Methodologies for sampling fish populations in Scottish freshwater lochs

Section 1: Project Overview
Introduction

The Centre of Expertise for Waters (CREW) intends to commission a **capacity building project** within **CREW's Hydrological Extremes, Coasts and Risk Management** theme to inform Environmental Impact Assessments under The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, (specifically hydroelectric scheme developments) and to fulfil regulatory requirements e.g., the Water Framework Directive (WFD) and the recently published Scottish Biodiversity Strategy to 2045. The WFD became law in Scotland as the Water Environment and Water Services (Scotland) Act 2003 (WEWS Act) and aims to ensure that waterbodies do not deteriorate in status. The Scottish Biodiversity Strategy sets out a vision that by 2045 Scotland will have restored and regenerated biodiversity in freshwater, marine and terrestrial environments.

Background & knowledge gap

In freshwater lochs, data on the fish species present and their abundance are required for management and conservation purposes and to fulfil regulatory requirements e.g., the Water Framework Directive and the Scottish Biodiversity Strategy. Furthermore, in Scotland there is an increasing number of pumped storage hydro-electric development proposals involving large freshwater lochs and consequently there is an increasing need to carry out fish surveys of waterbodies that are at risk of being impacted.

A variety of methods have been used to obtain these data, including gill netting, seine netting, hydroacoustic, electrofishing and eDNA surveys. However conventional methods for sampling fish populations can be detrimental to fish populations. For example, in England the Environmental Agency have adopted a policy against the extensive use of gill nets. While similar approach to gill netting is not currently applied in Scotland, the extensive use of a large number of gill nets is not encouraged. Furthermore, the combined use of quantitative hydroacoustic techniques with a lower level (compared to the more numerous nets used in the extensive gill netting surveys) of targeted gill netting, using standardised Nordic multi-mesh nets, was introduced as a means of providing abundance estimates specifically for Arctic charr, powan and vendace populations. eDNA metabarcoding, to identify the species of fish present, has been used for classifying the presence and relative abundance of fish in British Lakes. However, whilst this technique has many advantages, it does have some limitations.

There is a need to: 1) agree what type and level of information is appropriate to allow an assessment of the status of fish species within potentially impacted lochs; 2) review the ability of existing methodologies to provide the data required; and 3) provide recommendations on the best techniques for regulators and advisers in Scotland (e.g., SEPA, NatureScot, Scottish Government Marine Directorate) to recommend to prospective developers in order to enable them to provide a satisfactory evaluation of the potential impact on fish populations.

Aim and key questions

The overall aim of this project is to review available fish sampling techniques in freshwater lochs in Scotland, including the limitations of each method, and to provide recommendations on the best techniques for regulators and advisers. The outcome of the project is to produce guidance on agreed techniques that can be adopted by developers to enable them to meet regulatory requirements.

Through an **expert led workshop** the project will address these key questions:

1. What are the available fish sampling techniques[1] in freshwater lochs?
2. What are the limitations posed by each individual method?
3. What monitoring techniques are most reliable and cost effective for detecting different fish species in Scottish lochs?
4. What method(s) is optimum under a given set of conditions?
5. What techniques are least invasive on fish populations?
6. What techniques provide good quality data that can be used on a range of spatial and temporal scales?

Intended impacts

There are multiple pathways for a project to achieve impact, and multiple factors that can impact the project's ability to achieve what it intends to do; both along the project lifecycle (A.IMPACT) and beyond project completion (B.IMPACT) (Figure 1).
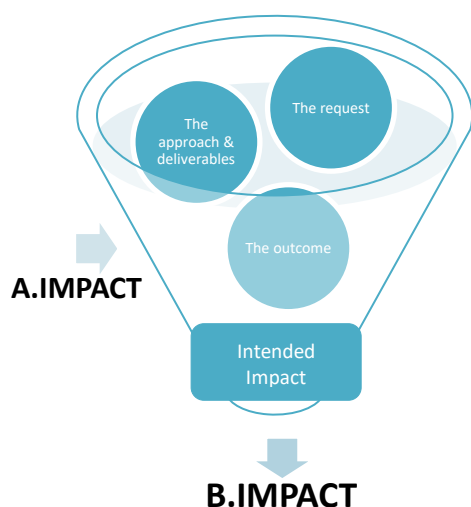
- **The request**: the problem/ gap that has been identified that drives the project.
- **The approach & deliverables:** the 'methods' that explain how the request is being answered and the 'outputs' that are tangible products delivered by the project.
- **The outcome:** this is directly correlated to the findings; this is short to mid-term change because of the research.
- **Intended impact:** Explicitly what this project intends to achieve to address, which is connected to the request.
- **Along impact**: the conditions and causal factors that can influence the project during its life cycle.
- **Beyond impact:** more significant wider change that occurs at a longer timescale following the project's completion.

Figure 1:Pathways to impact

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[1] It is desirable that these fish surveys should be carried out using agreed standardised survey methods to provide information on fish species composition, abundance, and age structure. The review should consider variations in techniques and comparison of UK and EU wide techniques.

Along Impact *(A.Impact)***:**

These stakeholders are anticipated to be a key influence on this project:

- NatureScot
- SEPA
- Scottish Government Marine Directorate
- Scottish Canals
- SFCC

Beyond Impact *(B.Impact)***:**

The intended audience for the project deliverables include:

- Scottish Government Marine Directorate
- NatureScot
- SEPA

The project deliverables (see following section) will produce guidance to allow developers to ascertain fish populations across temporal and spatial scales and thereby contribute to regulatory requirements. The consistent use of agreed sampling methodologies should ensure that fish populations in freshwater lochs are surveyed appropriately for habitat types and fish communities in the respective waterbody and to meet data requirements.

Deliverables

- Communications and impact plan for the workshop which includes:
    - Stakeholder Exploration (Stakeholder contact list to be developed with project steering group assistance)
    - Stakeholder mapping (Consideration of stakeholder influence: interest to the project)
    - Stakeholder communication strategy
- One in-person expert led workshop in a central location (anticipated to be a 1-day workshop)
- Workshop report *(max 15 pages, excluding annexes and the bibliography)*
- A plain English summary of aims and results *(up to 1 page)*
- Website summary *(200 words)*

Meetings

- Two Project Steering Group meetings throughout the project lifecycle[2] *(1 in-person, 1 online)*

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[2] Please note, CREW requests a brief written update c. two weeks prior to project steering group meetings.

Section 2: Further information for applicants

Project management

Day-to-day communication will be between the research/review team (the contractor) and a CREW Project Manager and is likely to involve short catchups as agreed.

Project steering group

A small group including representatives of Scottish Government and its delivery partners plus a CREW representative, will meet with the preferred bidder for a pre-contract meeting and provide feedback on the bidder's proposed approach.

Anticipated timescale

A pre-contract meeting will be held **c. wb.8**th**January 2024.** The project will commence on **wb.15**th **January 2024**. The workshop should take place **wb.19**th **February 2024** with the project outputs signed off by the CREW Director by **22**nd **March 2024.**

Funding

The maximum amount of funding available **exclusive of VAT** (where applicable) is £45,000

This includes an associated costs (excluding sub-contractor) budget of: £4500

- £2750 for 1 in-person workshop including the room, catering and equipment hire
- £1000 for travel and subsistence
- £750 for one project steering group in-person meeting

Submitting a proposal

Please send a completed application form using the most recent version (the link to this form is available on the CREW Call for Proposal webpage (Call for Proposals | CREW | Scotland's Centre of Expertise for Waters) addressing the project requirements.

A copy of expectations and the award criteria are provided below for reference.

Proposals need to be submitted to Procurement@crew.ac.uk for evaluation **by 15:00 on 28**th **November 2023.** We aim to notify the successful bidder by **15**th **December**.

Please contact Procurement@crew.ac.uk if you would like any clarification on any of the above **by 21**st **November 2023**. You should highlight any potential conflicts of interest in your proposal. For queries about what may constitute a potential conflict of interest please contact the CREW Deputy Manager (Nikki.Dodd@hutton.ac.uk).

Expectations

No.		Criteria	Descriptor
1		Duration	The proposed duration will align closely to the details provided in the anticipated timescales section of the specification.
2		Staff time and effort	The proposed allocation of staff time and effort is appropriate and includes all deliverables. The proposal provides a commitment that named staff members will be available to work on the contract if the bid is successful. For any unnamed staff, appropriate risk identification and mitigation measures are provided.
3		Project costs	The estimated breakdown of project costs is realistic and inclusive of all deliverables.

Award criteria

No.	Criteria	Descriptor
1	Understanding the project ask and policy background	The proposal should include an introduction which demonstrates a clear understanding of the project requirements. This should include an understanding of the policy background and the supporting role of this project; the need for this research; the project aim; and how the proposal will address this aim.
2	Proposed methodology	The proposal should demonstrate a high quality and workable methodology, including: how the evidence will be identified, reviewed and assessed; consulting relevant stakeholders and/or experts where appropriate to address the key questions and produce the deliverables in the timescales required. It should explain the suitability, robustness and limitations of the proposed methodology.
3	Milestones	The project milestones are logical, practical and include all deliverables.
4	Project Management	The staff, resources and expertise are appropriate for conducting the proposed project. The proposal should name the project lead and outline their project management experience.
5	General and specific topic expertise and experience	The proposal should provide details of individual staff members who will work on this project and demonstrate how they will meet the project requirements, specifically: - general research experience and expertise; - specific experience and expertise on the topic of fish population data requirements to fulfil regulatory and statutory requirements. Good understanding and experience of the different available fish sampling techniques in freshwater lochs. Good communication and engagement skills.
6	General communication and deliverables	The proposal should describe the approach to producing the deliverables, which will be published on the CREW website. It should detail who will take lead responsibility for report-writing and overall report quality. It should provide examples of workshops and previously published workshop reports in which they have been involved.
7	Quality assurance	The proposal should provide details of quality assurance procedures to demonstrate how the contract will be continuously delivered to a high standard. It should specifically address issues of quality control at different stages of the project, including evidence gathering, analysis and report writing. It should include a timetable for delivery of tasks, project milestones and allocation of staff and staff time against each task, covering the duration of the contract.
8	Risk	The proposal should provide a risk assessment matrix detailing any risks identified in relation to the delivery of this contract, and proposed mitigation measures to minimise their probability and impact, focused particularly on risk to completion on time.

Annex A. Relevant reports, studies and policies

- Natural England (2017) Designing a methodology for surveying fish populations in freshwater lakes. Natural England Commissioned Report NECR230 https://nora.nerc.ac.uk/id/eprint/516719/1/N516719CR.pdf
- Joint Nature Conservation Committee (2015) Common Standards Monitoring Guidance for Freshwater Fauna, Version October 2015. JNCC, Freshwater, ISSN 1743-8160
- Water Framework Directive – United Kingdom Technical Advisory Group (2021) UKTAG Environmental Standards GB Lake Fish e-DNA Assessment procedure GB Lake Fish e-DNA Assessment Procedure | wfd uktag
- Gilbey, J., Carvalho, G., Castilho, R., Coscia, I., Coulson, M.W., Dahle, G., Derycke, S., Francisco, S.M., Helyar, S.J., Johansen, T. and Junge, C., (2021) Life in a drop: Sampling environmental DNA for marine fishery management and ecosystem monitoring. *Marine Policy*, *124*, p.104331.
- Appelberg, M. (2000) Swedish standard methods for sampling freshwater fish with multi-mesh gill nets. Fiskeriverket Information 2000:1.
- Cruickshanks, K., Pauperio Castro, J., Tayleur, C., Bakker, J., Craig, H., Harper, L.R., Wort, E., Flintham, H., Victor-Matei, A., Devenish, C., Bruce, K., Egeter, B. (2022) Phase 1 Report – Developing Habitat Scale DNA Monitoring in Support of Post 2020 Biodiversity Reporting Requirements. NMP/001/20. NatureMetrics.
- Knudsen, F. R., Saegrov, H., (2002) Benefits from horizontal beaming during acoustic survey: application to three Norwegian lakes, *Fisheries Research*, 56 (2), pp. 205-211
- Champ, W.S.T., Kelly, F.L. and King, J.J. (2009) The Water Framework Directive: using fish as a management tool. *Biology and Environment: Proceedings of the Royal Irish Academy* 109B, 191–206
- Boivin-Delisle, D, Laporte, M, Burton, F, Dion, R, Normandeau, E, Bernatchez, L. (2020) Using environmental DNA for biomonitoring of freshwater fish communities: Comparison with established gillnet surveys in a boreal hydroelectric impoundment. Environmental DNA. 2021; 3: 105–120. https://doi.org/10.1002/edn3.135
- Radinger, J, Britton, JR, Carlson, SM, Magurran, A.E., Alcaraz-Hernandez, J.D., Almodovar, A., Benejam, L., Fernandez-Delgado, C., Nicola, G.G., Oliva-Paterna, F.J., Torralva, M., Garcia-Berthou, E. (2019) Effective monitoring of freshwater fish. Fish Fish. 2019; 20: 729–747. https://doi.org/10.1111/faf.12373
- British Standards Institution (2015) Water quality – Sampling of fish with multi-mesh gillnets. BS EN 14757:2015, BSI, London.
- Di Muri, C., Lawson Handley, L., Bean, C.W., Benucci, M., Harper, L.R., James, B., Li, J., Winfield, I.J. & Hänfling, B. (2022). Spatio-temporal monitoring of lake fish spawning activity using environmental DNA metabarcoding. Environmental DNA 00, 000-000. https://doi.org/10.1002/edn3.343
- Bean, C.W. (2003a). A standardised survey and monitoring protocol for the assessment of Arctic charr, Salvelinus alpinus L., populations in the UK. Joint Nature Conservation Committee, Peterborough 41pp.

- Bean, C.W. (2003b). A standardised survey and monitoring protocol for the assessment of whitefish, Coregonus albula (L.) and C. lavaretus (L.), populations in the UK. Joint Nature Conservation Committee, Peterborough 43pp
- CEN (2014). Water quality - Guidance on the estimation of fish abundance with mobile hydroacoustic methods. EN 15910:2014
- Griffiths, N.P., Hänfling, B. & Bean, C.W. (2023). Environmental DNA based approaches to Site Condition Monitoring of Fish in Standing Waters (eDNA-SCM). Unpubl. NatureScot Research Report.