

Report on the field sampling activities in 2025 for the GeneFlow project

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Report on the field sampling activities in 2025 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 routinely 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 regards to genetic introgression from farmed escaped salmon can be assessed and reported.

The project aimed to sample 200 salmon stocks from 144 salmon designated rivers in Ireland from 2023 to 2025. Following the collection of samples from 132 catchments between 2023 and 2024, a further 26 catchments were successfully sampled between July 15th and

September 30th, 2025. The 2025 field programme included repeat sampling of sites from previous years. In total in 2025, 41 genetic collections from 26 catchments were obtained comprising a total number of 1,568 samples. The GeneFlow project is supported by funding provided by Inland Fisheries Ireland and the European Maritime, Fisheries and Aquaculture Fund Marine Biodiversity Programme 2021-2027, co-funded by the EU and the Marine Institute on behalf of the Government of Ireland.

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 has averaged approx. 13,000 tonnes of farmed salmon annually in the last decade (Dennis *et al.*, 2024). After a very low output of 9,289 tonnes in 2023, salmon production increased by over 50% in 2024, reaching over 14,000 tonnes, the highest since 2017 (BIM, 2025).

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. The most recent high profile farm escape event occurred at Killary Harbour, located between counties Galway and Mayo on 11th August 2024. Subsequent to this, captures of adult farmed salmon were recorded in several rivers on the western seaboard between mid-August and September 2024 (Kelly *et al.*, 2025). High levels of such potential 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 has not routinely monitored the genetic status of its wild Atlantic salmon populations to date in this regard even though salmon farming is a significant endeavor along its Atlantic coast.

To address this deficit, University College Cork, Inland Fisheries Ireland and Teagasc 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 2025. Up to 200 salmon stocks in Ireland were 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 to collect samples for the third year of the project. In 2023 and 2024, samples were obtained from 132 catchments in total. In 2025, 41 genetic collections from a further 26 catchments were obtained. This included samples obtained from repeated catchments in 2023 and 2024. The field sampling element of the GeneFlow project is jointly funded by IFI and the European Maritime, Fisheries and Aquaculture Fund.

The IFI project team in 2025 comprised:

- Michael Millane (IFI, Senior Research Officer)
- John Coyne (IFI, Research Officer) GeneFlow-funded
- William Staunton (IFI, Fisheries Assistant) GeneFlow-funded

Project supervision was provided by Michael Millane. The project team was supported by regionally based IFI River Basin District (RBD) staff throughout the country. The sample collection programme was conducted under the guidance of the GeneFlow project leader Prof. Phil McGinnity (UCC).

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 close to 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 Climate, Energy and the Environment.
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 (year 1);
- a screening Appropriate Assessment was produced and approved (year 1);
- a Standard Operating Procedure was produced (year 1) (Appendix 1);
- A Research Officer and a Fisheries Assistant were hired to form a sampling team in 2025; and
- training was provided in the sampling techniques (fish identification, sampling processing), regulatory obligations, and electrofishing.

3.3. Field sampling

Full details on the field sampling procedures are contained in the SOP (Appendix 1). Sampling was undertaken between July 15th and September 30th, 2025.



Plate 3.1. Sampling for the Geneflow project. Glencullin Stream, Delphi Catchment (WRBD).

For 2025, the sampling team comprised two IFI R&D staff sometimes supported by locally-based colleagues from IFI Operations. A single electrofishing backpack with an appropriate control unit (DC converter), a cathode and an anode were used to capture candidate juvenile salmon for genetic sampling. A key consideration of the 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 present. Fishing was carried out by walking in an upstream direction and point source sampling, at two to three second bursts every 15-20m where possible of suitable habitat retaining one to two individuals per effort.

The sample target per catchment was 40 0+ Atlantic salmon fry. However, when numbers were low, this was complemented by the additional collection of samples from 1+ parr. Fin clips were taken from this cohort and fish were subsequently released. Individual 0+ fry for sample retention were euthanised with 8ml/l of MS222 anaesthetic, prepared at 100g/l solution (Appendix 1). Samples were preserved in ethanol for later DNA extraction. In order to minimise the inadvertent risk of spreading invasive species, standard IFI biosecurity measures were implemented by the field teams when moving between sampling sites (Appendix 1).

3.4. Biological analysis

All juvenile salmon collected were measured (fork length to the nearest mm) in conjunction with the collection of genetic material. Within this dataset, individuals identified as 0+ fry were weighed to two decimal places to establish a length-weight relationship and growth evaluation. This relationship was modelled using the standard allometric equation $W=aL^b$ from Ogle (2013). Condition factor (CF) for 0+ fry was subsequently estimated using the formula $CF = (M / L^{exp}) \times 100$ using an exponent of 3.14 and coefficient of 0.008cm as per Angus *et al.* (1998).

3.5. Identification

The identification of 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. All staff were providing 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 3.1, Fig. 3.1).

Table 3.1 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 (black 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 (black 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 (black circles)	Several red spots all over the flanks (black circles)

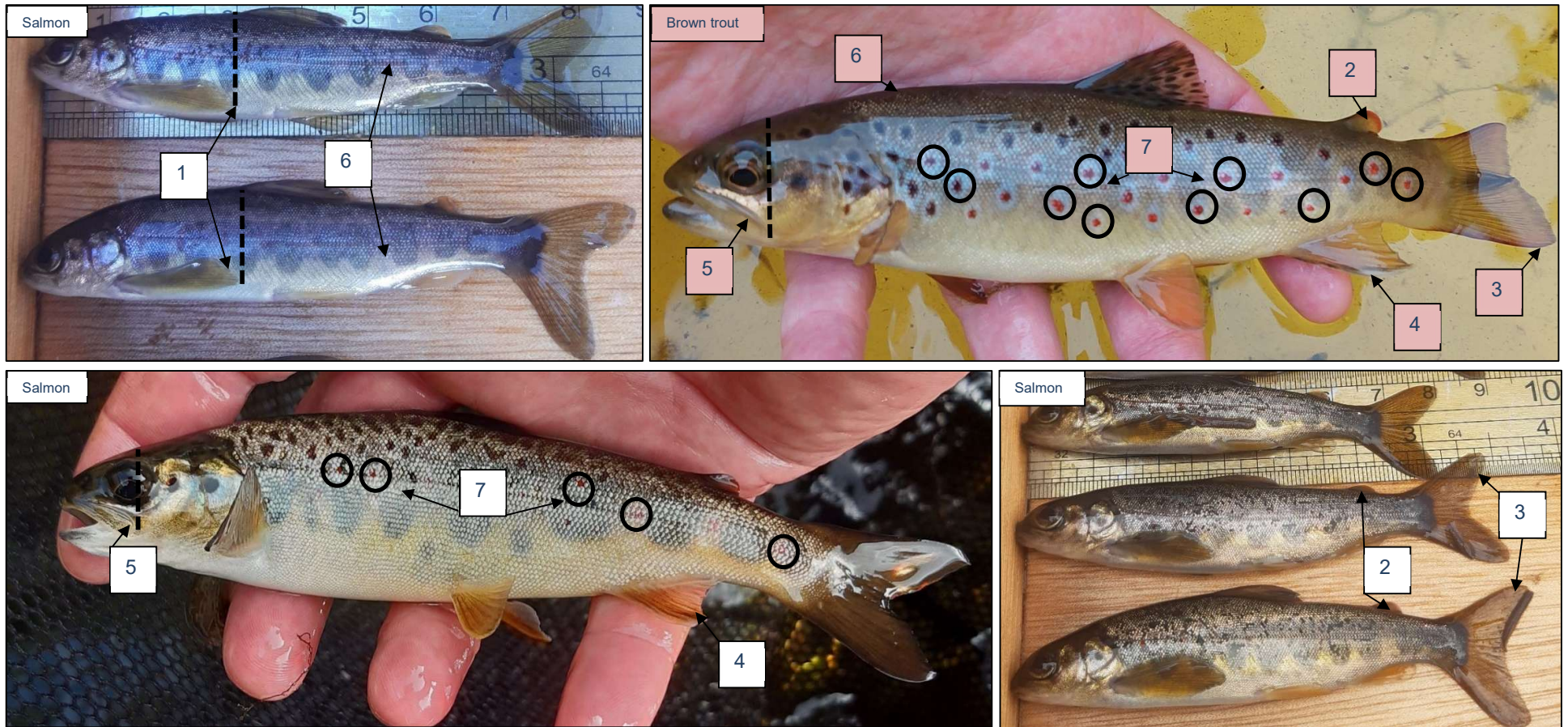


Fig. 3.1. Key characteristics of Atlantic salmon vs brown trout juveniles as described in Table 3.1. Marks 1-7 in white indicate key features for salmon. Marks 2-7 in coral indicate key features for brown trout.

3.6. 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. This was conducted at each survey location in a presence-absence format.

3.7. Assessment of fishing and wading difficulty

In order to inform 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. 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.

3.8. Site details and dimensions

GPS coordinates were recorded in ITM format 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 (m²) between these points. 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 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, and if the sample collection was well distributed. It also generated a general degree of effort utilised to produce a sufficient sample, another indicator of population status in a catchment.

4. Results

4.1. Summary of sampling effort (2023-2025)

A total of 223 sampling efforts were conducted in 157 catchments for the GeneFlow project between 2023 and 2025 (Fig. 4.1). Of this a total of 148 catchments produced genetic collections of juvenile salmon, with a total collection of 6,349 individual samples obtained (Fig. 4.2). A total sampling distance of 102 km was surveyed with an average length per site of 454 m (35-1383 m). Wetted width (m) and distance calculations recorded an average sample site area of 3,522 m² (171–14,220 m²) (Appendix 2). Details from previous surveys can be found in summary reports in 2023 (Coyne *et al.*, 2024) and 2024 (Coyne *et al.*, 2025).

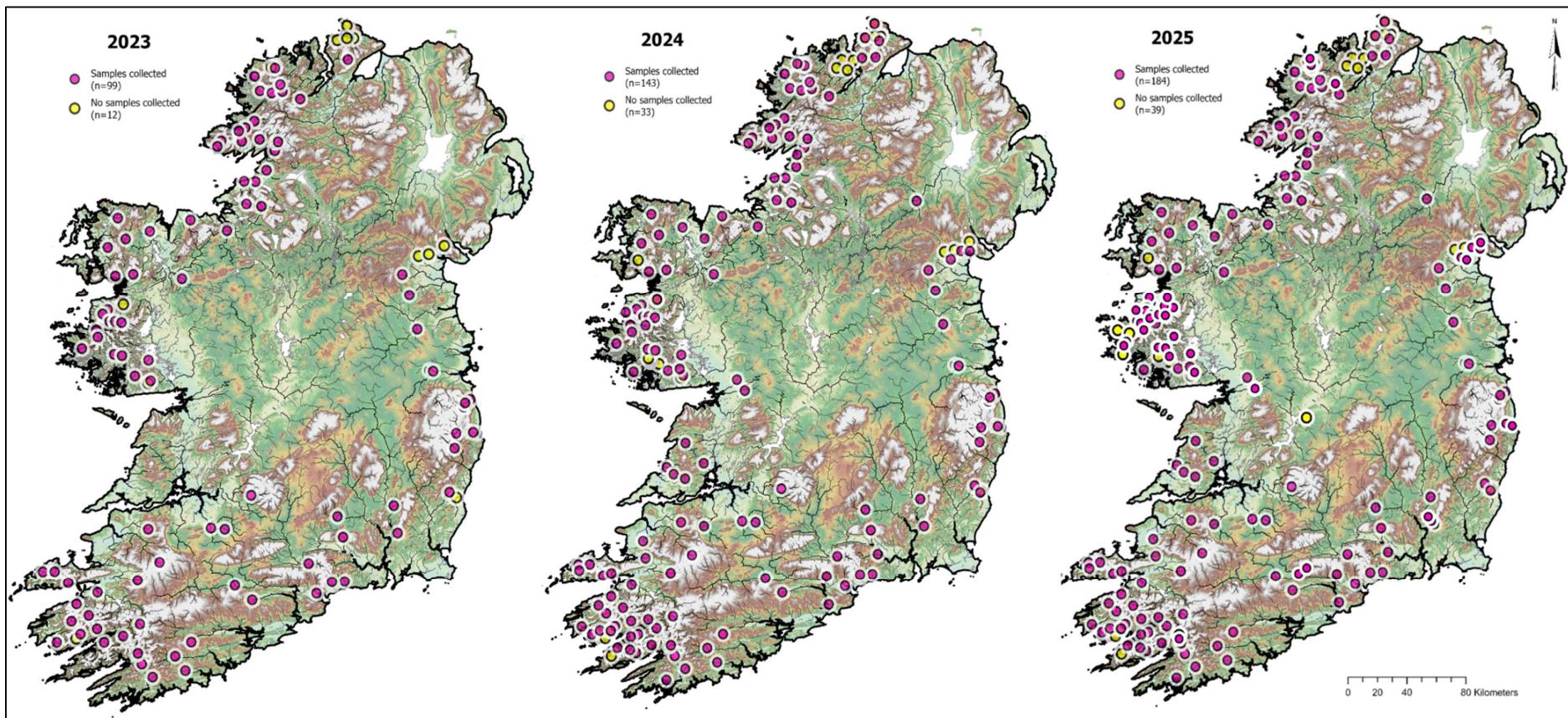


Fig. 4.1. Cumulative progression of sampling for the GeneFlow project from 2023-2025 (total n of sites by end of Q3 in 2025 = 223).

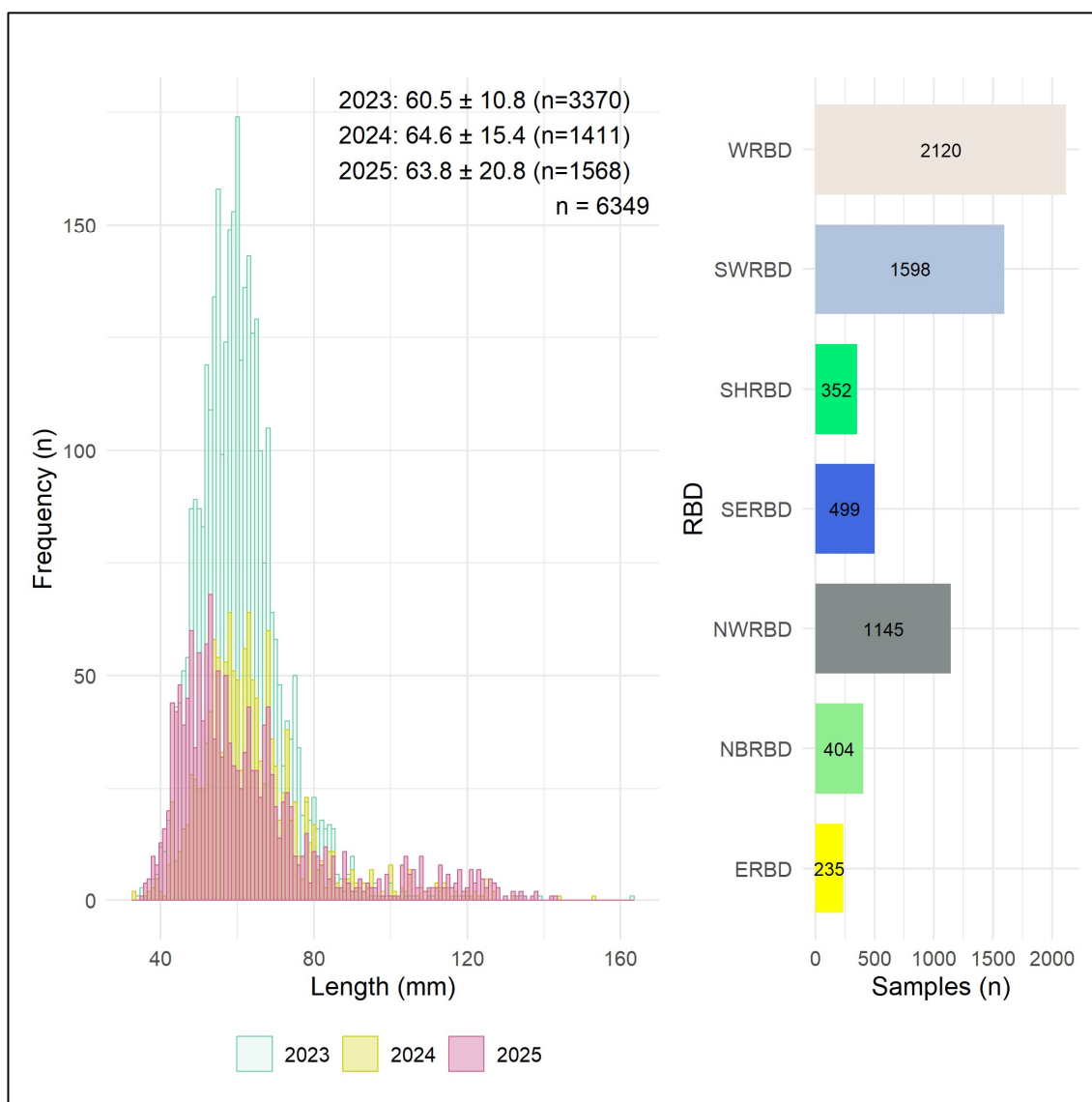


Fig. 4.2 Salmon juvenile (0+, 1+) length frequency (left panel) and number of samples collected per River Basin District (right panel) from 2023-2025 the GeneFlow project. A total of 6,349 samples (range: 33–163 mm) were recorded between 2023-2025. Mean fork length (mm) $\pm$ SD per year also displayed.

4.2. Sampling effort 2025

A total of 31 catchments were surveyed between July 15th and September 30th 2025 (Fig. 4.3) with a total of 47 sampling efforts. This comprised:

- 41 genetic collections of juvenile salmon were obtained from 26 catchments; and
- 6 rivers where no samples were available for collection due to a paucity of salmon.

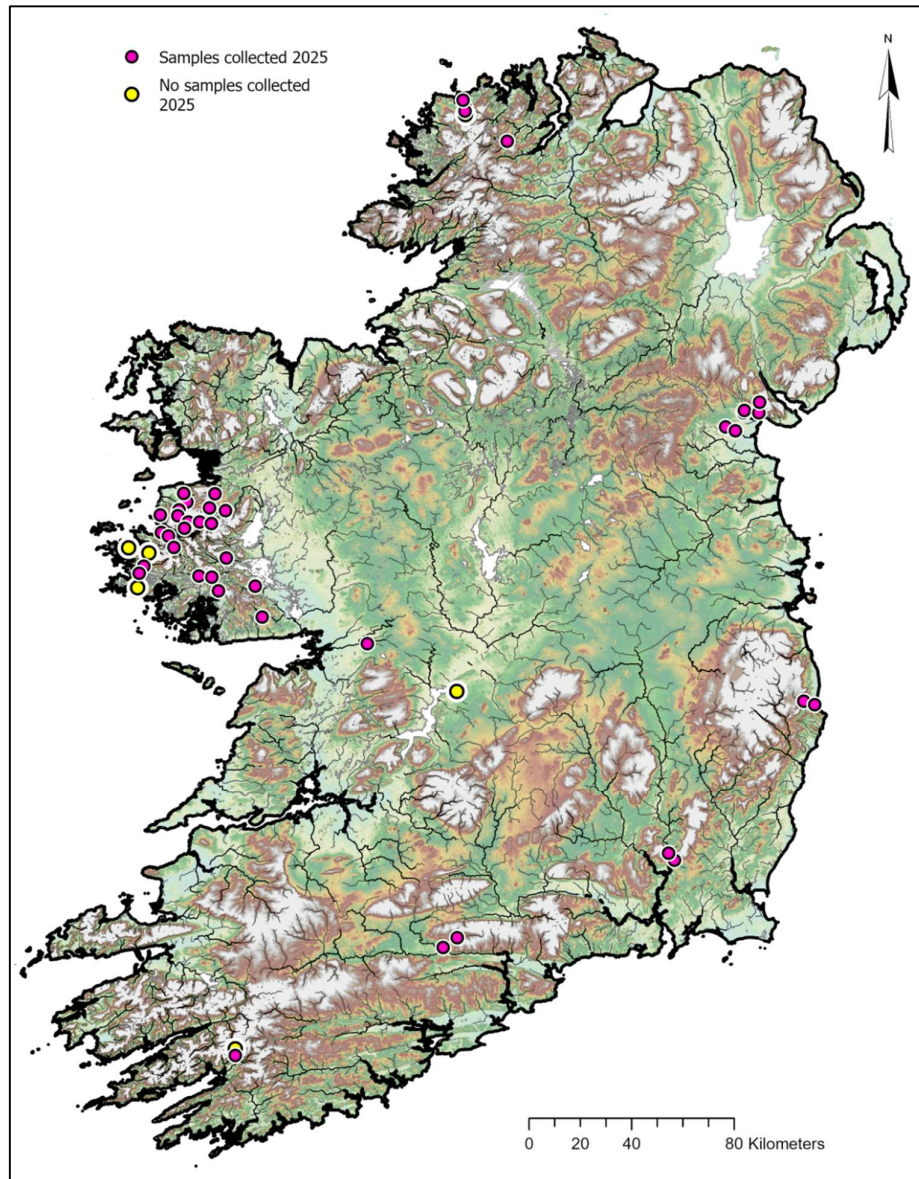


Fig. 4.3 Sites sampled for the GeneFlow project in 2025 (n=47).

An average distance per site of 400 m (35–1259 m) was covered, with a total sampling distance of c.19 km (Appendix 2). Wetted width (m) and distance calculations recorded an average site area of 2,679 m² (171–9,317 m²) (Appendix 2).

A total of 1,568 individual samples of juvenile salmon (0+ and 1+) were recorded in 2025. Mean fork length (FL) was 63.8 mm $\pm$ 20.8 mm SD (range: 35–143 mm) (Fig. 4.4). Length frequency data of juvenile salmon collected per RBD are presented in Fig 4.5.

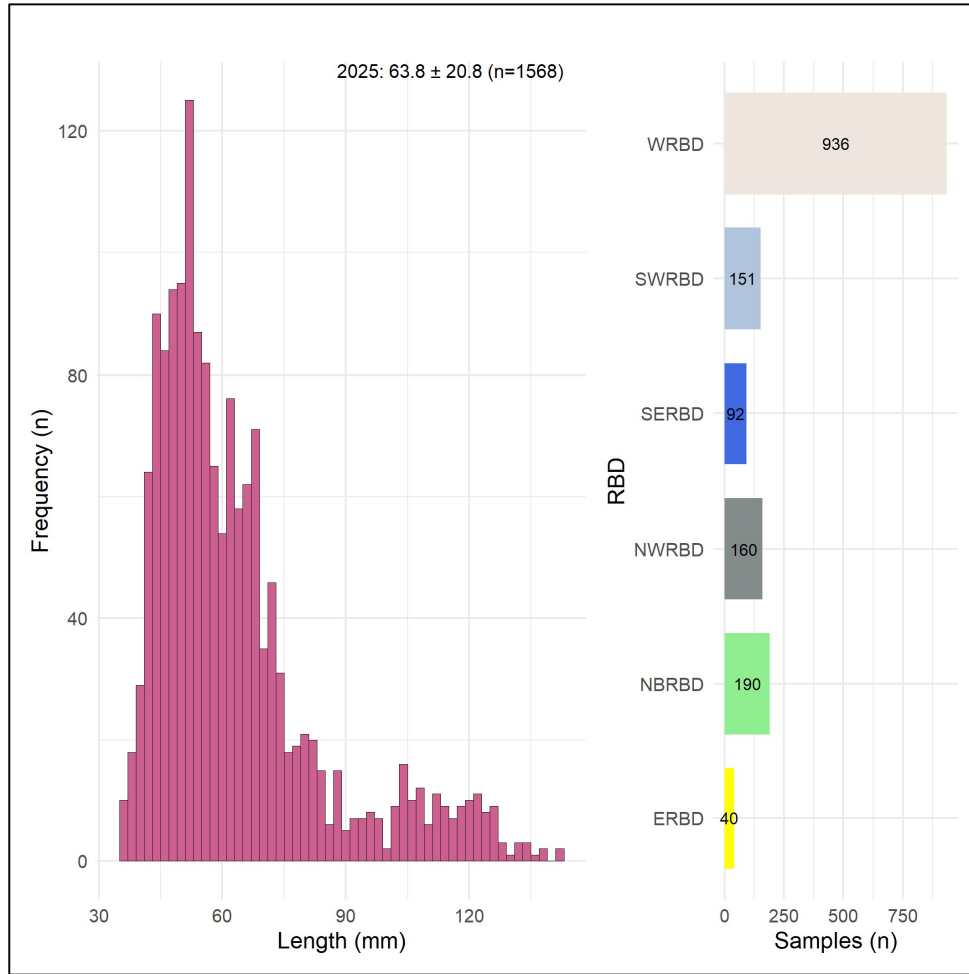


Fig. 4.4 Salmon juvenile length frequency (left panel) and number of samples collected per River Basin District (right panel) during year 3 of the GeneFlow project in 2025. A total of 1568 samples (range: 35–143 mm) were recorded from 26 catchments where samples.

A subset of 1,315 fish identified as 0+ were deemed suitable for inclusion in the length-weight fry model (Fig. 4.6). The data was limited to catchments where ≥ 30 individuals were recorded (Fig. 4.6). A mean fork length (FL) of $56.5 \text{ mm} \pm 10.7 \text{ mm SD}$ (range: 35–95 mm) and mean weight of $2.39 \text{ g} \pm 1.53 \text{ g SD}$ (range: 0.48–11.3 g) was calculated. The length-weight relationship was described by a power function ($W = aL^b$) fitted using log-log linear regression (Fig. 4.6). This produced an $R^2 = 0.98$, $p < 0.001$). The exponent b was greater than 3, indicating positive allometric growth.

Further analysis using Fulton's condition factor showed K values ranged from 1.02 to 1.14 over a 12 week period, with a mean ($\pm$ SD) of 1.07 ± 0.01 indicating generally positive condition across the population (Fig. 4.7).



Fig. 4.5 Length frequency data from both cohorts (0+,1+) of salmon juveniles collected from 25 catchments during the GeneFlow project in 2025 (n=1567). Catchments are in order of Julian calendar week when survey was completed. Does not include catchments where ≥ 30 individuals were recorded. Vertical dashed line indicates national mean fork length of 63.8mm for 2025.

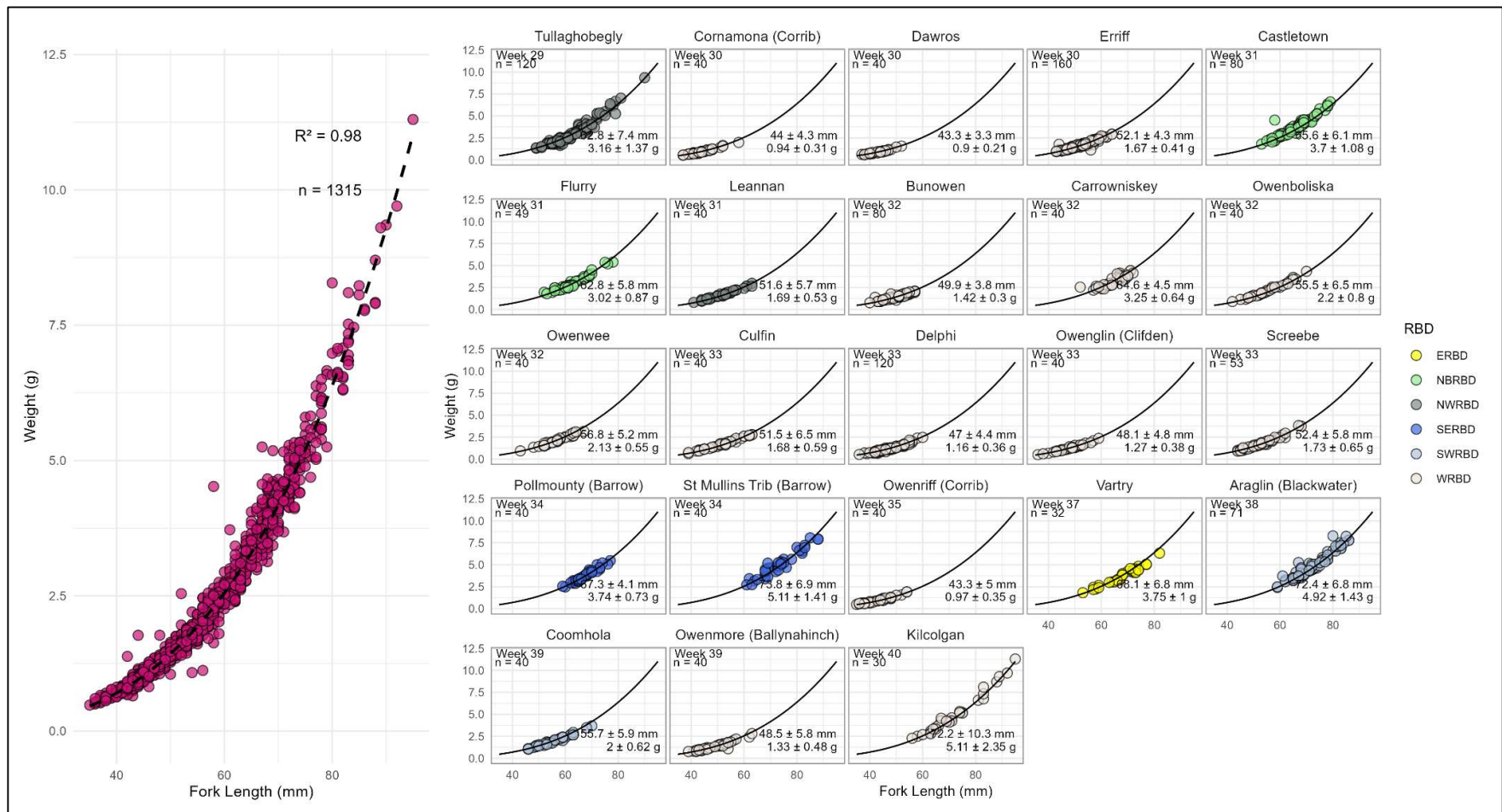


Fig. 4.6 Length weight relationship data of 0+ salmon fry collected during the GeneFlow project in 2025 (n=1315). Data limited to 23 catchments where ≥ 30 samples of 0+ fry were recorded. Data is in order of Julian week (29-40) in 2025. A power model has been fitted ($R^2 = 0.98$) as per Ogle (2013). Catchments are separated as per River Basin District (RBD) colours. Mean fork length/weight $\pm$ SD added in bottom corner of each plot.

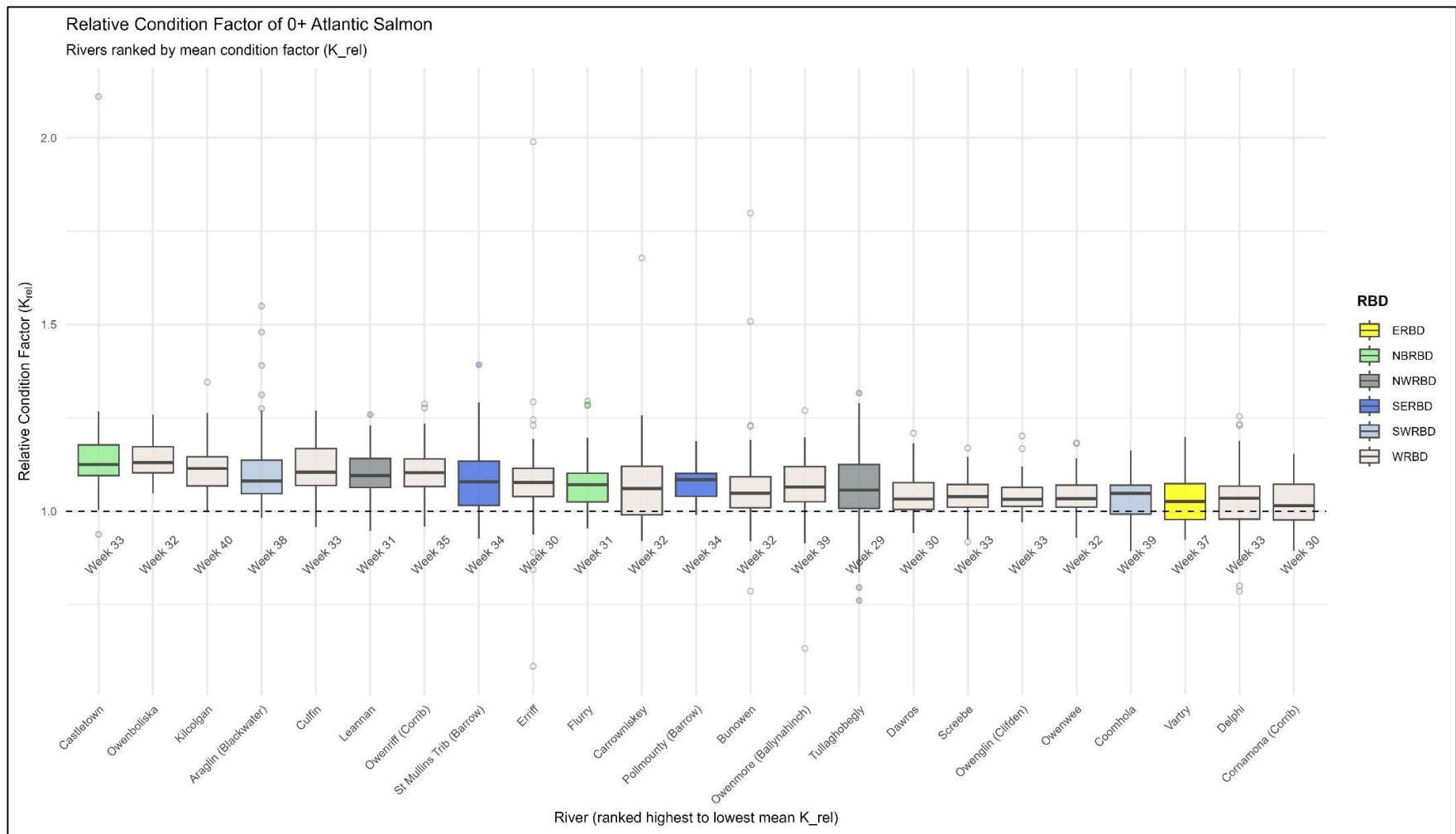


Fig. 4.7 Condition factor (K) calculation displaying 0+ salmon ($n=1315$) collected during the GeneFlow project in 2025. Data limited to catchments where ≥ 30 samples were recorded. Rankings are in order of highest to lowest mean K observed (left to right). Julian week is also notated and catchments are coloured by associated RBD.

4.3. Assessment of fishing and wading difficulty

Details of assessment of fishing and wading difficulty metrics recorded at each survey site are presented in Appendix 2.

4.4. Site details and dimensions

Details of each survey site covered in terms of distance (m) and area (m²) are presented in Appendix 2.

4.5. Additional species

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

4.6. Additional data metrics in 2025

Geographic location (latitude) and stream order were also recorded for each site where juvenile salmon were observed (Appendix 2).

5. Discussion

The GeneFlow project work in 2023-2024 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 intended to be made based on these results in 2025. Overall, 125 of the 144 designated salmon rivers produced samples with a further 23 additional rivers not in the designated salmon list were sampled between 2023-2025. This resulted in a total of 148 catchments where genetic samples were obtained.

In 2025, in response to a major salmon farm escape at Killary Harbour in 2024, there was specific focus to sample in west Galway and Mayo rivers to detect any potential introgression in the 2025 0+ fry cohort. Additional sampling for year 3 also focused on conducting multiple sampling efforts on some of the larger catchments on the western seaboard; as well as repeat sampling in other areas of the country that warranted additional attention based on previous findings. In 2025, a total of 1,568 samples were recorded among 26 catchments.

Biological data produced by the Geneflow project indicated variance in size among juvenile salmon populations. However, analysis of condition factor among 0+ fry revealed that

populations were in good condition and displayed positive allometric growth regardless of size variance. This is indicative of healthy, robust and well-conditioned populations. In general, this dataset may be valuable for further studies that could investigate the natural and anthropogenic influences on size and condition variability amongst river populations.

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 as to have a metric to potentially evaluate if the sampling area size was a factor in any family bias later evident in the samples taken.

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

2025

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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 'galvanotaxis', causing the fish to move towards the electrode (anode) where they are captured using a hand net (Lippert, 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 or 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°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 adaptations 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-five 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 individual zip lock bags for later freezing. A waterproof paper identification label recorded with pencil should be included in each 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 Unalter 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 if existing authorisations are not held. 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>

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
- Weighing scales –accuracy to 0.001g (10g limit)
- 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

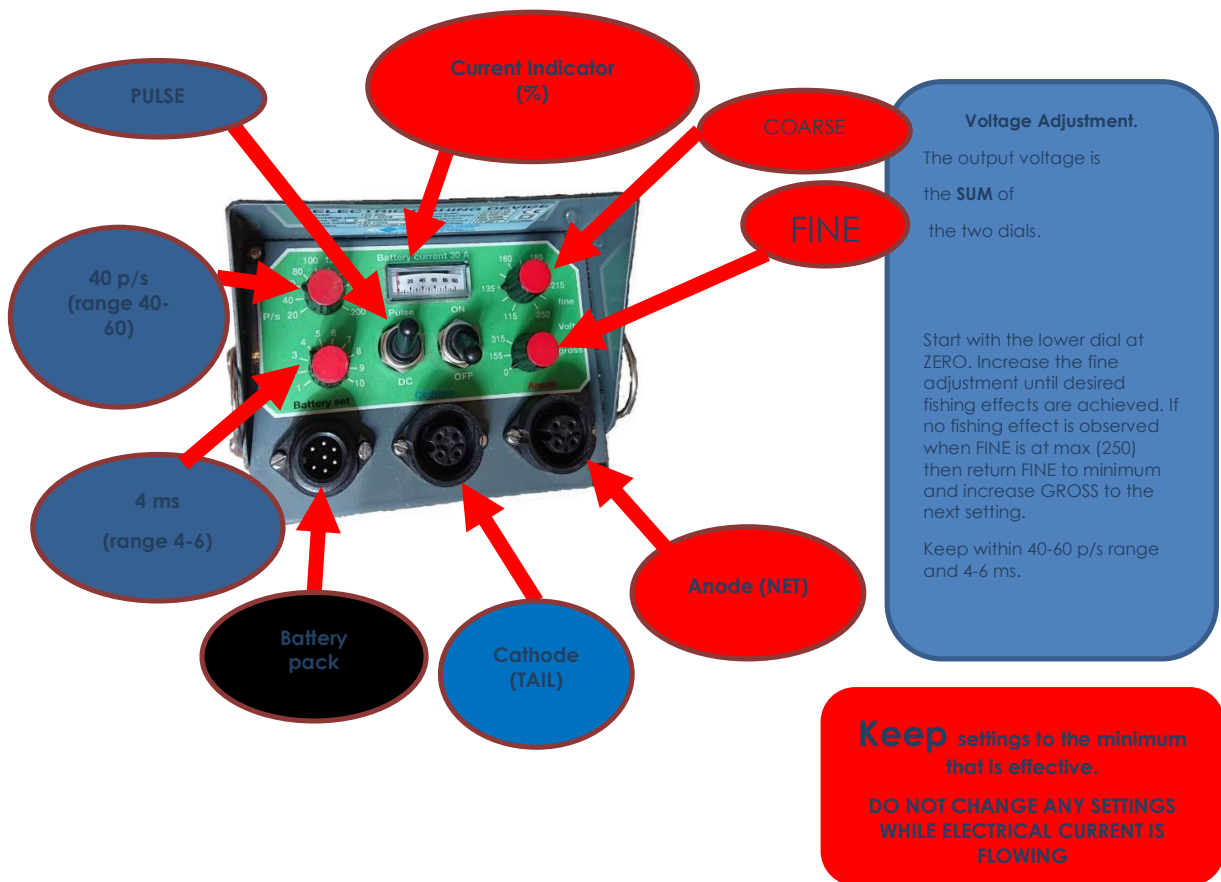
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SOP Appendix 1

Recommended initial settings for Hans Grassl for CWFEE 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: [\[http://www.hans-grassl.com/Bilder_DB/IG600_ds_E030314w.PDF\]](http://www.hans-grassl.com/Bilder_DB/IG600_ds_E030314w.PDF)



SOP Appendix 2
Safety Data Sheet for MS222

		www.sigmaaldrich.com
SAFETY DATA SHEET		Version 6.1
according to Regulation (EC) No. 1907/2006		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 <u>Ethyl 3-aminobenzoate methanesulfonate salt</u>
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	:	
Sigma-Aldrich- A5040		Page 1 of 9
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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	: $C_9H_{11}NO_2 \cdot CH_3SO_3$
Molecular weight	: 261.29 g/mol
CAS-No.	: 886-86-2
EC-No.	: 212-956-8

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

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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 (NO_x)

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 entrepreneur 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 |

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	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

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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

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12.6 Endocrine disrupting properties

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.

No data available

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.

Not classified as dangerous in the meaning of transport regulations.

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.

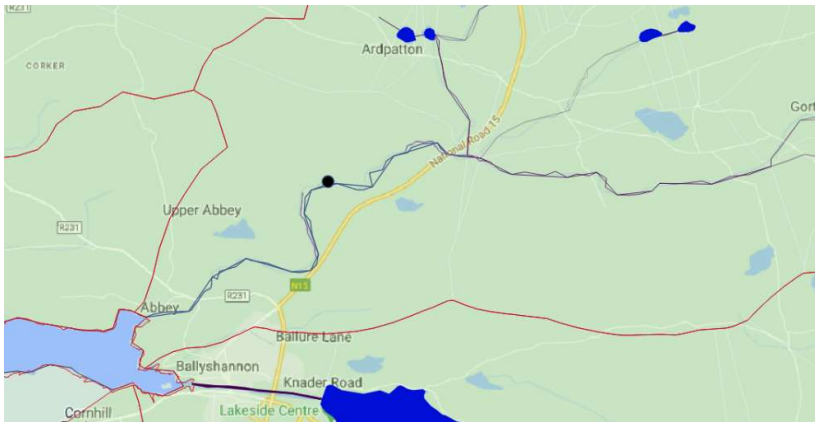
Further information

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.

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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	RNAIater	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
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21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				

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: $^{\circ}$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

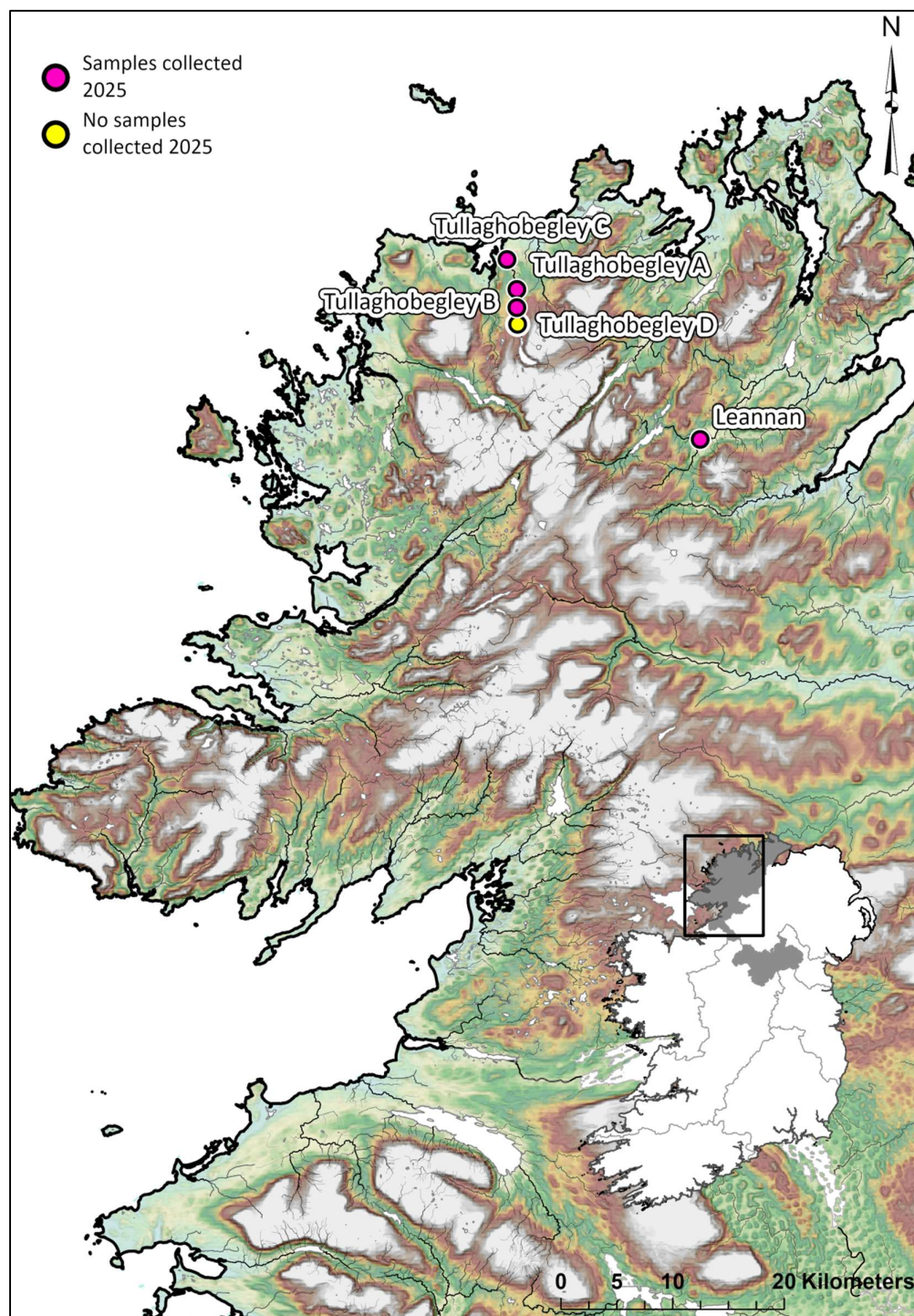


Fig. 7.1 Catchments surveyed for the GeneFlow project in 2025 within the NWRBD (n = 2). Pink dots indicate successful sample collections. Yellow circles indicate catchments where no salmon were recorded in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Table 7.1 Site details, additional information, and site segment dimensions for NWRBD rivers where samples were collected in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Site code	Catchment	Site	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Samples (n)	Size Range (mm)	Mean length $\pm$ SD (mm)	*Mean weight $\pm$ SD (g) 0+ Only	*k $\pm$ SD 0+ Only	Stream order	Latitude	Average wetted area (m ²)
221	Tullaghobegly	A	15/07/2025	593475	929326	593708	928851	2	3	40	58-90	69.3 $\pm$ 6.6	4.34 $\pm$ 0.23	1.12 $\pm$ 0.01	4	55.1	3080
222	Tullaghobegly	B	15/07/2025	593476	927672	593536	927310	3	3	40	44-69	58.6 $\pm$ 5.8	2.39 $\pm$ 0.13	1.03 $\pm$ 0.02	4	55.1	2424
223	Tullaghobegly	C	16/07/2025	593476	927672	593536	927310	3	3	40	51-71	60.5 $\pm$ 5.2	2.55 $\pm$ 0.13	1.02 $\pm$ 0.01	4	55.1	2337
229	Leannan		01/08/2025	609911	915893	609622	915923	4	2	40	41-63	51.6 $\pm$ 5.7	1.69 $\pm$ 0.08	1.11 $\pm$ 0.01	5	54.9	4736

* Length-weight data limited to 0+ fry where sample size is ≥ 17

Table 7.2 Species presence and absence (except salmon fry) in NWRBD rivers sampled for the GeneFlow programme in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc). Approximate numbers encountered are also noted where applicable.

River	Salmon	Trout		Eel	Lamprey	Stickleback	Stone loach	Minnow	Other species	Notes
	Parr	Parr	Fry							
Tullaghobegly A	Y (9)	Y(5)	Y (4)	Y	N	N	N	N	Flounder, Sea trout	No 1+ parr recorded
Tullaghobegly B	N	Y(7)	Y (3)	N	N	N	N	N		No 1+ parr recorded
Tullaghobegly C	N	Y(8)	Y (8)	N	N	N	N	N		
Tullaghobegly D	N	Y(30)	Y(30)	N	N	N	N	N		
Leannan	Y(30+)	Y(30+)	Y(30+)	N	N	N	N	N		Prolific no's of salmonids

7.2.2 WRBD

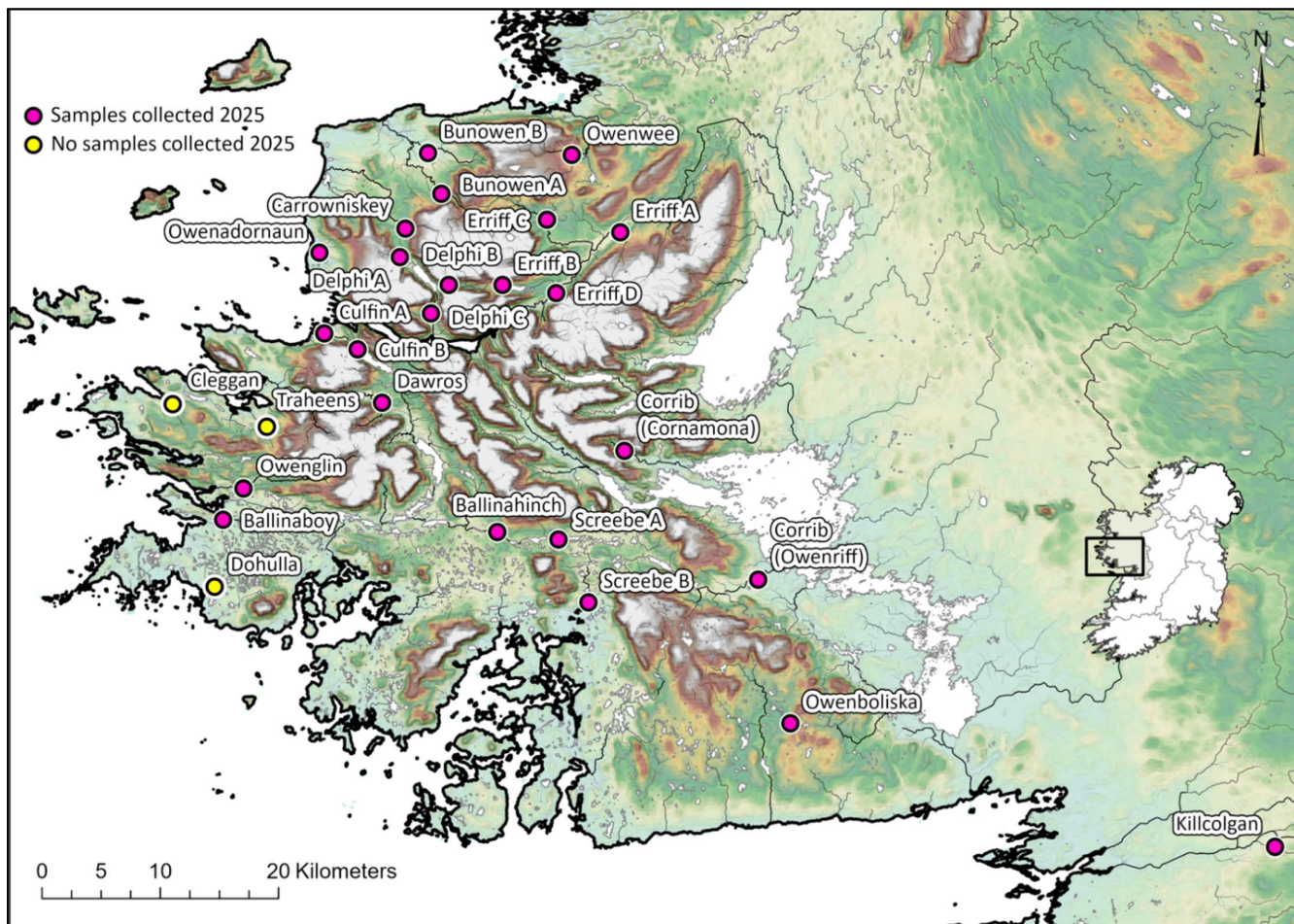


Fig. 7.2 Catchments surveyed for the GeneFlow project in 2025 within the WRBD (n = 20). Pink circles indicate successful sample collections. Yellow circles indicate catchments where no salmon were recorded in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Table 7.3 Site details, additional information, and site segment dimensions for WRBD rivers where samples were collected in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Site code	Catchment	Site	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Samples (n)	Size Range (mm)	Mean length $\pm$ SD (mm)	*Mean weight $\pm$ SD (g) 0+ Only	*k $\pm$ SD 0+ Only	Stream order	Latitude	Average wetted area (m ²)
224	Ballinaboy		29/09/2025	466384	747710	466409	747730	4	4	1	n/a	n/a	n/a	n/a	4	53.3	265
247	Bunowen	A	06/08/2025	484844	775359	485174	775107	3	1	40	43-57	50.2 $\pm$ 3.5	1.42 $\pm$ 0.04	1.04 $\pm$ 0.01	4	53.7	2594
248	Bunowen	B	06/08/2025	483728	778810	483822	778958	2	3	40	40-57	49.6 $\pm$ 4.1	1.42 $\pm$ 0.05	1.09 $\pm$ 0.02	4	53.7	1306
234/236	Carrowniskey		07/08/2025	481810	772403	482269	772398	3	4	48	52-114	71.3 $\pm$ 15.9	3.25 $\pm$ 0.01	1.07 $\pm$ 0.02	3	53.7	1691
213	Cornamona (Corrib)		25/07/2025	500321	753577	500032	753738	2	1	40	37-58	44.0 $\pm$ 4.3	0.94 $\pm$ 0.05	1.02 $\pm$ 0.01	4	53.5	1360
250	Culfin	A	13/08/2025	474949	763534	475062	763434	4	4	26	39-111	61.2 $\pm$ 20.0	1.68 $\pm$ 0.09	1.11 $\pm$ 0.01	4	53.6	1485
250	Culfin	B	13/08/2025	477760	762195	478009	762061	2	3	25					4	53.6	2911
244	Dawros		24/07/2025	479836	757696	480005	757433	2	1	45	37-103	47.2 $\pm$ 12.4	0.9 $\pm$ 0.03	1.05 $\pm$ 0.01	4	53.5	6370
206	Delphi	A	12/08/2025	485455	767636	485981	767680	2	1	40	39-56	47 $\pm$ 3.4	1.12 $\pm$ 0.05	1.00 $\pm$ 0.01	3	53.7	2410
205	Delphi	B	12/08/2025	481345	770009	481204	770213	1	2	40	36-60	46.6 $\pm$ 5.4	1.15 $\pm$ 0.07	1.03 $\pm$ 0.01	2	53.7	620
249	Delphi	C	12/08/2025	483956	765245	483665	765220	4	3	40	42-55	47.5 $\pm$ 3.7	1.22 $\pm$ 0.05	1.06 $\pm$ 0.01	3	53.6	1377
225	Erriff	A	22/07/2025	499974	772080	500324	772242	2	3	40	44-64	52.1 $\pm$ 5.0	1.71 $\pm$ 0.07	1.11 $\pm$ 0.02	4	53.7	1512

Site code	Catchment	Site	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Samples (n)	Size Range (mm)	Mean length $\pm$ SD (mm)	*Mean weight $\pm$ SD (g) 0+ Only	*k $\pm$ SD 0+ Only	Stream order	Latitude	Average wetted area (m ²)
226/ 231	Erriff	B	23/07/2025	489999	767650	489464	767146	4	3	55	45- 94	60.1 $\pm$ 13.6	1.65 $\pm$ 0.05	1.04 $\pm$ 0.01	3	53.7	2141
232	Erriff	C	23/07/2025	493804	772785	493787	773148	4	3	40	45- 64	52.9 $\pm$ 4.5	1.73 $\pm$ 0.07	1.07 $\pm$ 0.01	4	53.7	3242
243	Erriff	D	24/07/2025	494424	766875	494783	767075	2	2	46	43- 97	55.2 $\pm$ 12.5	1.57 $\pm$ 0.06	1.10 $\pm$ 0.01	5	53.6	5561
251	Kilcolgan		30/09/2025	553337	720179	555528	720004	4	3	38	56- 135	81.5 $\pm$ 21.5	5.11 $\pm$ 0.43	1.12 $\pm$ 0.01	3	53.2	1770
233	Owenadourman	A	07/08/2025	474281	770686	475315	770515	3	4	38	66- 138	100 $\pm$ 19.4	6.83 $\pm$ 0.27	1.23 $\pm$ 0.03	4	53.6	4290
211	Owenboliska		08/09/2025	514366	730590	514495	730706	3	1	40	42- 70	55.5 $\pm$ 6.5	2.20 $\pm$ 0.13	1.13 $\pm$ 0.01	3	53.3	904
217	Owenglin (Clifden)		14/08/2025	468118	750340	468414	750317	3	3	40	36- 59	48.1 $\pm$ 4.8	1.27 $\pm$ 0.06	1.04 $\pm$ 0.01	4	53.5	5710
214	Owenmore (Ballynahinch)		26/09/2025	489567	746681	489779	746343	3	2	55	39- 122	59 $\pm$ 20.0	1.33 $\pm$ 0.08	1.06 $\pm$ 0.02	3	53.5	2864
239	Owenriff (Corrib)		25/08/2025	511634	742676	511199	742550	2	1	51	39- 94	50.5 $\pm$ 15.4	0.97 $\pm$ 0.06	1.15 $\pm$ 0.09	4	53.5	3363
230	Owenwee		06/08/2025	495882	778652	495560	778652	2	2	40	43- 67	56.8 $\pm$ 5.2	2.13 $\pm$ 0.09	1.04 $\pm$ 0.01	4	53.4	1852
235	Screebe	A	11/08/2025	494734	746071	494449	746053	2	2	39	44- 68	56.8 $\pm$ 5.2	1.64 $\pm$ 0.10	1.04 $\pm$ 0.01	4	53.5	704
203	Screebe	B	25/08/2025	497287	740760	497233	740919	4	4	29	46- 104	56.8 $\pm$ 5.2	n/a	n/a	4	53.4	2400

* Length-weight data limited to 0+ fry where sample size is ≥ 17

Table 7.4 Species presence and absence (except 0+ salmon fry) recorded in WRBD rivers for the GeneFlow programme in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc). Approximate numbers encountered are also noted where applicable.

River	Salmon	Trout		Eel	Lamprey	Stickleback	Stone loach	Minnow	Other species	Notes
	Parr	Parr	Fry							
Ballinaboy	Y (1)	Y(10+)	Y(20+)	Y(10)	N	N	N	N	N	
Bunowen A	Y(50+)	Y(10)	Y(5)	Y	N	N	N	N	N	High numbers of juvenile salmonids
Bunowen B	Y(50+)	Y(20+)	Y(5)	N	N	N	N	N	N	High numbers of juvenile salmonids
Cleggan	N	Y	Y	N	N	N	N	N	N	High density of brown trout
Carrowniskey	Y(50+)	Y(20+)	Y(20+)	Y(20+)	N	N	N	N	N	Low numbers of juvenile salmonids. High effort required
Cornamona (Corrib)	Y(50+)	Y(50+)	Y(50+)	N	N	N	N	N	N	High numbers of juvenile salmonids
Culfin	Y(20+)	Y	Y(10+)	Y(20+)	N	N	N	N	Flounder	High numbers of juvenile salmonids
Cleggan	N	Y(10)	Y(5)	N	N	N	N	N		High density of brown trout
Dawros	Y (50)	Y(30)	Y(10)	N	N	N	N	Y	N	Habitat in excellent condition, very high fish population observed
Delphi A	Y (30+)	Y(20)	Y(20)	N	N	N	N	N	N	Abundant salmon both fry and parr
Delphi B	Y (20+)	Y(20)	Y(5)	Y(3)	N	Y(15)	N	N	N	
Delphi C	Y (20+)	Y	Y	N	N	N	N	N	N	
Dohulla	N	Y(50)	Y(30)	Y(3)	N	N	N	N	Sea trout	Abundant brown trout
Erriff A	Y (3)	Y	Y	Y(1)	N	N	N	N	N	
Erriff B	Y (40)	Y	Y (3)	Y (1)	N	N	N	N		High parr numbers
Erriff C	Y (20)	Y (4)	Y(10)	N	N	N	N	N	N	
Erriff D	Y (30+)	Y (3)	Y (6)	N	N	N	N	Y	N	
Kilcolgan	Y (30+)	Y(20+)	Y(20+)	Y(20+)	N	Y	Y	Y(20+)	N	
Owenadournan	Y (20)	Y (5)	Y (10)	Y(50+)	N	N	N	N	Flounder	
Owenboliska	Y (20)	Y (5)	Y (5)	N	N	N	N	N	N	
Owenglin	Y (20)	Y (5)	Y (5)	Y(5)	N	N	N	N	N	Excellent spawning habitat

River	Salmon	Trout		Eel	Lamprey	Stickleback	Stone loach	Minnow	Other species	Notes
	Parr	Parr	Fry							
(Clifden)										
Owenmore (Ballynahinch)	Y(50+)	Y(5)	N	Y	N	N	N	Y	N	High salmon parr population
Owenriff (Corrib)	Y (20+)	Y	Y	N	N	N	N	N	N	
Owenwee	Y (15+)	Y (15)	Y (15)	N	N	N	N	N	N	
Screebe A	Y (15+)	Y (15)	Y (15)	N	Y(20+)	N	N	Y(20)	N	
Screebe B	Y	Y	Y	Y(50+)	N	N	N	Y(50+)	N	
Traheens	N	Y (5)	Y (5)	Y(5)	N	N	N	N	N	No salmon present

7.2.2. SHRBD

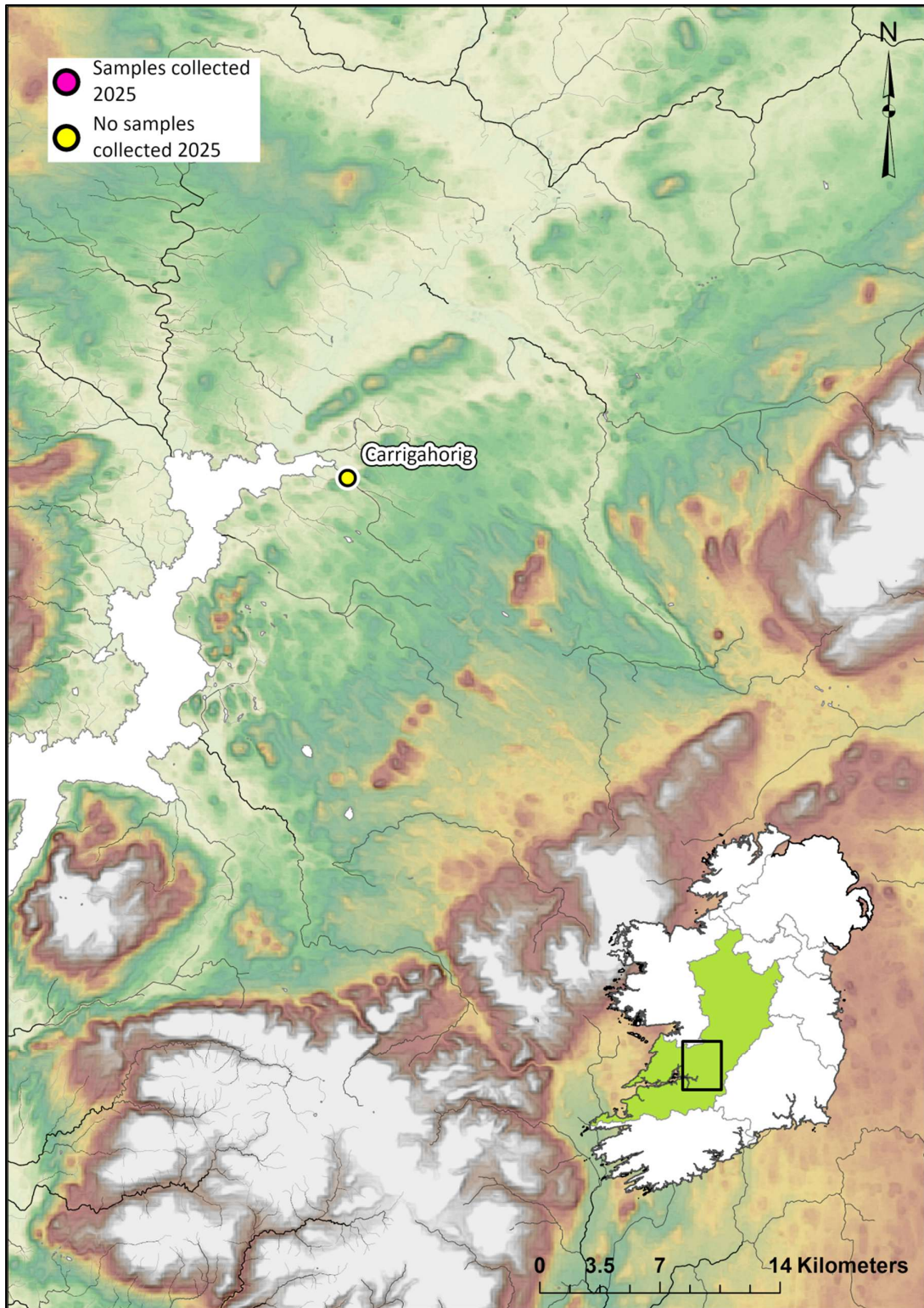


Fig. 7.3 Catchments surveyed for the GeneFlow project in 2025 within the SHRBD ($n = 1$). Pink circles indicate successful sample collections. Yellow circles indicate catchments where no salmon were recorded in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Table 7.5 Site details, additional information, and site segment dimensions for SHRBD rivers where samples were collected in 2025.

River	Salmon	Trout		Eel	Lamprey	Stickleback	Stone loach	Minnow	Other species	Notes
	Parr	Parr	Fry							
Carrigahorig Stream	N	Y	Y	N	N	N	N	N		

7.2.3. SWRBD

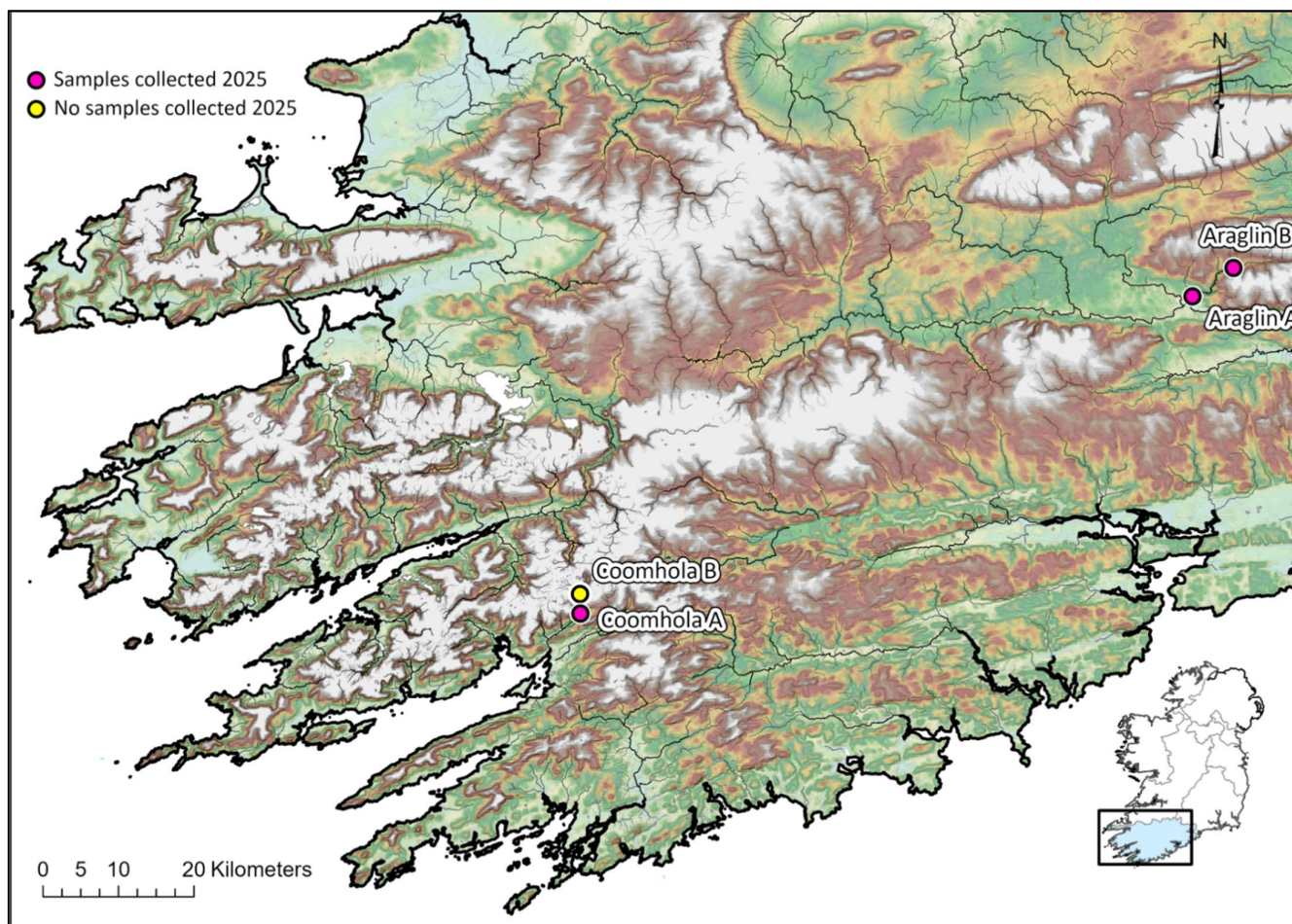


Fig. 7.4 Catchments surveyed for the GeneFlow project in 2025 within the SWRBD (n = 2). Pink circles indicate successful sample collections. Yellow circles indicate catchments where no salmon were recorded in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Table 7.6 Site details, additional information, and site segment dimensions in SWRBD rivers where samples were collected in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Site code	Catchment	Site	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Samples (n)	Size Range (mm)	Mean length $\pm$ SD (mm)	*Mean weight $\pm$ SD (g)0+ Only	*k $\pm$ SD 0+ Only	Stream order	Latitude	Average wetted area (m ²)
240	Araglin (Blackwater)	A	16/09/2025	584943	601533	584896	601719	3	3	64	64-142	96.5 $\pm$ 23.2	5.59 $\pm$ 0.23	1.09 $\pm$ 0.01	4	52.2	2513
227	Araglin (Blackwater)	B	16/09/2025	590402	605336	590100	605270	3	3	40	59-113	70.5 $\pm$ 9.1	4.37 $\pm$ 0.21	1.13 $\pm$ 0.02	4	52.2	4461
228/224	Coomhola		24/09/2025	503840	559496	503882	560108	3	1	47	46-104	61.3 $\pm$ 14.9	2.01 $\pm$ 0.01	1.04 $\pm$ 0.01	4	51.8	5580

* Length-weight data limited to 0+ fry where sample size is ≥ 17

Table 7.7 Species presence and absence (except salmon fry) in SWRBD rivers sampled for the GeneFlow programme in 2025. Approximate numbers encountered are also noted where applicable. Multiple sites within a catchment are presented in letter format (A,B,C etc).

River	Salmon	Trout		Eel	Lamprey	Stickleback	Stone loach	Minnow	Other species	Notes
	Parr	Parr	Fry							
Araglin (Blackwater) A	Y (30+)	Y (10)	Y (5)	Y(20)	N	N	Y (8)	N	N	High water level after rains. Fry difficult to capture
Araglin (Blackwater) B	Y (20+)	Y (15)	Y (1)	Y (20)	N	N	N	N	N	
Coomhola A	Y (30+)	Y (10)	Y (10)	N	N	N	N	N	N	Abundant salmon parr and fry
Coomhola B	N	Y (10)	Y (10)	N	N	N	N	N	N	

7.2.4. SERBD

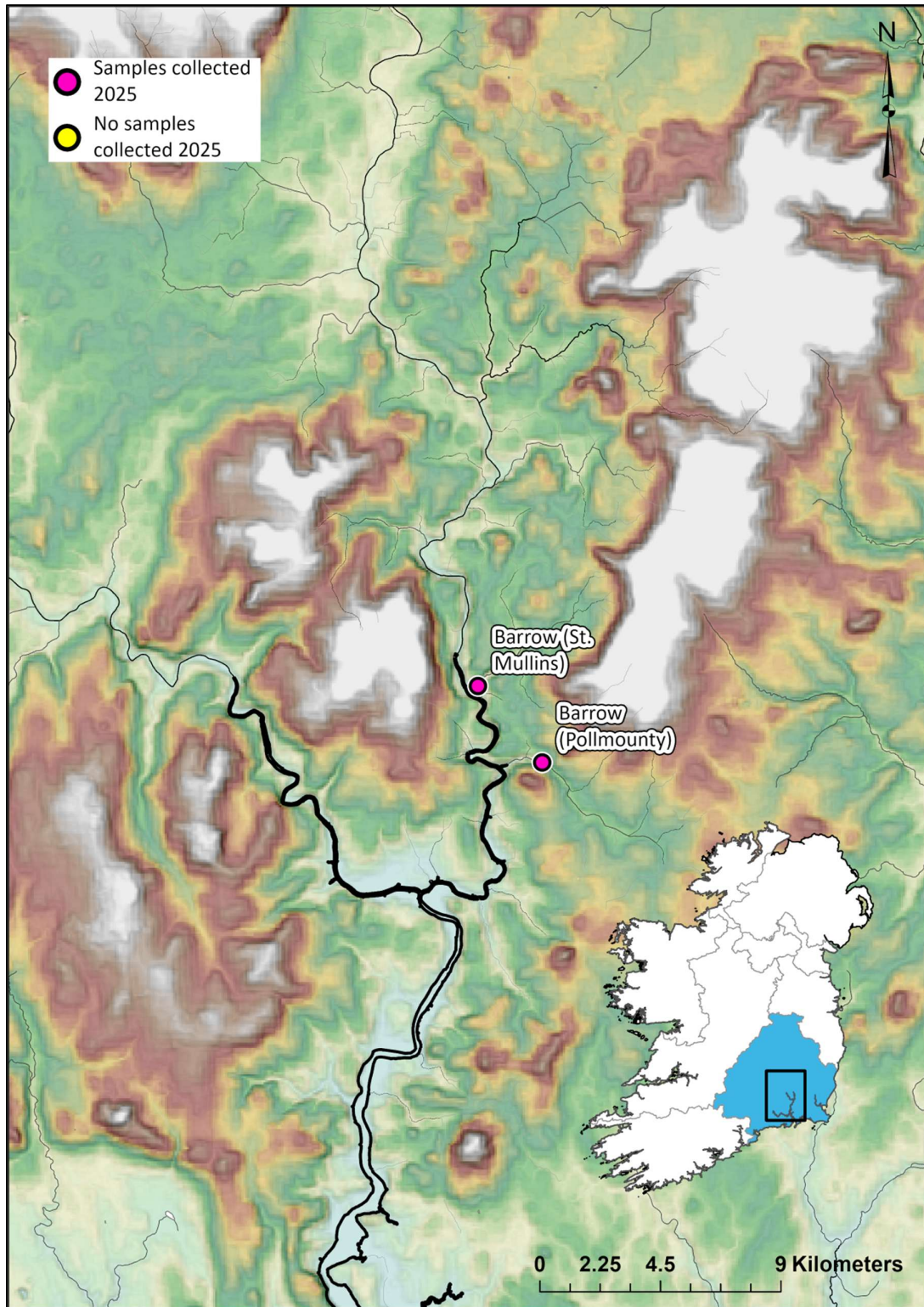


Fig. 7.5 Catchments surveyed for the GeneFlow project in 2025 within the SERBD (n = 2). Pink circles indicate successful sample collections. Yellow circles indicate catchments where no salmon were recorded in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Table 7.8 Site details, additional information, and site segment dimensions for SERBD rivers where samples were collected in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Site code	Catchment	Site	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Samples (n)	Size Range (mm)	Mean length $\pm$ SD (mm)	*Mean weight $\pm$ SD (g) 0+ Only	*k $\pm$ SD 0+ Only	Stream order	Latitude	Average wetted area (m ²)
236/238	Pollmouny (Barrow)	n/a	19/08/2025	675160	635445	675464	635271	4	3	41	61-120	82.3 $\pm$ 0.23	3.74 $\pm$ 0.11	1.07 $\pm$ 0.01	3	52.5	2459
236/217	St Mullins Trib (Barrow)	n/a	20/08/2025	672763	638308	672917	637916	3	3	51	59-112	68.4 $\pm$ 8.1	5.11 $\pm$ 0.22	1.09 $\pm$ 0.02	3	52.5	2765

* Length-weight data limited to 0+ fry where sample size is ≥ 17

Table 7.9 Species presence and absence (except 0+ salmon fry) recorded in SERBD rivers for the GeneFlow programme in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc). Approximate numbers encountered are also noted where applicable.

River	Salmon	Trout		Eel	Lamprey	Stickleback	Stone loach	Minnow	Other species	Notes
	Parr	Parr	Fry							
Pollmounty (Barrow)	Y (30+)	Y (20+)	Y (30+)	Y	N	N	N	N	N	
St Mullins Trib (Barrow)	Y (30+)	Y (20+)	Y (30+)	Y	N	N	N	N	N	

7.2.5. ERBD

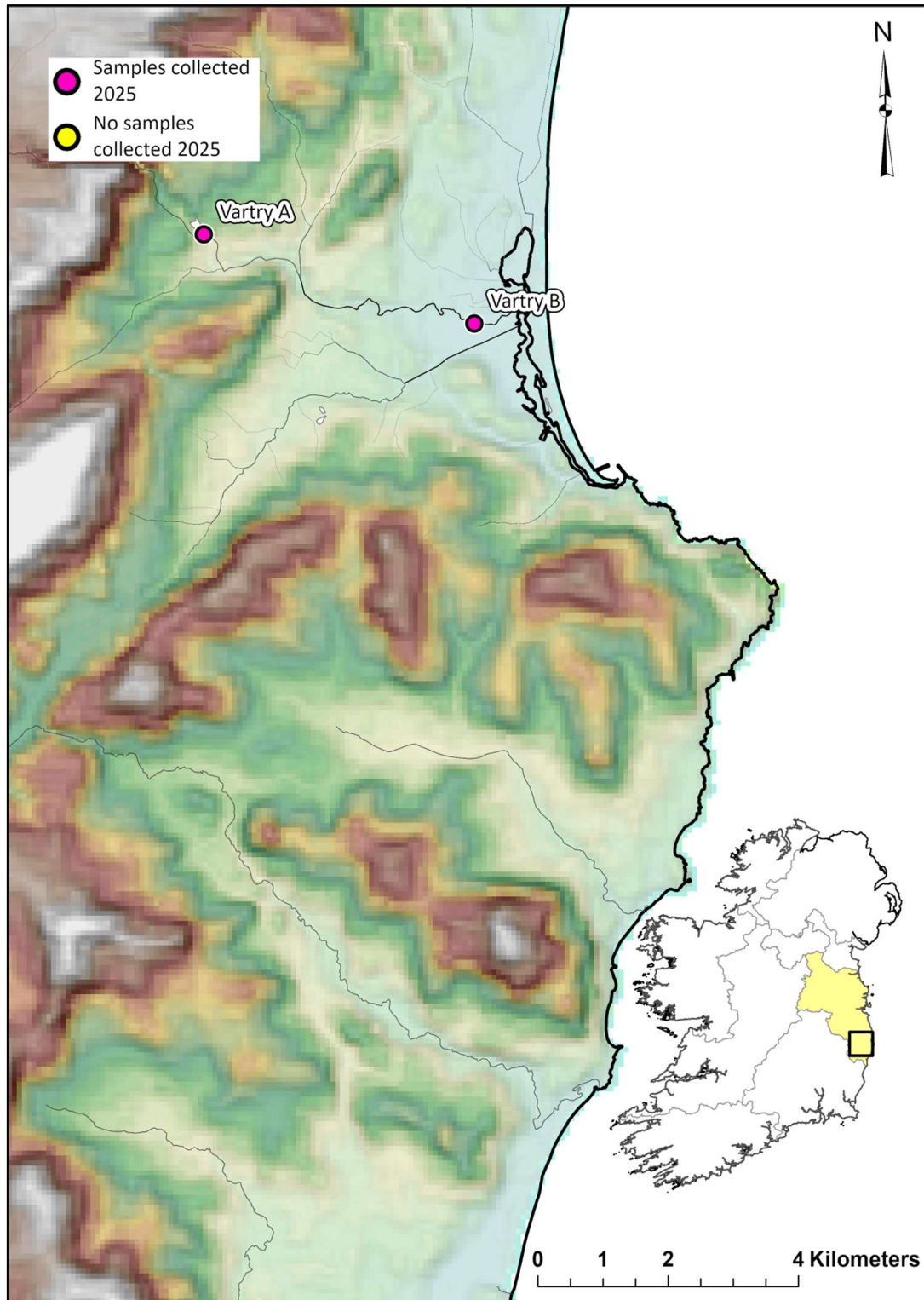


Fig. 7.6 Catchments surveyed for the GeneFlow project in 2025 within the ERBD (n = 1). Pink circles indicate successful sample collections. Yellow circles indicate catchments where no salmon were recorded in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Table 7.10 Site details, additional information, and site segment dimensions for ERBD rivers where samples were collected in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Site code	Catchment	Site	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Samples (n)	Size Range (mm)	Mean length $\pm$ SD (mm)	*Mean weight $\pm$ SD (g) 0+ Only	*k $\pm$ SD 0+ Only	Stream order	Latitude	Average wetted area (m ²)
246	Vartry	n/a	02/09/2025	725599	697879	725361	697945	3	4	40	53-125	76.4 $\pm$ 18.3	3.75 $\pm$ 0.18	1.18 $\pm$ 0.07	3	53.0	9316

* Length-weight data limited to 0+ fry where sample size is ≥ 17

Table 7.11 Species presence and absence (except 0+ salmon fry) recorded in ERBD rivers for the GeneFlow programme in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc). Approximate numbers encountered are also noted where applicable.

River	Salmon	Trout		Eel	Lamprey	Stickleback	Stone loach	Minnow	Other species	Notes
	Parr	Parr	Fry							
Vartry	Y (20+)	Y (30)	Y (30)	Y(30)	N	Y	N	Y(5)	Flounder	

7.2.6. NBRBD

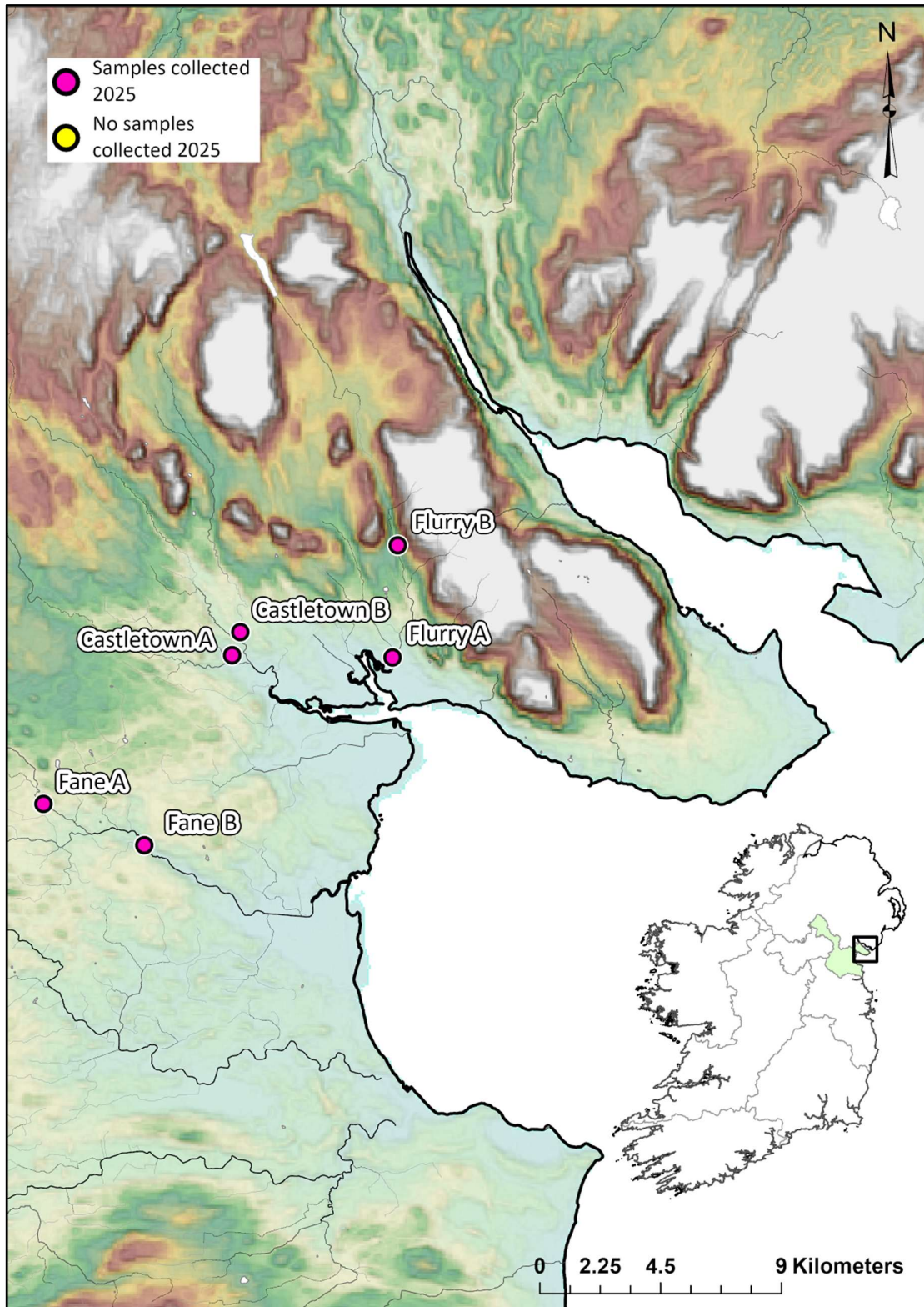


Fig. 7.7 Catchments surveyed for the Geneflow project in 2025 within the NBRBD ($n = 3$). Pink circles indicate successful sample collections. Yellow circles indicate catchments where no salmon were recorded in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Table 7.12 Site details, additional information, and site segment dimensions in NBRBD rivers where samples were collected in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc).

Site code	Catchment	Site	Date	Start location eastings (ITM)	Start location northings (ITM)	Finish location eastings (ITM)	Finish location northings (ITM)	Wading difficulty rating	Sample difficulty rating	Samples (n)	Size Range (mm)	Mean length $\pm$ SD (mm)	*Mean weight $\pm$ SD (g) 0+ Only	*k $\pm$ SD 0+ Only	Stream order	Latitude	Average wetted area (m ²)
202	Castletown	A	31/07/2025	702088	810185	701808	809870	2	3	40	53-78	63.9 $\pm$ 5.7	3.48 $\pm$ 0.16	1.17 $\pm$ 0.03	4	54.0	8880
204	Castletown	B	27/08/2025	702388	811038	702351	811329	2	2	40	55-79	67.2 $\pm$ 6.0	3.92 $\pm$ 0.17	1.12 $\pm$ 0.01	3	54.0	1302
204	Fane	A	21/08/2025	695109	804654	694751	804817	3	4	33	69-128	112.2 $\pm$ 15.6	n/a	n/a	3	53.9	4965
201	Fane	B	21/08/2025	698810	803116	695045	804649	1	4		n/a	n/a	n/a	n/a	4	53.9	1462
201	Flurry	A	31/07/2025	708071	810025	708324	810433	2	2	41	52-69	61.2 $\pm$ 4.5	2.77 $\pm$ 0.09	1.08 $\pm$ 0.01	3	54.0	3528
245	Flurry	B	01/09/2025	708252	814275	708090	814456	4	4	35	61-128	102.5 $\pm$ 19.7	n/a	n/a	3	54.0	1897

* Length-weight data limited to 0+ fry where sample size is ≥ 17

Table 7.13 Species presence and absence (except 0+ salmon fry) recorded in NBRBD rivers for the GeneFlow programme in 2025. Multiple sites within a catchment are presented in letter format (A,B,C etc). Approximate numbers encountered are also noted where applicable.

River	Salmon	Trout		Eel	Lamprey	Stickleback	Stone loach	Minnow	Other species	Notes
	Parr	Parr	Fry							
Castletown A	Y (30+)	Y (30+)	Y (30+)	Y(2)	N	Y	Y	Y	N	
Castletown B	Y (10)	Y(10+)	Y(20+)	Y (10)	N	N	Y	N	N	Prolific fry population
Fane A	Y (50+)	Y (20+)	Y (5)	Y (5)	N	Y	N	Y	N	Dense parr, low fry population
Fane B	Y (1)	Y (10)	Y (10)	Y (8)	N	Y	Y	Y	N	Low fry population
Flurry A	Y(30+)	Y (30)	Y (10)	Y(30)	N	N	N	N	Flounder	Mostly good condition in main channel
Flurry B	Y(30+)	Y (20)	Y (20)	Y(10)	N	N	N	N	N	Sampled in aftermath of flooding. Fewer fry compared to site B

7.3. Appendix 3: Photos of rivers sampled per RBD IN 2025

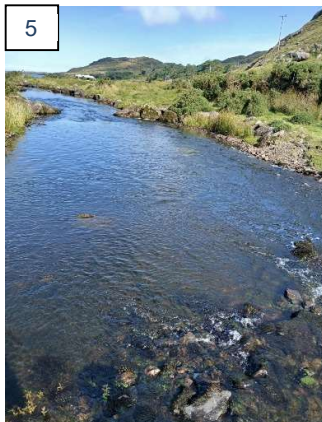
7.3.1. NWRBD

NWRBD		
1. Tullaghobegly A	2. Tullaghobegly B	3. Tullaghobegly C
4. Tullaghobegly D	5. Leannan	

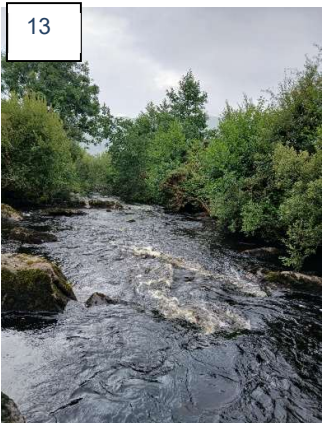


7.3.2. WRBD

WRBD		
1. Bunowen A	2. Bunowen B	3. Carrowniskey
4. Cornamona (Corrib)	5. Culfin B	6. Dawros
7. Delphi A	8. Delphi B	9. Delphi C



10. Erriff A	11. Erriff B	12. Erriff C
13. Erriff D	14. Kilcolgan	15. Owenadourman
16. Owenboliska	17. Owenglin (Clifden)	18. Owenmore (Ballynahinch)



19. Owenwee	20. Screebe A	
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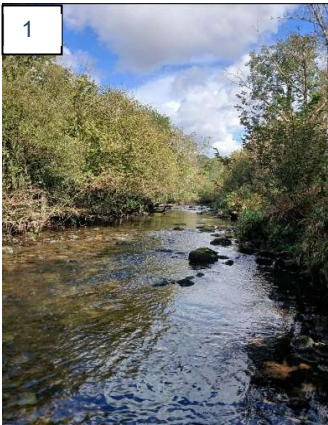
7.3.3. SHRBD

SHRBD		
1. Carrigahorig Stream		



7.3.4. SWRBD

SWRBD		
1. Coomhola A	2. Coomhola B	3. Araglin (Blackwater) B



7.3.5. SERBD

SERBD	
1. Barrow (Pollmounty)	2. Barrow (St. Mullins Stream)



7.3.6. ERBD

ERBD		
1. Vartry		

1



7.3.7. NBRBD

NBRBD		
1. Castletown A	2. Castletown B	3. Flurry A

1



2



3



4



5



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