Report on the field sampling activities in 2023 for the GeneFlow project

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1. Executive summary

There is increasing international and national concern for the conservation status of wild Atlantic salmon due to the threat of genetic introgression (i.e. harmful gene flow) from farm escaped fish into recipient wild populations. High levels of such gene flow into wild populations of Atlantic salmon may result in the disruption of their genetic and biological integrity, resulting in life history changes, reduced productivity and ultimately the loss of locally adapted populations. Ireland does not currently monitor the genetic status of its wild Atlantic salmon populations even though salmon farming is a significant endeavor along its Atlantic coast.

To address this deficit, University College Cork (UCC), Inland Fisheries Ireland (IFI) and Teagasc formed a partnership for the tender by the Marine Institute to undertake the project, "provision of the services to determine the level of genetic introgression in Irish wild salmon stocks from farmed escape salmon" (RFT ITT23-015). The project aims to establish a genetic baseline, deploying recently developed state-of-the-art genomics, by which the current and future status of wild Irish salmon populations with regard to genetic introgression from farmed escaped salmon can be assessed and reported.

The project aims to sample 200 salmon stocks from 144 salmon designed rivers in Ireland in the period 2023 to 2026. In the first year of this project, a total of 99 rivers were sampled between August 2nd and September 30th 2023, which comprised a total of 122 individual sites sampled. From this effort, full genetic collections were obtained from 88 individual catchments comprising a total number of 3,351 samples. The GeneFlow project is supported by funding provided by Inland Fisheries Ireland and the European Maritime, Fisheries and Aquaculture Fund.

2. Introduction

Inland Fisheries Ireland (IFI) is the State agency responsible for the protection, management and conservation of Ireland's inland fisheries and sea angling resources and is the competent authority in relation to “fish” elements of the EU Habitats Directive (European Commission 2000). Ireland has over 74,000 kilometres of rivers and streams and 128,000 hectares of lakes all of which fall under the jurisdiction of IFI. Wild salmon in Ireland are managed on a river-specific basis and comprise 144 salmon designated stocks in addition to *c*. 30 more minor systems with small populations of salmon present. The salmon farming sector in Ireland is principally active in the south-west, west and north-west of the country with *c*. 20 farms currently in operation. This sector produces between 12,800 and 19,300 tonnes of farmed salmon annually in recent years.

There is increasing international and national concern for the conservation status of wild Atlantic salmon due to the threat of genetic introgression (i.e. harmful gene flow) from farm escaped fish into recipient wild populations. High levels of such gene flow into wild populations of Atlantic salmon may result in the disruption of their genetic and biological integrity, resulting in life history changes, reduced productivity and ultimately the loss of locally adapted populations. Ireland does not currently monitor the genetic status of its wild Atlantic salmon populations even though salmon farming is a significant endeavor along its Atlantic coast.

To address this deficit, University College Cork, Inland Fisheries Ireland and Teagasc have formed a partnership for the tender issued by the Marine Institute to undertake the project “provision of the services to determine the level of genetic introgression in Irish wild salmon stocks from farmed escape salmon” (RFT ITT23-015) (GeneFlow). The project aims to establish a genetic baseline, deploying recently developed state-of-the-art genomics, by which the current and future status of wild Irish salmon populations with regard to genetic introgression from farmed escaped salmon can be assessed and reported.

The GeneFlow project is intended to run over a three-year period from 2023 to 2026 with up to 200 salmon stocks in Ireland designated for sampling and characterisation in regard to genetic introgression. IFI were tasked with collecting the field samples for the project. This document reports on the field sampling work undertaken in order to collect samples for the first year of the project. The field sampling element of the GeneFlow project was jointly funded by IFI and the European Maritime, Fisheries and Aquaculture Fund.

The IFI project team comprised:

- Dr Michael Millane (IFI, Senior Research Officer)
- Owen Kelly (IFI, Fisheries Inspector)
- Alastair Dudman (IFI Fisheries Officer)
- Miquel Fernandez (IFI Fisheries Officer)
- Local IFI River Basin District staff throughout the country
- John Coyne (IFI Research Officer) GeneFlow Funded
- Kevin Coogan (IFI Fisheries Assistant) GeneFlow Funded

Project supervision was provided by Michael Millane (Senior Research Officer, IFI) and Owen Kelly (Fisheries Inspector, IFI). The project team was supported by IFI River Basin District (RBD) staff and local expert knowledge throughout the country. The sample collection programme was conducted under the guidance of the GeneFlow project leader Prof. Phil McGinnity (UCC).

As part of the GeneFlow project extensive preparatory work was resourced, funded and undertaken by IFI in advance of the field sample collection. These included:

- submission of the project to the IFI Ethics Review Committee;
- submission of a Section 14 to undertake field sampling;
- preparation of a screening Appropriate Assessment;
- development of a Standard Operating Procedure (Appendix 1);
- hiring and induction of a Research Officer, a Fisheries Assistant and two Fisheries Officers and provision of PPE (Personal Protective Equipment);
- hosting of a two-day training programme at the National Salmonid Index Catchment which included provision of training to field personnel in the sampling techniques (fish identification, sampling processing, regulatory obligations; and electrofishing);
- provision of GIS data and expert resources to support sampling site identification;
- provision of a vehicle for one of the field teams; and
- provision of two sets of electrofishing equipment.

In addition, IFI provided funding to cover the operations of the additional field sample collection team including salaries, and travel and subsistence costs; as well as allocating, in-kind, the project management and supervisory resources of their permanent staff, which were significant, particularly during the preparatory and reporting phases of the project.

3. Methods

3.1. Sampling design

The key criteria of the sampling design to collect samples in the field were:

1. To provide sufficient national coverage as it is important to sample potentially affected and unaffected rivers to garner some determination of deviations from background levels of genetic variation;
2. To collect at least one sample from each of the principal identified salmon rivers (n=144);
3. To collect samples from a range of rivers with different population sizes on basis that small rivers are likely to be impacted proportionally more than larger ones, while impacted larger ones will likely produce more hybridised offspring;
4. To sample populations from two putative Irish phylogeographic lineages, namely Celtic and Boreal phylogeographic groups (Payne *et al.* 1971);
5. To identify and sample rivers substantially below conservation limits as demographically compromised populations are more susceptible to hybridisation than demographically strong populations (Hansen & Youngson, 1998, TEGOS 2023);
6. To prioritise areas where salmon farming is practiced or has previously been practiced https://www.marine.ie/site-area/areas-activity/aquaculture/locations-salmonid-farms;
7. To prioritise rivers and river samples where sampling has occurred previously i.e. the sampling carried out in 2006/2007 as part of the National Stock identification Project;
8. To utilise contemporary and historical spawning area distribution nationally based on field information mapped onto GIS in 2006 and supplemented by interrogation of the full national geo-rectified 1m resolution aerial photography database held by the Department of the Environment, Climate and Communications.
9. To prioritise spawning sites on the lower sections of individual river systems as most likely locations for spawning of farmed salmon (Clifford *et al.* 1998);
10. In the larger river systems with high potential for genetic structuring (usually associated with lakes) to ensure sampling of multiple populations e.g. the Moy river system (Dillane *et al.* 2008).
11. In rivers where significant genetic introgression is detected in year 1 and year 2 to re-sample the same sites in years 2 or year 3.
12. To include in site selection GIS calculated route planning to determine the most time and energy efficient sampling programme.

3.2. Preparations for field sampling

The following work was done in preparation for the field sampling:

- the project proposal was submitted to and approved by the IFI Ethics Review Committee;
- a Section 14 approval was secured to undertake field sampling;
- a screening Appropriate Assessment was produced and approved;
- a Standard Operating Procedure was finalised (Appendix 1);
- A Research Officer, a Fisheries Assistant and two Fisheries Officers were hired to comprise two sampling teams; and
- training was provided in the sampling techniques (fish identification, sampling processing, regulatory obligations; and electrofishing (Electric Fishing Technical Services).

3.3. Field sampling

Full details on the field sampling are contained in the SOP (Appendix 1). Sampling was undertaken between August 2nd and 30th of September 2023.

Figure 1 Sampling for the Geneflow project – River Inny (SWRBD).

The two field sampling teams (IFI and GeneFlow funded) each consisted of two staff sometimes supported by IFI Operations local colleagues. IFI provided each team with a single electrofishing backpack with an appropriate control unit (DC converter), a cathode and an

anode used per team to capture candidate juvenile salmon for genetic sampling. Fishing was carried out by walking in an upstream direction and point source sampling over every 15-20m of riverbed, retaining one-two individuals per effort. The prime goal of this qualitative sampling method was to cover a sufficient length of river in order to minimise sibling bias and represent the overall genetic composition of the fry year class as much as possible.

The sample target per catchment was forty 0+ Atlantic salmon fry. However, when numbers were low, this was complemented by the collection of samples from 1+ parr. Individual 0+ fry for sample retention were euthanised by MS222 anaesthetic (Appendix 1). Retained salmon were then measured for fork length (to the nearest mm) and samples were preserved in ethanol for later DNA extraction. A subset of 15 samples were preserved in RNAlater to facilitate profiling for transcriptional genetic markers. In order to minimise the inadvertent risk of spreading invasive species, standard IFI biosecurity measures were undertaken by the field teams when moving between sampling sites (Appendix 1).

3.4. Identification

The identification Atlantic salmon fry is a critical component of the project. The primary error potentially occurs in the form of misidentifying salmon as brown trout (*Salmo trutta*) fry. Over the course of two days at the National Salmonid Index Catchment (NSIC) Erriff, all staff were provided with training to aid correct identification which involved instruction on the visual and morphological differences between both species at 0+ and 1+ year classes (Table 1 and Figure 2).

Table 1 Characteristics of juvenile Atlantic salmon and brown trout (adapted from Bremset and Berg, 1999).

No.	Features	Atlantic salmon	Brown trout
1	Pectoral fin	Very long, broad with sharp lobes, reach beneath the anterior of the dorsal fin (white dashed line)	Short, relatively narrow and rounded, do not reach the anterior of the dorsal fin
2	Adipose fin	Brownish	Dark red
3	Tail fin	Forked with sharp lobes	Not forked, lobes are rounded
4	Anal fin	Brownish	White at apex
5	Maxilla	Reaches the posterior of iris. Does not extend past eye (white dashed line)	Reaches the posterior of eye (black dashed line)
6	Body shape	Slim, cylindrical body	Relatively deep body
7	Body pigmentation	Few red spots concentrated around the lateral line (white circles)	Several red spots all over the flanks (black circles)

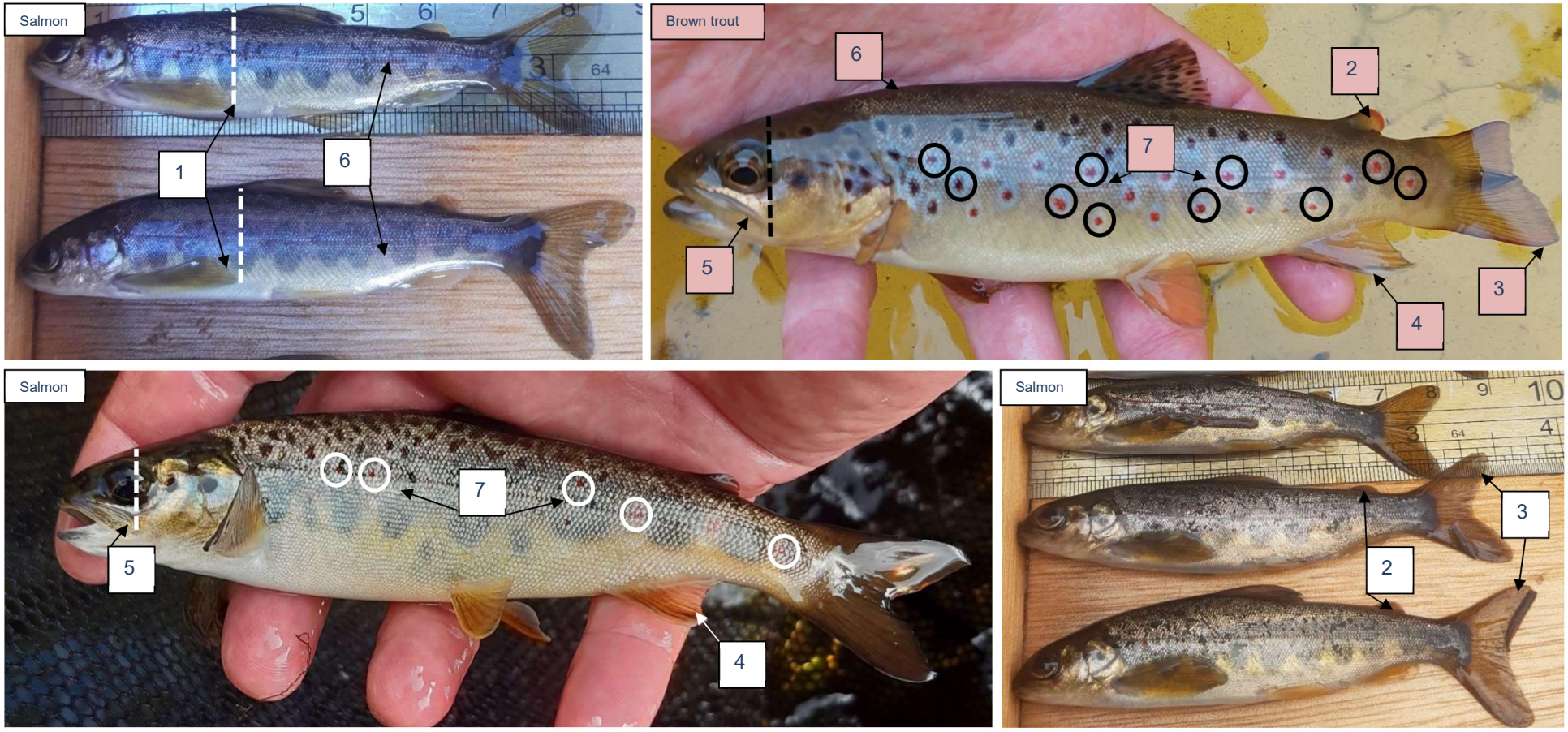

Figure 2 Key characteristics of Atlantic salmon vs brown trout juveniles recorded during the GeneFlow project in 2023 as described in Table 1. Marks 1-7 in white indicate key features for salmon. Marks 2-7 in coral indicate key features for brown trout.

3.5. Additional species

Another requirement of the sampling programme was to record the presence of other fish and invasive species in addition to salmon fry at each sampling site to fulfil the obligations of the Section 14 authorisation. This was done by each of the sampling teams at each survey location in a presence-absence format.

3.6. Assessment of fishing and wading difficulty

In order to evaluate future sampling at these locations and improve the time management and performance of the field sampling process, a per site qualitative metric of both wading and sample collection difficulty was recorded by each of the sampling teams. Both metrics were calculated by a score of 1-5. Wading difficulty was rated as:1 – easy; 2 – easy to moderate; 3 – moderate; 4 moderate to difficult; and 5 – difficult. Sample collection difficulty was recorded using the same scoring system.

3.7. Site details and dimensions

GPS coordinates were recorded in the field at the start and finish of each individual site sampled. GIS was then used to calculate the average wetted width (m) and additionally the approximate wetted area covered (m^2) between these points. Additionally the latitudinal position of each sampling site was also recorded. Maintaining a record of the area used to collect the samples was deemed important in the context of any family bias later becoming apparent in the subsequent sample analyses. This can inform whether the collection of samples may have influenced this or indeed indicate underlying issues with recruitment in a particular sampling area if the sample collection was well distributed.

4. Results

4.1. National sampling effort 2023

A total of 99 catchments were surveyed between August 2nd and September 30th 2023 (Figure 3). Complete genetic collections of juvenile salmon were obtained from 88 catchments and an additional sample on the River Erriff bringing the number of collections to 89 (Figure 3). An average distance per site of 569 m (range: 174–1,996 m) was covered, with a total distance of *c*. 50.5 km (Appendix 2). Wetted width (m) and distance calculations recorded an average site area of 5,049 m^2 (range: 691–22,665 m^2) (Appendix 2). A further 11 rivers recorded no samples collected in 2023 (Figure 3). In total, 122 individual sampling efforts were undertaken during this period, with 17 rivers requiring multiple efforts to acquire the requisite pool of genetic samples. The collection of 89 full samples acquired exceeded the original target of 66 as envisaged for year 1 of the project. This was facilitated by the addition of a second sampling team.

4.2. Results – National scale

A total of 3,351 individual samples of juvenile salmon were recorded during the nine week sampling window in 2023 (Figure 4). A mean fork length of 60.5 mm ± 10.9 SD (range: 34–163 mm) was recorded for juvenile salmon samples collected in the 88 catchments in 2023 (Figure 4). Length frequency data per RBD of salmon juveniles collected during the GeneFlow project in 2023 are presented in Figure 5.

4.3. Assessment of fishing and wading difficulty

Details of these metrics were recorded at each survey site and are presented in Appendix 2.

4.4. Site details and dimensions

Details of each survey site and their dimensions are presented in Appendix 2.

4.5. Additional species presence and absence

Additional species were recorded by each of the sampling teams during each individual survey location. Given the qualitative nature of the methodology used in the project, the data is provided in a presence-absence format (Appendix 2).

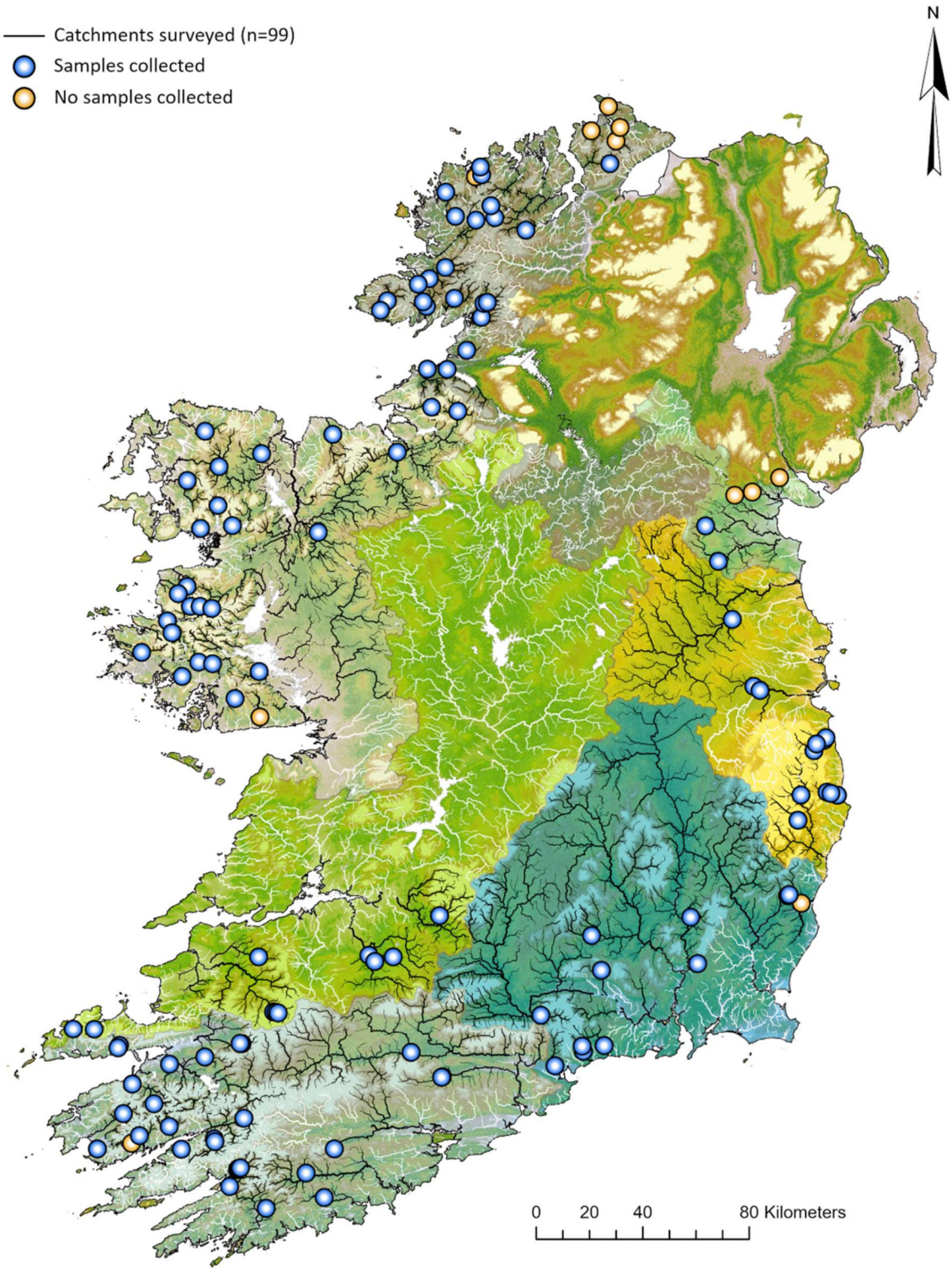

Figure 3 Sites sampled for the GeneFlow project in 2023.

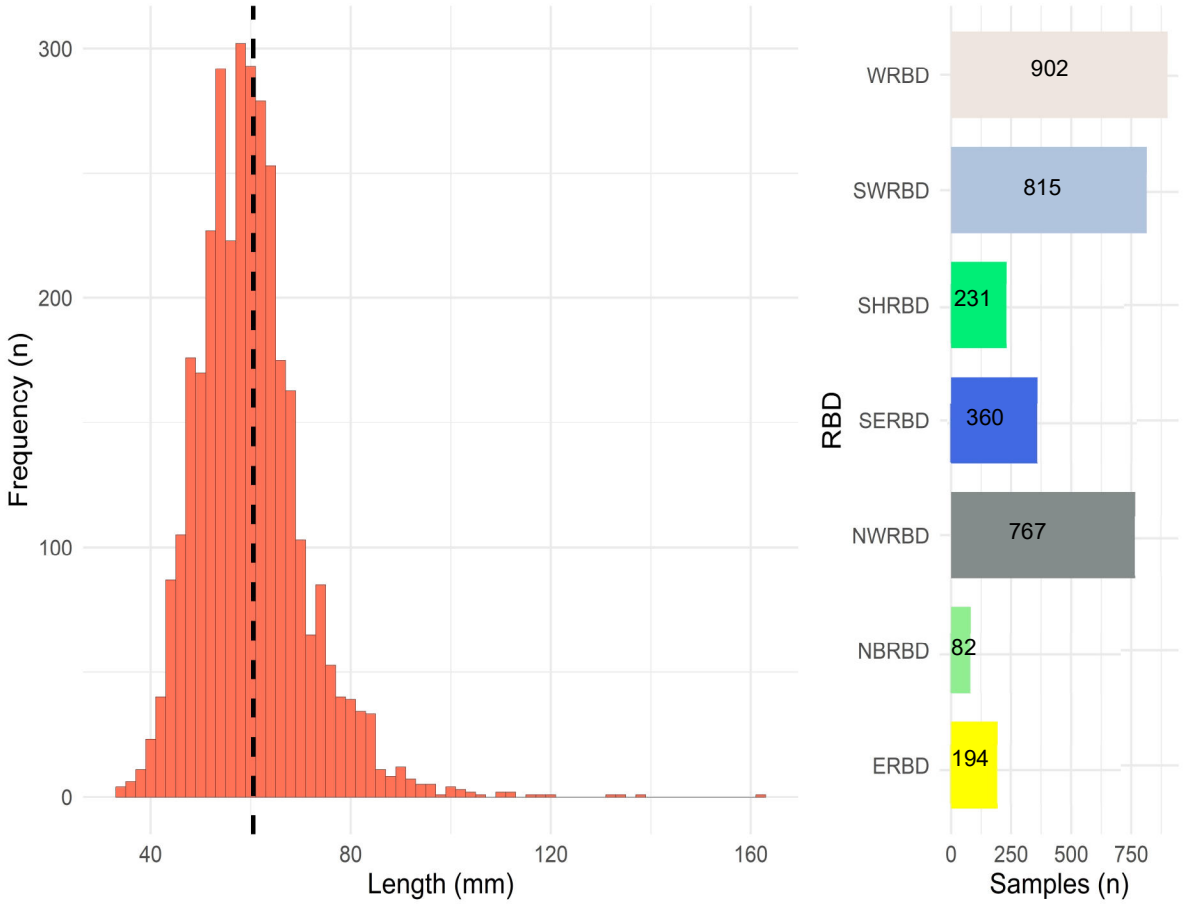

Figure 4 Salmon juvenile length frequency (left panel) and number of samples collected per River Basin District (right panel) during year 1 of the GeneFlow project. A total of 3,351 samples (range: 34–163 mm) were recorded from 88 catchments where samples were obtained in 2023. The mean length of juvenile salmon collected (60.5 mm ± 10.9 SD) is indicated by the black dashed line.

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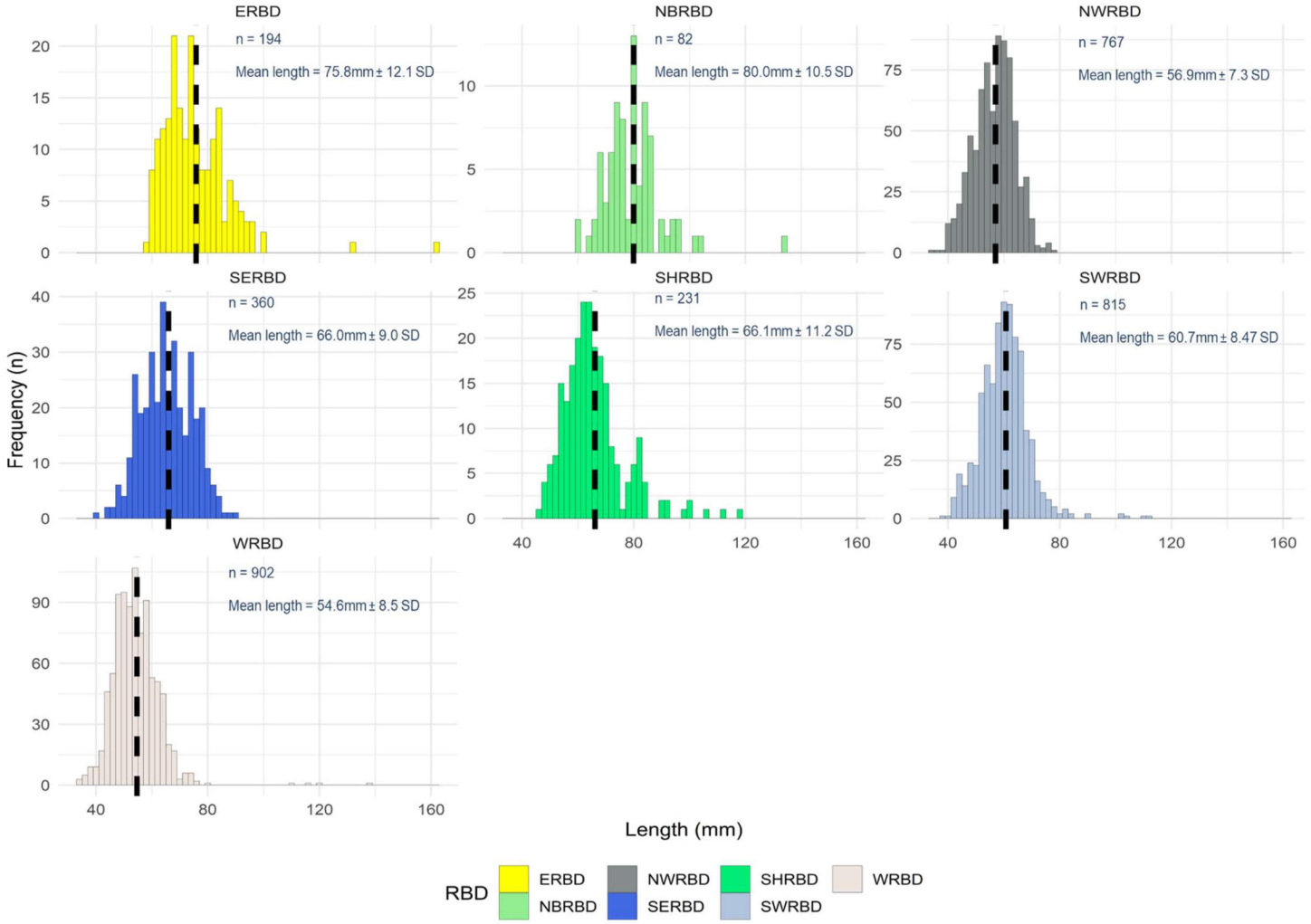

Figure 5 Length frequency data per River Basin District (RBD) of salmon juveniles collected during the GeneFlow project in 2023. The dashed black line indicates mean length of salmon (mm) per RDB. Associated standard deviations (SD) and number of replicates (n) are also displayed

5. Discussion

The GeneFlow project is intended to run over a three-year period from 2023 to 2026 with up to 200 salmon stocks in Ireland designated for sampling and characterisation in regard to genetic introgression. IFI were tasked with and co-funded the collection of the field samples for the project. This document reports on the field sampling work undertaken in order to collect samples for the first year of the project. The project work in year 1 and year 2 originally aimed to collect samples from as many of the 144 designated salmon rivers and minor salmon rivers as possible, with further refinements to the field sampling approach envisaged based on these results. The original target for salmon stocks sampled in year 1 was 66 stocks sampled. However, this target has been significantly exceeded in year 1 despite periods of weather unfavourable to sampling, when a total of 99 rivers were sampled and thus, may now allow the vast majority of the field collection programme of GeneFlow to be completed in year 2. The addition of a second field sampling team again in year 2 would enhance these prospects. However, it should be noted that this would require further careful consideration by IFI in the context of their staffing, financial and equipment resources available in 2024.

Greater field sampling effort in order to achieve the required sample sizes was required in systems where salmon stocks had low apparent abundance, notably in certain catchments in the south-east and east of Ireland. There were 17 systems where multiple locations had to be sampled in order to acquire the required samples size. In 11 catchments no samples were obtained despite significant sampling effort. From a project management perspective, the recording of metrics such as wading difficulty can help inform future field collection planning if further attempts are made to re-sample such sites for this or related projects. It was also considered valuable to have collected information on the wetted area covered to both document sampling effort as well have a metric to potentially evaluate if the sampling area size was a factor in any family bias later evident in the samples taken.

In advance of year 2, a recruitment process will again have to be undertaken to establish the field teams, along with similar training provided in advance of the fieldwork. The field team should be fully prepared to commence field work by the 1 July 2024 to maximise the sampling that can be achieved by the deadline of 30 September.

6. References

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7. Appendices

7.1. Appendix 1: Standard Operating Procedures

Standard Operating Procedure for GeneFlow field sampling activities

Inland Fisheries Ireland

2023

Name of Document:	Standard Operating Procedure for GeneFlow field sampling activities				
Author (s):	Michael Millane / Tony Holmes / Phil McGinnity/ John Coyne				
Authorised Officer:	Michael Millane				
Description of Content:	This SOP details the electric fishing, fish processing methods and safety procedures to be followed by Inland Fisheries Ireland.				
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Date of Approval:	04.08.2023				
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1. INTRODUCTION

All fish sampling techniques are generally considered to be selective to some degree; however, electric fishing has proven to be the single most comprehensive and effective method for collecting stream fish (Barbour *et al*., 1999). It is a well-established technique used by fishery biologists all over the world for sampling fish in freshwaters. It is generally the most non-destructive, effective and cost efficient means of sampling freshwater fish, particularly in rivers. The use of electric fishing for sampling fish populations was first described over 70 years ago (Schiemenz & Schonfelder, 1927). Moore (1968) proposed the use of a portable light-weight fish shocker which induces 'galvanotosis', causing the fish to move towards the electrode (anode) where they are captured using a hand net (Lippet, 1978). Electric fishing uses the physiological effect of an electric field in water produced by immersed electrodes to stimulate a fish's nervous system so that it swims towards the positive electrode (anode) and can be easily netted. In best practice, the goal is to attract, rather than stun the fish and prevent any harm to them.

1.2. Scope and Application

The purpose of this document is to define the electric fishing and collection methods for sampling juvenile salmon for the GeneFlow project. The electrofishing element of this SOP is based on the catchment-wide national sampling programme to assess salmon fry abundance in river catchments.

1.3 Site selection

There are 237 named discrete river basins on the island of Ireland, 208 in Ireland and 29 in Northern Ireland (Ordnance Survey of Ireland, 1958). There are 261 recognised salmonid 'Fishery' river systems with Atlantic salmon and or sea trout identified in Ireland (excluding Northern Ireland) of which 173 are known to have salmon and trout present with 88 having sea trout only (McGinnity *et al.* 2005). Of the 173 rivers with salmon, catch advice is provided for 144 of these annually (TEGOS, 2003). Each river has a genetically distinct salmon population. Many of the larger river systems will have two of more genetically discrete populations (Dillane *et al.* 2008).

The goal of Task 1 will be to design and communicate a sampling plan to establish a comprehensive and accurate genetic baseline upon which a fair and accurate assessment of the levels of gene flow from farmed escaped salmon can be provided for Irish salmon populations on an individual river basis. The tender call proposes the sampling of approximately 200 potential populations. It is proposed here to sample at least 200 sites

encompassing the collection of some 6,000 individuals and is deemed sufficient to capture the majority of the genetic variability present. The tender also envisages the profiling of up to 10,000 samples, thus providing scope for the analysis of additional material. In addition to the resampling of samples of interest subsequent to year one or year two analysis it is envisaged that a proportion of the juvenile salmon collected as parr for the National Genetic Stock Identification genetic baseline established in 2006/2007 will be re-characterised using selected diagnostic SNP markers in order to compare present status with regard to introgression to that which existed 18 years previously.

The key criteria of the sampling design are:

1. To provide sufficient national coverage as it is important to sample potentially affected and unaffected rivers to garner some determination of deviations from background levels of genetic variation;
2. To collect at least one sample from each of the principal identified salmon rivers (n=144);
3. To collect samples from a range of rivers with different population sizes on basis that small rivers are likely to be impacted proportionally more than larger ones, while impacted larger ones will likely produce more hybridised offspring;
4. To sample populations from two putative Irish phylogeographic lineages, namely Celtic and Boreal phylogeographic groups (Payne *et al.* 1971);
5. To identify and sample rivers substantially below conservation limits as demographically compromised populations are more susceptible to hybridisation than demographically strong populations (Hansen & Youngson, 1998, TEGOS 2023);
6. To prioritise areas where salmon farming is practiced or has previously been practiced https://www.marine.ie/site-area/areas-activity/aquaculture/locations-salmonid-farms;
7. To prioritise rivers and river samples where sampling has occurred previously i.e. the sampling carried out in 2006/2007 as part of the National Stock identification Project;
8. To utilise contemporary and historical spawning area distribution nationally based on field information mapped onto GIS in 2006 and supplemented by interrogation of the full national geo-rectified 1m resolution aerial photography database held by the Department of Communications, Marine, and Natural Resources.
9. To prioritise spawning sites on the lower sections of individual river systems as most likely locations for spawning of farmed salmon (Clifford *et al.* 1998);
10. In the larger river systems with high potential for genetic structuring (usually associated with lakes) to ensure sampling of multiple populations e.g. the Moy river system (Dillane *et al.* 2008).
11. In rivers where significant genetic introgression is detected in year 1 and year 2 to re-sample the same sites in years 2 or year 3.
12. To include in site selection GIS calculated route planning to determine the most time and energy efficient sampling programme.

1.4 Sample collection

Sample collection will be undertaken by IFI. IFI will deploy a sampling team who will carry out the sampling according to the design proposed and outlined in Task 1. The target number of sample sites (populations over the period of the project) is 200. The sampling will be undertaken in the summer period from July until the end of September. Conservatively, it is

proposed that the IFI team will sample six sites per week. IFI will endeavour to sample as many populations in as short a period as possible. However, we are cognisant that weather conditions either due to elevated temperatures or high flow conditions can preclude fishing. No fishing will take place where temperatures exceed 20^{O}C in order to minimise inadvertent mortalities to non-target, non-retained fish. Fishing and fish handling will be undertaken with regard to conforming with highest standards consistent with best practice for animal welfare, hygiene and protection of the environment. At an identified river reach (expected one to two km in length) 40 0+ individuals will be collected by electrofishing. The sample will be collected over a sufficient length of river in order to minimise the number of siblings sampled. The individual fish will be euthanized by overdose of anaesthetic. The fish will be measured for length and preserved in ethanol for later DNA extraction. A subset of samples will be preserved in RNAlater to facilitate profiling for transcriptional genetic markers at some later date. Non-target fish will be released after recovery from stunning. Training will be provided to the IFI teams by UCC in respect of site identification, site recording, sampling methodology, sample recording, sample preservation and sample storage. Electrofishing and fish handling training will also be provided to the teams.

2. Health and Safety

The primary responsibility of all staff engaged in field work is the health and safety of themselves and their colleagues. It must be recognised that any electric fishing equipment producing an effect of this type is potentially dangerous. The fishing efficiency is closely related to the experience of the electric fishing team and fishing should only be carried out by qualified personnel.

ELECTRIC FISHING CREWS MUST ADHERE TO THE INSTRUCTION OF THEIR SUPERVISOR. BEHAVIOUR WHICH COULD ENDANGER LIFE OR CAUSE INJURY WILL NOT BE TOLERATED.

2.1 Electrofishing training

One field team member should be trained in electric fishing safety precautions and operational procedures. Crew members are advised to familiarise themselves with the following manual: *Electric Fishing: Training Course Manual. Inland Fisheries Ireland WRC Beaumont 2012.* First aid certificates should be held by the field staff and training given if required.

2.2 Number of crew

A two-person crew is required for the electro-fishing. One member of the team should act as supervisor.

2.3 PPE

Each crew member should wear rubber soled waders and life jackets and insulation gloves. The collection bucket should be free of exposed metal and have a plastic / insulated handle.

2.4 Weather conditions

Electric fishing is not recommended in spate conditions and is strictly forbidden in wet weather (including mist) or when there is a risk of thunder and lightning. If it starts to rain, stop fishing immediately; turn off the power and cover electrical equipment appropriately, e.g., with a layer of tarpaulin.

2.5 Operations – Electrofishing Survey Method

- Provisional arrangements of the fieldwork schedule to be made (between Owen Kelly and John Coyne) a week prior to sampling with notification given to the relevant Fisheries Inspectors and/or Environmental Officers in the River Basin District (RBD) region where sampling is planned. Further adaptions to the planned schedule may be necessary in the event of adverse weather at shorter-notice and this should be done in consultation with the relevant RBD regional contact or their designate.
- Sampling is conducted by two operators.
- Locate identified (planned) fishing site using logbook provided. Directions can be supplemented using Google maps on phone or *via* in-vehicle GPS.
- Record fishing starting point using GPS or estimate extent of fishing site by pacing along river bank from river entry point.
- Note fishing start time.
- Electro-fishing to be conducted in an upstream direction in a riffle area away from sensitive habitats and non-target species.
- Forty 0+ salmon fry should be collected per catchment (or in designated large catchments it may be thirty-fvie 0+ salmon fry per sub-catchment as advised in the sampling plan).
- Sites in a catchment should be geographically dispersed when attempting the collection of the requisite number of fish to minimise the risk of siblings being sampled.
- The electrode needs to be dragged quickly back above the substrate towards the operator in order to disturb fry which are then captured in the net which is held firmly

to the substrate. Fry will be trapped in the net for transfer to the bucket. The technique is designed to capture salmon fry and capture of larger parr should be avoided.

- Preferably collect all samples in one fishing as this will ensure adequate mixing of samples in bucket and enable randomized selection of the first 15 individuals for RNAlater preservation. However, if a number of fishings are required, either because two or more distant locations within a site are required, or the site has to be fished over an extended period, or a site has to be fished over a two different days, these should be processed on their own merit and individuals selected for RNAlater preservation in proportion to the number of individuals collected.
- The presence and / or numbers of all fish captured during each survey by species at each site and sub-section fished should be recorded in the field sheets and this information provided to IFI in the Section 14 template.
- Time of fishing at each site and sub-section should be recorded and an estimate made of the length of the site / sub-section.

2.6 Operations – euthanasia and laboratory setup

The individual fish to be retained for genetic analyses will be euthanized by overdose of anaesthetic of MS222 (400mg/l). During the induction training, field operatives will be trained in this method of euthanasia.

- Ensure a clear area for fish processing in the back of vehicle is provided.
- Set up measuring board.
- Sequentially number 15 RNAlater tubes using indelible marker identifying site number and individual sample number.
- Select appropriate sample site ethanol tubes.
- Enter log book site data – site number; date; sampling team; distance fished; time fished; species encountered summary; any other comments .
- Allocate sampling tasks among sampling team: 1. person dissecting the fish; 2. data recorder/RNAlater tube management; and 3. ethanol tube manager/quality control/ procedure management.
- Prepare anesthesia.
- Protective latex or nitrile gloves and safety glasses should be worn during this procedure.
- Stock bottles of MS222 solution for the field sampling will be prepared before use by UCC (according to their safety protocols).

- The MSS222 solution will be mixed in a bucket of 1 litre of river water at a rate of 8-10ml/litre. Use a pipette to administer dosage.
- Add a proportional amount of baking powder to nullify the acidification effects of MS222 (Example – 0.5g of Baking Powder per litre, based on 10ml of stock solution (@400mg/l).
- Place small batches of fish (e.g. 10) in the anaesthetic solution and let them remain there until mortality is confirmed and proceed with sample processing thereafter. This reduces the time between mortality and sampling for the whole sample taken.
- The mortality point will be where there is no swimming / voluntary locomotor activity, buoyancy equilibrium is lost present, the opercular (gill) movements have ceased and no reflex response is evident after a tail-fin pinch stimulus.
- A Safety Data Sheet for MS222 is provided in Appendix 2 for reference.
- Measure individual fish fork length to one decimal point (e.g., 5.1, 5.2 etc.) and record in field sheet (Appendix 3).
- Once mortality point has been reached, a portion of the sample (from tail to just behind anus) is inserted into an ethanol tube. This is conducted for all samples.
- 15 samples are to be retained in vials of RNAlater. Open body cavity of remaining section of fish *via* anus up to and through to the jaw (mouth) using fine-pointed surgical scissors so as to expose internal organs to RNAlater. Care is taken to maintain the integrity of key organs and digestive system of the sample.
- The data recorder should identify on the datasheet samples retained in ethanol and RNAlater tubes.
- After 15 samples have been processed for RNAlater, the additional second section of fish bodies (no need to open up organ cavity) should be collected in zip lock bag for later freezing. A waterproof paper identification label recorded with pencil should be included in the bag; details should include site number, river name, date, number of 0+ salmon and numbers of any trout that may have been sampled inadvertently.
- The RNAlater samples should be bagged individually (ziplock bag) and secured. The waterproof paper pencil recorded identification label detailing sample site, river and date should be placed in the bag.
- Return any excess live fish to the river.
- Disinfection of all equipment and PPE is obligatory before leaving site (See section 2.7).

2.7 Operations – General

Equipment: Backpack units should be used for sampling by all teams to provide a consistent sampling effort and approach. Ensure that all connections are securely fastened, and that anode and cathode are attached to the backpack frame with the metal clip. Fry will escape through any holes in the net so ensure that any holes that may develop are repaired.

Backpack Settings: Note all IFI safety procedures and safety features on the backpack before commencing operations.

- For SAFARI EF unit: Pulsed DC to be used. Backpack should be set to deliver approx. 200v at low amps. The recommended power setting (switch located on the left of the backpack) is approximately 45% of available power.
- For Hans Grassl EF unit: Use Pulse electrofishing with initial setting of 60 pulses per seconds and a pulse width of 5 m/s, and minimum required voltage to effectively catch fish. Voltage output is the sum of the coarse and fine settings. When fishing for salmonids stay within 40-60 p/s – lower frequencies will attract but not stun, higher frequencies may be injurious; pulse widths of 4-6 m/s should prove effective - lower pulse widths use less power and cause less damage to fish. Never adjust settings when electrical current is flowing.

If any fish mortalities are observed reduce the power setting appropriately.

Batteries: the backpack equipment is very effective when used with fully charged batteries. Two sets of fully charged batteries will be required each day. It is recommended to change the batteries midway through the sampling day or when the audible “whine” from the backpack begins to weaken. Batteries will require overnight re-charging to be fully charged for activity the following day. It is recommended that the date of first use and a relevant number is written on each battery or double battery pack. This allows tracking of battery life and will ensure batteries can be replaced after fulfilling their natural usefulness/life span.

Survey Sheets: Special survey sheets will be provided and these are required to be completed for all sites fished (Appendix 3). All sheets should be scanned and paper copies retained.

Section 14 Authorisation & annual schedule of rivers to be fished

Each year an application is made for a Section 14 Authorisation for all staff undertaking the field work. A schedule of the proposed rivers to be fished is also included.

Sampling in SACs: NPWS should be notified in respect of any Natura 2000 catchments where relevant instream qualifying interest species are present (i.e. pearl mussel *Margaritifera* spp. and white-clawed crayfish *Austropotamobius pallipes*). IFI are aware of the precautions necessary regarding lamprey and other species which are qualifying interests in SACs and all staff are aware that particular care is required in pearl mussel SACs to ensure that these animals are not disturbed.

GPS: Readings should be taken using the Irish Transverse Mercator **ITM Grid system.** Calibrate GPS instrument by holding it upright and walking around in a 10 m circle on site. This is important if moving substantial distances > 50 miles between sites. GPS instrument **should be held and read upright** when capturing a location. The reading should be taken at the electrofishing starting point at the bottom of the riffle. Fill in all details from location to survey sheet when the GPS stabilises. Accuracy in most handheld units is about 5 m or so - when this is achieved it can be assumed that this is the best reading.

Reading format: ITM coordinates are based on 2 groups of six figures. Eastings (always 1st) and Northings (2nd). Example: 123456 125467.

If for any reason location cannot be obtained as ITM then a Lat/ Long is acceptable. Please make sure to write down the whole of the co-ordinates available. Lat longs are available from the TETRA radios by selecting 'Location' and 'Position' from the main menu.

Biosecurity/Disinfection: use IFI's standard operating procedure to prevent transfer of algae, higher plants, invasives etc. between systems. Sampling should be conducted starting at the uppermost site in the catchment to prevent transfer of invasives from the lower reaches. Extreme vigilance is essential if moving between catchments to avoid any possibility of transfer. All teams to strictly observe IFI's field survey biosecurity protocol. Download from http://www.fisheriesireland.ie/Research/invasive-species.html

https://www.fisheriesireland.ie/sites/default/files/migrated/docman/biosecurityforfieldsurveys2010.pdf

2.7 Equipment

Checklist of equipment:

- Electrofishing PPE (lifejackets, wades, jackets, sunhats, insulation gloves, polaroid glasses etc)
- MS222 PPE (gloves and safety glasses)
- Pipette for dispensing MS222
- GPS - Smartphone with appropriate app or Tetra radio can be used.
- Discovery map – locations on google maps
- Catchment map (from IFI /UCC) with sampling channels marked
- Biosecurity kit – including virkon tablets
- Electrofishing gear and spares – anode, cathode, (two fully charged battery packs)
- chargers
- Buckets (3 for sampling/collecting/euthanising) plus 1 large 42L bucket for disinfection
- Survey sheets packs
- Measuring board
- Measuring tape
- Camera
- Stopwatch
- Sampling containers – genetics (36 per site) and RnaLater tubes
- Scale envelopes
- Blue roll
- Ziplock bags for sample collection and storage
- Penknife for collecting scales
- Aquarium net (for catching fry in bucket)
- Prepared stock bottles of MS222
- Baking powder – in conjunction with MS222
- Stock bottle and funnels for disinfectant – repeat usage
- Stock bottles (covered to avoid light) for MS222 solution – maximum use: 4 occasions
- Rubber bands
- Surgical gloves
- Waterproof notebook – for labels

3. References

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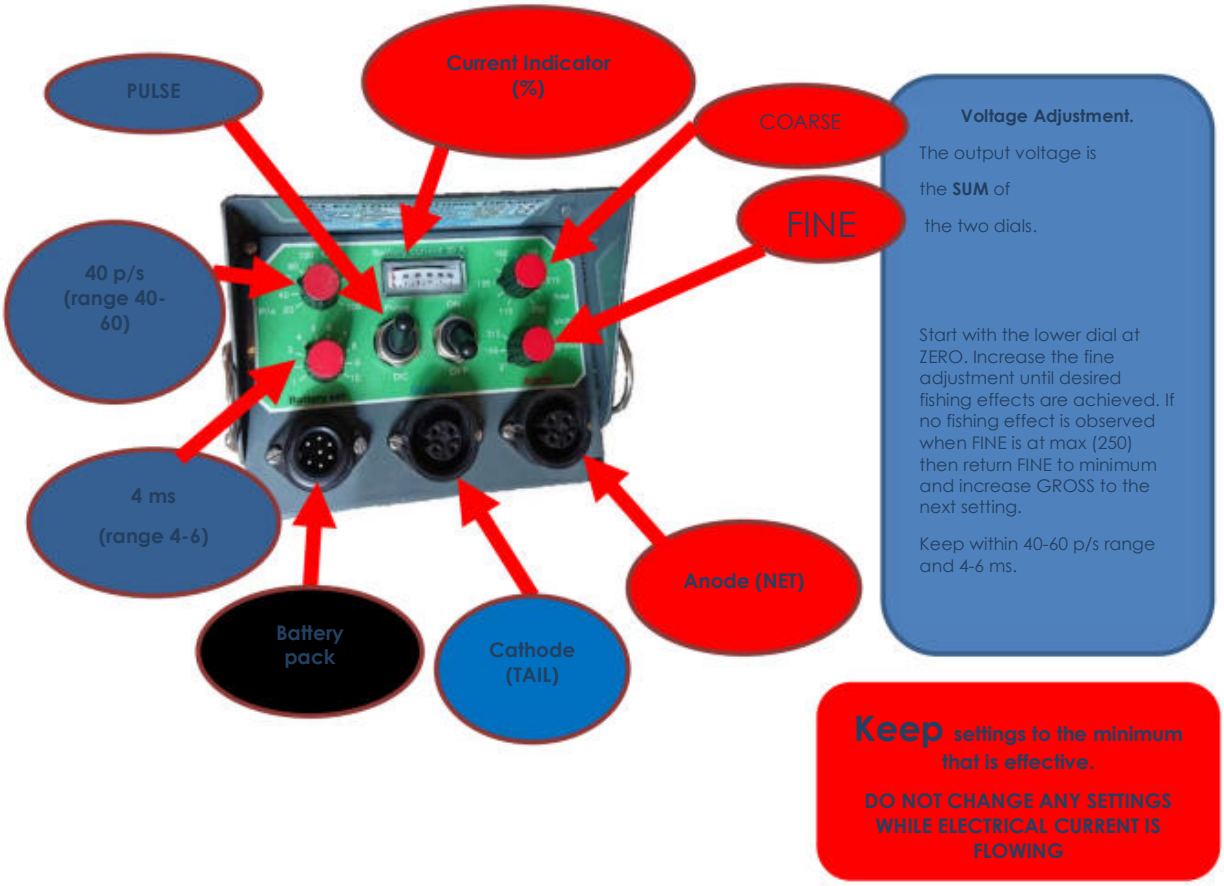
SOP Appendix 1

Recommended initial settings for Hans Grassl for CWEF programme

The device will be ready for operation a few seconds after switching on. The first actuation of the anode switch (Dead-man's Switch) (DMS) is ignored by the device. After the second activation of the DMS an audible tone and deflection of the current indicator needle indicates when electrical current is flowing.

The Device should only be used by trained personnel and this guide should be used in conjunction with the operating manual: [http://www.hans-grassl.com/Bilder_DB/IG600_ds_E030314w.PDF]



SOP Appendix 2

Safety Data Sheet for MS222

Supelco®

www.sigmaaldrich.com

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 6.1
Revision Date 06.09.2022
Print Date 25.07.2023

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name	:	Ethyl 3-aminobenzoate methanesulfonate salt Ethyl 3-aminobenzoate methanesulfonate salt
Product Number	:	A5040
Brand	:	Sigma-Aldrich
REACH No.	:	A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.
CAS-No.	:	886-86-2

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses	:	Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company	:	Merck Life Science Limited Vale Road Arklow CO WICKLOW Y14 EK18 IRELAND
Telephone	:	+353 402-20300
E-mail address	:	TechnicalService@merckgroup.com

1.4 Emergency telephone

Emergency Phone #	:	+(353)-19014670 (CHEMTREC)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008
Skin irritation (Category 2), H315
Eye irritation (Category 2), H319
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335
Long-term (chronic) aquatic hazard (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008
Pictogram

Signal Word	Warning
Hazard statement(s)	
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H412	Harmful to aquatic life with long lasting effects.
Precautionary statement(s)	
P261	Avoid breathing dust.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P302 + P352	IF ON SKIN: Wash with plenty of water.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Supplemental Hazard Statements	none

Reduced Labeling (<= 125 ml)

Pictogram

Signal Word	Warning
Hazard statement(s)	
H412	Harmful to aquatic life with long lasting effects.
Precautionary statement(s)	none
Supplemental Hazard Statements	none

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms	:	MS-222 Tricaine
Formula	:	$C_9H_{11}NO_2 \cdot CH_4SO_3$
Molecular weight	:	261.29 g/mol
CAS-No.	:	886-86-2
EC-No.	:	212-956-8

Component		Classification	Concentration
3-Ethoxycarbonylanilinium methanesulphonate			
CAS-No. EC-No.	886-86-2 212-956-8	Skin Irrit. 2; Eye Irrit. 2; STOT SE 3; Aquatic Chronic 3; H315, H319,	<= 100 %

	H335, H412	

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
Show this material safety data sheet to the doctor in attendance.

If inhaled
After inhalation: fresh air.

In case of skin contact
In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower.

In case of eye contact
After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed
After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Water Foam Carbon dioxide (CO2) Dry powder

Unsuitable extinguishing media
For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture
Carbon oxides
Nitrogen oxides (NOx)
Sulfur oxides
Combustible.
Development of hazardous combustion gases or vapours possible in the event of fire.

5.3 Advice for firefighters
Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information
Suppress (knock down) gases/vapors/mists with a water spray jet. Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Advice for non-emergency personnel: Avoid inhalation of dusts. Avoid substance contact. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up dry. Dispose of properly. Clean up affected area. Avoid generation of dusts.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Tightly closed. Dry.

Storage class
Storage class (TRGS 510): 11: Combustible Solids

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters
Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Safety glasses

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of Regulation (EU) 2016/425 and the standard EN 374 derived from it.

Full contact
Material: Nitrile rubber

Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the EC approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
protective clothing

Respiratory protection
required when dusts are generated.
Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.
Recommended Filter type: Filter type P2

The entrepeneur has to ensure that maintenance, cleaning and testing of respiratory protective devices are carried out according to the instructions of the producer. These measures have to be properly documented.

Control of environmental exposure
Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Physical state	powder
b)	Color	light gray
c)	Odor	No data available
d)	Melting point/freezing point	Melting point/range: 148 °C
e)	Initial boiling point and boiling range	No data available
f)	Flammability (solid, gas)	No data available
g)	Upper/lower flammability or explosive limits	No data available
h)	Flash point	No data available
i)	Autoignition	No data available

	temperature	
j)	Decomposition temperature	No data available
k)	pH	No data available
l)	Viscosity	Viscosity, kinematic: No data available Viscosity, dynamic: No data available
m)	Water solubility	No data available
n)	Partition coefficient: n-octanol/water	No data available
o)	Vapor pressure	No data available
p)	Density	No data available
	Relative density	No data available
q)	Relative vapor density	No data available
r)	Particle characteristics	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
The following applies in general to flammable organic substances and mixtures: in correspondingly fine distribution, when whirled up a dust explosion potential may generally be assumed.

10.2 Chemical stability
The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
no information available

10.5 Incompatible materials
Strong oxidizing agents

10.6 Hazardous decomposition products
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
Oral: No data available

Inhalation: No data available
Dermal: No data available
LD50 Intravenous - Mouse - 180 mg/kg

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitization
No data available

Germ cell mutagenicity
No data available

Carcinogenicity
No data available

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
Inhalation - May cause respiratory irritation.

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

11.2 Additional Information

Endocrine disrupting properties

Product:

Assessment	The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

RTECS: DG2455000
To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 40.9 mg/l - 96 h

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Endocrine disrupting properties

Product:

Assessment : The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

12.7 Other adverse effects

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself. Notice Directive on waste 2008/98/EC.

SECTION 14: Transport information

14.1 UN number

ADR/RID: - IMDG: - IATA: -

14.2 UN proper shipping name

ADR/RID: Not dangerous goods
IMDG: Not dangerous goods
IATA: Not dangerous goods

14.3 Transport hazard class(es)

ADR/RID: - IMDG: - IATA: -

14.4 Packaging group

ADR/RID: - IMDG: - IATA: -

14.5 Environmental hazards

ADR/RID: no IMDG Marine pollutant: no IATA: no

14.6 Special precautions for user

Further information

Not classified as dangerous in the meaning of transport regulations.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006.

Other regulations
Take note of Dir 94/33/EC on the protection of young people at work.

15.2 Chemical Safety Assessment
For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H412	Harmful to aquatic life with long lasting effects.

Further information
The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

SOP Appendix 3

Field sheet templates

District: Ballyshannon
River: Abbey
Site: Parkhill
OS Co-ordinates: 188839, 363686
Directions: Travelling north from Ballyshannon turn left off N15 approx. 1.3Km after Morning Star roundabout, continue for 700m to bridge crossing river at site.
Date sampled:
Team:

General Comments

No.	Length (mm)	Ethanol	RNAlater	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
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25				
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28				
29				
30				
31				
32				
33				
34				
35				

INLAND FISHERIES IRELAND

Introgression Project 2023

System name:	Date:	Site time arrival:	Site time finish:

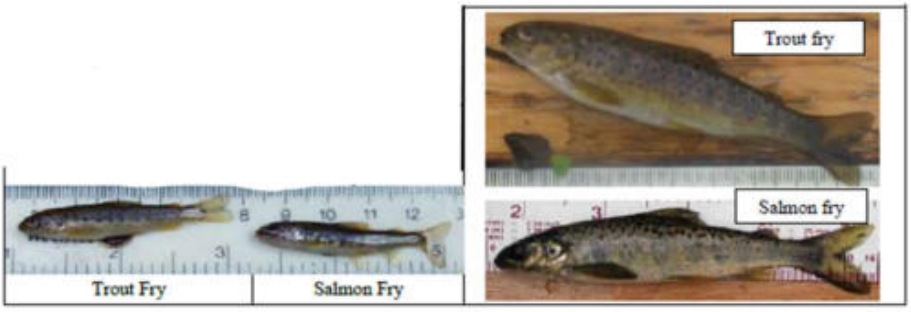
ITM GPS (at starting point) (include letter also):												Water level: (Circle)					
												1. V.Low	2. Low	3. Med/Low	4. Med	5. Med/High	6. High

Elevation from GPS:	m

Site Details / Location accessed at:

Conductivity (low water only):	µS	Photographs: (photo site & include upstream finish point)	Y	N
Water Temperature:	°C	Known spawning location:	Y	N	Unknown
E/F gear used:				
Backpack Output:	volts	amps		

Additional species/cohorts recorded	n	Total length of sample area:	m
Salmon parr (1+)			
Brown trout fry (0+)			
Brown trout parr (1+)			
Eels			
Lamprey			
Other species:			



7.2. Appendix 2: Site details

7.2.1. NWRBD

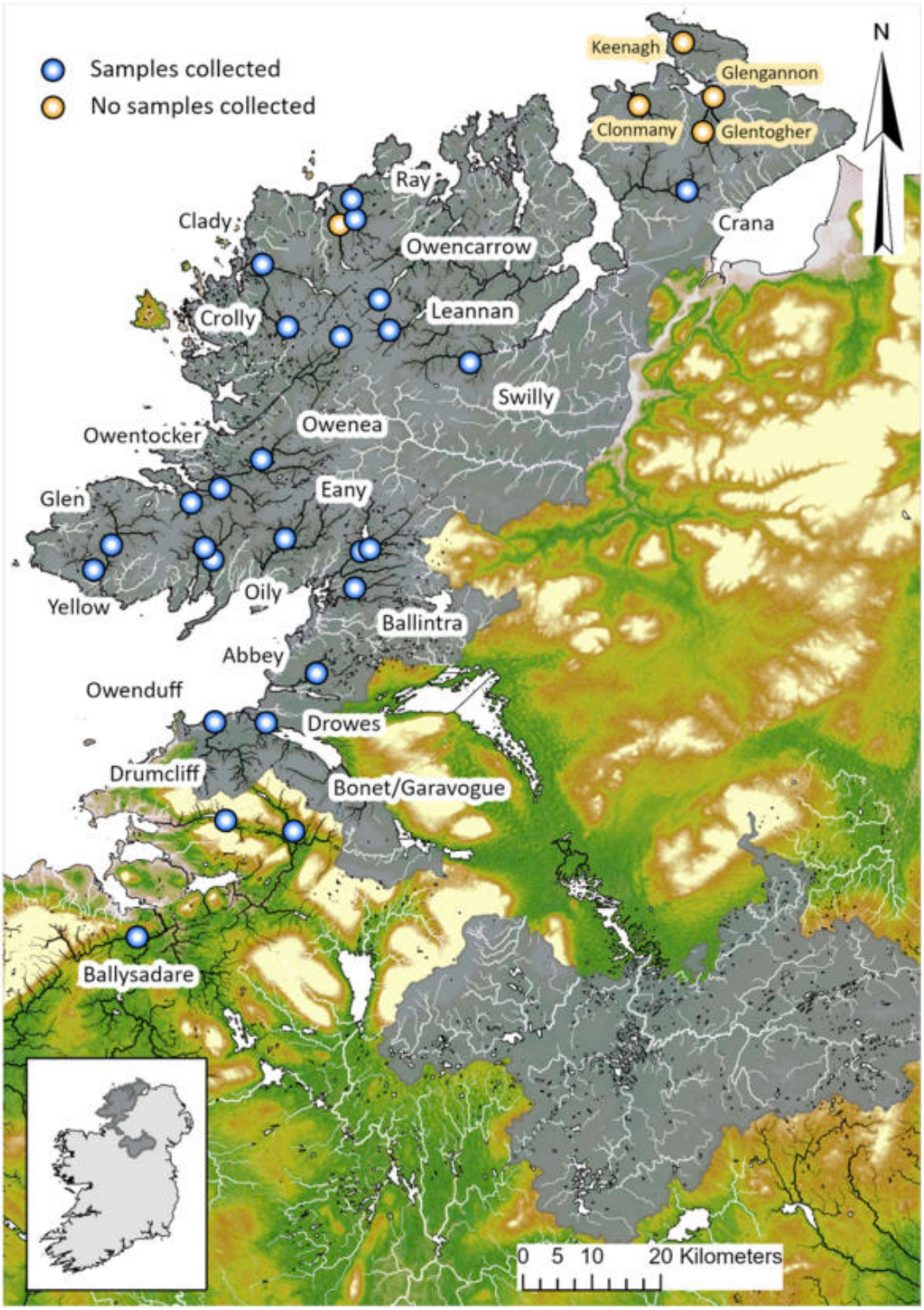


Figure 6 Rivers surveyed for the Geneflow project in 2023 within the NWRBD (n = 21). Blue dots indicate successful sample collections. Orange dots indicate that no sample was obtained for 2023 during the sampling despite efforts.

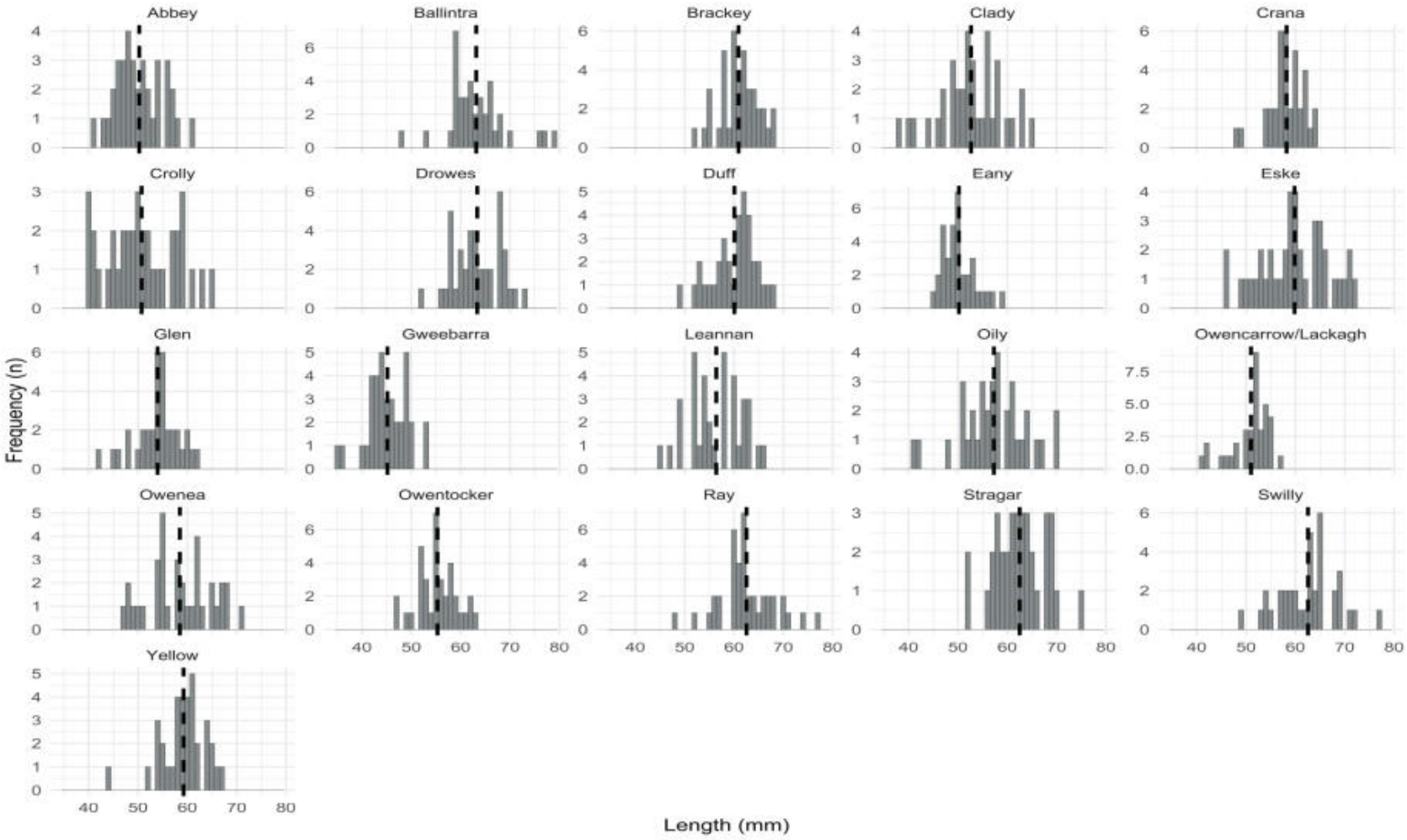


Figure 7 Length frequencies of juvenile salmon collected for the Geneflow project in 2023 in rivers sampled within the NWRBD (n = 21). Individual means are indicated in each of the histograms.

Table 2 Site details, additional information, and site segment dimensions for the NWRBD (n = 21)

NWRFB																
Site code	Catchment	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Size Range (mm)	Mean length (mm) ± SD	Stream order	Survey sections (n)	Latitude	Average wetted with (m)	Distance covered (m)	Average wetted area (m^2)
20	Abbey	15/08/2023	590165	863989	590315	864157	2	1	41-61	50.3±4.7	4	1	54.5	6.8	346.5	2371.2
98	Ballintra	22/09/2023	595705	876347	595964	876301	1	2	48-79	63.2±5.9	4	1	54.6	6.0	434.3	2590.4
100	Brackey	30/09/2023	571967	888786	571806	888405	1	1	52-68	60.9±3.8	2	1	54.7	4.5	523.2	2375.8
38	Clady	16/08/2023	582301	923361	582480	923166	5	3	38-65	52.6 ±6.3	4	1	55.1	12.6	275.0	3469.0
40	Crana	14/08/2023	643952	934055	644206	934284	2	2	48-64	58.2±3.6	4	1	55.2	7.2	418.5	3006.8
48	Crolly	17/08/2023	585972	914265	586286	913959	1	1	40-65	50.7±6.9	3	1	55.0	4.1	556.5	2276.2
88	Drowes	11/09/2023	582840	856816	583265	856578	2	2	52-73	63.4±4.8	5	1	54.5	18.5	554.0	10248.2
30	Eany	18/08/2023	585574	883496	585518	883669	3	2	49-68	60.1±4.5	5	1	54.7	17.0	692.9	11779.4
83	Eske	05/09/2023	596640	881632	596839	882046	4	4	45-59	50.2±3.3	4	2	54.7	8.5	228.5	1933.0
	Eske	05/09/2023	597907	882002	597833	882186	4	4			5		54.7	11.2	215.7	2411.6
26	Glen	16/08/2023	560378	882583	560489	883265	3	3	46-72	59.8±6.8	5	1	54.7	15.0	703.3	10558.9
25	Glen (Yellow)	17/08/2023	557800	878975	557521	879240	1	1	42-62	53.9±4.5	5	1	54.7	14.5	727.4	10542.7
46	Gweebarra	15/08/2023	593678	912856	593913	913070	1	1	44-67	59.2±4.5	4	1	55.0	7.9	471.2	3741.7
57	Leannan	18/08/2023	600738	913812	600070	914071	4	4	35-53	45.2±4.0	3	1	55.0	4.7	475.5	2230.3
28	Oily	17/08/2023	575101	880441	575149	880913	3	2	45-66	56.4±5.3	4	1	54.7	6.0	896.0	5396.7
37	Owencarrow	16/08/2023	599275	918267	599035	917918	1	1	41-70	57.3±6.6	4	1	55.0	10.3	516.5	5319.0
19	Owenduff	18/08/2023	575385	856915	575686	856579	1	1	41-57	51.0±3.8	3	1	54.5	4.9	439.4	2131.5

27	Owenea	16/08/2023	582178	895077	582516	895444	2	2	47-71	58.5 ±6.4	5	1	54.8	11.1	691.8	7691.0
47	Owentocker	17/08/2023	576141	890861	576525	890951	2	2	47-63	55.3±3.9	4	1	54.8	9.4	445.5	4166.7
99	Ray	25/09/2023	595782	929901	595929	929558	2	1	48-77	62.5±5.6	4	2	55.1	6.2	437.3	2690.0
	Ray	30/09/2023	595300	932791	595177	932535	2	3			4		55.1	8.2	361.3	2955.9
29	Stragar	17/08/2023	573887	882177	574202	882744	3	4	52-75	62.5±5.1	4	1	54.7	6.4	723.8	4647.5
45	Swilly	15/08/2023	612418	909100	612105	909058	2	3	49-77	62.5±5.9	4	1	54.9	11.2	324.0	3638.6

Table 3 Species presence and absence of each species recorded (except salmon fry) in rivers within the NWRBD during Geneflow sampling programme in 2023. Approximate numbers encountered are also noted where applicable.

NWRBD								
Catchment	Salmon	Trout		Eel	Stickleback	Stone loach	Minnow	Other species
	Parr	Parr	Fry					
Abbey	Y	Y	Y	N	N	N	N	
Brackey	Y	Y	Y	N	N	N	N	
Ballintra	Y	Y	Y	N	N	N	N	
Clady	Y	Y	Y (50+)	N	N	N	N	
Crana	Y	Y	Y	N	N	N	N	
Crolly	Y	Y	Y	N	N	N	N	
Drowes	Y	N	Y	N	N	N	N	
Duff	Y	N	N	Y (1)	N	N	N	
Eany	Y	Y	Y	N	N	N	N	Sea Trout
Eske	Y	Y	Y	N	N	N	N	
Glen	Y	N	N	N	N	N	N	
Glen (Yellow)	Y	Y	Y	N	N	N	N	
Gweebarra	Y	Y	Y	N	N	N	N	
Leannan	Y	Y	Y	N	N	N	N	
Oily	Y	N	N	N	N	N	N	
Owencarrow	Y	Y	Y (40+)	Y (1)	N	N	N	
Owenea	Y	N	Y	N	N	N	N	
Owentocker	Y(50)	Y	Y	N	N	N	N	
Ray	Y	Y	Y	N	N	N	N	
Stragar	Y	Y	Y	Y (1)	N	N	N	
Swilly	Y	Y(30)	Y	Y(5)	N	N	N	

7.2.2. WRBD

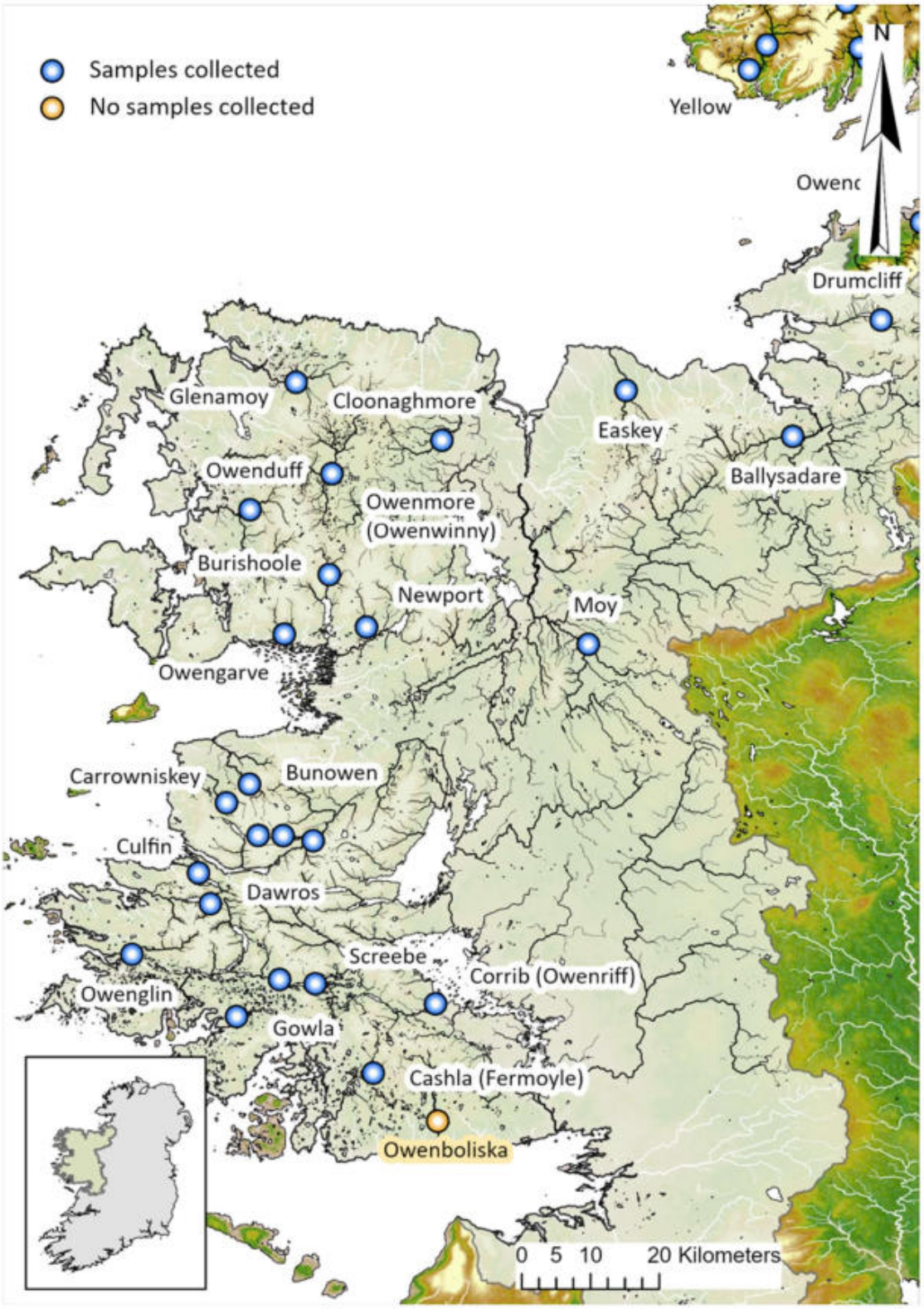


Figure 8 Rivers surveyed for the Geneflow project in 2023 within the WRBD (n = 24). Blue dots indicate successful sample collections. Orange dots indicate that no sample was obtained for 2023 during the sampling despite efforts.

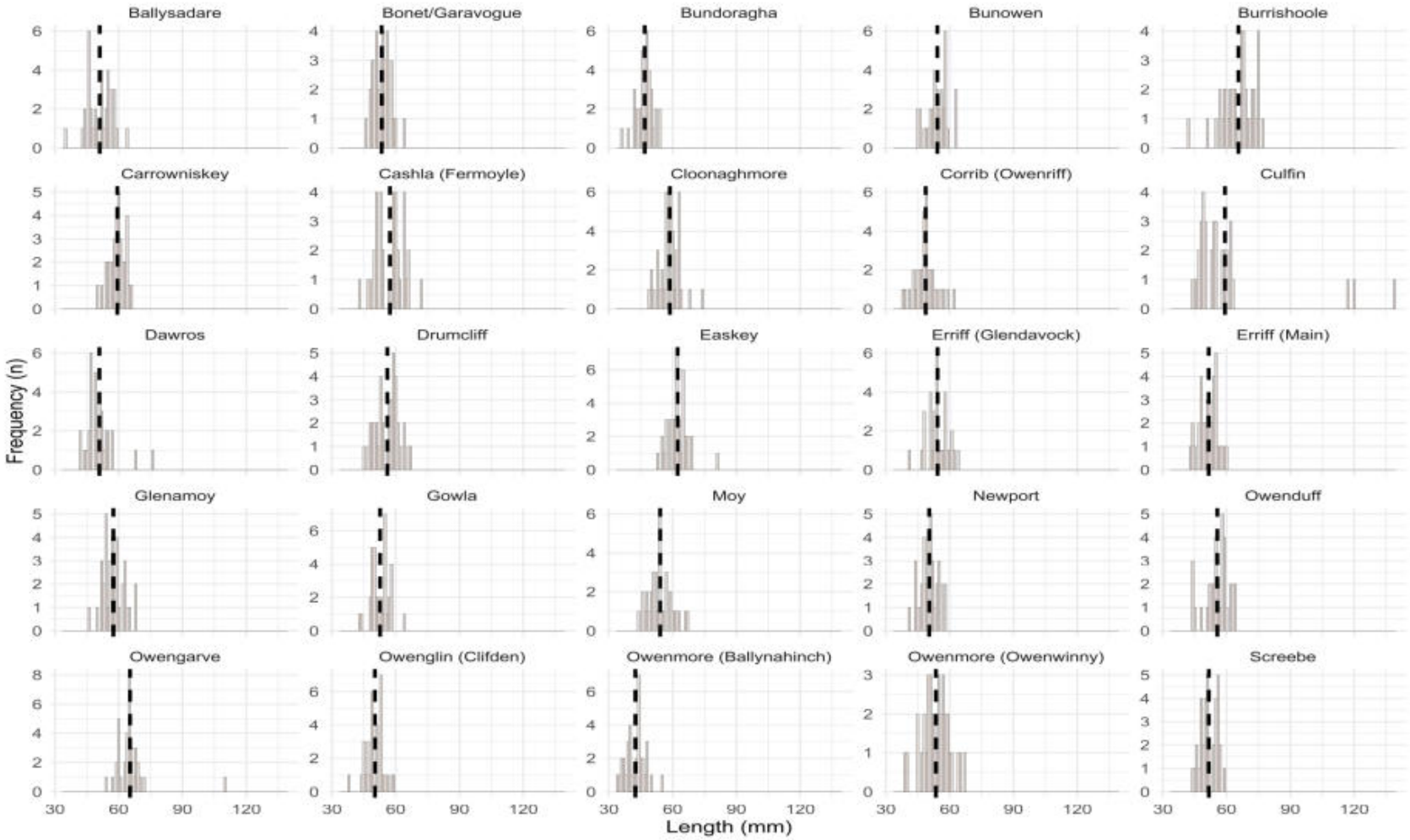


Figure 9 Length frequencies of juvenile salmon collected for the Geneflow project in 2023 in rivers sampled within the WRBD (n = 24). Black vertical segmented line indicates sample mean length (mm).

Table 4 Site details, additional information, and site segment dimensions for the WRBD (n = 24)

WRFB																
Site code	Catchment	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Size Range (mm)	Mean length (mm) ± SD	Stream order	Survey sections (n)	Latitude	Average wetted with (m)	Distance covered (m)	Average wetted area (m^2)
17	Ballysadare	14/08/2023	564119	825734	563885	825747	2	2	35-64	51.0± 5.8	5	1	54.2	13.8	259.4	3566.7
18	Bonet/Garavogue	14/08/2023	586847	841096	586889	841440	4	2	46-64	53.4± 3.9	4	1	54.3	10.3	418.7	4321.0
3	Bundoragha	03/08/2023	486424	767645	487050	767541	1	1	36-54	46.8± 3.9	3	1	53.6	3.2	736.0	2381.1
4	Bunowen	03/08/2023	485174	775100	485711	775182	1	1	45-63	54.2± 4.8	4	1	53.7	6.2	644.6	3981.5
41	Burrishoole	03/10/2023	496772	805578	496223	805569	n/a	n/a	42-77	65.5± 7.4	2	2	54.0	3.1	454.0	1407.0
		03/10/2023									4			8.0	238.2	1904.0
2	Carrowniskey	02/08/2023	481834	772389	481220	772664	1	1	50-66	59.3± 3.8	3	1	53.7	4.2	838.6	3555.7
10	Cashla (Fermoyle)	09/08/2023	503155	733029	503238	733518	3	2	43-72	57.3± 6.4	4	1	53.3	7.9	556.5	4390.4
96	Cloonaghmore	21/09/2023	513143	825169	512816	825100	3	2	49-74	58.7± 5.0	4	1	54.2	8.6	525.3	4515.1
9	Corrib (Owenriff)	09/08/2023	512217	743163	511798	742752	1	2	38-62	48.7± 5.1	4	1	53.4	11.2	607.4	6803.4
8	Culfin	08/08/2023	477768	762193	478011	762060	1	1	44-139	59.2± 21.1	4	1	53.6	8.2	342.5	2798.0
7	Dawros	08/08/2023	479488	757708	479961	757300	2	2	42-76	50.8± 6.5	4	1	53.5	6.5	964.7	6256.1
97	Drumcliff	21/09/2023	576973	842636	577220	842466	2	3	45-67	56.0± 5.5	4	1	54.3	7.3	380.6	2760.5
95	Easkey	18/09/2023	539908	832403	539645	832130	1	1	53-81	62.3± 4.9	5	1	54.2	14.4	396.5	5729.0
1	Erriff (Glenavock)	01/08/2023	490062	767619	489261	766854	2	3	41-64	54.3± 4.9	2	1	53.6	2.7	1383.1	3858.9
13	Erriff	10/08/2023	494426	766871	494789	767078	1	1	43-60	51.5± 4.3	5	1	53.6	16.3	460.3	7520.5
15	Glenamoy	10/08/2023	491950	833589	492320	833315	1	1	46-68	57.5± 4.9	5	1	54.2	9.4	786.3	7367.8

23	Gowla	09/08/2023	483294	741316	483755	741422	2	2	43-64	52.6± 4.3	4	1	53.4	6.5	492.0	3222.3
16	Moy	11/08/2023	534419	795443	534735	795236	3	4	44-67	54.0± 5.6	4	1	53.9	9.1	426.9	3891.9
39	Newport	11/08/2023	502181	797941	502035	798025	3	1	41-58	50.3± 4.1	4	1	53.9	7.3	291.5	2126.6
11	Owenduff	10/08/2023	485258	815075	485843	815233	2	2	44-64	55.6± 5.6	4	1	54.1	8.0	676.4	5397.3
14	Owengarve	10/08/2023	490234	796905	489818	796752	1	1	54-110	65.3± 8.6	3	1	53.9	5.0	508.5	2541.4
24	Owenglin (Clifden)	10/08/2023	468098	750349	468410	750475	4	4	38-59	50.2± 4.2	4	1	53.5	10.7	535.4	5710.9
21	Owenmore (Ballynahinch)	09/08/2023	489548	746701	489916	746220	3	2	34-55	42.4± 4.6	4	1	53.5	6.1	670.1	4089.9
12	Owenmore (Owenwinny)	10/08/2023	497161	820316	497436	820729	2	2	39-67	53.5± 6.3	5	1	54.1	14.2	578.7	8195.6
22	Screebe	09/08/2023	494735	746071	494450	746049	3	2	44-59	51.6± 3.9	2	1	53.5	2.0	352.6	691.7

Table 5 Species presence and absence of each species recorded (except salmon fry) in rivers within the WRBD during Geneflow sampling programme in 2023. Approximate numbers encountered are also noted where applicable.

WRBD								
River	Salmon	Trout		Eel	Stickleback	Stone loach	Minnow	Other species
	Parr	Parr	Fry					
Ballysadare	Y	Y	N	N	N	N	N	
Bonet/Garavogue	Y	Y	Y	N	N	N	N	
Bundoragha	Y	Y	Y	N	N	N	N	
Bunowen	Y	Y	Y	N	N	N	N	
Burrishoole	Y	na	na	na	na	na	na	
Carrowniskey	Y	Y	Y	Y	N	N	N	
Cashla (Fermoyle)	Y	Y	Y	Y (2)	N	N	N	
Cloonaghmore	Y	Y	Y	N	N	N	N	
Corrib (Owenriff)	Y	N	Y	N	N	N	N	
Culfin	Y	Y(20)	Y	Y(1)	Y	N	Y	
Dawros	Y	Y	Y	N	N	N	N	
Drumcliff	Y	Y	Y	N	N	N	N	
Easkey	Y	N	Y	N	N	N	N	
Erriff (Glenavock)	Y	N	Y	Y	N	N	N	
Erriff	Y	N	Y	N	N	N	N	
Glenamoy	Y	Y	Y	Y	N	N	N	
Gowla	Y	Y	Y	Y(10)	N	N	N	
Moy	Y	N	Y	N	N	N	N	
Newport	Y	Y	Y	Y	N	N	N	
Owenduff	Y	Y	Y	Y	N	N	N	
Owengarve	Y(46)	Y	Y	Y(30)	N	N	N	
Owenglin (Clifden)	Y(60)	Y	Y	Y	N	N	N	
Owenmore (Ballynahinch)	Y	Y	N	N	N	N	N	
Owenmore (Owenwinny)	Y	N	Y	Y(2)	N	N	N	
Screebe	Y	Y	Y	Y(10)	N	N	Y	

7.2.3. SHRBD

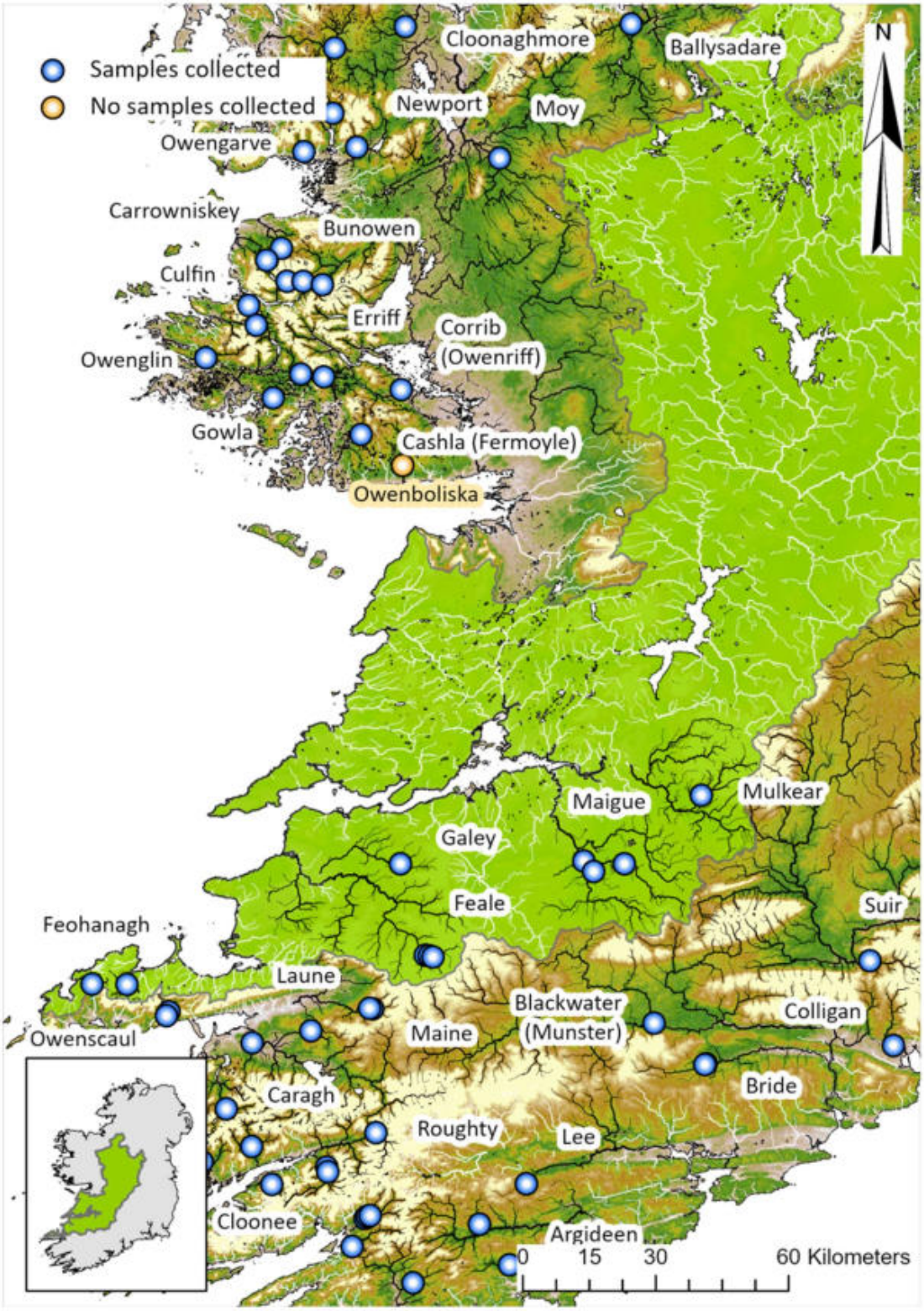


Figure 10 Rivers surveyed for the Geneflow project in 2023 within the SHRBD (n = 6). Blue dots indicate successful sample collections. Orange dots indicate that no sample was obtained for 2023 during the sampling despite efforts..

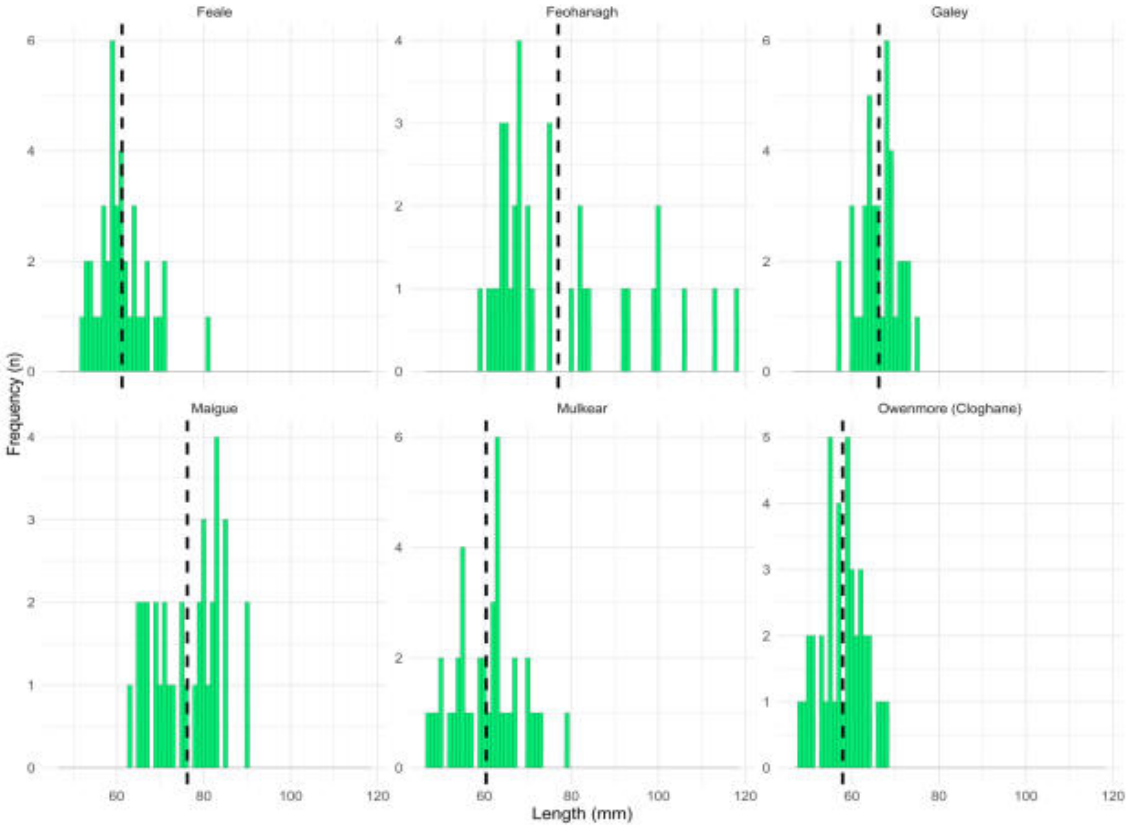


Figure 11 Length frequencies of juvenile salmon collected for the Geneflow project in 2023 in rivers sampled within the SHRBD (n = 6). Black vertical segmented line indicates sample mean length (mm).

Table 6 Site details, additional information, and site segment dimensions for the SHRBD (n = 6)

SHRFB																
Site code	Catchment	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Size Range (mm)	Mean length (mm) ± SD	Stream order	Survey sections (n)	Latitude	Average wetted with (m)	Distance covered (m)	Average wetted area (m^2)
90	Feale	12/09/2023	519520	614902	519520	614898	4	1	52-81	61.2± 5.9	4	3	52.3	7.7	212.0	1627.8
90	Feale	12/09/2023	518782	615210	517777	615466					4			7.7	210.9	1619.8
90	Feale	12/09/2023	519376	614593	518782	615210					4			7.7	180.6	1387.1
59	Feohanagh	24/08/2023	442412	608828	441964	608947	2	3	59-118	77± 15.8	4	1	52.2	6.1	665.3	4059.0
89	Galey	12/09/2023	512039	636011	512265	635598	1	1	57-75	66.2± 4.3	3	1	52.5	8.5	823.2	7034.6
93	Maigue	13/09/2023	553437	636648	553097	636697	3	3	63-90	76.2± 7.6	3	3	52.5	4.9	394.1	1945.8
93	Maigue	14/09/2023	562578	636015	555757	634343					4		52.5	10.8	61.1	660.1
93	Maigue	14/09/2023	555650	634288	562637	635997					4			12.7	121.3	1534.4
94	Mulkear	14/09/2023	579972	651510	580512	651444	1	1	47-79	60.4± 7.5	5	1	52.7	12.3	562.6	6942.4
77	Owenmore (Cloghane)	27/08/2023	450282	608757	450047	608643	4	2	48-68	57.9± 5.0	4	1	52.2	5.0	332.5	1648.6

Table 7 Species presence and absence of each species recorded (except salmon fry) in rivers within the SHRBD during Geneflow sampling programme in 2023. Approximate numbers encountered are also noted where applicable.

SHRBD								
River	Salmon	Trout		Eel	Stickleback	Stone loach	Minnow	Other species
	Parr	Parr	Fry					
Feale	Y	N	Y	N	N	N	N	
Feohanagh	Y(40)	Y	Y	Y(10)	N	N	N	
Galey	Y	N	Y	N	N	N	N	
Maigue	Y	N	N	N	N	Y	N	
Mulkear	Y	N	N	N	N	N	N	
Owenmore (Cloghane)	Y	N	Y	N	N	N	N	

7.2.4. SWRBD

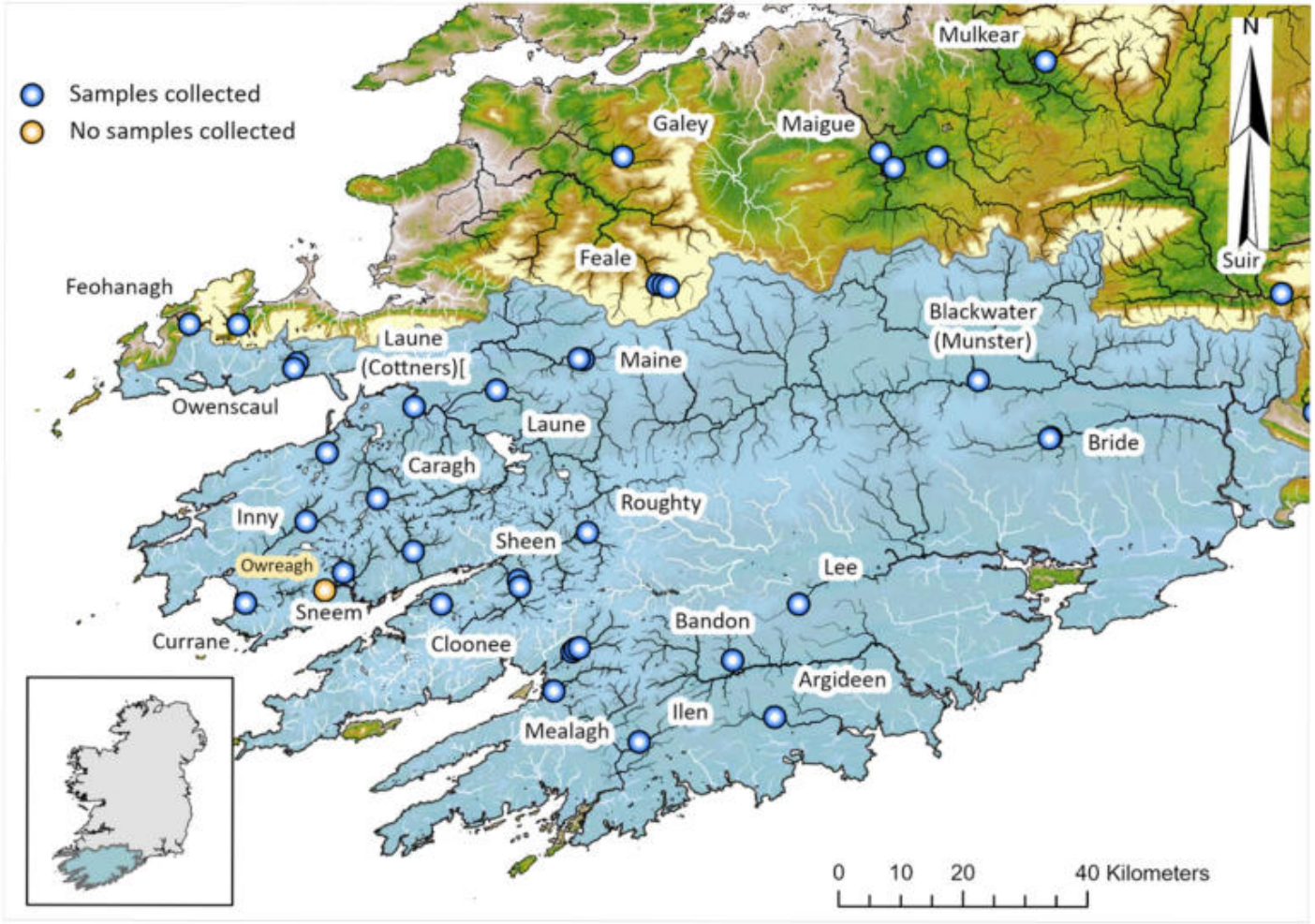


Figure 12 Rivers surveyed for the Geneflow project in 2023 within the SWRBD (n = 21). Blue dots indicate successful sample collections. Orange dots indicate that no sample was obtained for 2023 during the sampling despite efforts.

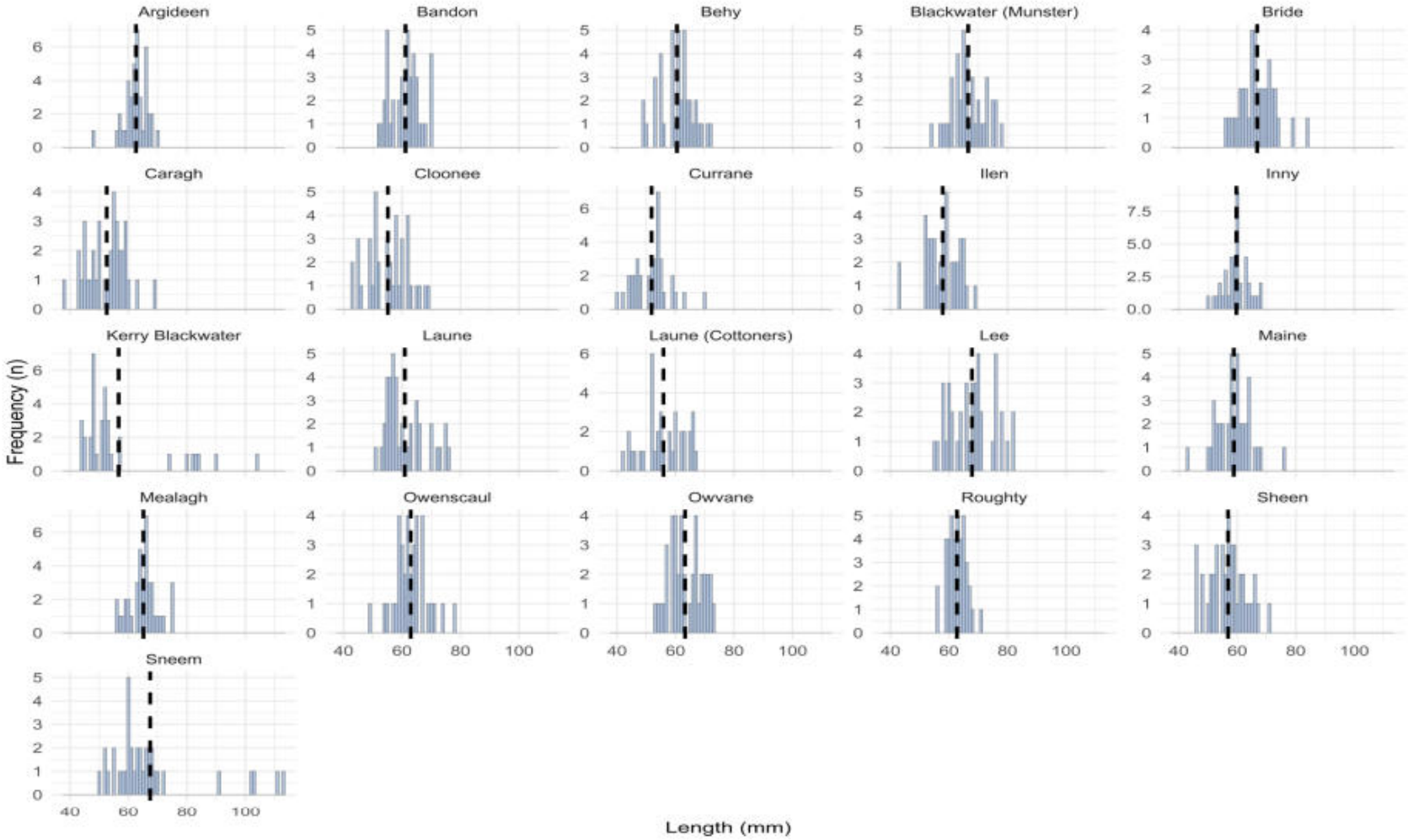


Figure 13 Length frequencies of juvenile salmon collected for the Geneflow project in 2023 in rivers sampled within the SWRBD (n = 21). Black vertical segmented line indicates sample mean length (mm).

Table 8 Site details, additional information, and site segment dimensions for the SWRBD (n = 21)

SWRFB																
Site code	Catchment	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Size Range (mm)	Mean length (mm) ± SD	Stream order	Survey sections (n)	Latitude	Average wetted with (m)	Distance covered (m)	Average wetted area (m^2)
79	Argideen	30/08/2023	536654	545695	536183	545520	3	3	62.5±3.9	48-70	4	1	51.7	8.9	534.5	4730.9
80	Bandon	30/08/2023	529867	554833	529695	555176	2	2	61.2±5.1	52-70	4	1	51.7	7.3	491.3	3571.1
75	Behy	27/08/2023	464593	588119	464299	587871	3	3	60.5±5.7	49-72	4	1	52.0	6.9	434.1	2986.5
78	Blackwater (Munster)	29/08/2023	569296	600007	569036	600543	2	3	66.5±5.7	54-78	4	1	52.2	17.2	651.8	11197.4
82	Bride	31/08/2023	581023	590806	581206	590764	2	2	66.8±5.9	56-84	4	2	52.1	9.7	249.5	2427.8
82	Bride	31/08/2023	580756	590663	580965	590799					4			9.7	189.3	1841.8
51	Caragh	23/08/2023	472720	580741	472714	580470	3	1	52.5±6.6	38-69	4	1	52.0	9.6	292.9	2804.4
72	Cloonee	25/08/2023	482994	563759	483527	563669	3	2	55.2±6.9	43-69	3	1	52.0	6.1	731.8	4464.1
55	Currane	22/08/2023	451504	563870	451815	563645	2	1	51.8±6.1	40-70	4	1	51.8	5.0	586.5	2950.7
74	Ilen	26/08/2023	514873	541655	515092	541872	2	2	57.8±5.8	43-69	4	1	51.6	7.5	331.4	2497.5
63	Inny	25/08/2023	461239	577058	461558	577220	2	2	59.7±4.2	50-68	4	1	51.9	8.3	375.0	3109.6
52	Kerry Blackwater	23/08/2023	478464	572266	478216	572218	3	3	56.6±15.2	44-104	5	1	51.9	11.4	301.7	3435.0
56	Laune (Cottoners)	23/08/2023	478564	595562	478611	595230	1	1	55.9±7.1	42-67	4	1	52.1	8.1	707.7	4885.6
91	Laune	13/09/2023	491829	598269	492368	598284	1	2	61.0±6.7	51-76	3	1	52.1	6.9	412.4	3346.5
81	Lee	31/08/2023	540470	563892	540261	564173	1	1	67.9±7.4	55-82	2	1	51.8	4.6	356.1	1655.2

92	Maine	13/09/2023	505760	603241	505954	603191	2	1	58.8±5.9	43-76	4	2	52.2	7.0	262.6	1831.2
92	Maine	13/09/2023	505065	603364	505315	603363					4		52.2	7.0	226.9	1582.4
75	Mealagh	26/08/2023	501138	549814	501284	550029	2	2	65.1±4.8	56-75	4	1	51.7	10.8	368.3	3992.7
60	Owenscaul	24/08/2023	459769	602571	459820	602570	2	3	63.0± 5.6	49-78	4	2	51.9	8.5	285.5	2414.0
60	Owenscaul	24/08/2023	459208	601684	459228	601945					4		52.1	5.6	51.4	290.2
31	Owvane	24/08/2023	504071	556153	504202	556234	5	4	63.3±5.5	53-73	5	3	51.7	9.3	223.4	2083.2
31	Owvane	24/08/2023	504576	556606	504803	556632					5		51.8	9.3	233.5	2177.0
31	Owvane	24/08/2023	505218	556780	505421	556872					5		51.8	9.3	119.6	1115.0
71	Roughty	25/08/2023	506503	575368	506959	574977	1	2	62.7±3.2	56-71	5	1	51.9	11.0	636.0	6997.8
73	Sheen	24/08/2023	495387	567633	495516	567470	1	1	56.8±6.1	46-71	5	2	51.9	14.9	252.0	3761.0
73	Sheen	24/08/2023	495632	566584	495589	566416								14.9	183.2	2734.6
58	Sneem	22/08/2023	467259	568845	467170	569072	3	4	67.4±16.1	50-113	5	1	51.9	7.4	250.7	1844.4

Table 9 Species presence and absence of each species recorded (except salmon fry) in rivers within the SWRBD during Geneflow sampling programme in 2023. Approximate numbers encountered are also noted where applicable.

SWRBD								
River	Salmon	Trout		Eel	Stickleback	Stone loach	Minnow	Other species
	Parr	Parr	Fry					
Argideen	Y	Y	Y	Y(1)	Y	Y	Y	
Bandon	Y	Y	Y	Y(2)	Y	Y	Y	Pearl mussel
Behy	Y	N	Y	Y	N	N	N	
Blackwater (Munster)	Y	Y	Y	N	N	Y	N	
Bride	Y	Y	Y	N	N	Y	N	
Caragh	Y	N	N	Y(3)	N	N	N	
Cloonee	Y	Y	Y	Y	N	N	N	
Currane	Y	Y	Y	Y(5)	N	N	N	
Ilen	Y	Y	Y	N	N	N	N	
Inny	Y	Y	Y	Y(1)	N	N	N	
Kerry Blackwater	Y	Y	Y	N	N	N	N	
Laune (Cottoners)	Y	Y(20)	Y	N	N	N	N	
Laune	Y	N	Y	N	N	Y	N	
Lee	Y	Y	Y	N	N	Y	N	
Maine	Y	N	Y	N	N	N	N	
Mealagh	Y	Y	Y	N	N	N	N	
Owenscaul	Y(50+)	Y	Y	Y(10)	N	N	N	
Owvane	Y	Y	Y	Y	N	N	N	
Roughty	Y	Y	Y	N	N	N	N	
Sheen	Y	N	N	N	N	N	N	
Sneem	Y	Y	Y	Y(5)	N	N	N	

7.2.5. SERBD

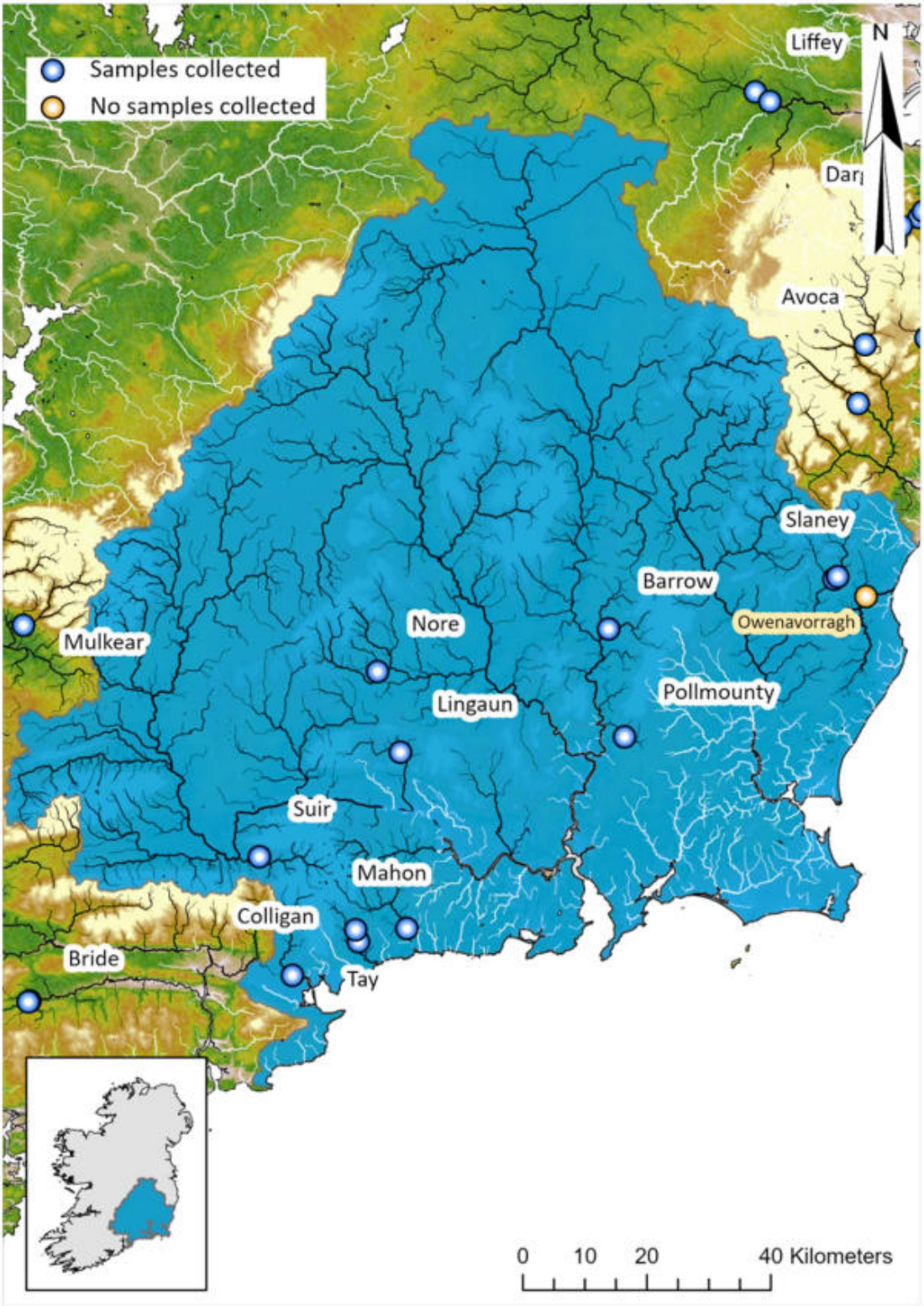


Figure 14 Rivers surveyed for the Geneflow project in 2023 within the SERBD (n = 9). Blue dots indicate successful sample collections. Orange dots indicate that no sample was obtained for 2023 during the sampling despite efforts.

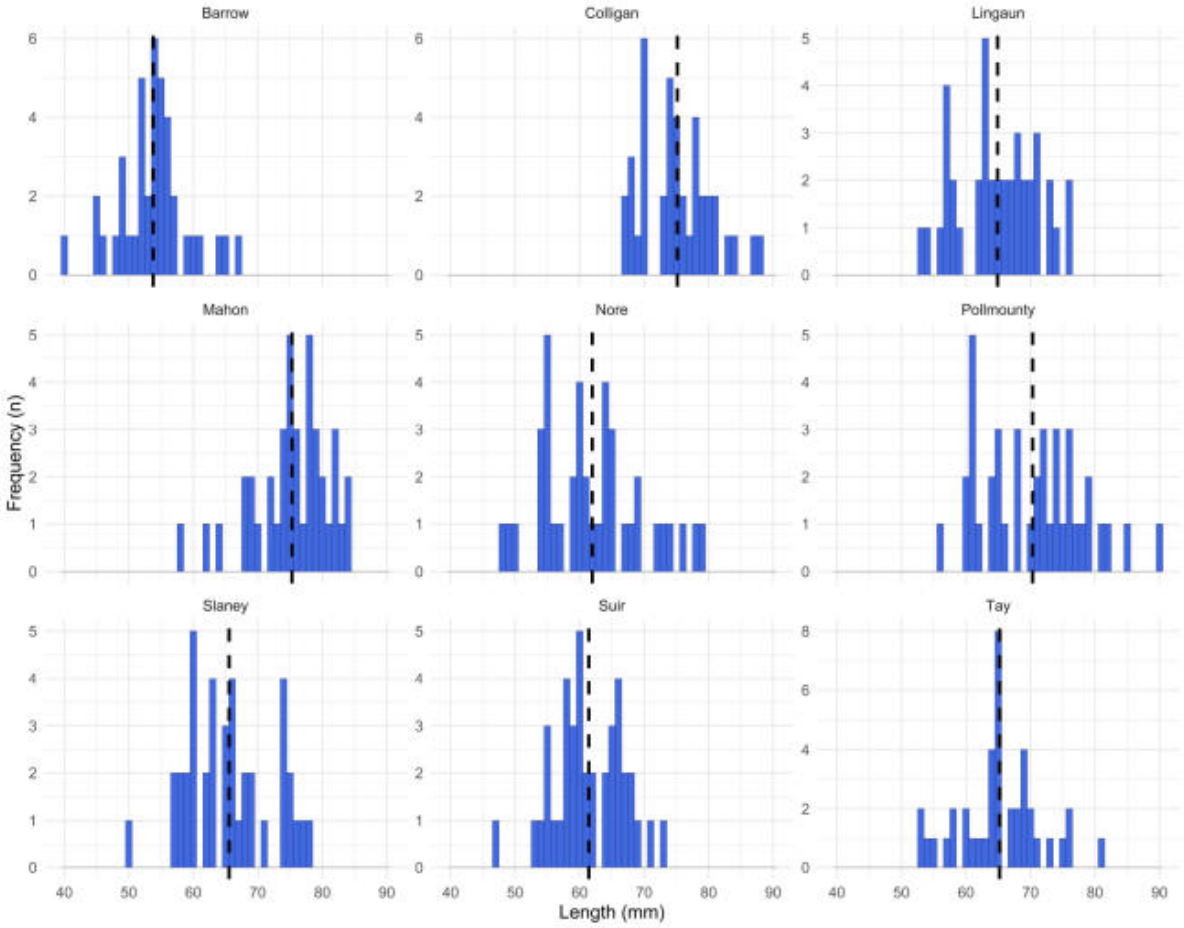


Figure 15 Length frequencies of juvenile salmon collected for the Geneflow project in 2023 in rivers sampled within the SERBD (n = 9). Black vertical segmented line indicates sample mean length (mm).

Table 10 Site details, additional information, and site segment dimensions for the SERBD (n = 9)

SERFB																
Site code	Catchment	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Size Range (mm)	Mean length (mm) ± SD	Stream order	Survey sections (n)	Latitude	Average wetted with (m)	Distance covered (m)	Average wetted area (m^2)
61	Barrow	01/09/2023	674330	650918	674384	651076	2	1	40-67	53.8± 5.4	4	1	52.6	7.9	174.4	1382.1
64	Colligan	29/08/2023	623348	594952	623072	595528	2	3	67-88	75.15± 5.4	4	1	52.1	11.4	675.4	7704.9
43	Lingaun	22/09/2023	640759	630985	640610	631191	2	1	53-76	64.9± 6.1	4	1	52.4	7.9	266.7	2117.4
66	Mahon	30/08/2023	641807	602528	641607	602917	2	4	58-84	75.3± 5.9	5	1	52.2	11.4	500.8	5698.4
68	Nore	31/08/2023	637081	644034	636925	643737	3	4	48-79	61.9± 7.8	5	1	52.5	10.8	387.4	4194.7
106	Pollmounty	21/09/2023	676914	633483	677193	633477	1	2	56-90	70.3± 7.8	3	1	52.4	4.8	288.2	1375.0
62	Slaney	04/09/2023	710697	658973	711011	659233	2	4	50-78	65.5± 6.6	4	2	52.7	11.2	446.0	4997.2
62	Slaney	04/09/2023	711285	659369	711363	659385	1	3			4		52.7	10.0	80.5	807.7
67	Suir	31/08/2023	618030	614098	618402	613671	3	1	47-73	61.4± 5.4	4	1	52.3	12.9	573.3	7396.6
65	Tay	30/08/2023	634007	600381	633920	600664	2	4	53-81	65.2± 6.4	4	2	52.2	5.0	310.3	1554.4
65	Tay	30/08/2023	633543	602311	633427	602424	2	4			3		52.2	6.1	162.5	988.1

Table 11 Species presence and absence of each species recorded (except salmon fry) in rivers within the SERBD during Geneflow sampling programme in 2023. Approximate numbers encountered are also noted where applicable.

SERBD								
River	Salmon	Trout		Eel	Stickleback	Stone loach	Minnow	Other species
	Parr	Parr	Fry					
Barrow	Y	Y	Y	N	N	N	N	
Colligan	Y(40)	Y	Y	Y(20)	N	Y	N	
Lingaun	Y	Y	Y	N	N	N	N	
Mahon	Y(40)	Y	Y	Y(5)	N	N	N	
Nore	Y	Y(20)	Y	N	N	Y	N	
Pollmounty	Y	Y	Y	N	N	N	N	
Slaney	Y	Y(50+)	Y	N	N	Y	Y	
Suir	Y	N	Y	N	N	N	N	
Tay	Y	Y(40)	Y	Y(7)	Y	N	N	

7.2.6. ERBD

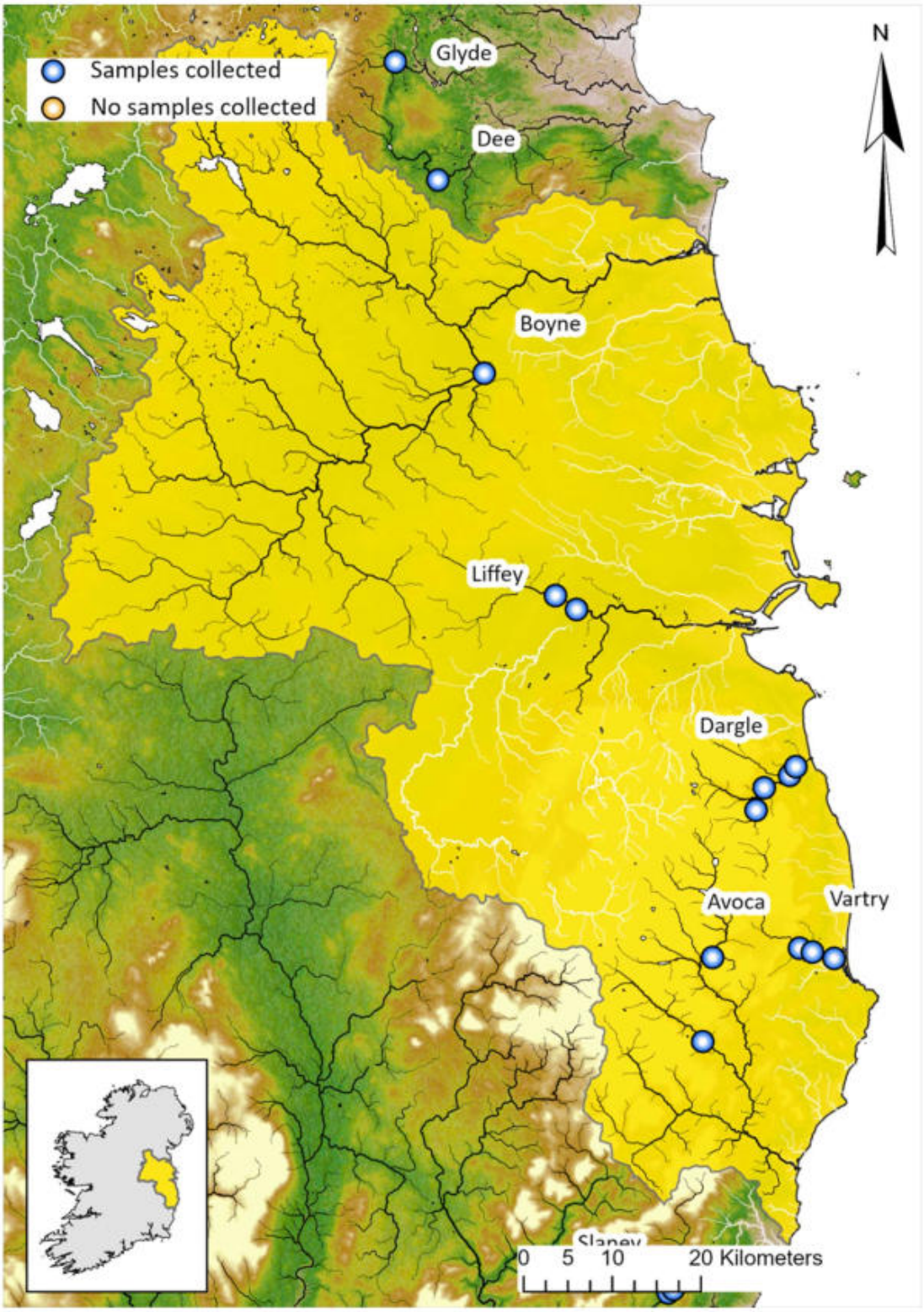


Figure 16 Rivers surveyed for the Geneflow project in 2023 within the ERBD (n = 5). Blue dots indicate successful sample collections. Orange dots indicate that no sample was obtained for 2023 during the sampling despite efforts.

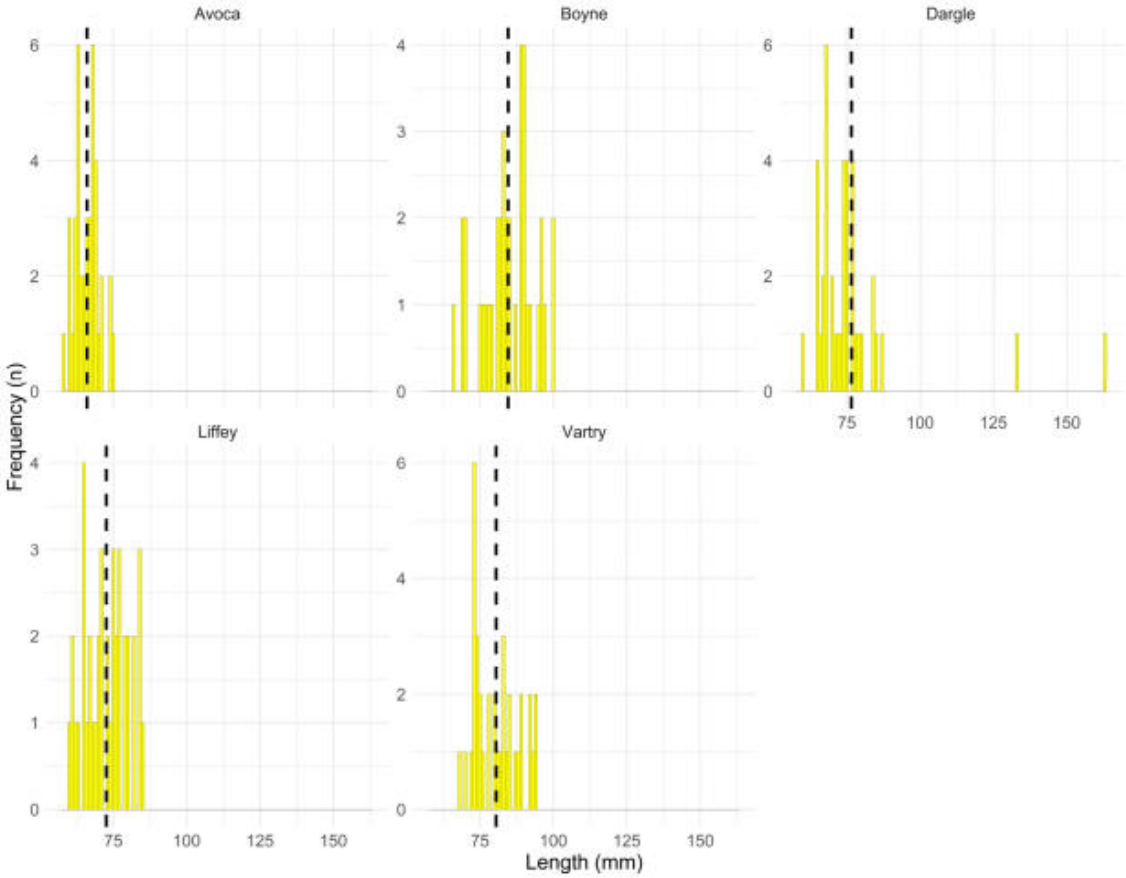


Figure 17 Length frequencies of juvenile salmon collected for the Geneflow project in 2023 in rivers sampled within the ERBD (n = 5). Black vertical segmented line indicates sample mean length (mm).

Table 12 Site details, additional information, and site segment dimensions for the ERBD (n = 5)

ERFB																
Site code	Catchment	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Size Range (mm)	Mean length (mm) ± SD	Stream order	Survey sections (n)	Latitude	Average wetted with (m)	Distance covered (m)	Average wetted area (m^2)
69	Avoca	05/09/2023	714595	687320	714446	687569	5	5	58-75	65.9± 4.1	4	2	52.9	10.3	365.1	3752.4
69	Avoca	05/09/2023	715706	696823	715869	696933	1	2			4		53.0	12.5	223.4	2798.4
87	Boyne	08/09/2023	689941	762734	690124	762629	2	2	66-100	84.5± 8.8	4	4	53.6	9.4	212.0	1996.0
50	Dargle	12/09/2023	724407	717349	724199	717014	4	5	60-163	76.5± 18.0	5		53.2	13.3	613.9	8166.7
50	Dargle	12/09/2023	725096	718324	724882	717823	4	5			5		53.2	10.6	804.6	8540.4
50	Dargle	13/09/2023	720615	713433	720716	713513	4	5			4		53.2	4.9	147.1	725.7
50	Dargle	13/09/2023	721531	715950	721127	715830	2	3			5		53.2	12.2	430.6	5233.2
49	Liffey	12/09/2023	697988	737615	697772	737608	3	3	60-85	72.6± 7.2	4	2	53.4	12.6	222.3	2797.7
49	Liffey	12/09/2023	700365	736051	700445	736456	2	3			4		53.4	13.3	440.3	5868.4
70	Vartry	11/09/2023	729418	696720	728525	696719	1	4	68-94	80.4± 7.6	4	3	53.0	10.1	1183.5	11926.2
70	Vartry	11/09/2023	725518	697869	725313	698001	2	4			3		53.0	8.6	305.1	2622.0
70	Vartry	11/09/2023	726970	697432	726995	697401	2	4			3		53.0	9.3	40.6	378.1

Table 13 Species presence and absence of each species (except salmon fry) recorded in rivers within the ERBD during Geneflow sampling programme in 2023. Approximate numbers encountered are also noted where applicable.

ERBD								
River	Salmon	Trout		Eel	Stickleback	Stone loach	Minnow	Other species
	Parr	Parr	Fry					
Avoca	Y	Y	Y	N	N	N	Y	
Boyne	Y	Y	Y	Y(2)	N	Y	Y	
Dargle	Y	Y	Y	Y	N	N	Y	Flounder Sea Trout
Liffey	Y	Y	Y	Y	N	N	N	
Vartry	Y	Y(100+)	Y(200+)	Y(40+)	N	N	N	Flounder

7.2.7. NBRBD

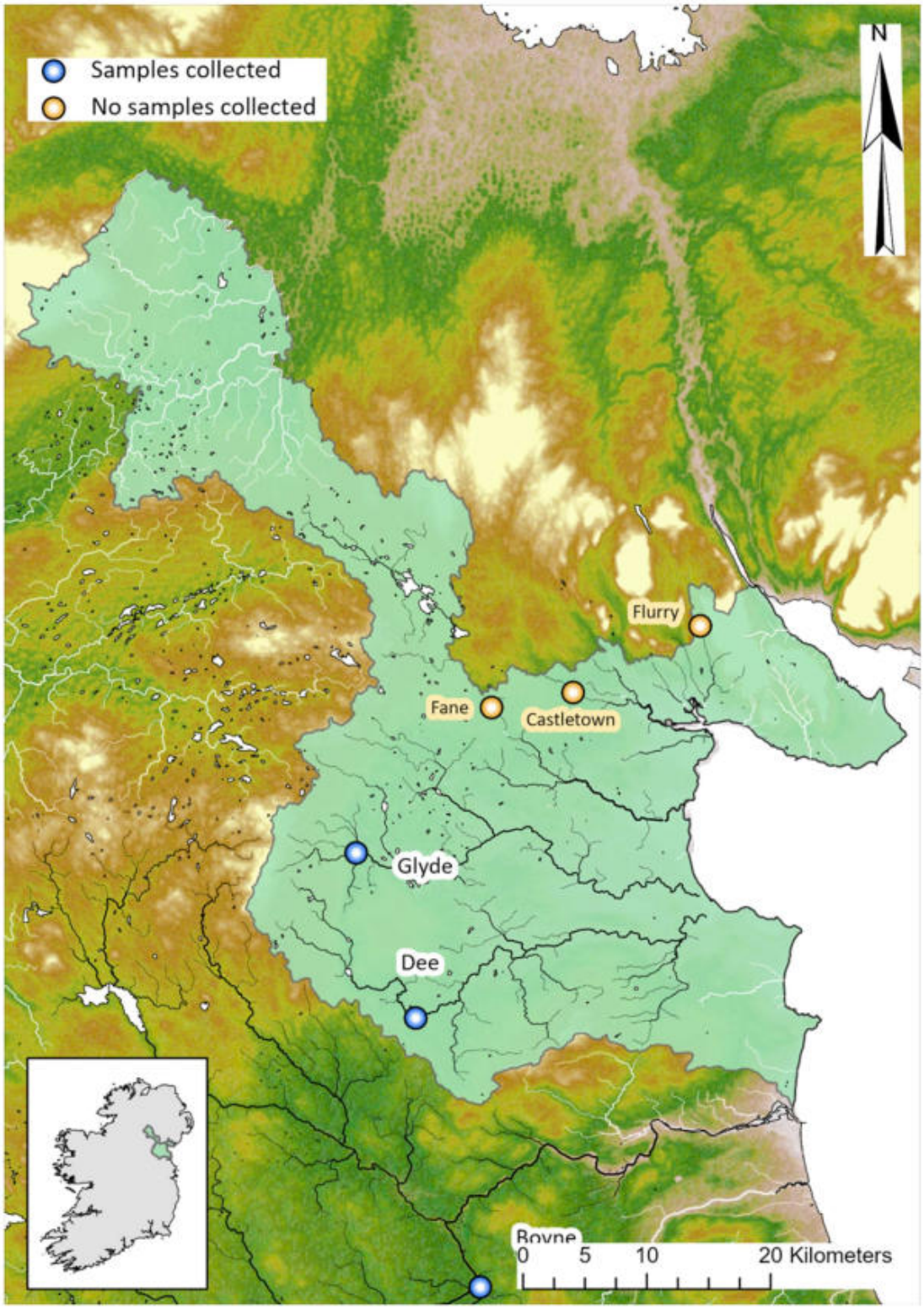


Figure 18 Rivers surveyed for the Geneflow project in 2023 within the NBRBD (n = 2). Blue dots indicate successful sample collections. Orange dots indicate that no sample was obtained for 2023 during the sampling despite efforts..

Table 14 Site details, additional information, and site segment dimensions for the NBRBD (n = 2)

NBRFB																
Site code	Catchment	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Size Range (mm)	Mean length (mm) ± SD	Stream order	Survey sections (n)	Latitude	Average wetted with (m)	Distance covered (m)	Average wetted area (m^2)
105	Dee	14/09/2023	684723	784523	684314	784518	2	2	64-134	82.9± 12.2	4		53.8	9.2	452.6	4153.1
85*	Dee	06/09/2023	684723	784523	684314	784518	2	2			4		53.8	9.2	452.6	4153.1
84	Glyde	06/09/2023	679916	797834	679718	797412	1	2	61-87	76.8± 7.1	3		53.9	5.3	478.8	2525.9

*Sub sample

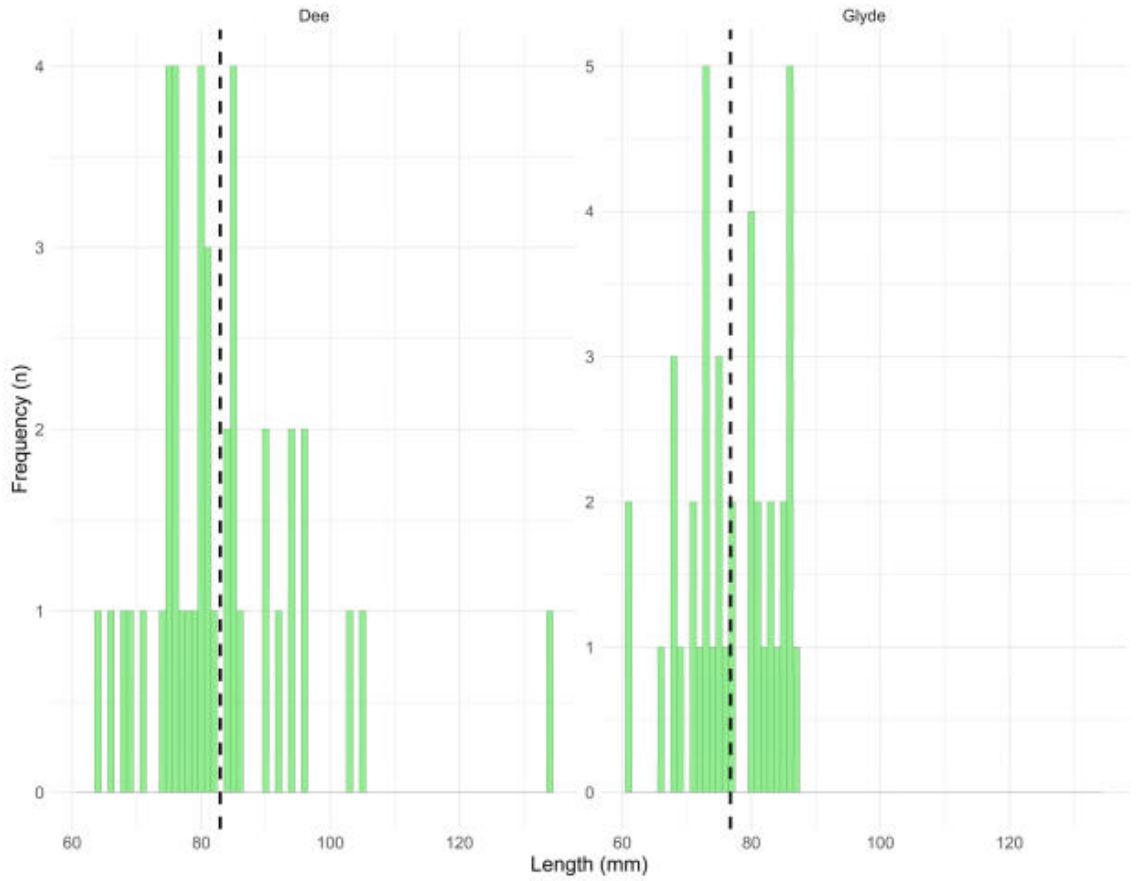


Figure 19 Length frequencies of juvenile salmon collected for the Geneflow project in 2023 in rivers sampled within the NBRBD (n = 2). Black vertical segmented line indicates sample mean length (mm).

Table 15 Species presence and absence of each species (except salmon fry) recorded in rivers within the NBRBD during Geneflow sampling programme in 2023. Approximate numbers encountered are also noted where applicable.

NBRBD										
Site number	River	Date	Salmon	Trout		Eel	Stickleback	Stone loach	Minnow	Other species
			Parr	Parr	Fry					
85	Dee	06/09/2023	Y	Y	Y	Y	N	Y	Y	
105	Dee	14/09/2023	Y	Y(30)	Y	Y(10)	N	Y	Y	Perch Sea Trout
84	Glyde	06/09/2023	Y	Y	Y	Y(1)	Y	Y	Y	

7.2.8. Length frequencies of all rivers sampled

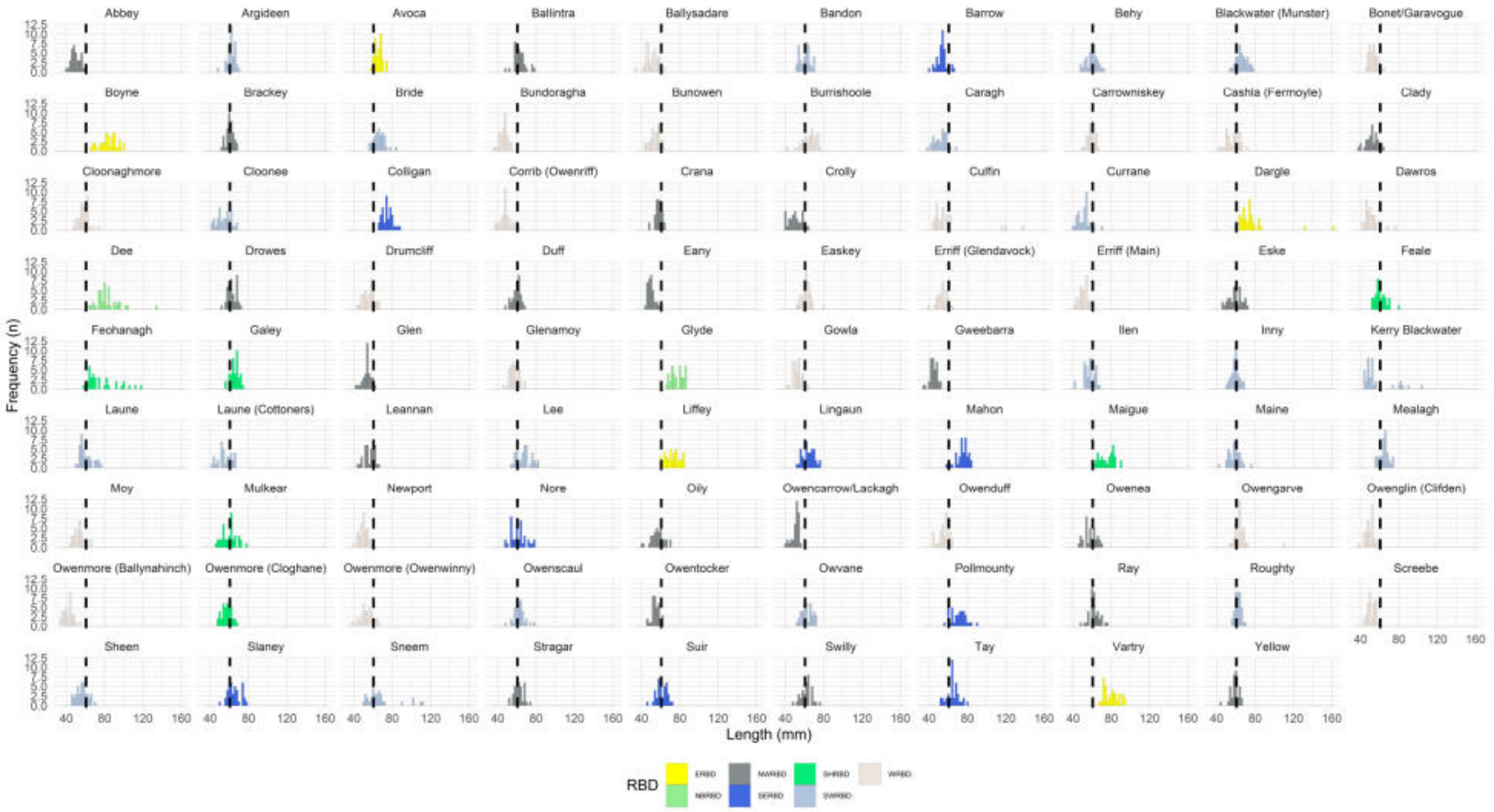
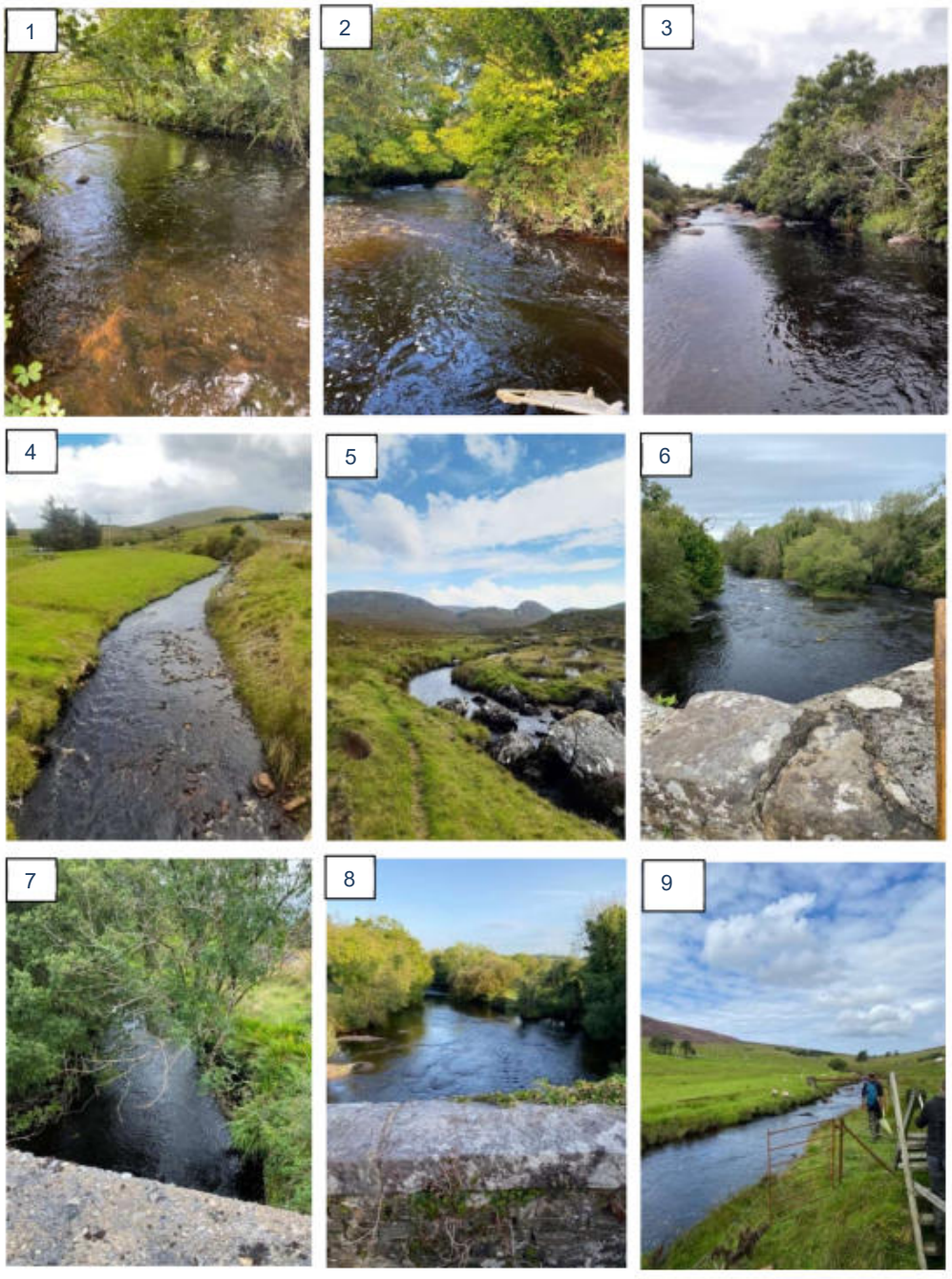


Figure 20 Length frequencies of juvenile salmon collected for the Geneflow project in 2023 in all rivers sampled (n =89). Rivers are in alphabetical order and split by RBD in colour. Black dashed line indicates sample national average mean length (60.5mm).

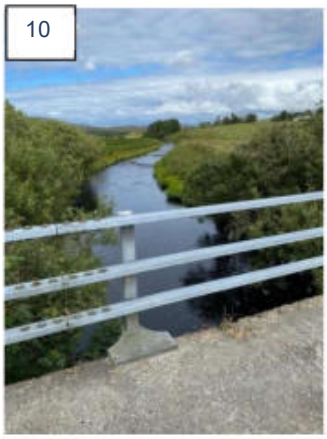
7.3. Appendix 3: Photos of rivers sampled per RBD

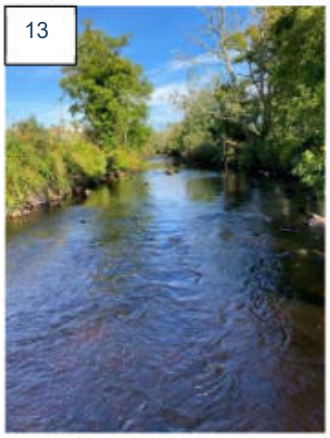
7.3.1. NWRBD

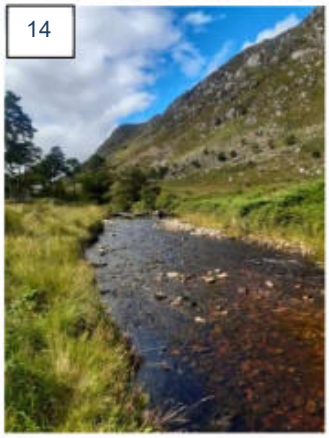
NWRBD		
1. Abbey	2. Ballintra	3. Clady
4. Crana	5. Crolly	6. Drowes
7. Eany	8. Eske	9. Glen (Yellow)

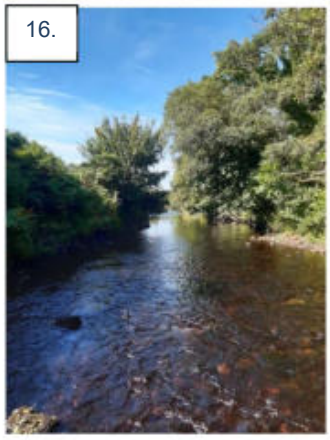


NWRBD		
10. Glen	11. Gweebarra	12. Lennon
13. Oily	14. Owencarrow/Lackagh	15. Owenea
16. Owentocker	n/a. Ray	17. Stragar
n/a.Brackey	18. Swilly	n/a. Duff



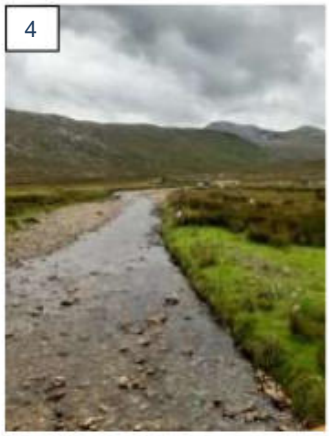


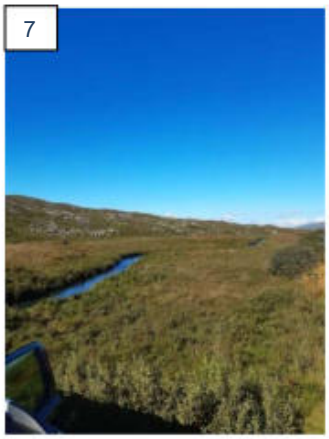




7.3.2. WRBD

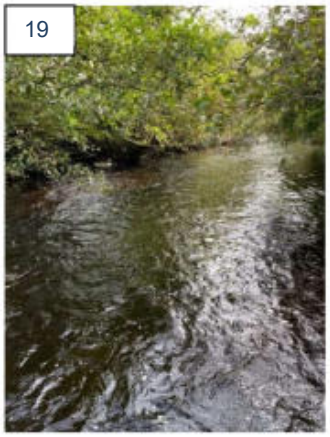
WRBD		
n/a. Bunowen	n/a. Carrowniskey	1. Cashla (Fermoyle)
2. Corrib (Owenriff)	3. Culfin	4. Dawros
n/a. Bundoragha	n/a. Erriff (Glendavock)	5. Erriff (Main channel)
6. Glenamoy	7. Gowla	8. Moy
9. Newport		

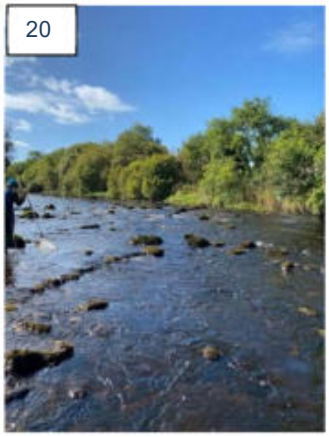




WRBD		
10. Owenduff	11. Owengarve	12. Owenglin
13. Owenmore (Ballynahinch)	14. Owenwinny	15. Screebe
16. Ballysadare	17. Bonet / Garavouge	18. Drumcliff

WRBD		
19. Clooghnamore	20. Easkey	



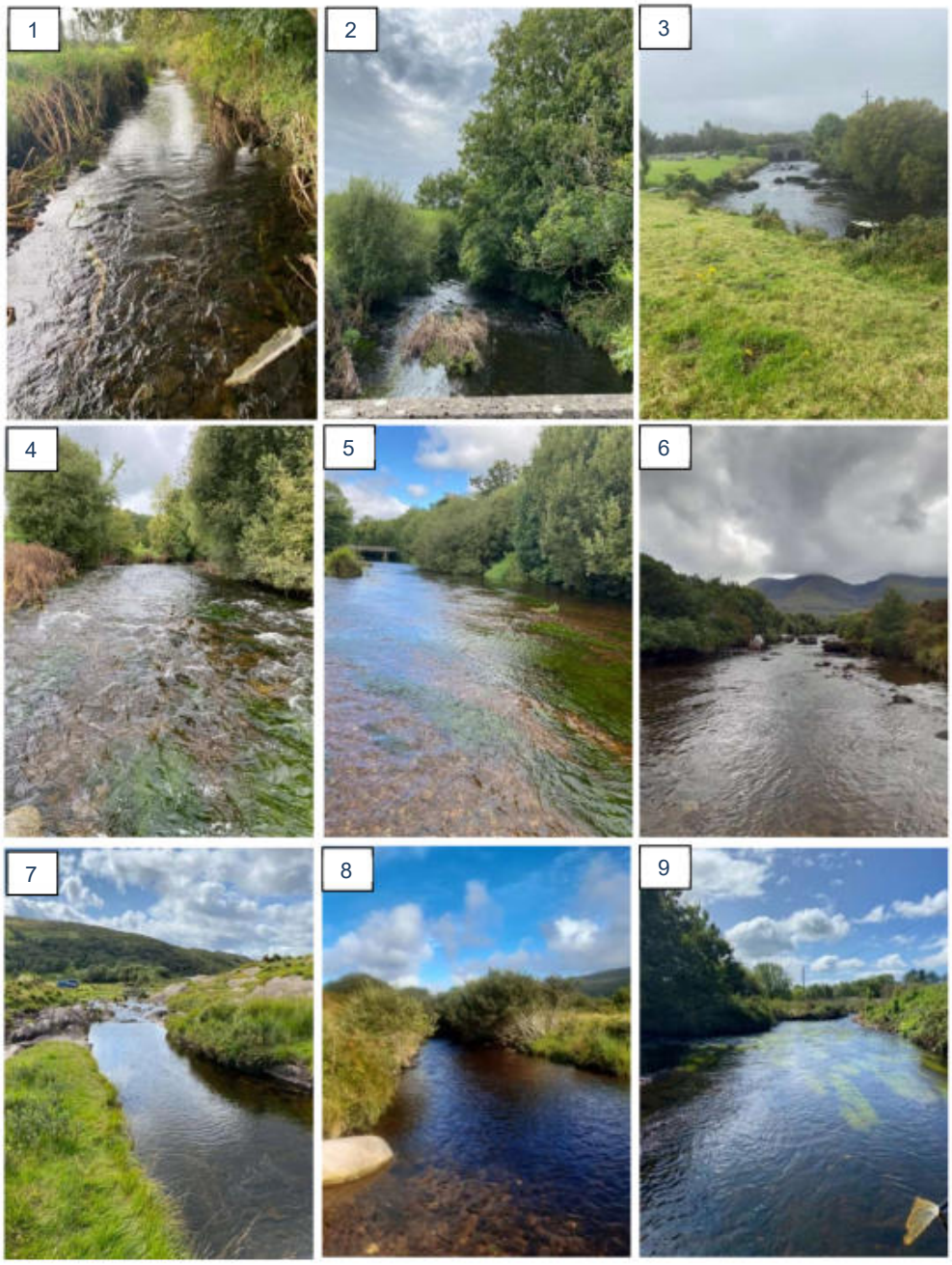


7.3.3. SHRBD

SHRBD		
1. Feale	2. Feoghanagh	3. Galey
4. Maigue	5. Mulkear	6. Owenmore (Cloghane)

7.3.4. SWRBD

SWRBD		
1. Argideen	2. Bandon	3. Behy
4. Blackwater (Munster)	5. Bride	6. Caragh
7. Cloonee	8. Currane	9. Ilen

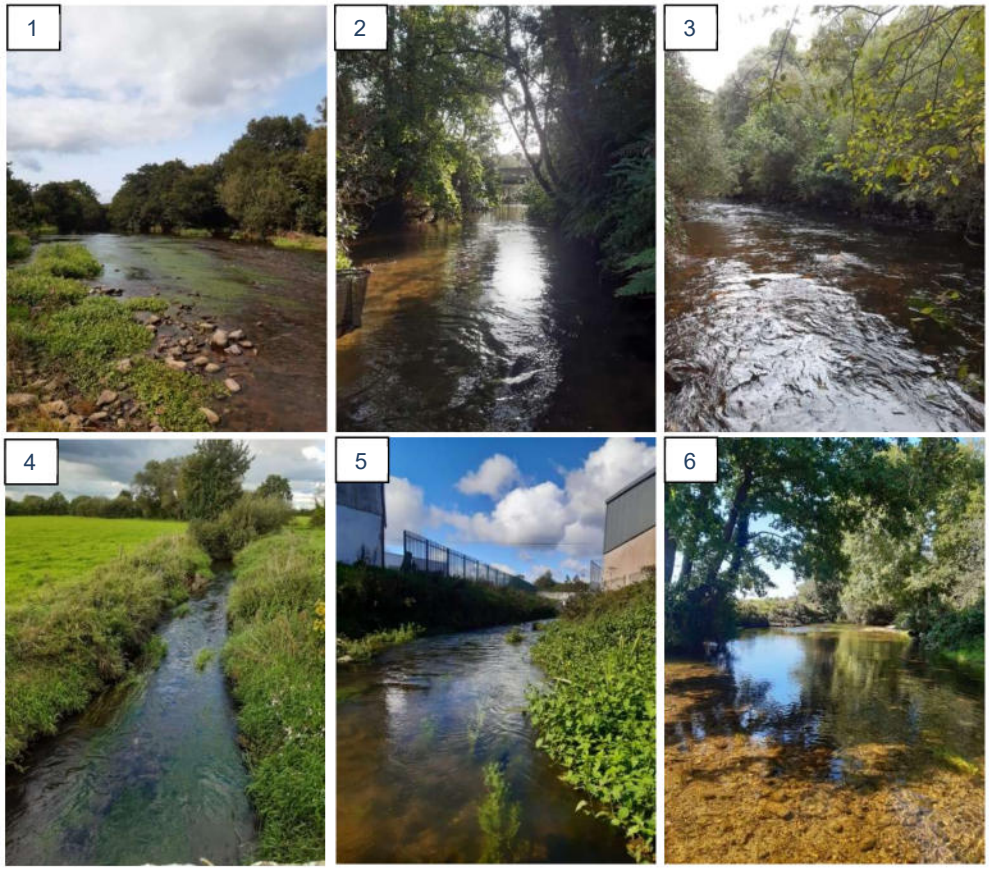


SWRBD		
10. Inny	11. Kery Blackwater	12. Laune (Cottoners)
13. Laune	14. Lee	15. Maine
16. Mealagh	17. Owenscaul	18. Owvane

SWRBD		
19. Roughy	20. Sheen	21. Sneem

7.3.5. SERBD

SERBD		
n/a. Barrow	1. Colligan	2. Lingaun
3. Mahon	4. Nore	5. Pollmounty
6. Slaney		



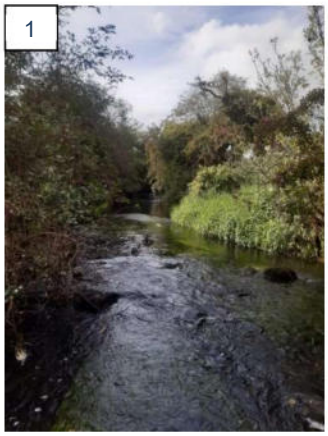
SERBD		
n/a. Barrow	7. Suir	8. Tay

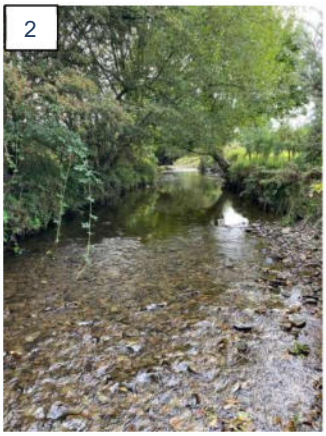
7.3.6. ERBD

ERBD		
1. Avoca	2. Boyne	3. Dargle
4. Liffey	5. Vartry	

7.3.7. NBRBD

NBRBD		
1. Dee	2. Glyde	





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