

Network for Aquaculture Education in the Arctic

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Helgi Thor Thorarensen
Björn-Steinar Sæther
The Norwegian College of Fishery Science
Faculty of Biosciences, Fisheries and Economics
The Arctic University of Norway (UiT)
Tromsø, NORWAY

Olafur Ingi Sigurgeirsson
Gudrun Helgadóttir
Hólar University
Hólar í Hjaltadal, ICELAND

Barry A. Costa-Pierce
Graduate Program in Ocean Food Systems
School of Marine & Environmental Programs
University of New England
Biddeford, Maine, USA

Catherine Chambers
Stefansson Arctic Institute and
Research Manager
University Centre of the Westfjords
Ísafjörður, ICELAND

The Purpose and Overall Goal

Arctic communities that have a long-standing tradition and experience of fishing and fisheries currently face a host of challenges and must seek new opportunities on which to base their economies. While climate change exerts negative effects on both environment and human activity, it also opens up new possibilities for industries such as aquaculture that may replace traditional industries. Population is declining throughout the region and many settlements in marginal areas are at risk of abandonment. In part, this is because traditional industries, such as fisheries, are declining or being restructured and moving jobs to more centralised locations. There is a natural progression from fisheries to aquaculture, which facilitates this transition to a new economic foundation. Moreover, aquaculture does not require a large labour force and is, therefore, very well suited for developing employment in small communities. However, the sustainability of aquaculture development in the Arctic depends on solid knowledge of aquaculture management, innovation and knowledge transfer in aquaculture technology to solve environmental issues in the sector.

Over the last decades, Atlantic salmon and salmonid aquaculture have grown rapidly in many parts of the Arctic region. In Norway, the Faroe Islands and Canada, Atlantic salmon aquaculture is already established, and it is expanding rapidly in Iceland. High market prices of salmon in recent years have facilitated significant technical advances and investment in technology. Still there are several challenges associated with the growth of Atlantic salmon aquaculture. These include very diverse issues such as coastal zone management and access to concessions as well as technical challenges in growing the fish. To contain the potential environmental effects of the production of salmon in net pens, most countries limit the expansion of salmon aquaculture.

Therefore, producers are seeking novel methods to grow salmon using large net pens for offshore aquaculture, closed or semi-closed systems in the sea or trying to grow salmon to market size on land.

An important part of this is the rapid development of technology for growing salmon in land-based units. The production of salmon juveniles in freshwater until they are ready (smolt) for transfer to sea is always performed in tanks on land. In recent years, the use of recirculating aquaculture systems (RAS) for the production of salmon smolts increasingly replaces the older flow through systems. The RAS require significantly less water than the flow-through systems and, as a result, open up possibilities for locating the farms, for example, near the net pen sites.

A challenge in switching from the flow-through systems to RAS is that the latter are more technically advanced, and hence call for more highly qualified staff. Staff with a strong university level educational background is needed to successfully manage, monitor and run competitive, sustainable and technologically advanced aquaculture in the Arctic. Access to this type of education may be difficult in remote regions and solutions are required to offer this type of education in Arctic communities. The technology is universal and, therefore, there are significant synergies in developing and delivering the courses on the subject through international Arctic collaboration. One of the objectives of this project is to make higher education in aquaculture more accessible by collaborating to develop and pilot flexible, on-line university level courses that can later be accessible to all member institutions of UArctic. Moreover, the project will include possibilities for student exchange between different institutions.

A second issue, which the project will address, is that wild populations of Atlantic salmon and salmonids have declined during the last decades. The reasons for this are highly debated but poorly understood. They likely include a range of anthropogenic factors such as climate change, hydropower developments and overfishing of wild populations. Aquaculture may contribute to the depression of wild salmon populations, although it is unclear to what extent. Various stakeholders, such as traditional fisheries, the salmon angling community, and environmental groups have opposed the development of salmon aquaculture in ocean net pens. The main concerns of these groups are similar in all countries and involve introgression of aquaculture fish into wild salmon populations, the effects of parasites and disease outbreaks on wild salmon, and the effect of discharge of organic material from net pens on other wild fish and invertebrate populations. Increasingly, these groups claim that all salmon aquaculture should move on land.

Following this lead, Trudeau, the prime minister of Canada, has issued a mandate where he proposes to close all net pen salmon farms in British Columbia. Several initiatives are currently in various stages of developing on-land salmon farming, both in Europe and North America. At present, the technical and economic feasibility of these operations is however, unproven. No land-based salmon farms using RAS in full cycle production have returned consistent profits and the technology is still under development. Interestingly, a large land-based salmon farm in Iceland has consistently returned profit. One of the objectives of the current project is to provide Arctic communities depending on salmon aquaculture with scientifically sound information through access to expert panels and on-line courses to empower them to make well-informed choices regarding aquaculture development.

The development of salmonid aquaculture has revitalized many coastal, Arctic communities, halting or reversing population decline. The development of aquaculture rests in part on the experience found in the communities on fishing and fish processing. Furthermore, aquaculture creates a wide range of employment opportunities for young people with university education. Aquaculture is highly relevant for the future of the Arctic communities and it is important to consider this when debating the expansion of aquaculture in the region. The development of aquaculture should always rest on the principles of sustainability, which include in addition to the important environmental aspects, also economic and social factors.

As any food production industry, aquaculture will always have an environmental impact, which needs balancing with the interests and sustainability of the communities. The issues at hand are complicated and their resolution must rest upon solid information and considerations involving environmental sciences, economics, sociology and ethics. The objectives of the current project are to establish multidisciplinary research groups and to disseminate information through workshops that can prepare arctic communities for this discussion and provide a balanced resolution to the interests of all stakeholders.

The Main Objective of the Project is to:

- Promote the sustainable development of aquaculture in the Arctic regions by generating and providing knowledge in relevant fields.

In the project, we will focus on three interrelated areas that are very relevant for the future development of aquaculture in the arctic.

These are:

- Land-based aquaculture of salmonid fishes in the Arctic.
- The environmental challenges of net pen aquaculture in the Arctic.
- Information and disinformation in the discourse on aquaculture in the Arctic.

We aim to empower the Arctic community with knowledge and education in these focal areas.

In order to do this, we will:

- Establish transdisciplinary research networks.
- Generate and disseminate sound information in the public discourse on aquaculture in the Arctic.
- Increase the competence in the Arctic communities through access to the best available education in the field of aquaculture by:
 - Collaborating in developing and delivering on-line courses.
 - Facilitating exchange of students among the participating institutions.
 - Offering students direct access to research through the education.
- Facilitate informed discourse and decision making on future growth of aquaculture in the arctic by:
 - Making relevant scientific information accessible to the public.
 - Running workshops for community leaders and government officials on aquaculture issues.

The project group consists of four UArctic member institutions. They are all providing degree granting educational programs at undergraduate and graduate levels in aquaculture or coastal zone management.

The project group will also include the UArctic Thematic Network on Ocean Food Systems (OFS). This thematic network is already actively working in this field. The contact persons in the thematic network are: Chair: Professor Barry Costa-Pierce (University of New England) and Vice-Chair: Program Director Catherine Chambers (University Centre of the Westfjords).

This project fits well with the objectives of the OFS thematic network to develop courses in this field and promote student mobility within existing funding-programmes (N2N) and initiating interdisciplinary research in the field of fisheries and aquaculture in the Arctic. Due to the number of synergies, the current project will strengthen the OFS thematic network, which in turn will help secure the future sustainability of the work performed.

The project has also synergies with a project funded by The Arctic Research and Studies Program/preparatory grant agreement 2019-ARS-86956 Climate change and value chains in the Arctic (CCvchainA), funded by the Norwegian and Icelandic ministries of foreign affairs by 281 000 NOK. In this project, an interdisciplinary team of researchers plans for a larger project with community and industry engagement for transdisciplinary solutions to sustainability. The team consists of experts on aquaculture, climate change, ecology, economy, eco philosophy, fish biology, rural development, and tourism. The applicant is The University of South-Eastern Norway, which led the previous project with Hólar University, Iceland as partner. Additional partners are the UIT - The Arctic University of Norway, the University of Iceland and Hólar University.

The aim of this project is to develop applications to EU and Nordfo funds for an international research project that will address the following:

- a. The climate change impact on salmon angling and aquaculture in the Nordic Arctic and Sub-Arctic
- b. The public discourse on issues related to salmon angling, salmon aquaculture and tourism in the region
- c. The value chains of wild and farmed salmonids in the Nordic Arctic and Sub-Arctic
- d. Possible future scenarios for sustainability management of these industries in the region.

In addition to the Ocean Food Systems thematic network, the following institutions will participate in the project:

- UIT - The Arctic University of Norway
- University of New England in Maine, USA
- Hólar University in Iceland
- University Centre of the West Fjords in Iceland

Description of Project Activities:

In this two-year project, we will set up research groups and collaborate on developing different on-line courses. The work in the project will be in four work packages (WP):

WP1: Land based aquaculture of Atlantic salmon. The activities in this work package include two subtasks:

WP1.1: Development of an on-line course in land-based aquaculture of Atlantic salmon. A group of specialists from all participating institutions will collaborate on developing an on-line course on land-based aquaculture of Atlantic salmon drawing on different experiences in the three participating countries. The course will be delivered through Canvas. The course will use recorded lectures mixed with on-line meetings and assignments. The participating institutions, before offering it to other UArctic institutions, will pilot the course.

WP1.2. Collecting information on land-based salmon aquaculture. The same group as in WP1.1 will collect information on the development of land-based Atlantic salmon aquaculture. This will be done through dialogue with fish farmers

and access to the operation of their facilities to identify problems and seeking solutions. This information will then be utilized in the development of the course.

WP2 Analysis of the discourse on Atlantic salmon aquaculture. The objective of this work package is to analyse knowledge gaps in the discourse with the aim to provide reliable information on the environmental and sociological effects of salmon aquaculture. A research group will collect data from the discourse on salmon aquaculture and perform content and discursive analysis. The group will then disseminate the results through workshops to salmon farmers and communities relying on salmon aquaculture.

WP3. Co-ordination. Daily management will be the responsibility of the project co-ordinator who reports to a project management committee with representatives from all participating institutions. The management committee members are contact persons with their respective universities. The management committee is responsible for facilitating student exchange, adopting a communication and action plan for the project and monitoring the project progression.

WP4. Dissemination. Through the project, we plan to have the expert panels meet three times, once in each country. In these meetings, results from the research group will be discussed and the course developed. Also, the meetings will be used to meet with fish farmers and community leaders. At the end of the project, workshops will be conducted in each of the countries.

Concrete Deliverables

The main deliverables of the project are the following:

- a. On-line course on land-based aquaculture of Atlantic salmon first delivered in Norway, then in Iceland and the USA.
- b. Report of expert panel 1 on the development of land-based Atlantic salmon aquaculture.
- c. Report by the expert panel 2 on the discussion of environmental and sociological effects of salmon aquaculture.
- d. Publications in a peer-reviewed journals presenting the results of both research groups.
- e. Workshops held in all three countries presenting and discussing the results of expert panel 2 with fish farmers and community leaders.
- f. Channels for student exchange between the participating institutions.
- g. Meetings of the management committee and annual and final reports of the project.

How will the Outcomes Benefit the Circumpolar World?

The project will provide a much-needed university level education in a relevant field to Arctic communities by developing an on-line course. The course will make this type of education accessible to Arctic communities that are geographically remote and lacking access to higher education. The course will be piloted by the participating institutions before making it accessible to other UArctic institutions.

The project will empower Arctic communities in the discussion on the future development of salmon aquaculture. Salmon farming is the economic foundation for many Arctic communities and an essential part of their sustainability. The results of this project will empower fish farmers and communities with reliable information on environmental, ecological, economical, and sociological impacts of salmon farming.

The project will research fields that are very relevant to the Arctic and disseminate the information through courses and workshops into the communities. Moreover, it will increase the visibility of the North by publishing the results of these studies in peer-reviewed journals.

Project Evaluation and Communication Plan

The execution of the project will be the responsibility of the three person management committee, which consists of members from each institution. The management committee will meet at the three meetings planned and also be in regular contact through email and ZOOM.

The impact of the project will be measured in the number of students attending the on-line course, the number of people attending the workshops and the visibility of the project in media. The sustainability of the project is ensured through the Thematic network Ocean Food Systems and the participating institutions continuing to offer the course as a part of their curriculum.

How the Project fits in with the UArctic Strategic Plan

The project fits well with the UArctic strategic plan. Specifically it:

- Works toward the goal to empower the people of the Circumpolar North by providing unique educational and research opportunities through collaboration within a powerful network of member institutions and researchers dedicated to transdisciplinary work.
- Creates shared knowledge, competences and resources by matching capacity to needs.
- Provides educational access for northern students through the online course developed and workshops.
- Gives students in the North access to the best and most relevant instructional and training resources in the field.
- Bridges dialogue across different sectors and regions of the North, and with the world by providing unbiased information on salmon aquaculture and promotes a healthy dialog among stakeholders based on a scientifically sound basis. As such, it broadens the voice of the North in the world.
- Increases collaboration opportunities for the UArctic of faculty, staff and students through the work in the project and through student exchange.
- Increases the Educational Access for Northern Students
- Expands the Knowledge of the North through research and dissemination