National Adult Salmon Sampling Project – 2021 season

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Background

Sampling of individual adult salmon is used to collect information on the size, sex and age of the fish. This information feeds directly into stock assessment used for national and international management. In Scotland, and other countries, scale samples were historically collected from commercial netting. With the closure of the majority of these fisheries in recent years, the options for using existing rod fisheries and targeted scientific sampling as a source of biological information on salmon is being investigated.

In 2021, a pilot national adult salmon sampling programme was developed by Marine Scotland, Fisheries Management Scotland and local Fisheries Trusts and Boards to develop a pilot national adult sampling programme. The objectives of the programme were:

- To trial different approaches to obtaining biological data on adult salmon (length, weight, age) and to see what approaches work in different settings.
- To determine whether measurements taken with sedated and unsedated fish are comparable.
- To obtain data that can be used to inform the design of any future adult sampling programme for use in stock assessments.

Methods

A standard operating procedure was developed detailing a set of agreed shared practices for the sampling (see Annex 1). These were designed to allow the maximum flexibility for local arrangements to be made on, for example, how fish would be collected for sampling. Samplers were encouraged to (where possible) select sites:

- From rivers with historic data collections;
- With the best chance of returning a good number of fish;
- As close to the sea as possible.

Samplers were requested to sample both retained and released fish, where appropriate, and to sample a proportion of released fish both unsedated and under anaesthetic to allow calculation of variation in measurements due to the state of the fish. Sedated fish were marked prior to release to inform anglers of the potential presence of anaethetic.

Adult salmon were sampled July - September; fish were primarily captured by rod angling with some catch and release netting. An online GIS-based reporting tool was used to allow easy and standardised data collection. The reporting form collected information on the location of capture, fish biometrics, equipment used, photographs and sampler identification. The tool generated a unique code which was written on scale packets. Scale packets were sent to Marine Scotland for pressing, ageing and imaging.

Results

A total of 321 adult salmon were sampled during July-September 2021 across 18 different rivers. There was a wide geographic range in the numbers of salmon sampled (Figure 1)

with the largest numbers tending to be sampled on large east coast rivers. The dry conditions and associated low catches experienced during the sampling period left some project partners unable to sample any fish during the study.

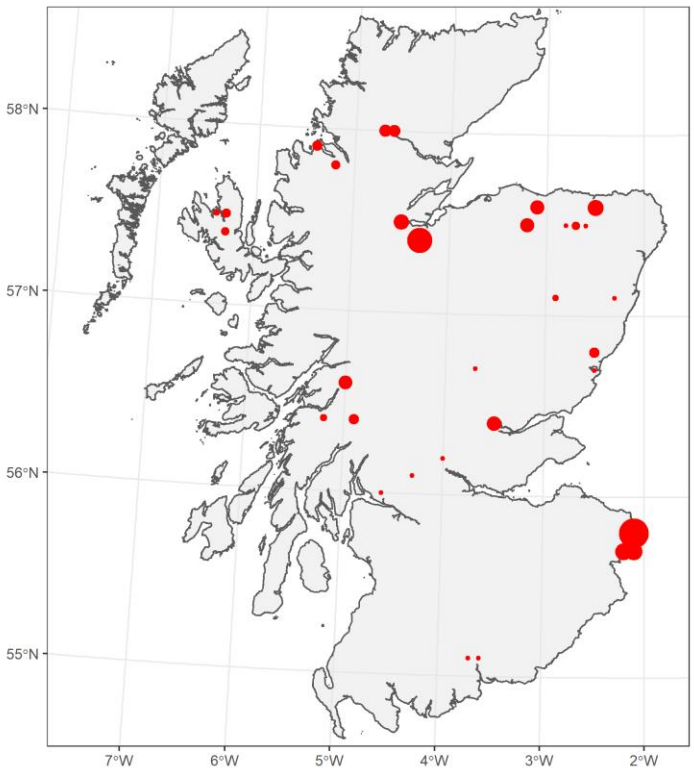


Figure 1 Map showing the locations of adult salmon sampled during late summer/autumn 2021. The size of the point relates to the number of individuals sampled in each location.

It was not possible to determine the sea age of 26 out of the 321 samples (8%) due to the presence of erosion around the outside of the scale. Such erosion occurs when a fish has been in the river for a considerable period and was more prevalent towards the end of the sampling (Figure 2). The aim of the sampling is to provide information on fish entering the river and this result suggests that the sampling period should remain restricted to the end of September to avoid significantly eroded scale samples.

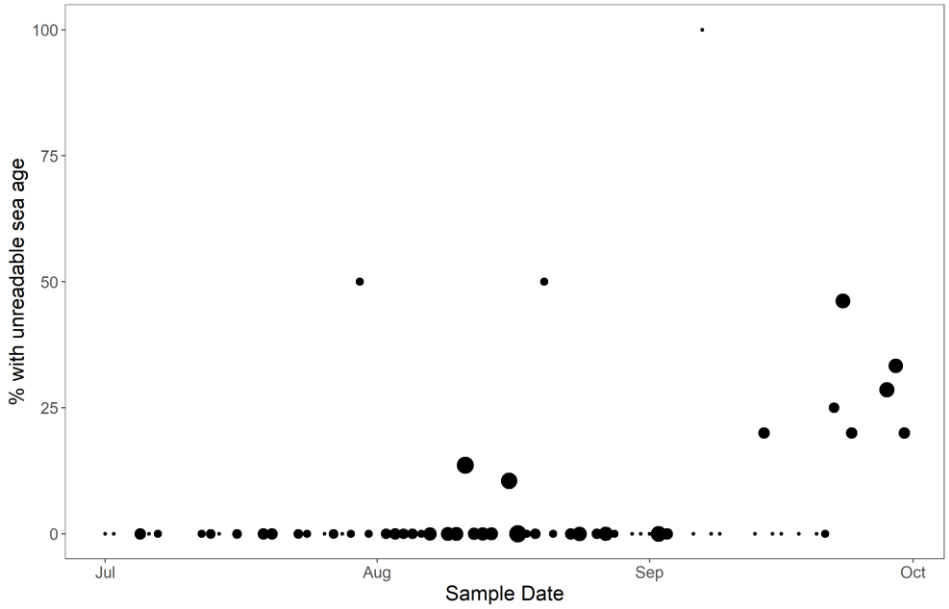


Figure 2 Change in the proportion of samples with unreadable sea ages through the sampling period.

Although the relatively small number of samples gathered from some areas precludes an in depth investigation of between river differences in the ages and sizes of sampled fish it was possible to look at differences between fishery regions (Figure 3). There was a greater percentage of multi-sea winter salmon found in regions on the east coast (including the North region), than those in the west (North West, West and Clyde).

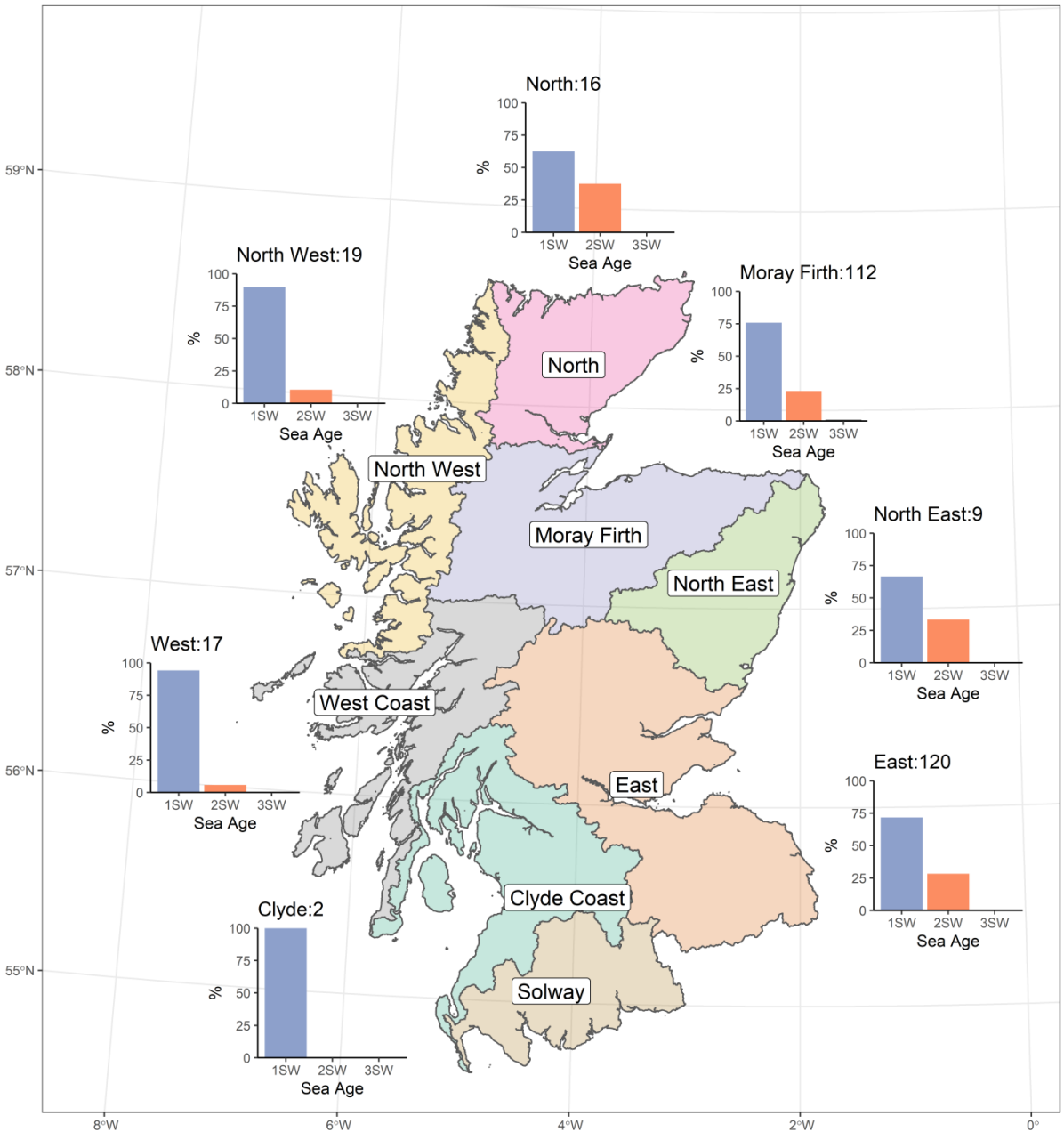


Figure 3 Percentage of salmon belonging to the different sea age classes broken down by fishery region (regions indicated on map). The title of the bar charts gives total number of samples with a readable sea age in each region. 1SW = one year at sea; 2SW = two years at sea; 3SW = three years at sea.

The dominant smolt age class was primarily S2 (two years in freshwater prior to emigration), except in the East region where S1 (one year in freshwater) salmon dominated (Figure 4).

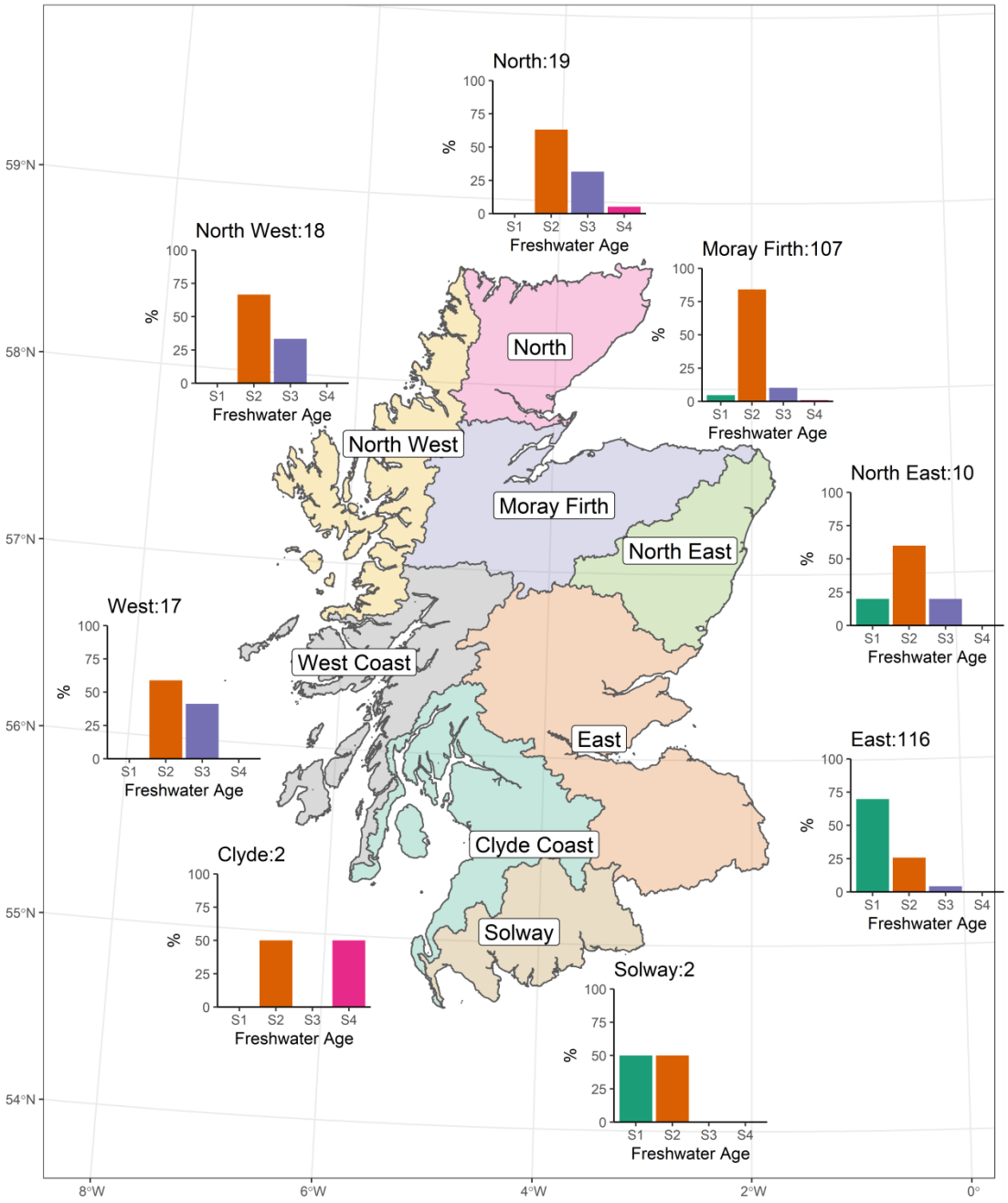


Figure 4 Percentage of salmon belonging to the different freshwater age classes broken down by fishery region (regions indicated on map). The title of the bar charts gives total number of samples with a readable freshwater age in each region. S1 = one year in freshwater; S2 = two years in freshwater; S3 = three years in freshwater; S4 = four years in freshwater.

Regional differences in the length and weight of sampled fish did not show as clear a pattern as seen in sea age. However, the East and Moray Firth regions sampled the largest fish in terms of both length and weight (Figure 5 & 6). Both 1SW and 2SW salmon showed this pattern.

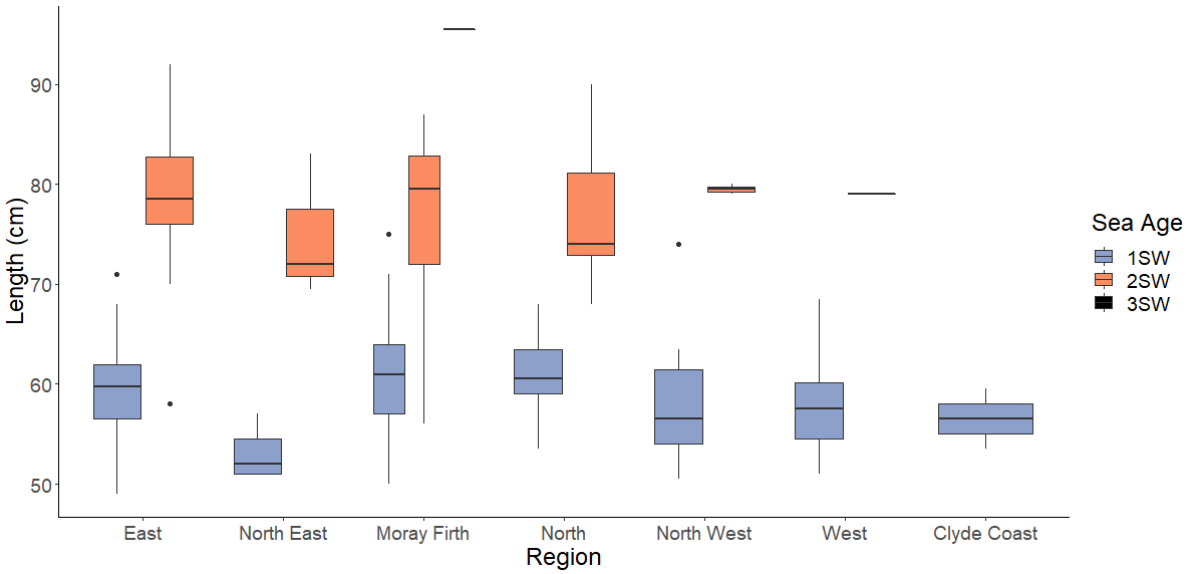


Figure 5 Boxplots showing the length of sampled salmon in the different regions in cm. Results are presented by sea age. 1SW = one year at sea; 2SW = two years at sea; 3SW = three years at sea.

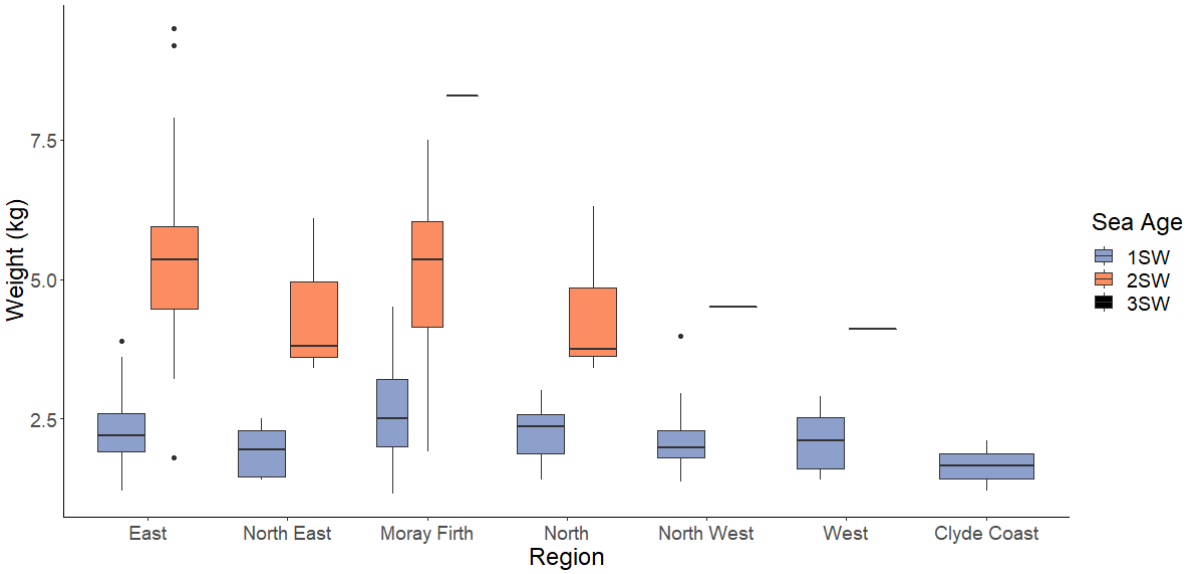


Figure 6 Boxplots showing the weight of sampled salmon in the different regions in kg. Results are presented by sea age. 1SW = one year at sea; 2SW = two years at sea; 3SW = three years at sea.

A total of 93 salmon were sampled to allow comparison of sedated and unsedated measurements (93 lengths and 92 weights). Lengths were identical for all but one fish where the sedated measurement was 0.5cm greater than the unsedated measurement (Figure 7). All but 5 of the weights were identical. For fish where differences were noted sedated measures were marginally higher in 4 out of 5 cases (Figure 6). The average difference was 0.15 kg.

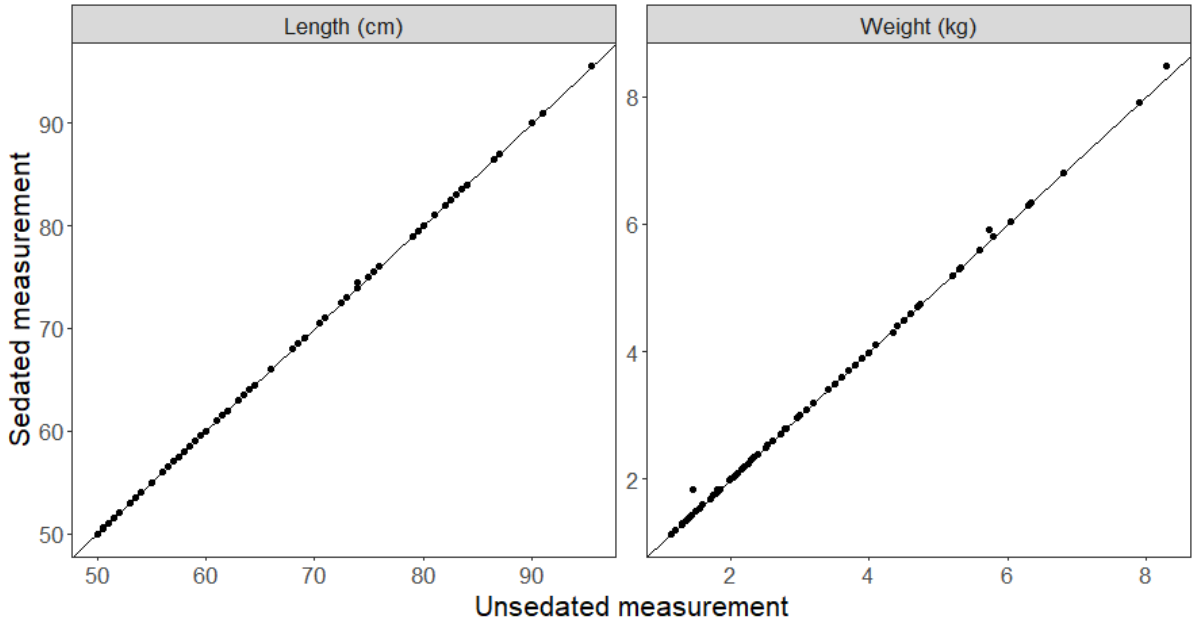


Figure 7 Comparison of pairs of lengths and weights taken from individual salmon under sedated and without the use of sedation. Line shows the 1:1 relationship.

Discussion

The fundamental data pillars for wild Atlantic salmon stock assessment in Scotland are catches, counts, sex ratios, fecundities, sizes and ages. The 2021 pilot National Adult Salmon Sampling Programme demonstrated the potential for local managers to contribute valuable information on the ages and sizes of returning stocks that can be used within population dynamics models to estimate stock status. Ages, sizes and sex ratios are used to estimate egg deposition of returning salmon; ages (smolt and sea age) are used to assign returning adults back to their cohort year.

A list of comments and recommendations for future sampling was compiled following a review of feedback on the pilot programme from data providers, FMS and Marine Scotland project partners.

High river temperatures and low flows – many samplers experienced challenging sampling conditions for extended periods between July and September due to high water temperatures and low water flows. In addition to reduced catches and therefore sampling opportunities, samplers were concerned about fish welfare when handling them in these conditions. Some suggestions to mitigate this issue were to:

- Restrict sampling based on water temperature;
- Extend sampling into earlier months;
- Reduce handling time as much as possible.

It was felt that the decision over whether or not to sample is best left up to individuals as this will involve a judgement on the water conditions, condition of the fish and the experience of the sampler.

Developing local relationships – the ad-hoc nature of sampling rod caught salmon was resource intensive. Each organisation developed its own approach to obtaining sampling, but in many cases samplers were required to travel long distances and/or spend a large

amount of time developing relationships with ghillies and anglers. In most cases, data providers felt that good communication was key and that the effort put into developing these relationships in 2021 would provide a good foundation for future sampling efforts.

Sampling equipment and processes – a number of suggestions were made to improve the sampling process.

- Sample numbers could be increased in some cases by the use of targeted seine netting where appropriate. If this method of fish capture were considered in future sampling, it will be important to obtain licences in a timely manner. In other areas, trained ghillies may be an effective means of increasing sample size of (non-sedated) fish.
- The use of keep nets was an effective means of distributing fish holding locations among disparate capture locations.
- Weigh slings with digital scales were considered the best equipment for providing accurate weights from live fish.
- Oxygenated containers can be useful for allowing fish to recover from capture prior to handling and release.
- While the web-based reporting tool generally was viewed positively, it could be improved to make reporting even easier by allowing for pre-population of administrative details and for retrieving submitted information (e.g. including the scale reference number).
- The Standard Operating Procedure should be modified to make clearer the requirement for measurements to be taken in kilograms and centimetres, the minimum number of scale samples required, and that fish photographs are optional.

Sedation – there was little difference in recorded length or weight of fish that were measured both sedated and unsedated. However, there were contrasting views on the value of sedating fish prior to measurements among samplers. In some cases, samplers considered the process of sedating fish and the additional handling time that entails was not justified given the similarity to unsedated measurements and concerns for fish welfare, especially at higher water temperatures. In other cases, samplers recommended sedation prior to handling to reduce the risk of scale loss through handling live, struggling fish. The differences in perspective may be, in part, dependent on local conditions and future sampling may allow data providers to choose their method of handling fish to suit local circumstances and protocols.

These points will be taken into consideration when developing future National Adult Salmon Sampling Programmes. Although the work highlighted areas for improvement, the 2021 pilot programme proved that a sampling approach which combines national co-ordination with the use of local networks and resources can be used to obtain the biological information required for salmon stock assessments.

Annex 1 – Standard Operating Procedure (2021)

Minimum requirements:

- Fork length (Figure 1) of the fish should be recorded to the nearest 0.5 cm either using a measuring board or a tape measure.
- Weight of the fish should be measured to the nearest 0.1 kg.
- For consistency, scales should be taken from the left flank of the fish, from an area immediately behind the dorsal fin and midway between the back of the fish and the lateral line (see Figure 1). Occasionally, in situations where fish may have been sampled previously, consideration instead, should be given to take scales from the right flank, where a higher proportion should be originals.

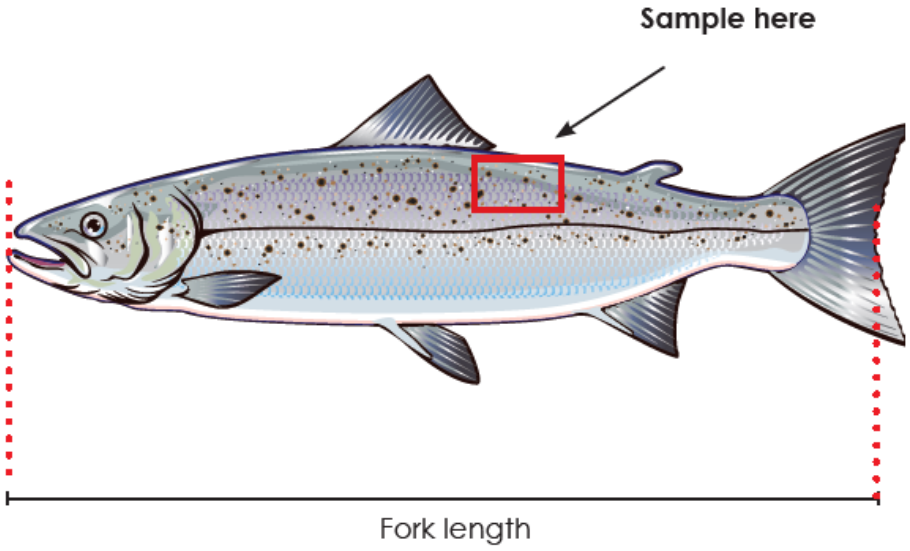
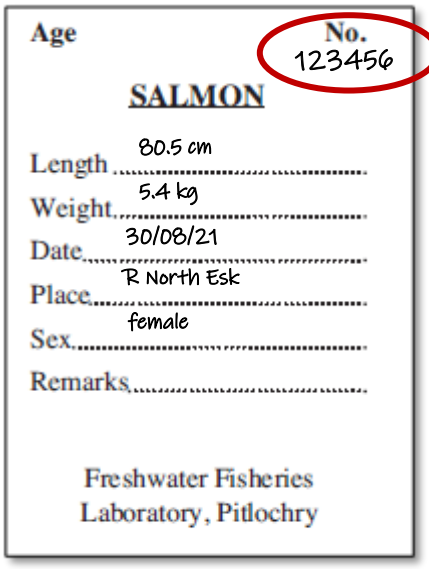


Figure 4 Measurement of fork length and scale sample location for adult Atlantic salmon (Source: Inland Fisheries Ireland)

- A blunt scalpel or a knife blade is used initially in a head to tail direction to remove excess mucus. Then, working in the opposite direction, and by applying more pressure, scales are scraped loose from the fish. In general, a relatively large sample (10+ scales) is likely to provide more useable scales. Alternatively, for larger fish, dissection forceps can be used to remove individual scales. Scales are transferred from the blade/forceps to a paper scale packet, taking care to clean the instrument between samples.
- For dead fish, a relatively large sample (10+ scales) should be collected.
- For fish that will be returned live to the water, fewer scales should be taken (6-8).
- Each scale packet should be clearly labelled to identify the sample it contains, with details that will help a scale reader interpret growth (length, weight, date, place, sex if known). A unique scale sample identification number will be provided by the online reporting tool when submitting a record; this must be transcribed onto the scale packet to enable linking of the physical and digital record. Scale packets should be allowed to dry fully in open air before being stored.



Unique Scale Sample Identification Number provided by the online reporting tool

Figure 5 Example scale packet.