

It's all FYNE: How a novel management tool for the salmon aquaculture industry brings together nutrition and environment

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[Twitter abstract: The #FYNE GUI is a management tool for #aquaculture businesses to achieve targets for seafood fatty acid nutritional quality and harvestable weight, while estimating environmental impact and complying with farm discharges' regulation. <https://bit.ly/2Y29i3n> #salmon #kelp #mussels]

Atlantic salmon, *Salmo salar*, is a key source of polyunsaturated fatty acids (PUFA), essential to human health, which is vastly fulfilled by the aquaculture industry worldwide. With salmon farming representing an important sector to the Scottish economy, there is considerable interest in ensuring its environmental sustainability, from the control of farm discharges and minimisation of benthic impacts, to improved animal health and decreased reliance on wild-caught fish for feed.

In recent years, this has prompted research into the potential of integrated multi-trophic aquaculture (IMTA) as an option to reduce the local footprint of fish farms and industry efforts to replace wild-caught fish in feeds with terrestrial ingredients. However, the continued decrease of wild-caught fish in the salmon feeds has reduced the PUFA content in the final product (Sprague et al., 2016), affecting the key marketable and health attribute. It is also unclear how varying the diet composition translates into changes in the farm-level environmental footprint of salmon production, a crucial issue to the sector's regulation and social license to operate. We therefore propose an holistic approach to farm management, which simultaneously considers the nutritional quality of final products and the local environmental impacts at farm-level.

We present a new application for industry to quantify the environmental and nutritional output of both monoculture and IMTA, given multiple operational changes. The FYNE graphical user interface (GUI) allows the user to create a virtual IMTA (currently for Atlantic salmon, blue mussels, sugar kelp) farm or

monoculture (one of the aforementioned species) and predict the consequence of operational changes to the local environment and nutritional output. The user can vary farm location, abundance of cultured and co-cultured species, as well as salmon feed proximate composition. Values selected by the user are input into underlying ecosystem and PUFA models. Modelled outputs include harvestable weight, salmon fatty-acid content and total organic carbon and nitrogen concentrations on the sediment over time. The concentration of the latter nutrients can be used as a proxy for the farm-level environmental footprint.

The FYNE model was designed to support aquaculture operators and feed manufacturers to achieve targets for fatty-acid nutritional quality and harvestable weight, while helping to comply with regulatory frameworks on farm discharges. Current work is being done on model validation and parameterisation of the ecosystem component. To ensure that the GUI offers a comprehensive approach to optimise trade-offs between product nutritional value and local environmental impacts during grow-out stage, future work will include user testing of the GUI by businesses to improve features and enhance user experience,

Acknowledgements

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References

Sprague, M., Dick, J.R., Tocher, D.R. (2016). Impact of sustainable feeds on omega-3 long-chain fatty acid levels in farmed Atlantic salmon, 2006-2015 Sci Rep, 6, p. 21892.