MOWI Scotland Ltd / Bakkafrost Scotland Ltd

Torridon Wild Fish Monitoring - 2023

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V1	03/1/23	All	All	First draft to client	LV

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1. Introduction

1.1. Background

In 2022, APEM Ltd was jointly commissioned by MOWI Scotland Ltd (MOWI) and Bakkafrost Scotland Ltd to develop and provide a programme of wild fish monitoring to fulfil obligations under Environmental Management Plans (EMPs) for their marine fish farm sites which had recently received planning consent in Loch Torridon, Ross and Cromarty.

Under this programme, APEM field scientists successfully completed a suite of marine and freshwater monitoring surveys, providing baseline data for both sea lice numbers and juvenile salmonid populations within the Loch Torridon catchment. APEM Ltd were further commissioned in 2023 to continue monitoring of these sites and build some context onto the initial baseline data. Specifically;

- Monitor numbers of sea lice (predominantly *Lepeophtheirus salmonis*) on wild salmonids, captured from within the vicinity of Loch Torridon on the west coast of Scotland, and;
- Monitor population densities of juvenile salmonids in the rivers Torridon and Balgy, which flow into Loch Torridon, via electrofishing methods.

Monitoring completed by APEM in 2023 has been undertaken to comply with client obligations under EMPs for consented aquaculture developments within the region and to inform regional management of aquaculture activities. Currently, no designations apply to the Loch Torridon, River Torridon or River Balgy areas for which any migratory salmonid species are a feature.

This report presents a summary of the fisheries monitoring conducted in 2023, a comparison with results from the 2022 surveys, and provides recommendations for further monitoring in 2024.

2. Methodology

2.1. Sea Lice Monitoring

Permissions for the monitoring (*Scientific Research Derogation* and *Consent to Catch Salmon*) were obtained from Marine Scotland Science (MSS) prior to commencement of the 2023 monitoring surveys. It was initially proposed to complete all seine netting within three single-day surveys between May – June, as per standard Scottish Fisheries Coordination Centre protocol. However, the final survey was rescheduled to August 2023 at the client's request to ensure the highest catch probability, due to continuing low riverine water levels and bright weather conditions through the summer adversely affecting wild salmonid capture rate in the marine environment.

2.1.1. Monitoring Locations (Seine Netting)

To ensure the highest catch probability, sites surveyed in 2022 were replicated in 2023. The seine netting survey was designed to focus catch effort on areas known anecdotally to hold fish over low water. Sites surveyed in 2023 are detailed below:

- Torridon, along the foreshore, either side of the mouth of the River Torridon between NG 89733 56093 ad NG 89393 54507 (Figure 1).

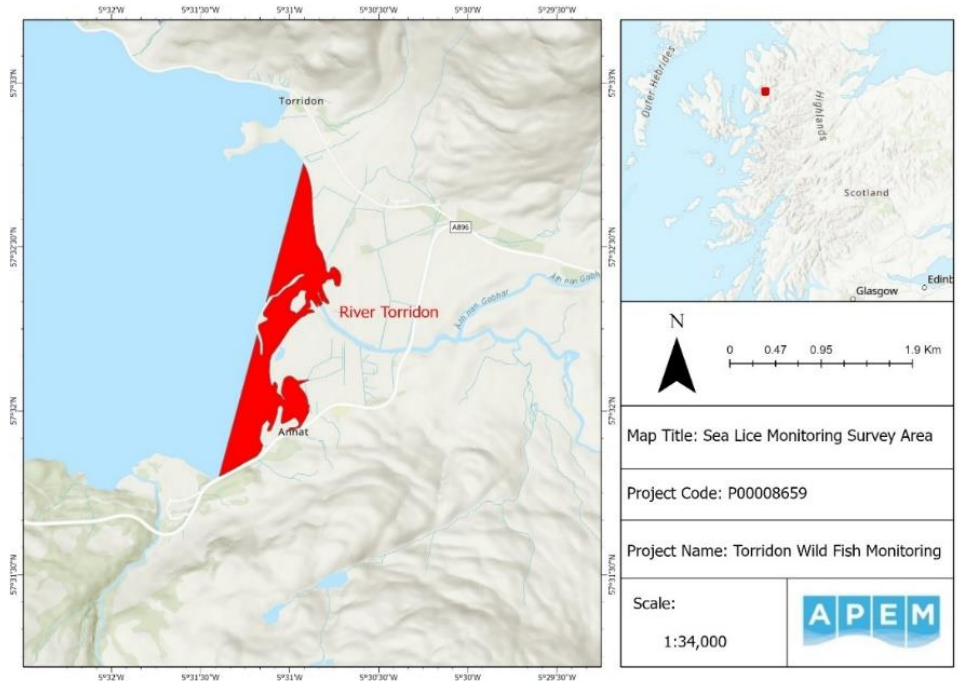

Figure 1: Sea Lice Monitoring Survey Area – Torridon Wild Fish Monitoring Surveys (2023).

The 2022 surveys identified survey areas within the foreshore at Torridon that held migratory salmonids during low tidal conditions. Subsequently these sites were resurveyed in 2023 to increase catch probability and enable comparison amongst the results. In addition, the following factors were also considered fully before the commencement of the 2022 monitoring surveys, and re-considered before commencement of the 2023 surveys.

- Proximity of the survey site to the River Torridon, with priority given to sites immediately adjacent to this area.
- Location of each survey site in relation to the downstream tidal limit to minimise potential detachment of sea lice from their host fish, as occurs within a short space of time once these migratory fish enter freshwater.
- The level of assistance provided by each potential site through natural morphological constraint and effective corralling of target fish into limited areas of water over low tidal conditions.
- Suitability of the potential survey site regarding its morphological compatibility with the licensed methods used to conduct this monitoring.
- Ability of the surveyors to access the survey site fully and safely with full equipment requirements to carry out the monitoring as per the appropriate methodology.

2.1.2. Seine Netting

Seine netting was the sole survey method utilised during the 2023 sea lice monitoring programme and was conducted along the foreshore around the mouth of the river Torridon (Figure 1). Long seine nets were operated with two fixed ropes for hauling and herding the fish. The seine net utilised for all surveys in 2023 was consistent throughout, with a 50 m x 3.5 m net being used of a 20 mm mesh diameter. This mesh diameter has previously been successfully deployed on other, similar wild salmonid surveys in previous years and so was employed to reduce the risk of non-targeted bycatch species being captured. Nets were deployed both manually from the shore, as well as with assistance of a small rigid inflatable boat (RIB), which was used to assist the survey team in deploying the net into deeper water, as required (Figure 2).

This technique permitted the sampling of relatively large areas in short periods of time as well as the capture and release of fish without significant stress or harm. Seine net surveys were conducted over low tide, with available survey time allowing for eight pulls of the net per day, working in a south to north direction across the Torridon foreshore, to cover as much of the foreshore as possible, where it was likely that migratory salmonids would be holding, awaiting the incoming tide to attempt to move upstream.

Figure 2: APEM surveyors deploying the seine net for migratory salmonids from a rigid inflatable boat at Torridon – May 2023.

2.1.3. Sea Lice Enumeration Procedure

Once fish were successfully captured, they were visually assessed within the net to identify species. If no salmonids were present, the nets were immediately emptied to ensure minimal disturbance to bycatch species. Bycatch release could be achieved by opening out the seine to allow fish to swim free themselves, ensuring minimal unnecessary handling of the fish. Any fish physically caught in the net and unable to release themselves were then gently removed

to ensure they remained undamaged. Captured salmonids were transferred to knotless soft rubber mesh landing nets for further examination. Individuals were measured, photographed and assessed for sea lice presence, sea lice attachment spots, black spot disease and additional notes (such as prominent scars or marks).

Sea lice count metrics recorded during the survey included:

- Prevalence (the percentage of infested fish in the sample)
- Abundance (mean number of lice in the sample) and;
- Intensity (mean number of lice per infected fish).

Observed sea lice were counted and assigned to life stages (e.g. juvenile, mobile and gravid female following Moore *et al.,* 2018). Optimal fish welfare was considered throughout, and air exposure was kept to a minimum during the entire process. All fish were given time to fully recover from being netted before being released unharmed back into their approximate capture location.

2.2. Time-Delineated Electrofishing Surveys

As part of obligations under EMPs, a requirement for juvenile salmonid population surveys exists, to understand the potential impact of fish farms on the local fish populations. The fisheries surveys of the rivers Balgy and Torridon conducted in 2022 provided the first-year baseline information for each of these watercourses against which the data collected in 2023 will be compared.

Permissions for the monitoring (*Scientific Research Derogation* and *Consent to Catch Salmon*) were obtained from MSS prior to the commencement of the 2023 monitoring surveys. All electrofishing surveys were conducted as per Scottish Fisheries Co-ordination Centre (SFCC) standards and led by an APEM fisheries scientist qualified to SFCC Team Leader standard.

2.2.1. Electrofishing Site Locations

Electrofishing surveys were conducted at five sites on the River Torridon, and five sites on the River Balgy, on the 31st of August, 2023 (Table 1, Figure 3 and Figure 4)

Table 1: Electrofishing locations on the Rivers Torridon and Balgy, August 2023.

Electrofishing Sites	NGR	Survey Type
River Balgy (Site A)	NG 84657 54370	Time Delineated (CPUE)
River Balgy (Site B)	NG 84757 54221	Time Delineated (CPUE)
River Balgy (Site C)	NG 84816 53910	Time Delineated (CPUE)
River Balgy (Site D)	NG 84920 53848	Time Delineated (CPUE)
River Balgy (Site E)	NG 85112 53411	Time Delineated (CPUE)
River Torridon (Site F)	NG 90421 55041	Time Delineated (CPUE)
River Torridon (Site J)	NG 91377 55372	Time Delineated (CPUE)
River Torridon (Site K)	NG 92317 55892	Time Delineated (CPUE)
River Torridon (Site L)	NG 94189 56601	Time Delineated (CPUE)
River Torridon (Site M)	NG 95074 56612	Time Delineated (CPUE)

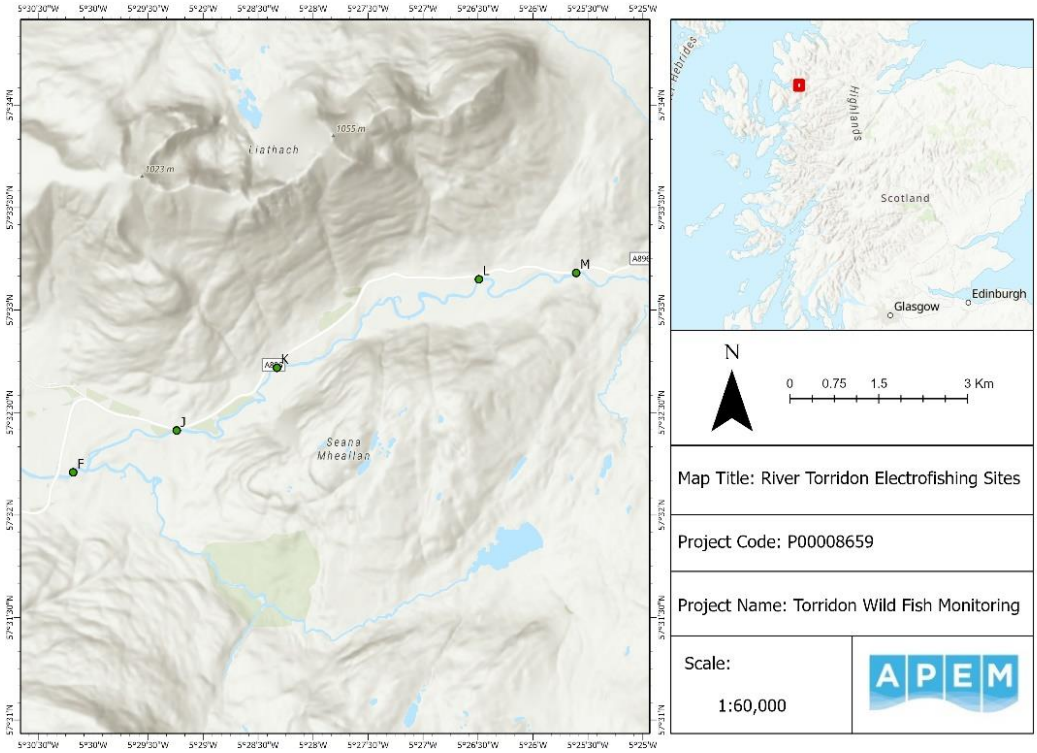

Figure 3: Electrofishing Monitoring Sites (River Torridon) – Torridon Wild Fish Monitoring Surveys (2023).

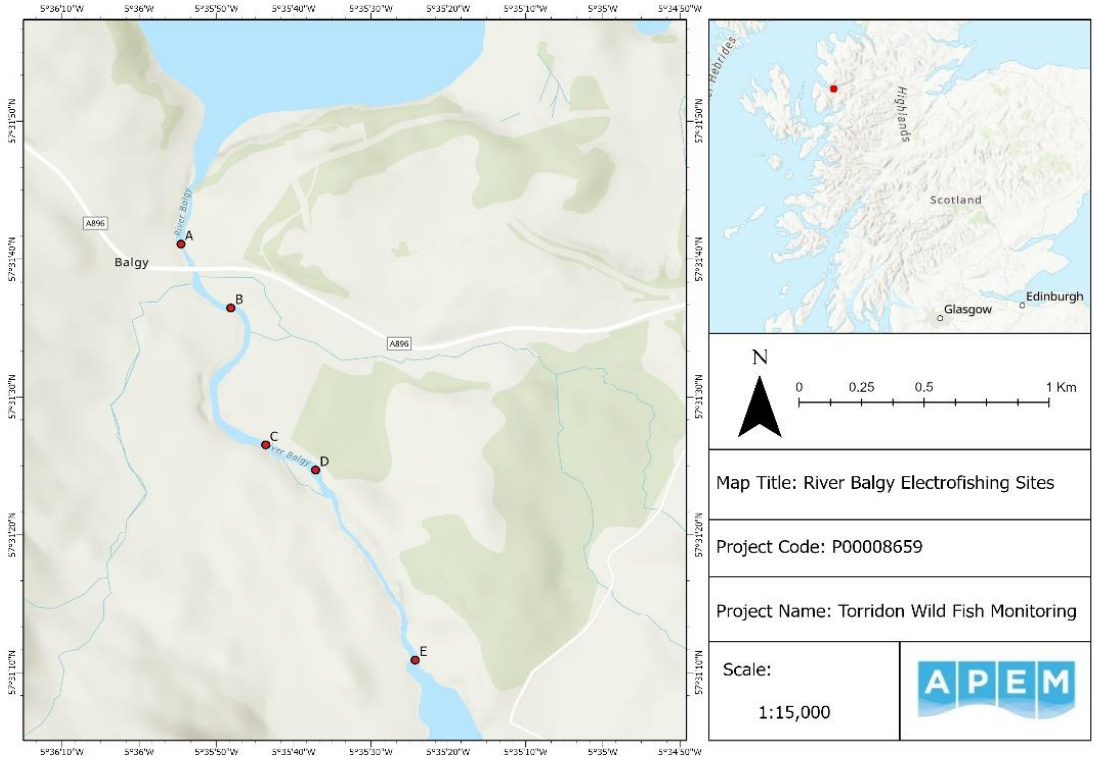

Figure 4: Electrofishing Monitoring Sites (River Balgy) – Torridon Wild Fish Monitoring Surveys (2023).

2.3. Electrofishing Methodology

All electrofishing surveys were conducted to Scottish Fisheries Co-ordination Centre (SFCC) standards (SFCC, 2007a). The method of electrofishing uses a battery powered backpack and three operatives wading upstream along the watercourse. A direct current of electricity flows between a submerged cathode and an anode. When a fish encounters a large enough potential gradient in its path this elicits a muscular convulsion and the fish swims towards the anode where it is stunned and can be easily and safely captured. Fish are retained in aerated water long enough to enable identification, and a length measurement is recorded. After a short recovery period, the fish are returned to the watercourse.

All surveys in the 2023 monitoring programme were conducted using time delineated sampling. Time delineated surveying is more suited to wider, faster-flowing, rivers such as the Torridon and Balgy, where isolation of a stretch of river with stop-nets for fully quantitative

(depletion) surveying may not be practicable. Time delineated surveys require a site to be fished for a prescribed length of time (in this instance, as per SFCC guidance, 6 minutes per site). The number of fish caught is reported as catch per unit effort (CPUE), with minimum density estimates (numbers of fish caught per 100 m^2) also recorded.

As per SFCC standards, a general electrofishing habitat survey was completed for each site, detailing site dynamics, including the width of survey area, average depth, substrate dynamics, water temperature and vegetation, both instream and bankside.

2.4. SFCC Classification

The Scottish National Classification Scheme derived from Godfrey (2006) is a simple system for grading rivers based on their salmonid populations and data from over 1600 sites surveyed between 1997 and 2002. In Scotland, regional variation in salmonid population density is incorporated in the grading system. This system provides context for the results from the Balgy and Torridon electric fishing surveys, to make comparisons within and between watercourses. The rivers Balgy and Torridon lie within the North-West region. Classification of both Atlantic salmon (*Salmo salar*) (hence forth known as salmon) and brown trout (*Salmo trutta*) (hence forth known as trout) fry and parr densities for the North-West region are defined by the SFCC Scottish Classification for salmon and trout, which can be found below (Table 2 - Table 5). The results are presented as densities of fish per 100 m^2 wetted area in Section 3, Results.

Table 2: SFCC North-West Region Salmon Fry Densities

	Salmon fry density per 100 m^2			
Width class	**<4m**	**4-6m**	**6-9m**	**>9m**
A – Excellent	23.0+	33.1+	17.8+	28.6+
B – Good	<23.0 – 11.5	<33.1 – 20.8	<17.8 – 8.7	<28.6 – 14.2
C – Moderate	<11.5 – 7.0	<20.8 - 10.6	<8.7 - 5.5	<14.2 – 11.4
D – Low	<7.0 – 4.4	<10.6 - 4.5	<5.5 – 2.7	<11.4 – 5.5
E – Very Low	<4.4 - 0.8	<4.5 – 1.0	<2.7 – 0.8	<5.5 – 1.0
Absent	0.0	0.0	0.0	0.0

Table 3: SFCC North-West Region Salmon Parr Densities

	Salmon parr density per 100 m^2			
Width class	**<4m**	**4-6m**	**6-9m**	**>9m**
A – Excellent	13.9+	13.7+	12.5+	11.8+
B – Good	<13.9 – 7.9	<13.7 – 8.0	<12.5 – 9.0	<11.8 – 8.0
C – Moderate	<7.9 – 4.9	<8.0 – 3.7	<9.0 – 5.5	<8.0 – 4.3
D – Low	<4.9 - 2.6	<3.7 – 2.4	<5.5 – 2.5	<4.3 – 2.9
E – Very Low	<2.6 - 0.7	<2.4 – 0.7	<2.5 – 0.7	<2.9 – 0.7
Absent	0.0	0.0	0.0	0.0

Table 4: SFCC North-West Region Trout Fry Densities

	Trout fry density per 100 m^2			
Width class	**<4m**	**4-6m**	**6-9m**	**>9m**
A – Excellent	29.7+	11.5+	8.6+	8.3+
B – Good	<29.7 – 15.8	<11.5 – 5.9	<8.6 – 4.9	<8.3 – 3.1
C – Moderate	<15.8 – 8.8	<5.9 – 4.3	<4.9 – 2.9	<3.1– 1.4
D – Low	<8.8 – 4.4	<4.3 – 2.2	<2.9 – 1.9	<1.4 – 1.1
E – Very Low	<4.4 – 0.9	<2.2 – 0.7	<1.9 – 0.7	<1.1 – 0.4
Absent	0.0	0.0	0.0	0.0

Table 5: SFCC North-West Region Trout Parr Densities

	Trout parr density per 100 m^2			
Width class	**<4m**	**4-6m**	**6-9m**	**>9m**
A – Excellent	12.6+	5.6+	4.6+	4.3+
B – Good	<12.6 – 7.2	<5.6 – 3.3	<4.6 – 2.8	<4.3 – 2.4
C – Moderate	<7.2 – 4.1	<3.3 – 2.1	<2.8 – 1.8	<2.4 – 0.8
D – Low	<4.1 – 2.6	<2.1 – 1.1	<1.8 – 1.2	<0.8 – 0.7
E – Very Low	<2.6 – 1.1	<1.1 – 0.7	<1.2 – 0.8	<0.7 – 0.2
Absent	0.0	0.0	0.0	0.0

3. Results

3.1. Seine Netting

Access to the survey area was clear for three single-day seine netting surveys, with calm, warm conditions allowing the survey team to enjoy safe, uninhibited access to all survey areas and deployment and retrieval of seine nets without incident. A full breakdown of each of the monitoring surveys, including date, location, methodology, effort and capture, can be found in Table 6 below.

Table 6: Torridon Wild Fish Monitoring: 2023 Sea Lice Survey Results

Date	Sample Area	Grid Reference	Capture Method	Number of Net Deployments	Sea Trout Captured
18/05/2023	Torridon	NG 89733 56093 to NG 89393 54507	Seine Netting	8	0
01/06/2023	Torridon	NG 89733 56093 to NG 89393 54507	Seine Netting	8	0
30/08/2023	Torridon	NG 89733 56093 to NG 89393 54507	Seine Netting	8	1
Total				24	1

The seine nets used caught a total of 1 salmonid, which was a sea trout (*Salmo trutta*), from an effort of 24 seine net hauls. Whilst presence of other species at Torridon was noticeably low, adoption of the use of a 20 mm diameter seine net proved highly effective in allowing much of any bycatch to swim free of the net. Recorded bycatch included:

- Plaice (*Pleuronectes platessa*)
- Flounder (*Platichthys flesus*)
- Pollack (*Pollachius pollachius*)
- Grey Gurnard (*Eutrigla gurnardus*)
- Lesser-Spotted Dogfish (*Scyliorhinus canicula*)
- Green Shore Crab (*Carcinus maenas*)

3.1.1. Sea Lice

The information presented in Table 7 below details all of the sea lice data from the three days of monitoring surveys conducted in 2023 In total, 1 sea trout was examined, with 0 sea lice found present on this fish.

Table 7: Sea Lice Monitoring Results – MOWI/Bakkafrost Wild Fish Monitoring – Torridon (2023).

ID Serial	Method	Date	Location	Time	Tide	Species	Life Stage	Fork Length (mm)	Total Length (mm)	Juvenile Sea Lice	Mobile Sea Lice	Gravid Lice	Total Lice	Dorsal Lice Damage (0 – 3) *
1	Seine	30/08/2023	Torridon	12.50	Low	sea trout	Post Smolt	200	210	0	0	0	**0**	**0**

**Lice damage to dorsal fin (0= no damage; 1=<33% damage; 2=33-66% damage; 3=>66% damage)*

3.2. Electrofishing Results

The electrofishing surveys of the Rivers Balgy and Torridon were completed on 31st August 2023. A total of 136 fish were caught across the two watercourses. Of these, salmon were the most dominant species captured (n=99), with trout being recorded in lower abundance (n=37). For both salmon and trout, the length data indicates multiple year classes due to the range of sizes captured. Catchment-specific classification of fry and parr for both salmon and trout, provided by the Wester Ross Fisheries Trust (WRFT) indicate that the division between year classes for salmon fry and parr on the Balgy is at approximately <80 mm for fry and >80 mm for parr, and the data presented in Table 8 and Table 9 below has been recorded to align with WRFT assessments.

Table 8: Summary of fish caught during electrofishing at 5 sites on the River Torridon (2023)

Sites	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Torridon F	0	1	2	0
Torridon J	0	0	7	0
Torridon K	0	1	1	1
Torridon L	4	8	1	0
Torridon M	6	3	1	3
Number (n)	**10**	**13**	**12**	**4**
Mean Length (mm)	**56**	**100**	**58**	**114**
Species Total Number (n)	**23**		**16**	
Species Minimum length (mm)	**44**		**48**	
Species Maximum length (mm)	**120**		**136**	
Species Mean length (mm)	**81**		**72**	

Table 9: Summary of fish caught during electrofishing at 5 sites on the River Balgy (2023)

Sites	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Balgy A	11	20	3	3
Balgy B	8	26	1	1
Balgy C	1	7	2	8
Balgy D	0	3	0	0
Balgy E	0	0	2	1
Number (n)	**20**	**56**	**8**	**13**
Mean Length (mm)	**73**	**90**	**72**	**95**
Species Total Number (n)	**76**		**21**	
Species Minimum length (mm)	**62**		**68**	
Species Maximum length (mm)	**140**		**111**	
Species Mean length (mm)	**85**		**86**	

3.2.1. River Torridon (CPUE)

The time delineated survey results (CPUE) for the River Torridon for 2023 are shown below (Table 10), For comparative purposes, CPUE results from the 2022 surveys are also provided (Table 11) with variance (+/-) between the two sets of results also provided (Table 12).

Table 10: CPUE results for River Torridon (time delineated surveys) 2023.

CPUE	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Torridon F 2023	0.00	0.17	0.33	0.00
Torridon J 2023	0.00	0.00	1.17	0.00
Torridon K 2023	0.00	0.17	0.17	0.17
Torridon L 2023	0.67	1.33	0.17	0.00
Torridon M 2023	1.00	0.50	0.17	0.50

Table 11 CPUE results for River Torridon (time delineated surveys) 2022.

CPUE	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Torridon F 2022	0.50	0.00	0.00	0.00
Torridon J 2022	0.00	0.50	0.00	0.17
Torridon K 2022	0.00	1.33	0.00	0.00
Torridon L 2022	0.17	0.67	0.00	0.00
Torridon M 2022	0.00	0.83	0.00	0.17

Table 12: Change (+/-) CPUE results for River Torridon (timed delineated surveys) 2023 vs 2022.

CPUE	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Torridon F	-0.50	-0.17	0.33	0.00
Torridon J	0.00	-0.50	1.17	-0.17
Torridon K	0.00	-1.17	0.17	0.17
Torridon L	0.50	0.67	0.17	0.00
Torridon M	1.00	-0.33	0.17	0.33

The electrofishing surveys conducted on the River Torridon in 2023 (Table 8) had a total count of 39 salmonids (an increase of 11 on 2022) captured across the five sites with 10 salmon fry, 13 salmon parr, 12 trout fry and 4 trout parr recorded. As per the 2022 survey results on the Torridon, salmon parr were the most abundant within the juvenile salmonid populations of the Torridon within the 2023 surveys. Trout fry, which were recorded as absent across all sites in 2022 (Table 12), were recorded as present at all sites in 2023.

Table 12 shows an increase (Green), decrease (Red) or no change (Orange) in CPUE between 2022 and 2023. Figure 5 (below) shows CPUE results from both 2022 and 2023 datasets by

site and illustrates any variation between them. In 2023, survey results have shown an overall increase in trout fry and parr, with increases in salmon fry recorded at sites L and M and a marginal decrease at site F. Recorded numbers of salmon parr decreased across four Torridon sites, increasing at one (Site L).

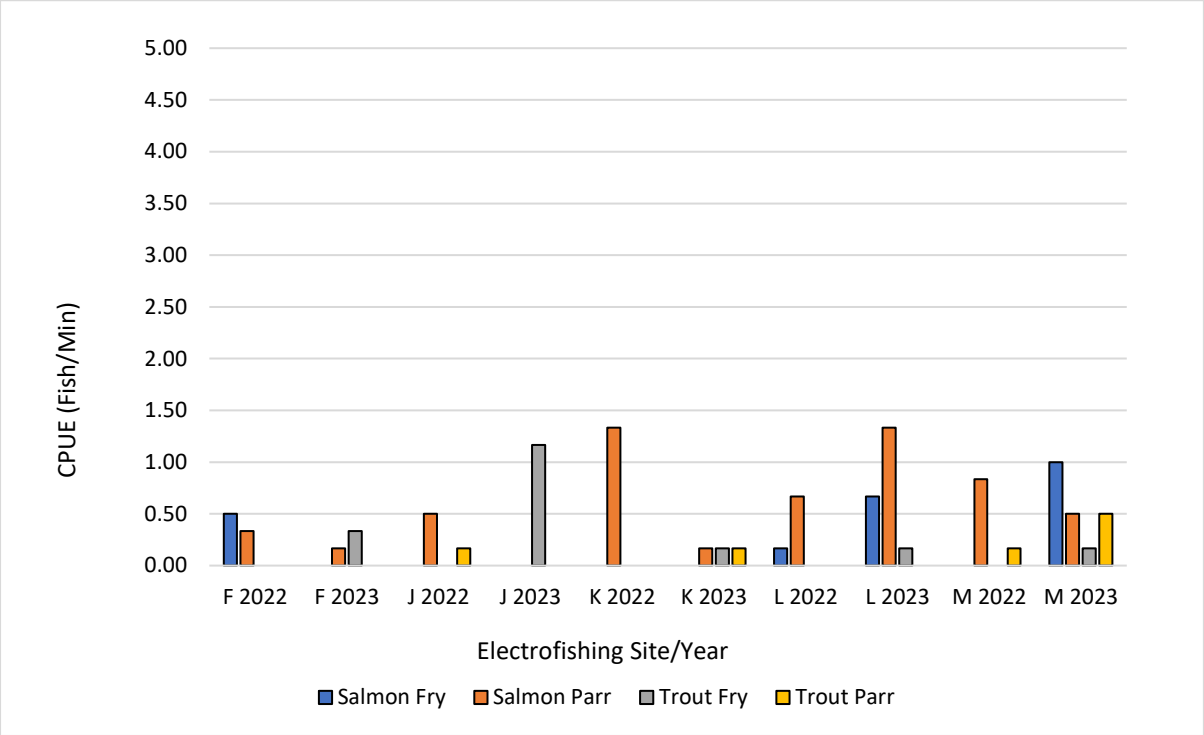

Figure 5: CPUE results comparison for River Torridon (time delineated surveys) 2022 - 2023.

3.2.2. River Torridon (Densities)

The time delineated survey results for minimum density estimates (fish caught per/100m^2) for the River Torridon in 2023 are shown below (Table 13). For comparative purposes, minimum density estimates from the 2022 surveys are also provided (Table 14) with variance (+/-) between the two sets of results also provided (Table 15).

Table 13: Minimum density estimates (100m2) results for River Torridon (time delineated surveys) 2023

Density	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Torridon F 2023	0.00	0.35	0.70	0.00
Torridon J 2023	0.00	0.00	2.59	0.00
Torridon K 2023	0.00	0.38	0.38	0.38
Torridon L 2023	0.84	1.68	0.21	0.00
Torridon M 2023	0.84	1.68	0.21	0.00

Table 14: Minimum density estimates (100m2) results for River Torridon (time delineated surveys) 2022

Density	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Torridon F 2022	7.58	5.05	0.00	0.00
Torridon J 2022	0.00	8.51	0.00	2.84
Torridon K 2022	0.00	1.33	0.00	0.00
Torridon L 2022	2.43	9.73	0.00	0.00
Torridon M 2022	0.00	13.55	0.00	2.71

Table 15: Change (+/-) Minimum density estimates (100m2) results for River Torridon (timed delineated surveys) 2023 vs 2022.

Density	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Torridon F	-7.58	-4.70	0.70	0.00
Torridon J	0.00	-8.51	2.59	-2.84
Torridon K	0.00	-0.95	0.38	0.38
Torridon L	-1.59	-8.05	0.21	0.00
Torridon M	0.84	-11.87	0.21	-2.71

Table 15 shows either an increase (Green), decrease (Red) or no change (Orange) in density estimates between 2022 and 2023. Figure 6 shows density estimates from both 2022 and 2023 datasets by site and illustrates any variation between them. In 2023, results have shown an overall decrease in density estimates for salmon parr across all sites on the Torridon, with an increase in density estimates for trout fry across all sites.

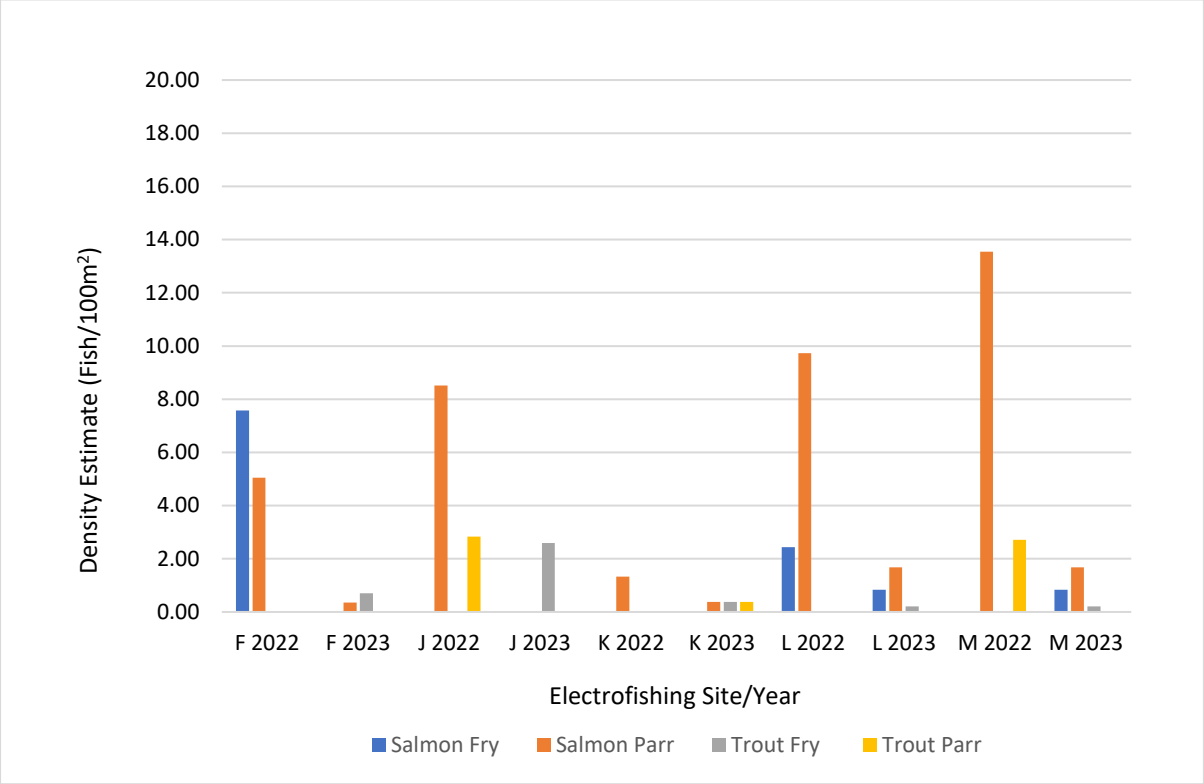

Figure 6: Density estimate results comparison for River Torridon (time delineated surveys) 2022 - 2023.

3.2.3. River Balgy (CPUE)

The time delineated survey results (CPUE) for the River Balgy for 2022 and 2023 are shown below in Table 16 and Table 17, with comparison (+/-) between the two years also provided (Table 18).

Table 16: CPUE results for River Balgy (time delineated surveys) 2023.

CPUE	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Balgy A 2023	1.83	3.33	0.50	0.50
Balgy B 2023	1.33	4.33	0.17	0.17
Balgy C 2023	0.17	1.17	0.33	1.33
Balgy D 2023	0.00	0.50	0.00	0.00
Balgy E 2023	0.00	0.00	0.17	0.33

Table 17: CPUE Results for River Balgy (time delineated surveys) 2022.

CPUE	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Balgy A 2022	1.5	0.67	0.00	0.00
Balgy B 2022	1.5	1.67	0.00	0.00
Balgy C 2022	0.17	1.00	0.00	0.00
Balgy D 2022	0.00	0.00	0.00	0.00
Balgy E 2022	0.00	0.17	0.00	0.00

Table 18: Change (+/-) CPUE results for River Balgy (timed delineated surveys) 2023 vs 2022.

CPUE	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Balgy A	0.33	2.67	0.5	0.5
Balgy B	-0.17	2.67	0.17	0.17
Balgy C	0.00	0.17	0.33	1.33
Balgy D	0.00	0.5	0.00	0.00
Balgy E	0.00	-0.17	0.17	0.33

The surveys conducted on the River Balgy for 2023 (Table 9) had a total count of 98 salmonids (an increase of 57 on 2022) captured across the five sites with 57 salmon parr, 20 salmon fry, 13 trout parr and eight trout fry recorded. As per the 2022 survey results on the Balgy, salmon parr were the most abundant within the 2023 surveys. Trout fry and trout parr, which were recorded as absent across all sites in 2022 (Table 17), were recorded as present at three and four survey sites respectively in 2023.

Table 18 shows either an increase (Green), decrease (Red) or no change (Orange) in CPUE between 2022 and 2023. Figure 7 (below) shows CPUE results from both 2022 and 2023 datasets by site and illustrates any variation between them. In 2023, results have shown an overall increase in all four juvenile salmonid classifications within the Balgy survey results, with the most marked increases observed in salmon and trout parr.

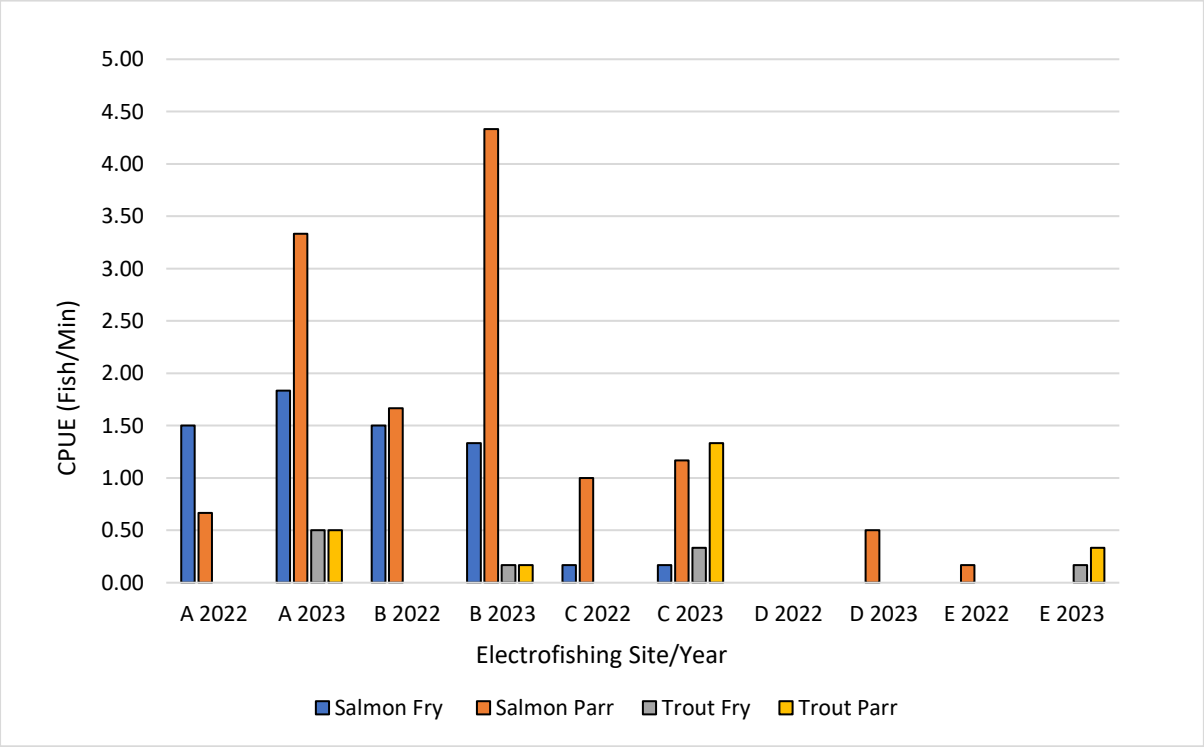

Figure 7: CPUE results comparison for River Balgy (time delineated surveys) 2022 - 2023.

3.2.4. River Balgy (Densities)

The time delineated survey results for minimum density estimates (fish caught per/100m^2) for the River Balgy in 2023 are shown below (Table 19). For comparative purposes, minimum

density estimates from the 2022 surveys are also provided (Table 20) with variance (+/-) between the two sets of results also provided (Table 21).

Table 19: Minimum density estimates (100m2) results for River Balgy (time delineated surveys) 2023.

Density	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Balgy A 2023	3.19	5.81	0.87	0.87
Balgy B 2023	2.66	8.63	0.33	0.33
Balgy C 2023	0.21	1.50	0.43	1.71
Balgy D 2023	0.00	1.28	0.00	0.00
Balgy E 2023	0.00	0.00	0.69	0.35

Table 20: Minimum density estimates (100m2) results for River Balgy (time delineated surveys) 2022.

Density	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Balgy A 2022	30.77	13.68	0.00	0.00
Balgy B 2022	24.73	27.47	0.00	0.00
Balgy C 2022	2.45	14.71	0.00	0.00
Balgy D 2022	0.00	0.00	0.00	0.00
Balgy E 2022	0.00	2.90	0.00	0.00

Table 21: Change (+/-) Minimum density estimates (100m2) results for River Balgy (timed delineated surveys) 2023 vs 2022

Density	Salmon Fry	Salmon Parr	Trout Fry	Trout Parr
Balgy A	-27.58	-7.87	0.87	0.87
Balgy B	-22.07	-18.84	0.33	0.33
Balgy C	-2.24	-13.21	0.43	1.71
Balgy D	0.00	1.28	0.00	0.00
Balgy E	0.00	-2.90	0.69	0.35

Table 21 shows either an increase (Green), decrease (Red) or no change (Orange) in density estimates between 2022 and 2023. Figure 8 (below) shows density estimates from both 2022 and 2023 datasets by site and illustrates any variation between them. In 2023, results have shown an overall decrease in density estimates for salmon fry at three out of five sites, and salmon parr across four out of five sites on the Balgy. Increase in density estimates for trout fry and parr have both been recorded across 4 sites, and remained as per 2022 results at site Balgy D. The reasons for these notable changes are discussed in Electrofishing Monitoring Discussion 4.3 of this document.

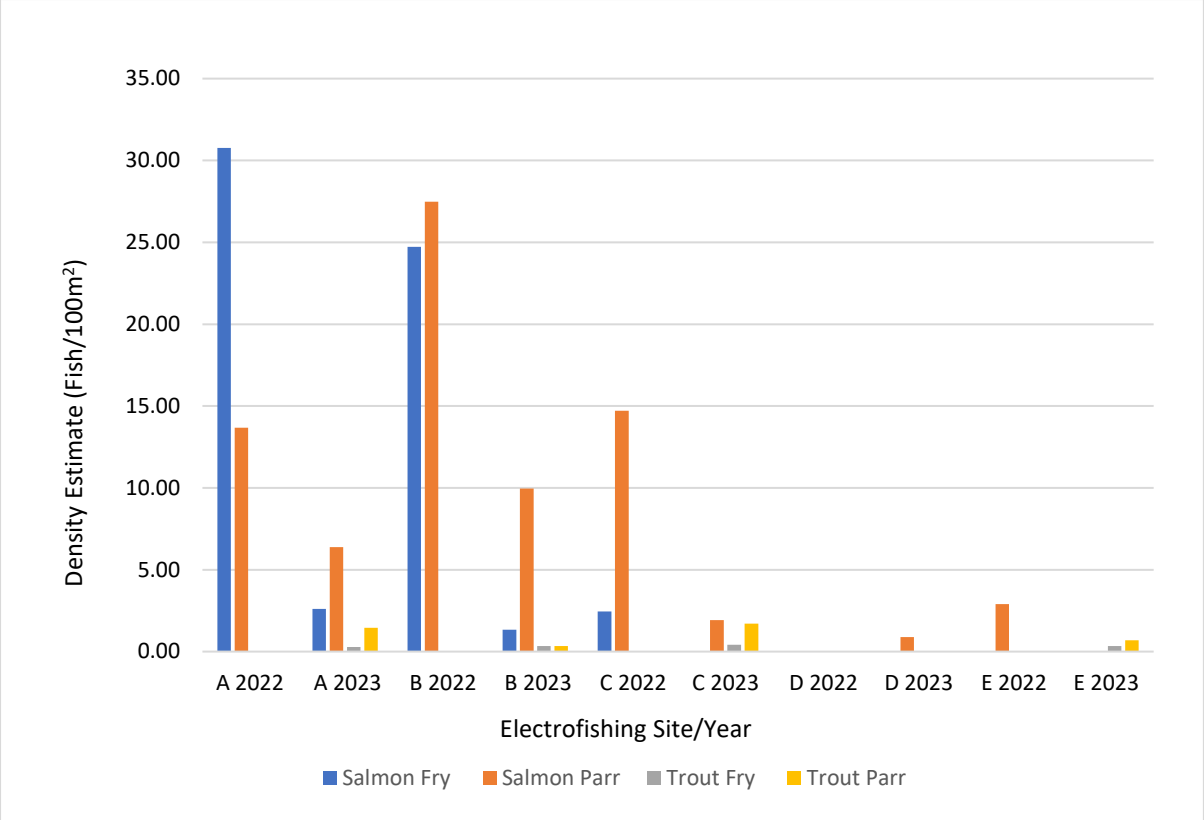

Figure 8: Density estimate results comparison for River Balgy (time delineated surveys) 2022 - 2023.

3.2.5. River Torridon (Length/Frequency)

The survey results for juvenile salmon caught on the River Torridon in 2023 show a clear life stage difference between fry and parr (Figure 9). Salmon fry have a length frequency distribution between 45 mm and 65 mm and parr have a range between 85 mm and 120 mm. Whilst not corroborated via scale readings from individual fish, these results broadly align with catchment-specific classification of fry and parr for both salmon and trout, provided by the WRFT.

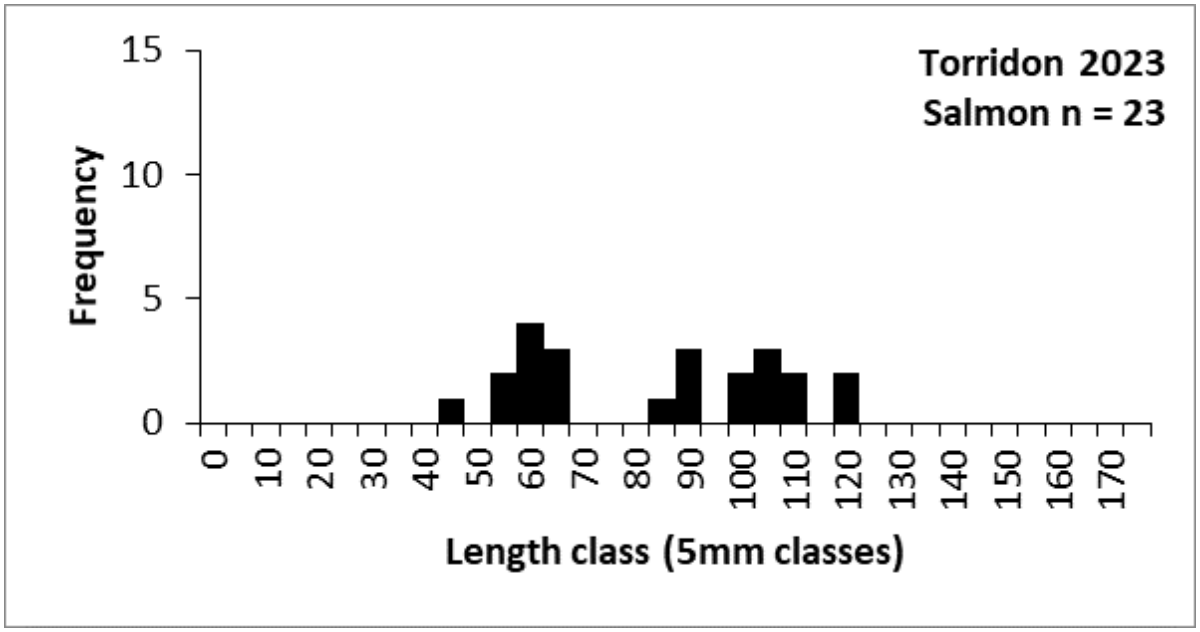

Figure 9: Length/Frequency data for juvenile salmon – River Torridon APEM surveys (2023)

The survey results for juvenile trout caught on the River Torridon 2023 show a clear life stage difference between fry and parr (Figure 10). Trout fry have a length frequency distribution between 50 mm and 75 mm and parr have a range between 105 mm and 140 mm. Whilst not corroborated via scale readings from individual fish, these results broadly align with catchment-specific classification of fry and parr for both salmon and trout, provided by the WRFT.

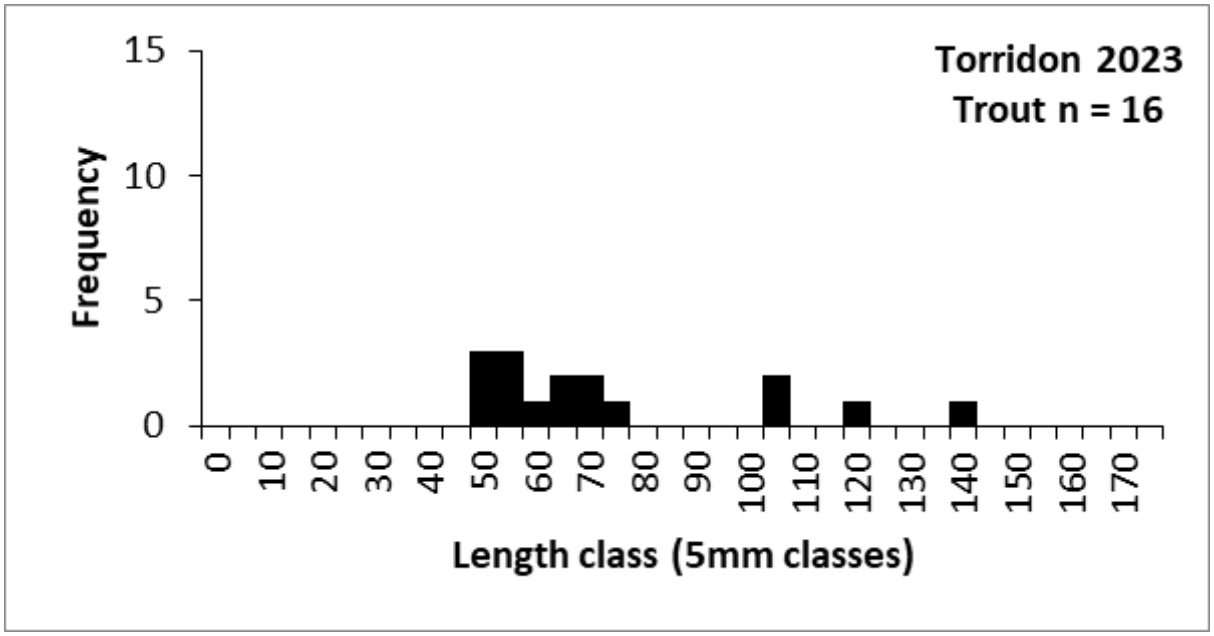

Figure 10: Length/Frequency data for juvenile trout - River Torridon APEM surveys 2023

3.2.6. River Balgy (Length/Frequency)

The survey results for juvenile salmon caught on the River Balgy in 2023 show no clear separation of year class between 0+ fry and 1+ parr between 60 and 100 mm in length (Figure 11). Whilst not corroborated via scale readings from individual fish, catchment-specific classification of fry and parr for both salmon and trout, provided by the WRFT, would indicate that the division between year classes for salmon fry and parr on the Balgy is at approximately <80mm for fry and >80 mm for parr (Figure 12).

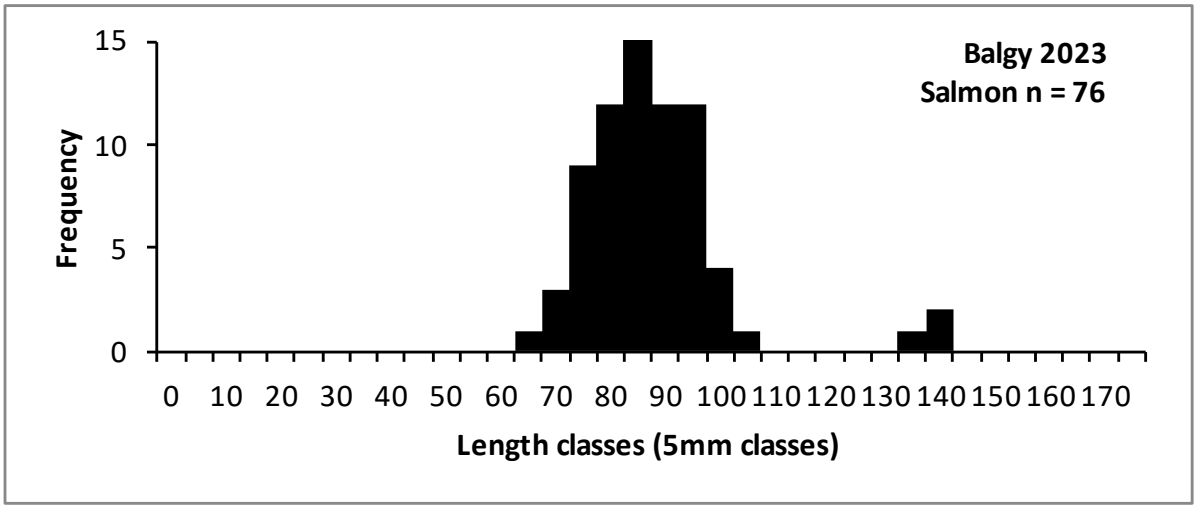

Figure 11: Length/Frequency data for juvenile salmon – River Balgy APEM surveys (2023)

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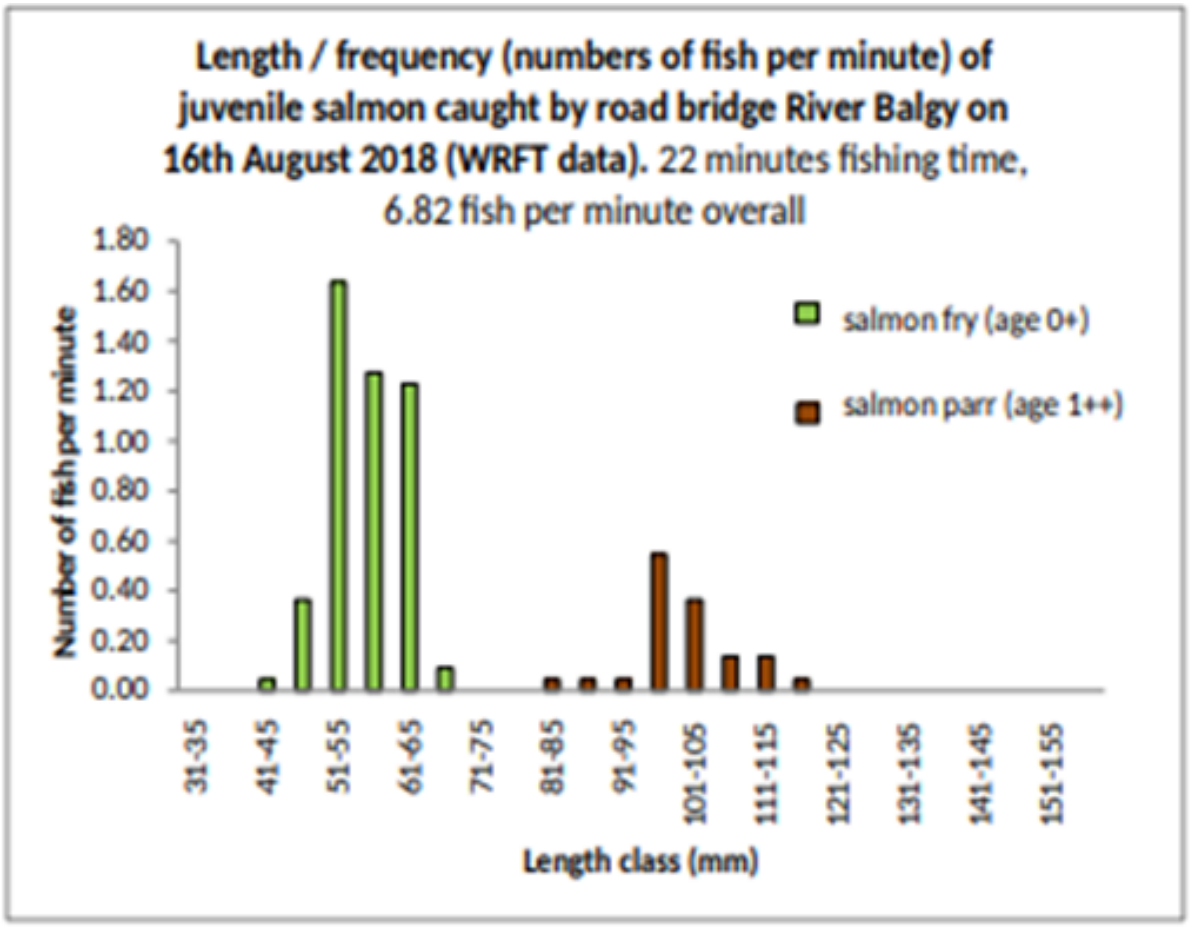

Figure 12: Length/Frequency (numbers of fish per minute) of juvenile salmon caught by the road bridge River Balgy on 16th August 2018 – WRFT Data. 22 minutes fishing time, 6.82 fish per minute overall

The clearest examples of salmon parr from the Balgy were from three individual fish, whose sizes ranged from 135 mm to 140 mm, with an example of one of these fish shown in Figure 13. One individual fish, captured at site C on the Balgy and measuring 154 mm, was indicative of a smolt (Figure 14). As such, this fish was excluded from the CPUE and densities data pertaining to fry and parr.

Figure 13: Salmon parr (135mm) – River Balgy APEM surveys (2023)

Figure 14: Salmon smolt (154mm) – River Balgy APEM surveys (2023)

The survey results for juvenile trout caught on the River Balgy in 2023 show no clear separation of year class between 0+ fry and 1+ parr between 70 and 100 mm in length (Figure 15). Whilst not corroborated via scale readings from individual fish, catchment-specific classification of fry and parr for both salmon and trout, provided by the WRFT, would indicate that the division between year classes for trout fry and parr on the Balgy comes at approximately <80 mm for fry and >80 mm for parr (pers comms, Peter Cunningham (WRFT) 2023).

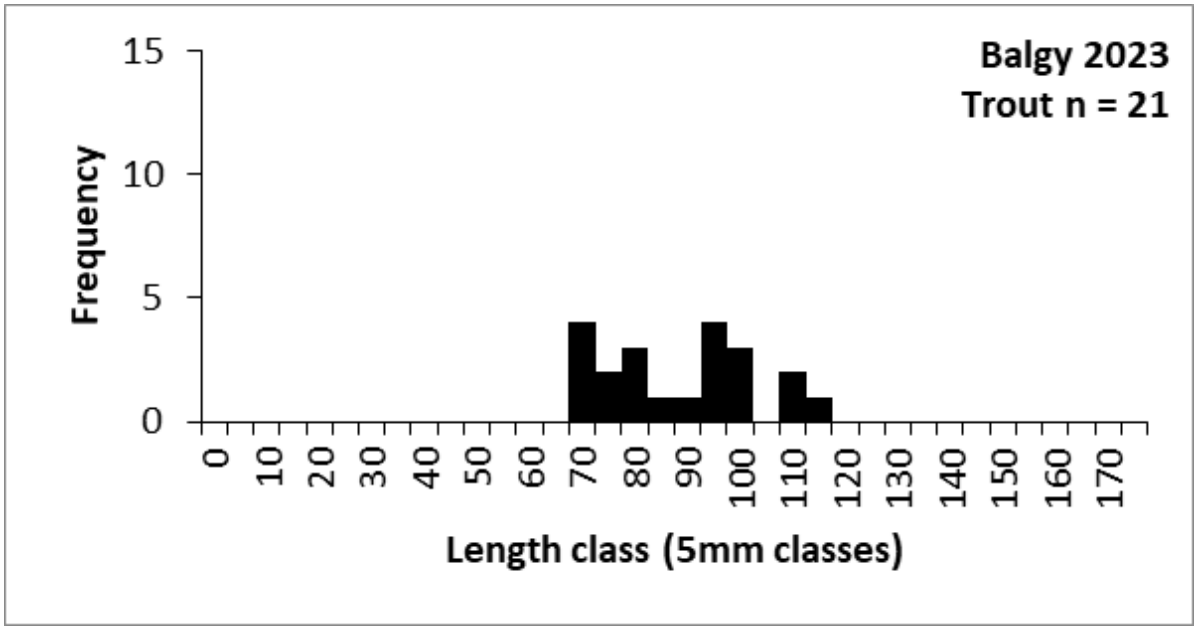

Figure 15: Length/Frequency data for juvenile trout - River Balgy APEM surveys 2023

4. Discussion and Recommendations

4.1. Sea Lice Monitoring Discussion

The foreshore at Torridon is a very open, flat beach with little by way of feature or suitable resting habitat for holding migratory salmonids over periods of low water. However, locations of total captures to date have indicated that the target species are more prevalent at the southern end of the foreshore. Limited points of discussion can be raised from a return of one individual sea trout across the three days of seine netting completed as part of the 2023 monitoring programme. The one fish captured was an adult sea trout, as opposed to a post smolt (which comprised the vast majority of the fish captured in the 2022 surveys) and was clear of sea lice, with no visible signs of prior lice damage.

By comparison, the 2022 surveys returned a total of 27 sea trout captures across the three days, 25 of these fish were recorded as post smolts, which would have been in the marine environment for a very short time and would (in all probability) have had limited exposure to possible parasitisation by sea lice. However, with only three adult sea trout recorded in total for the 2022 and 2023 surveys, across six total days of netting, it is suggested that an

adaptation to the monitoring strategy for this work might be beneficial and is discussed further in Section 4.2.

4.2. Sea Lice Future Monitoring Recommendations

Continuation of the monitoring of wild salmonids in the marine environment is recommended for 2024, to attempt to provide greater context to the existing data set and develop some understanding of any trends in the numbers of the sea lice present upon wild salmonids in Loch Torridon.

It is suggested that, given the results to date and specifically the limited captures of adult sea trout, the provision of a larger data set would benefit from a more concentrated and elongated effort than the current schedule of 1-day surveys permits. Other similar projects deliveries, conducted by APEM, are facilitated by several days of seine netting running concurrently, to help offset the natural variance in presence of migratory fish numbers at an individual location. Whilst there is no guarantees of the presence of wild fish on any given day, continual effort of this nature certainly increases the probability of improved results.

It is also recommended that the potential to expand the current survey area, to at least assess the functionality of alternative survey sites, particularly around the mouth of the Balgy, be considered. A viable alternative survey site to the Torridon foreshore, particularly one within such close proximity to the aquaculture facilities in Loch Torridon, would have the potential to provide pertinent data, as well as increase survey options to the netting programme.

4.3. Electrofishing Monitoring Discussion

In August 2023, APEM fisheries scientists were able to successfully complete 10 time-delineated electrofishing surveys, split evenly between the rivers Balgy and Torridon, to complete year two of the monitoring surveys of these watercourses, in line with MOWI and Bakkafrost's obligations under their respective EMPs. The aim of these surveys was primarily to provide an initial comparison with the 2022 (year one) baseline data and start to build a longer term data set for analysis of trends in juvenile salmonid populations within the catchment.

Survey conditions in 2023 were much improved on those in which the baseline data was gathered in 2022. The 2022 surveys had seen both rivers (Torridon and Balgy) in high (albeit still surveyable) flow states. Water levels in both rivers were broadly much lower than previously endured in 2023, and this allowed for working conditions which permitted optimal movement of field staff within the watercourses and excellent visibility through the water.

Results of time delineated surveys such as those conducted on the Torridon and Balgy in 2022 and 2023 are most accurately and comparably reported as catch per unit effort, as has been provided within this document. With the time of the survey (in these cases, six minutes) being the common denominator across all sites annually, repetition of these surveys and reporting of average fish per minute effort provides the most accurate indication of trends in juvenile salmonid populations on a site by site basis. It is also noted that additional historic data for the catchment, gathered by the WRFT (Figure 10) is similarly reported in this way, and therefore reporting of CPUE will only serve to provide additional context to any historic data the trust holds.

Population density estimates (fish/100m^2) have also been provided within the results section of this report. Whilst still a valuable long-term metric for analysing trends in population abundance, their short-term value is limited due to their vulnerability to variance caused by changes in survey conditions. The 2023 electrofishing surveys, unlike those of 2022, benefitted from almost perfect survey conditions, with low water and associated reduced flow rate. As a consequence, the survey team was able to cover a significantly increased area of the watercourse, within the allotted 6-minute survey time period. Despite an overall increase in the number of salmonids caught in these favourable conditions, population density estimate calculations for salmon fry and parr in particular, are broadly less in 2023 compared to 2022 results. The overall increase in trout fry and parr catches recorded in 2023, against very low baseline numbers recorded in 2022, have seen density estimates increase on the majority of sites in 2023.

In both rivers, fish numbers for both salmon fry and parr were higher within the downstream sites. With regard to fish numbers recorded from the Balgy, it is considered that higher presence of oxygenated riffle habitat suitable for juveniles at sites A and B has been a

significant contributor to the observation of higher numbers of juveniles present within these sites. Similarly for the Torridon, increased presence of riffle habitat in the downstream sites (L and M) as well as greater bankside vegetation cover (M) is likely to have contributed to the suitability of these sites to hold greater numbers of juveniles.

Data provided to APEM by the WRFT, detailing their assessment of catchment-specific classifications of fry and parr sizes for both salmon and trout, has been utilised to provide as much clarity as possible to the population strengths of each year class recorded in 2023. Where differences between specific year classes were not completely obvious, as seen in the results for juvenile salmon and trout on the Balgy for example, recommendations to assist in providing greater clarity to these distinct classes is provided within Section 4.4 below.

4.4. Electrofishing Monitoring Recommendations

It is recommended that electrofishing surveys are continued through 2024, to add additional robustness to the baseline data set, with additional years thereafter for continued impact assessment, while local aquaculture practices remain operational.

Section 4.3 of this report highlights that the current monitoring strategy would benefit from provision of additional clarity with regard to the identification of fry and parr within the fish populations surveyed. APEM have been in consistent dialogue with representatives of the Marine Directorate (Scottish Government) freshwater fisheries laboratories at Shieldaig regarding our works on the Torridon and Balgy during 2023. It is proposed that APEM tie in surveys in the area for 2024 to coincide with availability of laboratory staff to join us on site, to permit them to take scale and genetic samples from fish captured and assist in provision of these desired classifications and better understanding of the population densities required as part of this monitoring programme.

5. References

Godfrey, J. D. 2006. Site condition monitoring of Atlantic salmon SACs. Commissioned report to Scottish Natural Heritage, December 2006. Scottish Fisheries Co-ordination Centre, Pitlochry.

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