

	<p><b>International Atlantic Salmon Research Board</b></p> <p><i>Modified Proposal for an Updated Comprehensive trans-European Genetic Reference Baseline to Assign Atlantic Salmon (<i>Salmo salar</i>) to Rivers and Region of Origin across the Eastern North Atlantic</i></p>	<p><b>ICR(23)19</b></p>
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***Modified Proposal for an Updated Comprehensive trans-European Genetic Reference Baseline to Assign Atlantic Salmon (*Salmo salar*) to Rivers and Region of Origin across the Eastern North Atlantic***

**Purpose**

The purpose of this paper is to inform the Board of a modified proposal for funding to enable the Board to make decisions on the modified proposal.

**Background**

As you may recall, at the [2023 Annual Meeting of the Board](#), an updated version of a proposal endorsed in 2022, entitled a ‘Proposal for an Updated Comprehensive trans-European Genetic Reference Baseline to Assign Atlantic Salmon (*Salmo salar*) to Rivers and Region of Origin across the Eastern North Atlantic’, ICR(23)11, was submitted by the UK for the Board’s consideration. This updated Proposal sought strategic funding of €41,000 from the Board’s International Atlantic Salmon Research Fund to promote the international aspect of the initiative.

The Board was very supportive of the proposed work. The Board asked for the rationale for hosting a hybrid, rather than virtual, scoping workshop as this accounted for €10,000 of the €41,000 estimated costs. This information was not available at the meeting and the Secretariat was asked to seek this information and to confirm who is the lead scientist on the proposed project. The Board indicated that it would consider providing €10,000 (or less if virtual) for the scoping workshop once the rationale for the hybrid meeting had been explained. The Board agreed to make a decision on funding the scoping workshop, by correspondence, once the information sought had been provided.

**Information Provided**

The consortium working on the proposal has now submitted a modified version of the proposal, (Annex 1), along with the other information sought by the Board as follows:

- Vidar Wennevik (Norway) will lead the project; and
- the rationale for a hybrid workshop would be the possibility to meet in person with the student doing the analysis, draft a more detailed project proposal on the spot with the whole team, and to physically bring tissue samples to the lab doing the analysis.

As you will see in the modified proposal, the consortium now seeks the lesser amount of €19,000 funding **for this year**.

**Decisions**

The following decisions are required:

1. Given the information provided, do you agree that the International Atlantic Salmon Research Fund provides the ~€3,000 to support a hybrid two-day meeting at the Institute of Marine Research (IMR) in Norway?

2. Do you agree that the International Atlantic Salmon Research Fund provides the estimated costs of ~ €16,000 to support 200 post-doc hours based at IMR in Norway to collate information on the various sample and data availability across the eastern Atlantic and Baltic range and to perform both a power analysis of new baseline capabilities and to examine novel analytical methods of performing robust GSI?

Secretariat  
Edinburgh  
24 August 2023

***Proposal for an Updated Comprehensive trans-European Genetic Reference Baseline to Assign Atlantic Salmon (*Salmo salar*) to Rivers and Region of Origin across the Eastern North Atlantic***

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## **Background**

Genetic Stock Identification (GSI) can be a useful tool for fisheries managers as it can identify contributing stocks in Mixed-Stock Fishery (MSF) samples. GSI studies depend on the existence of a comprehensive genetic baselines, which should include samples from all stocks likely to be present in the assignment sample and consist of genetic marker panels of sufficient discriminatory power to be able to differentiate among contributing stocks, and ideally differentiate among individual populations, i.e., more-or-less discrete reproductively isolated groups of individuals.

There are several genetic reference baselines in use presently across the Atlantic salmon species range facilitating stock assignment at different levels of resolution. At a continental level of resolution, fish have been assigned with high accuracy to either North American or European rivers using microsatellites (e.g. Sheehan, et al. 2010), and Single Nucleotide Polymorphisms (SNPs) (e.g. Jeffery, et al., 2018). In the Northwest Atlantic (NAC) area a SNP baseline is also used to assign fish from the Northwest Atlantic at a relatively high-resolution to 22 regional groups (Bradbury, et al., 2021). In the Northeast Atlantic (NEAC) area assignment a microsatellite genetic baseline originally developed for the SALSEA-Merge project (Gilbey et al., 2018) provides accurate individual assignment of fish to eighteen European regional stock groups. However, the SALSEA reference baseline of Gilbey, et al. (2018) has relatively coarse assignment units in areas of its coverage (e.g., the salmon populations of Britain and Ireland are assigned to as a single group, similarly it is difficult to separate populations and regional groups in large parts of Norway). Within Europe there are also several other reference genetic baselines which provide enhanced resolution at a within country level but are not based on standardised marker panel sets and as a result have limited applicability across the range. For example, in Scotland a 288 SNP marker baseline allows Scottish fish to be assigned to 18 assignment units (Gilbey, et al., 2016). In Ireland a 17-microsatellite panel baseline has been used to assign to individual rivers (P McGinnity *pers. comm.*). In the northern European part of the range a 31-microsatellite baseline is available that enables assignment to 26 reporting groups (Ozerov, et al., 2017) within northern Norway and Russia. The coverage of this baseline has now been extended to include also southern Norway and is expected to increase the number of reporting groups in Norway significantly (analysis ongoing at present). The same marker set has also been applied to extend the number of markers for a select set of Scottish and Irish rivers that were included in the SALSEA-Merge baseline.

## **Requirements**

There is a need for an enhanced genetic baseline which covers species distribution across the rivers in the entire eastern Atlantic, but at a much greater resolution than is currently available. New stock assessment initiatives and associated management such as for example the Life Cycle Model (ICES 2021) would benefit substantially from stock discrimination and assignment units across the range with a single European reference baseline at a much finer resolution than is currently available.

## Progress

Work has been ongoing on the development, testing and application of a new genetic baseline in Norway and Russia based on a highly discriminatory panel of 31 microsatellite loci with the comprehensive sampling of 272 rivers. In addition, 85 rivers from Scotland and Ireland have recently been included in this new baseline (37 Irish rivers 48 Scottish rivers). A final QC of genotypes from recently acquired data is now underway and assessment of the assignment resolution will commence soon. Investigations are also underway on the feasibility of converting and deploying the new Norwegian microsatellite marker panel from older fragment size analysis technology to a new high-throughput genotyping by sequencing platform which is the state-of-the-art approach and increasingly the standard in most laboratories. This would allow for further use of the comprehensive European baseline already developed. A consortium of 23 scientists from all 14 European countries with salmon rivers, have expressed an interest in participating in the development of an extended and enhanced baseline based on the new Norwegian microsatellite panel.

The objectives of ongoing preparatory investigations are to determine: 1) what level of assignment resolution can be achieved with the new 31-microsatellite panel; and 2) assess whether the marker can be screened using the modern high-throughput genotyping by sequencing. Once these questions have been addressed, discussions will progress focusing on whether the new panel of markers has sufficient merit in respect of stock and individual river discriminatory power to roll out across the species European distribution or should other panels (e.g., SNPs) be the focus of future work. Furthermore, some consideration is being given to the advantages of adding extra markers (i.e., adaptive markers linked to important life history traits) to the panel.

## Proposal

Considering that a new panel is already well established and ongoing collaborations, focusing on the development of an enhanced baseline which strategically could be valuably deployed for the assignment of salmon collected in fisheries and surveys in East- and West Greenland and in the Irminger Sea, are in early stages of discussion, some strategic funding from the International Atlantic Salmon Research Board would be extremely beneficial in promoting the international aspect of the initiative

Thus, in the current year the plan for taking the work forward and associated funding requests are:

- 1) Funding to support a hybrid two-day meeting (workshop format) at Institute of Marine Research (IMR) in Norway of the five principal scientists who have been instrumental in previous baseline building collaborations and have been leading the preliminary discussions on future directions and new eastern Atlantic baseline requirements. This workshop will be used to produce an outline plan which will detail options for the development and application of a trans-European baseline to be discussed by a larger international consortium. **Estimated costs: ~€3,000**
- 2) The draft plan developed during the workshop will be presented in advance to representatives with genetic expertise from all countries with salmon rivers in the eastern Atlantic and Baltic Sea. Preliminary discussions have already been had with these representatives, and a high level of interest has been expressed in the development of a new baseline. Countries which have expressed an interest are Denmark, England, Finland, France, Germany, Iceland, Ireland, Northern Ireland, Norway, Portugal, Scotland, Spain, Sweden, and Wales. A virtual workshop will then be held where all collaborators can discuss the draft plan and outline what data/coverage/markers they have, the issues they

would like to be able to address, and the preferred methods of taking things forward. Discussions will also be had regarding technical issues around the development of a new baseline (marker choice, platforms for screening etc). Following the meeting the principal project partners will draw together and circulate an updated draft project proposal which will aim to address all issues raised at the virtual workshop and outline the approach to be taken going forward. **Costs: Nil** (virtual meeting and time given by principal scientists pro bono).

- 3) Following the virtual meeting and the development of the plan to take the project forward, a small amount of funding will be required to support 200 post-doc hours based at IMR in Norway to collate information on the various sample and data availability across the eastern Atlantic and Baltic range. Time to be also used to perform both a power analysis of new baseline capabilities and to examine novel analytical methods of performing robust GSI. **Estimated costs: €16,000**

Deliverable: Report outlining data availability power analysis and future directions. To be presented at ICES WGNAS and IASRB in 2024

- 4) The principal scientists will bring together the information from the collaborators captured from the virtual workshop, together with the power and analytical information gained from the preliminary analysis, to develop a full project proposal. **Costs: Nil** (virtual meetings and time given by principal scientists pro bono).

**We therefore this year seek total funding of €19,000.**

## **Roadmap**

### Short-term (over next 6 months)

- QC existing 31-microsatellite reference data: - ongoing
- Perform power analysis to examine levels of resolution
- Identify datasets/samples
- Investigate new developments in screening platform and genetic marker options
- Hold meeting with interested parties to examine options for eastern Atlantic genetic baseline coverage
- Identify topics of international, pan-Atlantic, interest and research questions that can be addressed with the updated genetic baseline, with input from NASCO Parties, ICES Expert Groups, and project partners

### Medium-term (over next 6 months-2 years)

- Set-up consortium/project to update reference baseline across the species range in the eastern Atlantic
- Screen samples from across eastern Atlantic with optimum marker set
- Perform and publish marker set and power analysis
- Publication of Report to ICES WGNAS and IASRB
- Establish a large-scale international collaborative project and in conjunction with partners from the western Atlantic to update and apply the enhanced baseline across the species range to address questions of international importance relating to the biology of Atlantic salmon at sea
- Acquire appropriate- scale funding for this project (estimated at €1.0-3.0 million)

### Longer-term (2+ years)

- Screen marine samples from areas of interest, and/or to address specific questions of importance and use enhanced resolution to examine stock specific distributions
- Establish an open Database of genetic baseline data
- Communicate project findings to stakeholders such as ICES Expert Groups and NASCO

### **References**

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