolites) and body composition (moisture, protein, lipids, ash)
- Assessment on installation and use of pumping, recycling, filtration, sterilization, heating and chilling systems.
- Assessment on non-invasive sizing bluefin tuna by means of the VICASS (Video Image Capturing and Sizing System).
- Formation and training of technicians on bluefin tuna rearing.

3.19.2.3 Modality of access

IEO-ICRA will carry out experiments for potential users and provide physical access to its facilities during crucial periods of the running experiments. Up to the shifting of the bluefin tuna spawning season, planned in the ICRA, rearing experiments with bluefin tuna must be done during June and July, which is the period of spawning in natural conditions. 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. This trial will be done in IEO MAP.

Access will comprise the use of non invasive methods to watch the behaviour of broodstock, sampling of water and sometimes (but not normally) of fish, and incubation of egg 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-ICRA provides standardized experimental protocols, documentation of results, and appropriate sampling and conservation of samples.

3.19.2.4 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-ICRA 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-ICRA over the life of the project.

3.19.3 IEO- MAP

Name of the infrastructure: IEO-MAP (Marine Aquaculture Plant)

Location: Puerto de Mazarrón (Murcia), SPAIN

Web site address: https://www.mu.ieo.es

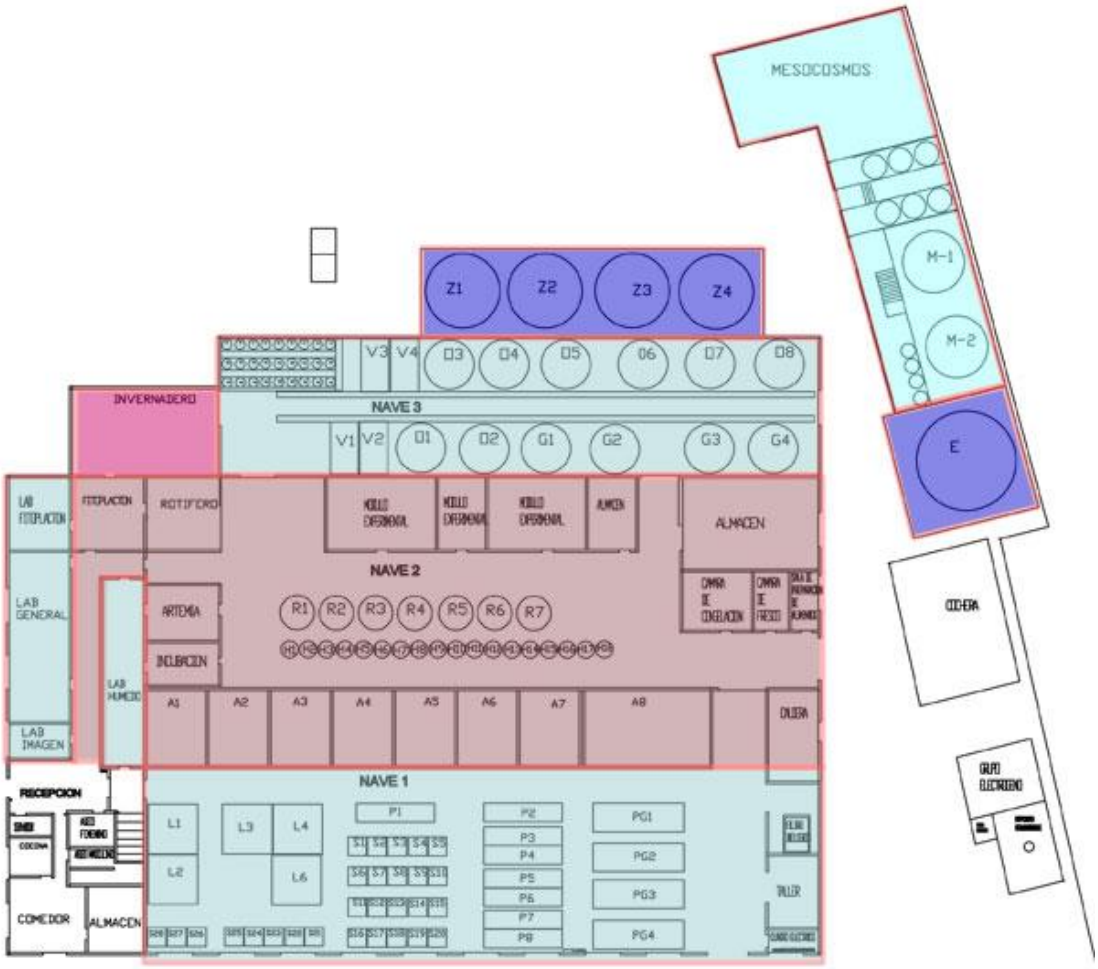
Contact: Aurelio Ortega García (aurelio.ortega@mu.ieo.es)

3.19.3.1 Facilities

IEO-MAP has a total surface of 8,000 m^2 with a building of 3,500 m^2. It includes more than 200 culture units, between 200 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 behaviour by means of self-feeders and video cameras.

- Office area (upper floor) 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 3 submersible pumps of 12.5 kw each (individual water flow 40-60 l/s) and a 15 Kw self-priming emergency pump (water flow of 40-60 l/s)
- Cold and freeze rooms at 2ºC (18 m^2) and at –20ºC (27 m^2).
- Gas oil heaters of 300 kw each for warmed sea water supply. In close circuit with four pumps generating a water flow of 40 l/s. In open circuit the system is able to warm and generate a water flow of 5 l/s. They are located in a isolated 27 m^2 room.

- Sea water cooler system of 43 Kw of cooling performance.
- Biological filter of 36 m^3 (3mx3mx4m) in a 28m^2 area.
- Air blower system consisting in 6 electrical air blowers of 8 Kw (0.6 - 0.2 Kg/cm^2 of pressure).
- Power generator of 222 kw and 250 kVA of electrical power.
- Phytoplancton production unit (*Tetraselmis, Nannochloropsis, Isochrysis* and *Rhodomonas*)
    - Small isotherm room (30 m^2) for phytoplankton strains conservation
    - Small isotherm room (26 m^2) for phytoplankton production
    - Greenhouse (80 m^2) for massive phytoplankton production
- Isotherm room for rotifer production and enrichment (29m^2) with 4 (1.6 m^3) and 5 (600 liters) cylindrical tanks.
- Unit for Artemia hatching and enrichment. Isotherm room (24 m^2) with 11 cylinder-conical (160 l) tanks for Artemia hatching and enrichment.
- Incubation room (22 m^2) provided with 4 (500 l) and 3 (1000 l) cylinder-conical tanks.
- Unit for tunids juveniles stockage consisting in 1 (100 m^3) and 4 (50m^3) cylindrical tanks.
- Mesocosm unit (400 m^2) for larval rearing consisting in 2 (45 m^3) cylindrical tanks and living prey culture facilities: phytoplankton, Rotifer, Artemia and copepod (Acartia) dimensioned for covering the total mesocosm needs
- Building with 4 (23 m^3) and 8 (13 m^3) cylindrical and 4 (8m^3) rectangular tanks.
- Water recycled full control unit for larval rearing with 27 (500 l) cylindrical tanks.
- Greenhouse for phytoplankton massive culture (83 m^2).
- Larval rearing area with 7 (5 m^3) and 18 (1m^3) cylindrical tanks
- Two experimental isotherm rooms with 12 y 27 (170 l) cylindrical tanks respectively.
- Broodstock area with 7 (45 m^3) square-based tanks and 1 (90 m^3) rectangular-based tank.
- Pre-ongrowing and ongrowing area with 4 (14m^3), 28 (2m^3), 8 (7m^3) and 4 (14m^3) (4) rectangular and square-based tanks.



3.19.3.2 Services currently offered by the infrastructure

IEO-MAP is devoted to develop techniques for juvenile production of bluefin tuna, as well as breeding and juvenile production of other Mediterranean fish species.

IEO-MAP 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.

Services:

- SPECIES DIVERSIFICATION
- TUNA FARMING
- NUTRITION AND FOOD: Feeding strategies and diets specifically adapted to the species, Study of the physiological processes involved in the regulation of feeding behaviour, food intake and food selection, Using food products and developing alternative sources of feed and Study of food additives for fish that provide to the fish an additional paper apart of the basic nutritive one; such as a health benefits on the treatment of human disease (i.e. obesity, atherosclerosis, etc.).
- RECIRCULATION SYSTEMS (RAS) DEVELOPMENT
- ANIMAL HEALTH AND WELFARE
- TECHNICAL larval culture

3.19.3.3 Modality of access

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

3.19.3.4 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-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 40 units of access allocated to IEO-MAP over the life of the project.

3.19.4 IEO-AquaCOV

Name of the infrastructure: IEO-AquaCOV

Location: Vigo, SPAIN

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

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

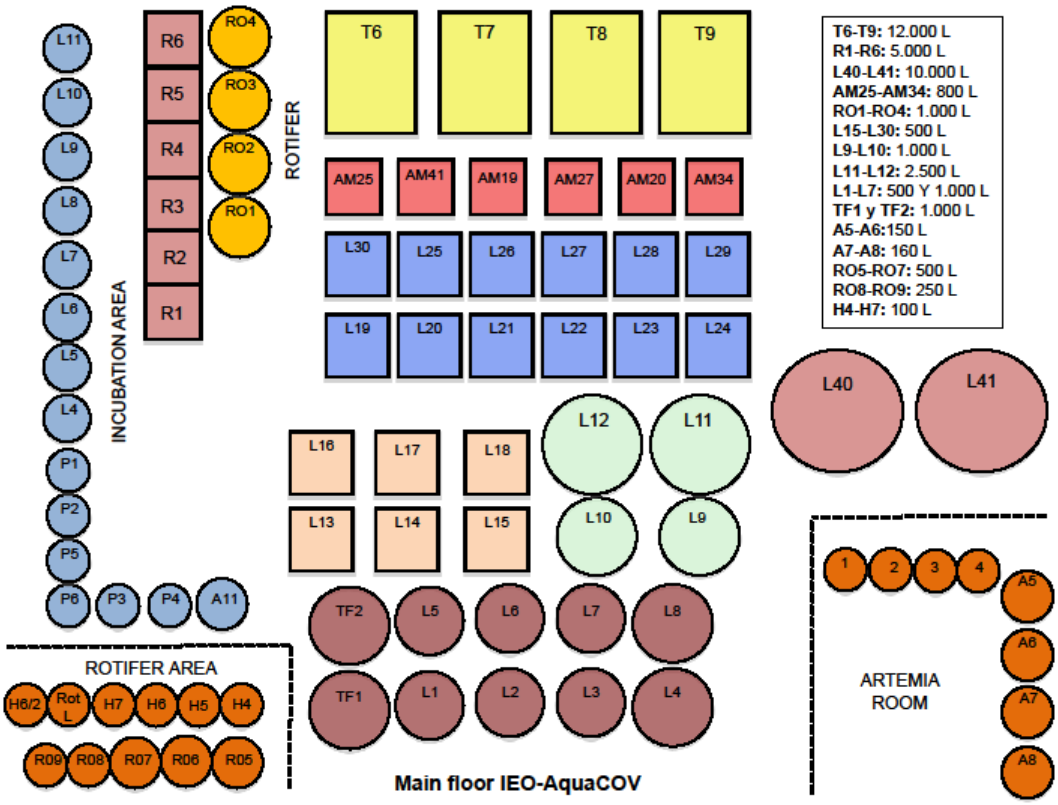
3.19.4.1 Facilities

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*, Senegalese sole *Solea senegalensis*), crustaceans (crab *Maja brachydactyla*) and molluscs (*Octopus vulgaris*), as well as in the development of the culture of new species such as wreckfish *Polyprion americanus* and European hake *Merluccius merluccius*.

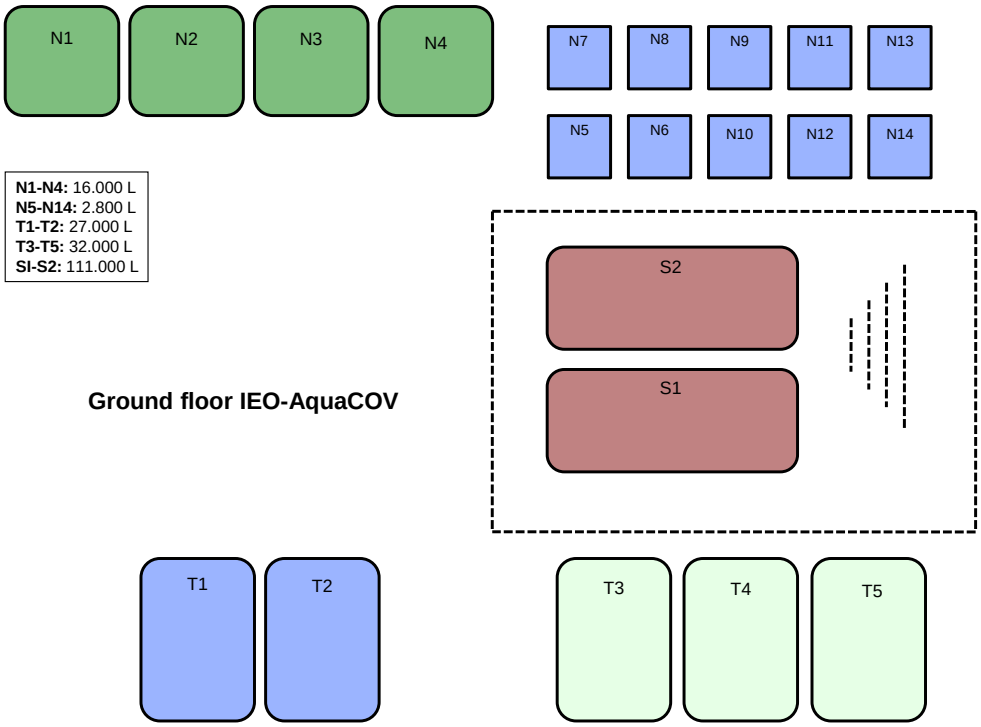
Diversification in aquaculture and animal husbandry are two fundamental elements in research at IEO-AquaCOV, as well as more specific aspects such as genetic and environmental factors in turbot and wreckfish sex determination, physiology and quality of triploid turbot, use of alternative diets in sea 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:



3.19.4.2 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.

3.19.4.3 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.

3.19.4.4 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-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 30 units of access allocated to IEO- AquaCOV over the life of the project.