GAIN
Green Aquaculture Intensification

newsletter

Number 3 February 2020

Recent GAIN highlights

A low-cost temperature sensor package to provide early warning of temperature increases to oyster farmers

AFBI has developed a low-cost temperature sensor package to provide near real-time data (daily downloads) in response to oyster farmers main concerns (Stakeholder questionnaire as part of a Queen's University PhD, M. Fox) related to disease as temperature increases. This novel work has been presented at the UK Integrated Marine Observing Network and is a valuable asset to the oyster farmer. Instrumentation of the Dundrum catchment is ongoing to provide early warning for declining water quality, another main concern of the shellfish industry in Northern Ireland.

Aquafeeds to support eco-intensification of fish farms

One of GAIN´s aims is to develop a new generation of sustainable fish feeds specifically designed to facilitate aquaculture eco-intensification through increased circularity and resource utilization. Therefore, 4 trials with trout, salmon, seabream and turbot were performed during the last year in order to access growth performance and health status of fish fed with formulations based on emerging ingredients. Overall the results of new formulations guarantee growth and health performances of the target species when compared with current feed formulations. Eventual positive or negative effects on fish immune status, including several humoral and gene expression parameters are still being assessed. Further results will be released during the next months.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773330 (GAIN).

Precision Aquaculture

The rapid expansion of aquaculture over the past 50 years is pushing farms towards more efficient management practices aimed at the sustainable intensification – or Eco intensification – of the industry. At the same time, innovative technologies are making the collection, processing and analysis of large volumes of heterogeneous datasets possible. Taken together, these two factors are empowering a precision aquaculture framework that combines sensors, cloud, and machine learning to enable real-time, evidence-based decision making to optimise operations.

Precision aquaculture is founded on a variety of sensors and technologies used to gain insight into the farm environment, make decisions which optimise fish health, growth, and economic return, and reduce risk to the environment. Across nine pilot study sites, the GAIN project has deployed hundreds of real-time underwater sensors measuring a range of environmental variables such as temperature, salinity, dissolved oxygen, blue-green algae, chlorophyll and turbidity. Environmental data at multiple locations are collected using probe-type sensors, while information on fish position are provided by innovative acoustic sensors such as CageEye (https://www.cageeye.no/) or Aquaculture Biomass Monitor (https://www.bio-metrics.no/aquaculture-biomass-monitor). Figure 1 presents a schematic of an idealised fish cage.

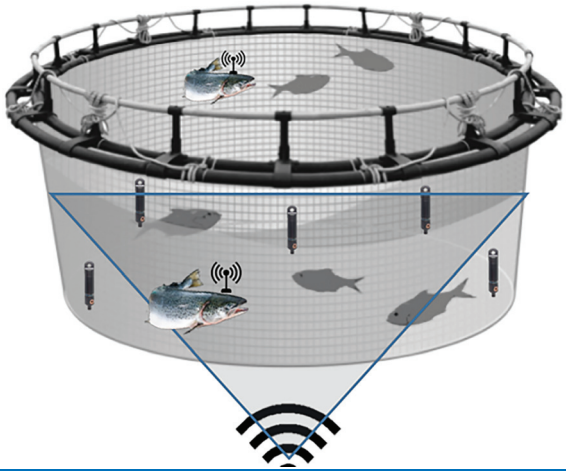

Figure 1: Sensor configuration within a stylized cage. Multiple sensors are deployed within each cage. Operational metrics related to fish position and behaviour are estimated using acoustic systems which can be complemented by a number of individually tagged fish.

All data generated on farms are communicated to IBM® Cloud, utilising the open-standard MQTT Protocol for data transport. For each cage, a comprehensive set of variables are collected, communicated and updated, continuously informing on environmental and animal conditions. As an example Figure 2 presents information on fish behaviour within a cage sampled by the Aquaculture Biomass Monitor – data that can be used to provide insight into fish welfare, biomass, and guide operations such as feeding.

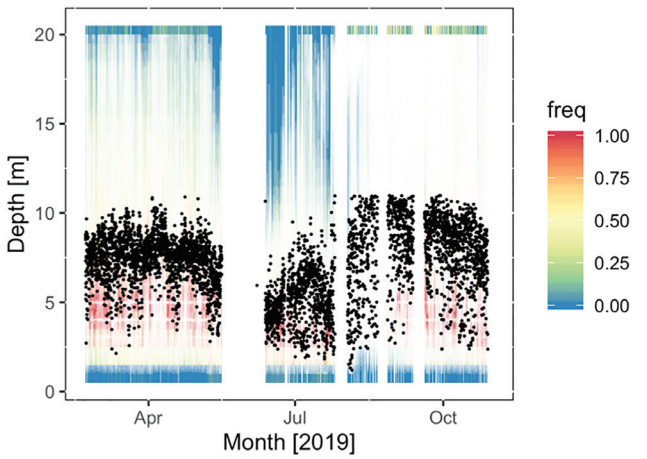

Figure 2: The vertical distribution of fish within a cage as sampled by the Aquaculture Biomass Monitor sensor. The black points denote the average position of the fish while the colour bar denotes the relative intensity of the fish biomass position.

The key objective of precision aquaculture is moving beyond data toward decision. Within GAIN, we are working to transition the aquaculture industry from ad hoc decision making based on heuristics and intuition to real-time informed decisions backed by Artificial Intelligence (AI) insights and Internet of Things (IoT) connectivity. The standardisation and curation of heterogeneous datasets facilitates the development of a range of machine learning and mechanistic models relate to managing aquaculture operations. Examples include:

- Mechanistic and data-driven models to predict fish health, biomass, and mortality based on information on feed and environmental stressors
- Predictive models to inform on outbreaks of parasitic infections
- Deep learning models to forecast oceanographic condition multiple days/weeks in advance

Fish farming is a relatively young industry but, in some ways, has been quicker to adapt to difficult circumstances than land-based farming because of modern technology. The next phase of industrialisation is dependent on using data to inform decision. GAIN is committed to being central to that transition. For further details on this work see our recent paper published in the IEEE IoT Magazine (https://ieeexplore.ieee.org/document/8982744, also available in Open-access at https://zenodo.org/record/3664885#.XkP5gBfLdTZ).

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The European Aquaculture Value Chain

To understand the structure of an industry; who the main actors and stakeholders are, where are the power relationships, who is driving the industry and innovations we use a method called Value Chain Analysis (VCA). Value chain insights are combined with a methodology called Life Cycle Assessment (LCA), which totals the cumulative environmental impact along a supply chain. Together, VCA and LCA give a comprehensive overview of where economic social and environmental bottlenecks are which will underpin the sustainability index for innovations to be developed during the GAIN project.

Work is initially led by the University of Stirling (UoS) with further LCA work led by the University of Venice to analyse EU aquaculture value chains. Fieldwork started in Norway in summer 2019 looking at salmon culture, to be followed by Poland, Italy and Spain for other GAIN species (carp, seabass, sea bream and trout).

Figure 3: Cornelia Kreiss (AWI), Wesley Malcorps (UoS), Richard Newton (UoS), Giulia Micaleff (GIFAS) visiting the GIFAS research site.

The UoS will gain insight into complex international seafood supply chains that European consumers depend upon which will aid understanding of the competitiveness of European aquaculture. Consumers are increasingly aware of sustainability issues and consequently, the industry uses various strategies to promote seafood. UoS, University of Massachusetts, The University of Venice, South China Sea Fisheries Research Institute and Shanghai Ocean University visited major seafood shows in Boston, Brussels, Guangzhou, Shanghai and Qingdao and analysed marketing messaging on trade booths targeting business to business trade representing the largest producers and consumers of seafood in the world.

Complementary work from Alfred Wegener Institute will assess social acceptance of European aquaculture products by cross referencing sustainability and public perceptions aspects. Posters and other information will be posted in public places and questionnaires used to gauge public perceptions. Additionally, UoS will produce a series of videos called ‘Voices from the water’, featuring personal stories from the industry. These videos will be made available through project websites and may eventually be used to help promote instore products. The effects of the improved information availability on consumers attitudes will be analysed.

Figure 4; Silvia Maiolo (University Venice) and Wesley Malcorps (University of Stirling) at the Brussel Seafood Show and researchers from South China Sea Fisheries Research Institute at the Guanzhou Seafood Show.

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Drying protein hydrolysates from aquaculture by-products using a novel drying technology

In January, ANFACO carried out trials on the drying of liquid fish protein hydrolysates (FPH) using a WAISTER dryer being also used in other activities of the GAIN project. These FPH were obtained by enzymatic hydrolyses of fish heads, frames and trimmings resulting from processing of seabass and seabream. The purpose is to obtain a dry ingredient to be used in the novel feeds formulated by SPAROS and testing WAISTER technology on a new application. ANFACO is still working on the subject to sort out issues regarding the low solid content of the raw material that involved mixing the FPH with other ingredients in high proportions.

The GAIN consortium

Ca' Foscari University of Venice
University of Stirling
AWI
IBM
Longline Environment
sparos I&D nutrition in aquaculture
Salten Havbrukspark
CSIC Consejo Superior de Investigaciones Científicas
Wageningen University & Research
Thünen
Multivector
GIFAS
lebeche grupo cumarex
Zachodniopomorski Uniwersytet Technologiczny w Szczecinie
Dalhousie University 1818 2018
South China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences
afbi Agri-Food and Biosciences Institute
ANFACO CECOPESCA
Fondazione Edmund Mach
NOAA

More info:
www.unive.it/gainh2020_eu
twitter https://twitter.com/gain2020
Facebook: https://www.facebook.com/gain2020

Coordination:
Roberto Pastres
Email: gain2020@unive.it

Communication and press:
Email: info@gain2020.eu

Main topics for the coming issue:

- Innovative aquafeed formulations for eco-eficient fish farming

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