Natural Environment Research Council

CENTA

Research Experience Placement (REP) Scheme 2023

Supervisor Project Proforma

Project title:	The microplastic footprint of aquaculture on the Isle of Skye
Host Institution:	Loughborough University
Project supervisor (name, department):	Thomas Stanton, Geography and Environment
Project enquiries (supervisor email):	t.stanton@lboro.ac.uk
Co-Supervisor, if any (name, department):	Paul Roach, Chemistry
Proposed start date:	10/07/2023

Project description (max 700 words, 1-2 figures may be included):

Proposed projects must:

- have a clearly defined objective.
- be within the science remit of NERC.
- be feasible for a student to complete within the timescale of the award.
- include more than purely a computer/modelling component i.e., some element of fieldwork, data collection, activity to give an understanding of the wider context etc.*
- give scope for thought and initiative on the part of the student and should not use the student as a general assistant.
- be based at an eligible UK research organisation (remote placements are also an option for enabling inclusivity).

Since 2017, aquaculture has contributed between £350 and £600 million to the Scottish economy annually, representing 9% of its marine economy (Marine Scotland, 2023). The UK's aquaculture industry is concentrated on Scotland's west coast (Fig. 1) and is a dominant industry across Scotland's island communities. However, despite its economic benefits, aquaculture is a controversial industry (Osmundsen and Olsen, 2017). Fish loss, spread of diseases, and fertilisation of coastal waters must all be managed by aquaculture sites, and the use of plastic in the aquaculture industry is also known to introduce microplastics to marine environment which can be ingested by the organisms being farmed (Chen et al. 2021). But the most salient impact of aquaculture on Scotland's coastline is the presence of fish farm-associated debris on beaches. The loss of debris is particularly associated with storm events, and once ashore aquaculture gear will persist until it is recovered or breaks down.

Aquaculture debris on Scotland's beaches therefore poses an environmental threat to terrestrial wildlife and people, as well as the coastal zone it originates from, and compromises another key industry of the region: tourism. Once on a beach, plastic debris will degrade over time, fragmenting into smaller pieces of plastic and potentially leaching chemicals into the coastal environment. Many aquaculture sites will recover their debris from beaches, but this is not possible for all beaches, and requires debris to be identified and reported appropriately.

This summer, Dr Stanton will lead fieldwork on the Isle of Skye to investigate the types of litter on the island's beaches, and the significance of this litter to the island's community. Funded by the Sea Changers Innovation fund, this project titled *50 years of litter on Skye* will follow in the footsteps of a 1972 seminal publication documenting sea-borne litter on remote Skye beaches (Scott, 1972). It

will engage with the local community to understand how the types of litter have changed over the past 50 years, and involve the community in its surveying of beaches around the island.

This work commenced virtually in January 2023 through a series of online meetings with the local community. It has identified aquaculture as a dominant form of litter on the island, but also an environmental issue that requires considerable sensitivity as a stable year-round industry that supports the local community.

Conversations with members of the Skye community suggested that some of this aquaculture debris could introduce microplastic particles into the environment. Locals have reported observing small black particles on beaches that may be associated with the internal abrasion of plastic aquaculture feeding tubes, which are also black, during their use to deliver food pellets at high pressure. This has been experimentally demonstrated previously by NORCE (2020).

This CENTA REP project will extend the scope of *50 years of Litter in Skye* with the objective of investigating the role of aquaculture – particularly feeding tubes – as a source of microplastics in marine and coastal environments. Fieldwork will include the surveying of beaches for litter and the collection of reference aquaculture plastics. Beach sediment samples and coastal water samples will also be collected for microplastic analysis. FTIR spectroscopy will be used to compare the chemical signatures of reference aquaculture beach litter with microplastics isolated from sediment and water samples to consider the potential for aquaculture debris to act as a source of microplastic particles during its useful lifetime, as well as once lost to the marine environment. Recognising the sensitive nature of this work, findings will build on Stanton et al. (2022) to carefully consider how the results of the project can inform policies and best practice within the aquaculture industry.

The successful applicant will be required to travel to Skye for fieldwork this summer, with all accommodation costs already covered and travel costs covered by the funding associated with this project. Fieldwork will take place between 22nd July and 5th August 2023, but the applicant will not be required to join for the whole trip if they are not available for all of it.

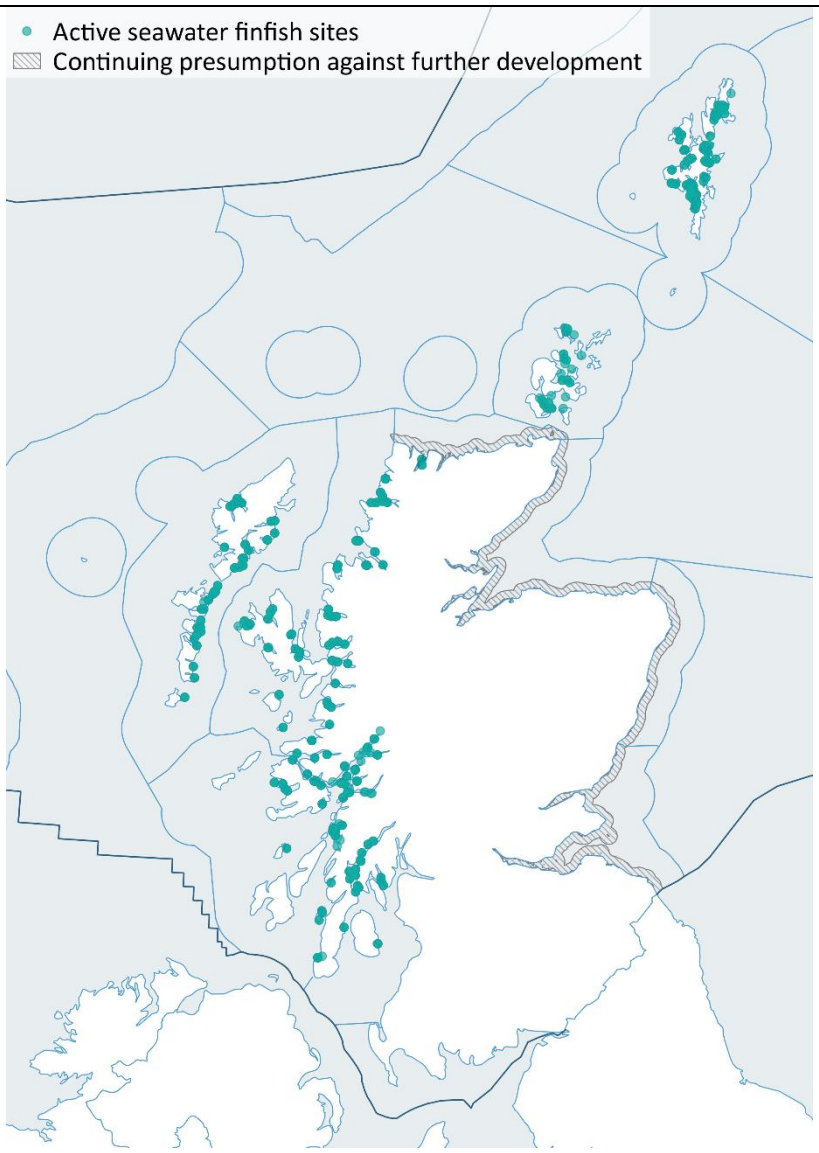

Fig. 1: Map of active finfish aquaculture farms in Scotland from 2019, taken from Marine Scotland (2020)

Project timeline:

Week 1

- Placement researcher to complete health and safety training.
- Project induction.
- Training in sampling and identification methodologies.
- Fieldtrip preparation

Week 2

- Fieldwork on Skye

Week 3

- Fieldwork on Skye

Week 4

- Sample processing
- Microplastic characterization

Week 5

- Sample processing
- Microplastic characterization

Week 6

- Data analysis

Week 7

- Data analysis
- Report writing

Week 8

- Report writing

Candidate requirements:

Essential:

- Availability for fieldwork during field period.
- Be able to work from Loughborough when required for laboratory work.
- Have an ability to work in a laboratory setting.
- Have a willingness to work across the geographical and chemistry disciplines.
- Be willing to work in the field.
- Be willing to undertake repetitive tasks.
- Be willing to learn new sampling and analytical techniques.
- Be willing to write a scientific report based on the results generated during the project.
- Be willing to work as part of a team in the field.

Desired:

- Previous fieldwork experience.
- Previous GIS experience.

Background reading and references:

- Chen, G., Li, Y. and Wang, J., 2021. Occurrence and ecological impact of microplastics in aquaculture ecosystems. Chemosphere, 274, p.129989.
- Hastings, E. and Potts, T., 2013. Marine litter: Progress in developing an integrated policy approach in Scotland. Marine Policy, 42, pp.49-55.
- Marine Scotland 2020. *Aquaculture*. Marine Scotland. Available at: https://marine.gov.scot/sma/assessment/aquaculture
- Marine Scotland, 2023. *Scotland's Marine Economic Statistics 2020*. Marine Scotland. Available at: https://www.gov.scot/publications/scotlands-marine-economic-statistics-2020/documents/
- Osmundsen, T.C. and Olsen, M.S., 2017. The imperishable controversy over aquaculture. Marine Policy, 76, pp.136-142.
- Scott, G. 1972 Plastics packaging and coastal pollution. International Journal of Environmental Studies, 3, pp. 35-36
- Skirtun, M., Sandra, M., Strietman, W.J., van den Burg, S.W., De Raedemaecker, F. and Devriese, L.I., 2022. Plastic pollution pathways from marine aquaculture practices and potential solutions for the North-East Atlantic region. Marine Pollution Bulletin, 174, p.113178.
- Stanton, T., Chico, G., Carr, E., Cook, S., Gomes, R.L., Heard, E., Law, A., Wilson, H.L. and Johnson, M., 2022. Planet Patrolling: A citizen science brand audit of anthropogenic litter in the context of national legislation and international policy. Journal of Hazardous Materials, 436, p.129118.

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To be completed by institutional CENTA PoC

I confirm that:

- Appropriate supervisory arrangements are in place
- Any necessary ethical committee approvals, animal licences & requirements of regulatory authorities will be in place before the work begins and will be maintained for the duration of the project
- We will take responsibility for identification, protection & exploitation of any intellectual property rights arising from the project
- All facilities, agreements regarding access and collaborations necessary for the work will be obtained before the work commences and can be ensured for the duration of the project
- All costs awarded by NERC for the REP will be used and accounted for appropriately
- A report of the project by the student will be submitted no later than one week after the end date of the placement or 15th September 2023, whichever falls first.

Signed:

Date: May 4th 2023

Position:

Professor of Environmental Change

Point of Contact for Centa for Loughborough University