Deliverable 10.1
Analysis of access provided by University of Stirling Institute of Aquaculture performance Infrastructure: types and users

Version 2.0

WP 10
Deliverable 10.1
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Executive Summary

Objectives

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.

Main Results:

In total 5 projects have been undertaken to date to the UoS facilities. There are a further two projects upcoming in 2025.

Authors/Teams involved:

Professor Amaya Albalat

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1. Overview of TNA users projects realized in UoS Institute of Aquaculture

1.1.1. Installations

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

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

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

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

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1.1.2. User projects

Min. quantity of access units to be provided according ther DoA: 99
Total number of access units (sum of access units in the table): 47

Installation number	Installation code	Project title	Project acronym	Description about the experiment	Coordinator	Already used installation (Yes/No)	Nature of the access unit*	Number of used access units during the project	(Potential) paper	How many people was trained by this procedure ?
3	IoA	PID19189 Lipid mediators of inflammation in European seabass	EicoBass	Please see below. Dates 02/2023	Andrea Bertini, University of Trento, Italy	No	tank.week	8		1
3	IoA	PID21817 essential fatty acids_broodstock	MIRAGE	Please see below. 01/2023 - 03/2023	Emilie Cardona, INRAE, France	No	tank.week	8		1
3	IoA	PID28710 Salmon parr thermal rhythms	SPARR	Please see below. 02/24-04/2024	Maria Valado, Miramontes, Universidade de Vigo, Spain	No	tank.week	4	terminated early	1
3	IoA	PID29856 Functional feeds for ballan wrasse	FUNWRASSE	Please see below 09/2024-12/2024	An Goncalves Teresa, Sparos, Portugal	No	tank.week	15		2
3	IoA	PID34436 Phytogenic nutraceuticals to ameliorate seabream welfare	RESIBREAM	Please see below 04/2025-06/2025	Sara Cartan Moya, University of Cadiz, Spain	No	tank.week	12		1

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2. TNA projects

2.1.1. TNA projects description

PID19189 Lipid mediators of inflammation in European seabass study objective:
The overall objective of this proposal was to investigate the effect of free-catches diets (fish oil and meal from trimmings and microalgae meal) on the European seabass lipid class and fatty acid composition, anti-inflammatory response and eicosanoids production after the exposure to a stress event. In this project, we had one visitor at our facility. He was trained in person and he was also responsible for the analysis of the samples of this project. It is expected that one or two publications will arise from this project.

PID21817 Essential fatty acids broodstock study objectives:
This study aimed to define the optimal ratio of essential fatty acids in the feed for female rainbow trout broodstock to increase their robustness, their reproductive performance and the quality of their eggs. This study was to serve as a basis for the definition of sustainable feed formulations (without fish oil and fishmeal) adapted as much as possible to the nutritional needs of female trout broodstock. Within this project we had two visitors that received training in the techniques used for the analysis of the samples and they also received training in how to analyse the data. It is expected that one publication will arise from this project.

PID28710 Salmon parr and thermal rhythms study objectives: (*this project was terminated early)*
1. Thermal preferences of the animals throughout the daily cycle will be tested (experimental conditions and sampling).
2. Daily circadian rhythms at the central and peripheral levels involved in thermal preference in juvenile salmon will be evaluated (experimental conditions and sampling).
In this project, we hosted a researcher from Spain. We had mortality issues in this trial, which cause could not be identified. For this reason, the project was terminated early.

PID29856 Functional feeds for ballan wrasse study objectives:
1. To assess the effect of functional feeds on the immune response of early juvenile ballan wrasse
2.To study the impact of novel functional feeds on the growth and overall performance of fish.
This project was completed successfully and we expect at least one publication from this project.

PID34436 Phytogenic nutraceuticals to ameliorate seabream welfare study objectives:
(*this project is ongoing)*
1. Evaluate the effects of dietary supplementation with a *Cannabis sativa* non-psychoactive extract (CSNPE) over stress axis in gilthead seabream (*Sparus aurata*) after a chronic and an acute stress situation.
2. Assess the influence of chronic and acute stress on lipid metabolism and its modulation with the CSNPE in seabream.
3. Evaluate the antioxidant and anti-inflammatory potential of the CSNPE administered through the diet in seabream.

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2.1.2. Selection of One exemplary project

Functional feeds for ballan wrasse (FUNWRASSE)

Ballan wrasse is a cleaner fish used for sea lice control in salmon farming. Although its production has been increasing to reduce the dependency on wild captures, improvements are needed to support fish welfare and performance. Nutritional strategies that will support fish coping with demanding periods need to be implemented to increase production efficiency leading to more efficient cleaner fish. This study investigated and developed new wrasse functional feeds to be applied as protective measures for juveniles during stressful periods. Five diets were formulated with different combinations of bioactive ingredients:

CTRL: commercial-like formula isonitrogenous and isoenergetic.
DIET1: a diet with a commercial-like formula and inclusion of plant-derived essential oil extract
DIET2: A diet supplemented with an algae-derived extract/ingredient.
DIET3: A diet supplemented with beta-glucans.
DIET4: A diet supplemented with the mix of the three functional ingredients.

A total of 600 juvenile wrasse (40 fish per tank) with an initial body weight of approx. 5 g were used. The experiment was performed with a randomized blocking design, with five treatments in triplicate (5 x 3= 15 tanks). The fish were randomly distributed to 15 fiberglass tanks (100 L; Figure 1) in recirculation with constant monitoring of water conditions including oxygen, ammonia, and nitrites. During the feeding trial, the fish were hand-fed three times a day until satiation to ensure that feed availability does not restrict growth for 2 weeks. After 14 days of feeding, half of the fish in each tank were randomly collected for LPS (Lipopolysaccharide) challenge that will intensify the inflammatory responses. Fish were anaesthetized (MS-222) and individually injected intraperitoneally with 0.1 mL with a 5 mg/kg body weight dose. The remaining fish were sham controls, intraperitoneally injected with PBS. After 24 hours, fish were humanely euthanized, measured for length and weight and operational welfare indicators (OWI) recorded. In addition, several samples were collected for histology, molecular and microbiome analysis. All feeds were well accepted and mortalities less than 5% were observed among all treatments. All groups showed adequate OWI. Presently, a MSc student is analysing the histology and intestinal molecular response to the different feeds what will cast if any of the additive was beneficial to promote fish health when challenged against LPS.

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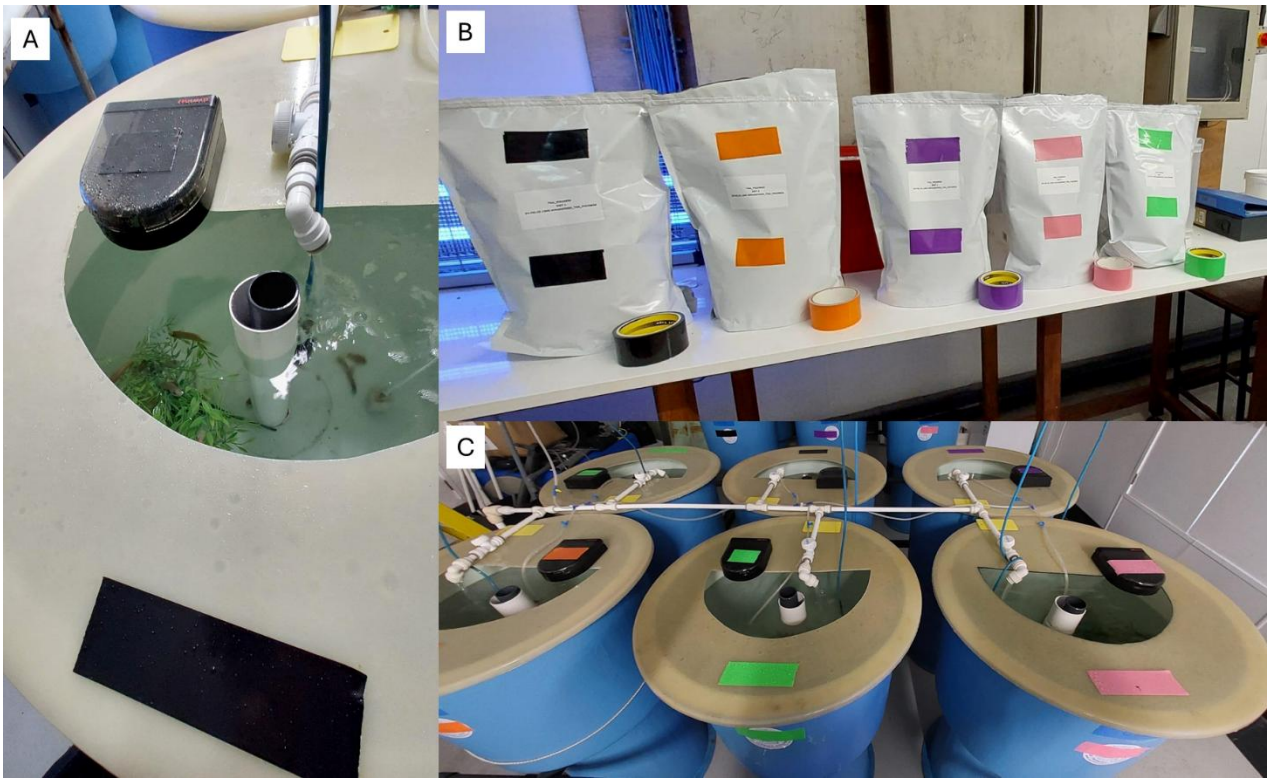

Figure 1.- Experimental set up showing (A) A close up of the experimental tanks including kelp hides to ensure fish welfare and automatic feeder (B) The five experimental feeds colour coded (C) An experimental block.

3. Reflection on results of the TNA programme

4. References

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Work Package Leader	Amaya Albalat, TNA manager			
Work Participants				

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