



The Institute of Aquaculture

International Centre of Excellence for Aquaculture



The Institute of Aquaculture



- Established in 1971 as the Unit of Aquatic Pathobiology
- Became the Institute of Aquaculture in 1979
- Currently:
 - 35 academic staff
 - 15 post-doctoral researchers
 - 25 support staff
 - 18 external facility staff
 - 55 PhD students
 - 45 Master's students
 - 100+ undergraduates

Learning and Teaching



The University was awarded 5 stars for teaching.



Postgraduate Courses

- MSc/Diploma in Aquaculture (+ other outcomes)
- MSc/Diploma in Aquatic Veterinary Studies/Aquatic Pathobiology
- **MSc/Diploma in Marine Biotechnology**
- MSc/Diploma in Aquatic Food Security

Undergraduate Courses

- BSc (Hons) Aquaculture
- BSc (Hons) Marine Biology

Short courses

MSc Marine Biotechnology



- 12-month taught programme available since 2012
- Students complete 180 SQCF credits at level 11:
 - 60-credit Foundation module;
 - 60-credit Advanced module;
 - 60-credit Research Project module
- Foundation module: Biodiversity; Opportunities in marine biotechnology; Genomics; Proteomics; transcriptomics; Research methods and ethics
- Advanced module: Recombinant protein production; development of diagnostic test kit; Intellectual property; The Research Environment
- External stakeholders provide teaching (e.g. Xelect Ltd.; Jellagen; etc.)
- Student achievement assessed by range of diverse and innovative coursework assessments

Research themes

Reproduction and Genetics

- Genetics
- Genomics
- Reproductive physiology

Health and Welfare

- Virology
- Bacteriology
- Parasitology
- Immunology
- Welfare

Nutrition

- Lipids
- Proteins
- Contaminants
- Pigments

Sustainable Aquaculture

- Aquatic resources and development
- Systems design
- Environment
- Spatial analysis and GIS
- Modelling

Overarching themes

- Food Security
- Marine biotechnology

Diagnostics

Contract Research

Nutritional Analysis

Water Quality

Consultancy

Commercial Activities

Reproduction and Genetics



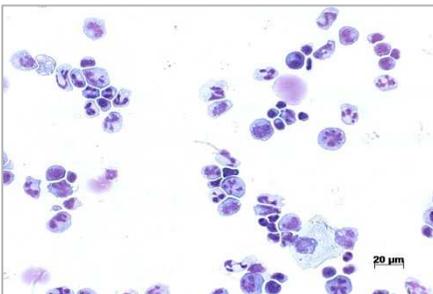
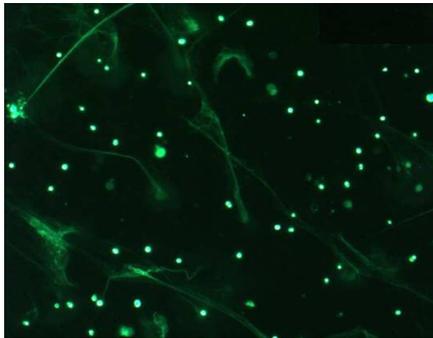
- Genetic management and selective breeding – from Asian carps to halibut in Scotland
- Sex determination and manipulation – using advanced techniques e.g. genomics, karyotype analysis
- Genomics and molecular genetics – understanding the molecular basis of traits of fish and their parasites and pathogens
- Stock management strategies – including control of sexual maturation e.g. using fish endocrinology
- Clonal lines – developed for research on sex determination, genetics of colour, immunology and disease resistance and as controls in selective breeding programmes

Health and Welfare



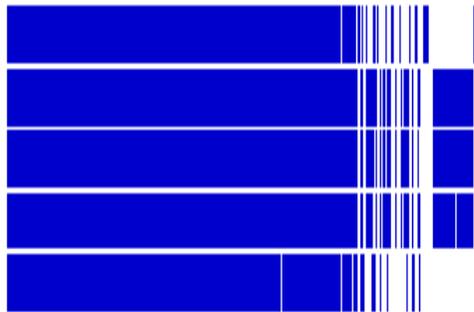
- Immunology and aquatic vaccines – developing rapid diagnostic tests (molecular and antibody based) and vaccines for both fresh and marine cultured fish species
- Bacteriology – researching pathogens of farmed aquatic species as well as microbial safety of aquatic seafood; using traditional and molecular assays, microbial epidemiology and antimicrobial therapy
- Virology – identifying and characterising waterborne viruses using classical and molecular techniques
- Parasitology – studying the biology and ecology of parasites affecting aquatic species, including molecular parasitology and automated recognition systems
- Aquatic population health and welfare – epidemiology and modelling to inform health management and disease control

Innate immunity in fish



- Research focuses on applied aspects of immunity (e.g. vaccinology) but also fundamental process in host-pathogen interactions
- **Chromatin trap formation** by immune cells of salmonids
- Antimicrobial defence mechanism of phagocytic cells in addition to phagocytosis and degranulation
- Prevents pathogen dissemination around the infected host, thus reducing effects of disease
- Other projects focus on pathogen interactions with the chromatin traps, i.e. virulence factors

Microbial virulence factors



- **Use of alternative insect model of infection:** benefits (zoonotics, temperature, high-throughput, 3Rs); validation (*V. anguillarum*, *F. psychrophilum*, *F. noatuensis*); application (transposon mutant screen)
- **Whole-genome sequencing of bacterial pathogens** (e.g. *V. anguillarum*) to understand evolution and identify genetic factors governing host specificity; virulence traits; environmental niche (funded by BBSRC/NERC 2015-17)
- **Insertion sequencing of transposon mutants** to identify 'required' genes sets and determine fitness of genes in different selection conditions (MiSeq platform) (funded by Cefas and UoS)
- Combined approaches to provide deeper insight into **genotype-phenotype associations**

Other ongoing projects



- **Optimisation of antibiotic regimens for reducing antimicrobial usage and selection of resistance**
- **Development of a commercial mussel hatchery in Shetland (SAIC and industry funded project)**
- **Dr Andrew Desbois**
(andrew.desbois@stir.ac.uk)

Nutrition



- Nutrient requirements – researching novel methods for determining and quantifying nutritional requirements
- Sustainable ingredients – investigating vegetable oils and other potential replacements for marine fish oils and also protein replacements for fishmeal
- Molecular mechanisms – basic biochemical and molecular mechanisms of lipid metabolism
- Genetic improvement – relating to the ability of fish to produce and retain long chain polyunsaturated fatty acids
- Seafood and human health – the role of omega 3 long chain polyunsaturated fatty acids in human health

Sustainable Aquaculture



- Spatial analysis – using GIS and RS for strategic evaluations of regions for aquaculture development
- Environmental modelling and sustainability – investigating aquaculture interactions with ecology and environment
- Aquatic resources and development – understanding aquaculture in context of natural resources, social, market, economic, political and other perspectives
- Aquaculture and biodiversity – native species selection and development for aquaculture
- Aquaculture industry knowledge management and networking

Commercial Services



- Contract research
- Disease diagnostics
- Water quality
- Nutrition analytical services
- Reproduction and genetics services
- General aquaculture consultancy for government or private organisations including feasibility studies, due diligence and technical support

Consultancy



- Primarily carried out through the “Stirling Aquaculture” arm of the Institute
- Core staff plus several part-time associate consultants and access to other staff in the Faculty of Natural Science and the Scottish Institute of Aquaculture
- Regularly carry out sector, market and feasibility studies, manage aquaculture start-ups and expansion, provide expert witnesses or trouble shooting

On-campus Facilities



- Over 1200m² of well-equipped laboratories
- 1000m² of aquarium facilities suitable for cold and warm freshwater and marine species, and for work with infectious diseases





Our External Facilities: Machrihanish



- 100+ holding tanks (0.5 to 4m diameter)
- Broodstock holding, egg and larval production facilities for marine fish
- Heated and cooled sea water for temperature dependent or out-of-season studies
- Purpose built facilities for drug testing and feed trials
- Isolation suite with effluent disinfection
- Heated systems for studies with tropical and warm-water species
- Well-equipped laboratory
- A range of species and sizes of fish available throughout the year
- Facilities for radioisotope and X-ray studies

Our External Facilities: Machrihanish



Visit: fishresearch.co.uk

Wrasse hatchery

The Institute is working with Marine Harvest (a leading salmon producer) to develop wrasse breeding and production for the biological control of sea lice

Isolation Facility

Machrihanish is one of the Institute's main GLP facilities. The isolation facility for example, permits work on viruses and parasites that would otherwise threaten the health of aquaculture species.

Our External Freshwater Research Units: Howietoun and Buckieburn



Howietoun

Howietoun

- Commercial brown trout and salmon hatchery producing 525,000 salmon smolts annually; 50% of which are produced out of season
- Boast 99.8% survival 28 days after transfer to sea water which is arguably the best in the industry
- Three dedicated salmon smolt units and separate facilities for rearing and maturing brown trout



Buckieburn

Buckieburn

- The freshwater facility consists of three steel buildings housing 100+ 1-5m tanks
- Facility is used for trials of nutritional and salmon health products, and research into the role of light on growth and maturation of rainbow trout
- There is also a purpose built lab for the processing of research material

Collaborations

The Institute of Aquaculture collaborates with a wide variety of partners in many different projects in Europe, Asia, Africa and the Americas and is always open to new partnerships in areas of mutual interest.



Management contacts



Professor Herve Migaud
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Professor Brett Glencross
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'Blue Biotechnology Master for a Blue Career' (BBMBC) project

January 2017 to December 2018



Applied Blue
Biotechnology Master

Project overview

WP1: Project management (Leader: ULR; month 1-24)

WP2: Design of the Blue Master's courses (Leader: ULR; month 1-7)

WP3: Apprenticeship and Life Long Learning (Co-leaders: Maison de la Réussite et de l'Insertion Professionnelle and ULR; month 4-24)

WP4: Delivering the masters courses (Leader: ULR; month 6-19)

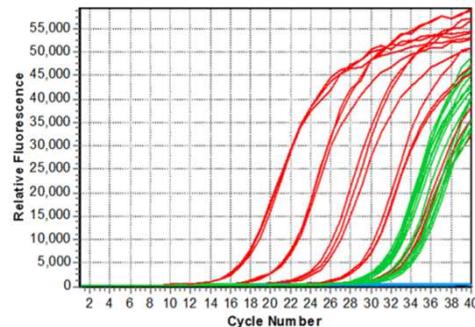
WP5: Transferability and feedback of the Applied Blue Biotechnology Master II (Leader: UCV; month 16 to 24)

WP6: Communication and dissemination (Leader: CRPM; month 1-24)

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Recent Research Projects



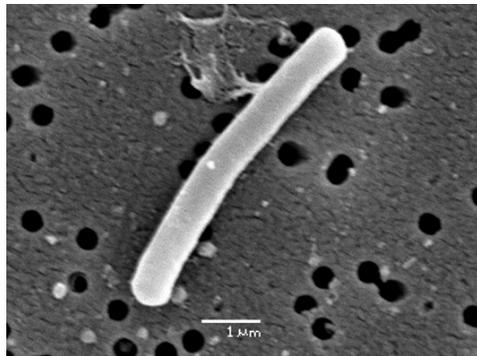
- Comparison of different sample preparation methods for analysis of the plasma proteome of Atlantic salmon, *Salmo salar*
- Development of biomarkers for smoltification in Atlantic salmon, *Salmo salar*
- Development of quantitative PCR assays to measure inflammatory gene expression in the brain of *Oreochromis niloticus*, Nile Tilapia
- Differential regulation of Toll-like receptor-9 paralogues in pathogen-associated molecular pattern-activated Atlantic cod (*Gadus morhua*) macrophages

Recent Research Projects



- Dynamic thermal choice and its effects on the expression of thermo-sensitive TRP channels and brain plasticity markers in zebrafish larvae (*Danio rerio*)
- Multiplex real-time PCR detection assay for SAV, PRV and PMCV
- Impact of mycotoxins on cellular activity in rainbow trout, *Oncorhynchus mykiss*, RTG-W1 epithelial cell line
- Video tracking of behaviour and tank distribution of lumpfish (*Cyclopterus lumpus*) related to fin damage to develop operational welfare indicators

Recent Research Projects



- Mechanism of antimicrobial action of the marine-derived fatty acid, eicosapentaenoic acid
- Antibacterial activity of extracts from marine-isolated bacteria and synergy with clinical antibiotics
- Cultivable bacteria from *Mytilus edulis* as a source of novel antimicrobial compounds
- Fatty acid and lipid composition of commercial marine oil supplements
- Effects of fish oil supplementation on muscle function, muscle soreness and markers of muscle damage during recovery from intense eccentric based exercise
- Persistent organic pollutant concentrations of long-finned pilot whales (*Globicephala melas*) in two pods stranded in Scotland