

Cullen Scholarship: Enhancing farmed Atlantic salmon quality through new production technologies (PhD Award)

Background

Since reaching a peak production of *ca.* 22,000 tonnes in 2001, Atlantic salmon aquaculture in Ireland has fluctuated, but generally remains around 12,000 tonnes annually. Currently, all Irish Atlantic salmon production is to independently accredited organic standards, focused on low volume high value niche markets, and now accounts for over 50% of EU organic salmon production. Recirculation Aquaculture Systems (RAS) are increasingly employed globally to utilize the inherent benefits of a controlled rearing environment to increase the overall size of Atlantic salmon smolt produced. The idea being that this would lead to the production of a more robust smolt, increasing the production capacity of hatcheries and sea sites. A reduction in the time spent at sea will address a number of other concerns including disease and sea lice. According to the current organic regulations (EU Regulation 710/2009), production using recirculation technology is permitted during the hatchery and nursery stages, up to and including smoltification. Production post smoltification, using recirculation technology is prohibited. The parr-smolt transformation (PST) in Atlantic salmon signifies a number of behavioral, morphological and physiological changes including increased salinity tolerance, silvering, increased growth in length, slimming of the body shape, metabolic preparations and migratory behavior. The tolerance to seawater (SW) developed during the PST is a temporary “physiological smolt window” and smolts that fail to enter SW will undergo a process of de-smoltification. Such variation in the physiological state may have implications with regards to fish health and welfare during the production of larger smolts in RAS and should be fully investigated. To ensure that RAS production of large salmon smolts is to be acceptable under the organic standard, it will be prudent to fully understand and define the process of smoltification in Atlantic salmon held in RAS in comparison to current flow-through production systems, including characterisation of changes in the microbiome.

Proposal

We propose a structured four-year PhD on a full-time basis to study the effects of producing large Atlantic salmon smolts using RAS technology on the parr-smolt transformation. This will include investigations on:

- Increasing our understanding of the smoltification process, including associated changes in the microbiome and the development of better techniques to predict the onset of smoltification and optimize the timing of sea transfer.
- Evaluating the influence of the rearing environment (flow through and RAS) on the biological (skin, gut, mucosal) and physical (water, tank) microbiome and its influence on smoltification/health status of the fish.
- The effect of manipulating environmental parameters (e.g. temperature and light) on the physiology, microbiome and smoltification process of the fish.
- The effectiveness of specialized diets to increase fish robustness (through changes in physiology and microbiome) and health during the smoltification process.

Outcome

A PhD thesis, comprising of four chapters published in peer reviewed scientific journals. This research is designed to be multidisciplinary to train the researcher to have a broad set of skills and knowledge of fish farming, fisheries and the latest aquatic technology developments. Furthermore, the research outputs will create an array of

fundamental and applied knowledge in developing farmed Atlantic salmon to be sustainable and limiting potential environmental impacts. This will be key to assessing the suitability of this production system for inclusion under future organic regulations. The project will also provide the necessary skills and tools for assessing smoltification in RAS that will be essential for the successful integration of this technology into Irish production.

The scholar will engage with different industries (i.e. aquafeed, salmon farmers, certification agencies, lighting and RAS development companies) to fully realise the knowledge developed into commercial salmon farming operations.

1. Enhancing Irish salmon farming practices. These new developments will have a knock-on effect on global and conventional salmon farming, leading to a higher standard of animal welfare, increased productivity and efficiency/sustainability.
2. Using the research to further inform and drive new salmon farming practices, policies and legislation.
3. Validating whether prolonging the production of salmon in freshwater would meet global organic standards (e.g. EU organic certification, Bord Bia and Natuurland) in the context of energy input, greenhouse emissions and animal welfare metrics.
4. A series of industry-oriented peer-reviewed publications on the research development and presentations at scientific/industry-based conferences/workshops.

Links to MI Strategy

This proposal falls under Strategic Focus Area 3 - Research & Innovation, and links with Strategic Focus Area 1 – Scientific advice and services, which support important commercial services such as aquaculture.

Specific Requirements

The scholar should have a primary degree/post graduate qualification in the biological sciences with an interest in fish biology and aquaculture. The host institute should have a proven track record in fish physiology and applied research.

Financial Details

Scholarships will be up to €25,000 per annum (maximum funding of €100,000 over four years). This amount comprises a maintenance award of €16,000 (Irish Research Council rate) to the student as well as payment of fees to the host higher education institution (HEI). The maximum fees payable to the HEI will be €6,000 per annum. The scholarship award also includes a budget of up to €3,000 per annum for eligible research costs (travel & subsistence, publication costs, consumables and other costs e.g. laptop) for the sole use of the student, and are payable on a reimbursement basis direct to the host institution where the postgraduate student (scholar) is registered. There are no overheads payable on the scholarship. Publication costs are intended to cover publications on which the scholar is listed as first author and are published under Open Access.

Marine Institute Co-Supervisor(s)

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