
Millenium East Wind Farm

Environmental Impact Assessment (EIA) Report

Appendix 6.5: Fish Population Survey and Freshwater Pearl Mussel Survey



Millenium East Wind Farm Fish Population Survey and Freshwater Pearl Mussel Survey



Ness District Salmon Fishery Board

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Millenium Wind Farm Fish Population and Freshwater Pearl Mussel Surveys

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Millenium Wind Farm Fish Population and Freshwater Pearl Mussel Surveys

Introduction

Ness District Salmon Fishery Board was commissioned to carry out Fish population surveys and Freshwater Pearl Mussel surveys on behalf of Avian Ecology with regard to the proposed Millennium East Wind Farm to the west of Fort Augustus. There was a requirement to collect information on fish populations locally along with Freshwater pearl mussel populations, particularly in relation to watercourses draining the Site with connectivity to the River Moriston SAC, and for the River Moriston SAC itself.

The SAC is located to the north of the proposed development site and is protected for salmon and freshwater pearl mussel. A map of the site area and boundary is shown below in **Figure 1**.

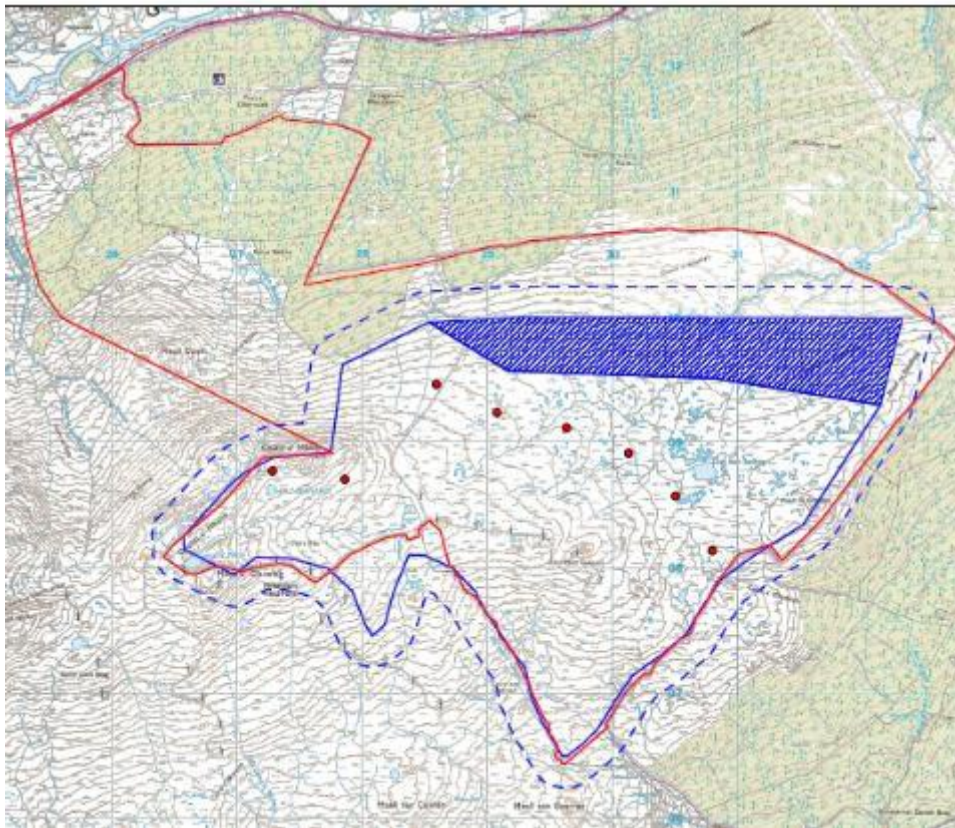


Figure 1 Map showing proposed development area and site boundaries.

A total of four fish population surveys were carried out in the summer of 2024 on three watercourses.

These sites are listed below:

- Allt Phocaichain x 2
- River Moriston
- Allt Lundie

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A map showing the location of these sites is shown below in **Figure 2**.

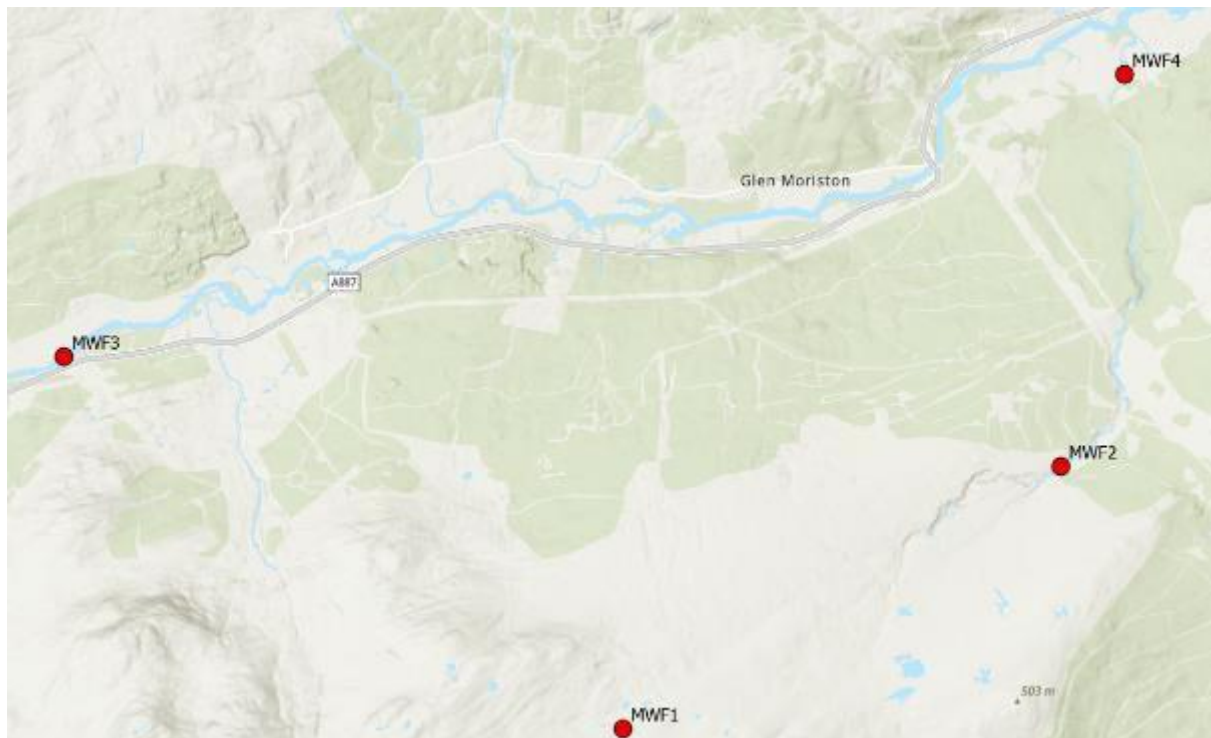


Figure 2 Map showing Fish population survey locations

In addition, three freshwater pearl mussel surveys were carried out on the River Moriston directly downstream of the tributaries Allt Phocaichain and Allt an Eoin. These locations are shown in **Figure 3**.



Figure 3 Location of Freshwater pear mussel transects (Left Allt an Eoin, Right Allt Phocaichain)

A number of spot checks were carried in the immediate areas out with the 50m transect lengths.

Key Species of Interest

Atlantic Salmon *Salmo salar*

Atlantic salmon in the UK are now listed as “Endangered” by the IUCN (IUCN, 2024) and are listed in Appendix III of the Bern Convention and Annex II and V of the EC Habitats & Species Directive (OSPAR Convention, 2010). The multi-sea-winter component of the Atlantic salmon population is included in the UK Biodiversity Action Plan (UKBAP) Priority Species List (UKBAP, 2007). While the River Ness itself is not a statutory designated site, the River Moriston is designated as a Special Area of Conservation (SAC) due to its importance for Atlantic salmon and Freshwater pearl mussels (*Margaritifera margaritifera*) (NatureScot Sitelink).

Brown Trout *Salmo trutta*

Brown trout are a UKBAP species and therefore deemed to be of national importance (UKBAP, 2007a). Sea trout are the sea-running form of the brown trout. Neither form of trout receives extensive protection within conservation legislation. Some protection in terms of exploitation controls exist within fisheries legislation and sea trout are further protected within Scottish fisheries acts relating to the protection of 'salmon.

European Eel *Anguilla anguilla*

The European eel is listed as ‘critically endangered’ on the International Union for Conservation of Nature (IUCN) Red List (IUCN, a.). A widespread decline has led the European Commission to develop an Eel Recovery Plan (Council Regulation No 1100/2007). This aims to return European eel stocks to sustainable levels. Each Member State is required to establish national Eel Management Plans, with an Eel Management Plan for Scotland developed by Marine Scotland Science in 2008 (Scottish Government, 2008). The European eel was also added to the UKBAP Priority Species List in 2007 (UKBAP, 2007).

Lamprey Species

There are three lamprey species present in UK; brook lamprey (*Lampetra planeri*), river lamprey (*Lampetra fluviatilis*) and sea lamprey (*Petromyzon marinus*). All three species are afforded protection within conservation legislation:

- Brook Lamprey Annex II of the EU Habitats Directive Appendix III of the Bern Convention;
- River Lamprey Annexes II and V of the EU Habitats Directive Appendix III of the Bern Convention and are on the UKBAP Priority List; and
- Sea Lamprey Annex II of the EU Habitats Directive Appendix III of the Bern Convention and are on the UKBAP Priority List.

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Freshwater Pearl Mussel *Margaritifera margaritifera*

The Freshwater pearl mussel in Europe are now listed as “Critically Endangered” by the IUCN (IUCN, 2024). *Margaritifera margaritifera* is an Annex II species and is the primary reason for the selection of the River Moriston as an SAC (JNCC, 2007 b).

Non-Technical Summary

- A total of four fish population surveys were carried out in the Summer of 2024. These sites were located on the River Moriston (MWF3), Allt Lundie (MWF1) and Allt Phocaichain (MWF2 and MWF4).
- Juvenile salmon were recorded at the lower site on Allt Phocaichain and on The River Moriston.
- Trout were recorded at all sites except Allt Lundie where all species were recorded as absent.
- No other relevant species were recorded.
- Salmon Densities at MWF3 were classified as ‘Excellent’ for both fry 0+ and parr 1++
- Salmon densities at MWF4 were classified as ‘Moderate’ and ‘Low’ for fry 0+ and parr 1++ respectively.
- Both sites are important spawning and juvenile nursery areas for salmon.
- Trout were present in much lower densities for both fry 0+ and parr 1++ at all sites where recorded.
- The highest densities of trout were recorded at MWF2. These densities were classified as ‘Low’ for both fry 0+ and parr 1++. This site and the immediate area acts as an important spawning and nursery area for trout.
- A total of three Freshwater pearl mussel surveys were carried out at two locations on the River Moriston, along with additional searches within the local area and also juvenile searches.
- Although no pearl mussels were observed it is likely that the species is present within this locale.

A precautionary approach should be adopted with regard to any developments within these catchments. Any works should be carried out with the recognised spawning, incubation and hatching times.

All works should ensure that suitable mitigation is in place to reduce sediment input which is likely to smother spawning gravels and areas containing Freshwater Pearl Mussels.

Methodology

Electrofishing protocol

Fishing with electricity is the most common method employed to survey a river dwelling fish species. Back-pack electro-fishing equipment was utilized during these electro-fishing surveys. Semi quantitative surveys and the time Delineated survey and were carried out and recorded in accordance with the protocols established by the Scottish Fisheries Co-ordination Centre (<https://fms.scot/sfcc/>).

Area delineated – Semi quantitative surveys

During each survey, where possible areas of river/burn (approximately 50-100m²) were identified. The area was fished through in a methodical and thorough manner with fish being retained in buckets. Captured fish were lightly anaesthetized in order to facilitate accurate length measurements (mm) and species identification. Scale samples were taken when required. The sites were fished through once only and densities recorded as a minimum density estimate – number of fish per 100m² Instream habitat of each site was also recorded

All fish were lightly anaesthetised using a solution of MS222, species identified and a length measurement taken. Instream habitat was also recorded.

Data Analysis

Area Delineated surveys were classified under the SFCC Moray Firth region and corrected for stream width (Godfrey, 2005).

Table 1: SFCC Moray Firth Region salmon and trout densities, corrected for stream width.

	Salmon fry density/100m ²				Salmon parr density/100m ²			
Width Class	< 4m	4-6m	6-9m	>9m	< 4m	4-6m	6-9m	>9m
A - Excellent	86.8+	77.3+	40.4+	32.3+	30.9+	25.3+	22.8+	16.0+
B - Good	<86.8 - 35.8	<77.3 - 42.6	<40.4 - 26.8	<32.3 - 15.1	<30.9 - 18.9	<25.3 - 18.4	<22.8 - 12.4	<16.0 - 12.1
C - Moderate	<35.8 - 22.6	<42.6 - 27.5	<26.8 - 18.7	<15.1 - 9.9	<18.9 - 11.7	<18.4 - 10.8	<12.4 - 9.2	<12.1 - 6.7
D - Low	<22.6 - 8.6	<27.5 - 7.7	<18.7 - 11.2	<9.9 - 4.0	<11.7 - 5.3	<10.8 - 3.7	<9.2 - 4.9	<6.7 - 3.0
E - Very Low	<8.6 - 1.5	<7.7 - 1.0	<11.2 - 0.7	<4.0 - 0.9	<5.3 - 1.2	<3.7 - 1.0	<4.9 - 0.7	<3.0 - 0.9
Absent	0.0	0.0	0.0	0.0	0	0	0	0
	Trout fry density/100m ²				Trout parr density/100m ²			
Width Class	< 4m	4-6m	6-9m	>9m	< 4m	4-6m	6-9m	>9m
A - Excellent	39.0+	26.4+	9.3+	5.4+	18.1+	13.3+	6.1+	2.7+
B - Good	<39.0 - 21.0	<26.4 - 10.4	<9.3 - 6.0	<5.4 - 3.3	<18.1 - 13.7	<13.3 - 7.2	<6.1 - 4.0	<2.7 - 1.9
C - Moderate	<21.0 - 14.3	<10.4 - 7.0	<6.0 - 4.5	<3.3 - 1.6	<13.7 - 9.1	<7.2 - 5.2	<4.0 - 2.3	<1.9 - 1.7
D - Low	<14.3 - 5.9	<7.0 - 2.9	<4.5 - 3.1	<1.6 - 1.2	<9.1 - 3.9	<5.2 - 2.3	<2.3 - 1.3	<1.7 - 1.0
E - Very Low	<5.9 - 1.1	<2.9 - 0.5	<3.1 - 0.8	<1.2 - 0.3	<3.9 - 1.4	<2.3 - 1.0	<1.3 - 0.6	<1.0 - 0.6
Absent	0.0	0.0	0.0	0.0	0	0	0	0

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Allt Phocaichain

Site Code MWF2



Figure 4 MWF2 Site Photograph

An area of 97.2m² was surveyed at grid reference **231967 – 810443**. The site was located in the upper reaches of the catchment approximately 3km upstream of a series of impassable waterfalls.

Habitat within the site was predominantly boulder and cobble with bedrock also present along with small pockets of pebble. The main flow type was run with small areas of riffle and glide. Depths varied throughout the site with a range of 11cm – 40cm occurring for the majority of its length.

Atlantic salmon were recorded as absent with no fry or parr captured during the survey. This was as expected due to the aforementioned falls lower down the system. A total of six trout fry (0+) and four trout parr (1++) were recorded.

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The presence of trout fry indicates that some spawning had occurred within the vicinity. The minimum density estimate for trout fry was 6.17/100m². This density generated a classification of 'Low' according to the SFCC classification scheme. Again, this was as expected due to the locale and habitat found therein with limited 'smaller' substrate available for spawning. The average length of fry was 70mm.

The minimum density estimate for trout parr was 4.11/100m² and can be classified as 'Low' under the SFCC classification scheme. The average length of parr was 124mm. A length frequency histogram for trout captured at MWF2 is shown below in **Figure 5**.

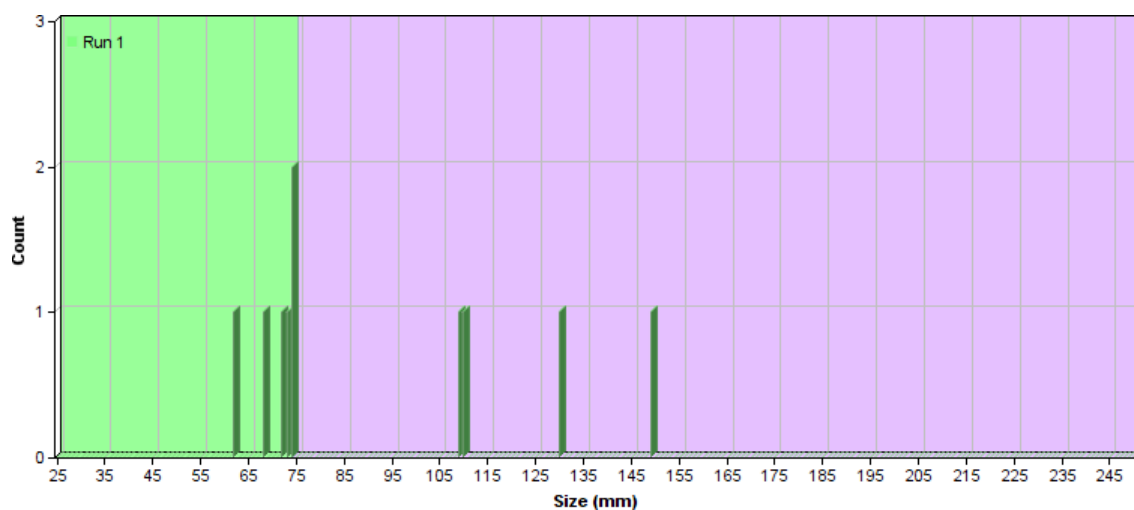


Figure 5 Trout length frequency histogram for Site MWF2

It is likely that three separate year classes were observed during this survey, 0+ (fry) 1+(parr) and 2+ (parr). These densities and year classes are as expected and are typical of upland rivers and streams. It is also important to note that trout captured above impassable waterfalls are likely to be genetically distinct from trout found below these obstacles.

Only one previous electrofishing survey had been carried out in this area of the Allt Phocaichain. A single run survey was completed in September 2012 when a single trout parr was recorded. This site was approximately 500m downstream of the site carried out for the present survey. The 2024 survey recorded the presence of a healthy trout population. This is unusual for upland burns in the Ness catchment, where trout are often absent or present in very low densities, primarily due to access issues but also drying out during drought conditions.

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Figure 6: A selection of trout parr from MWF2.

No other fish species were recorded at this site

Site Code MWF4



Figure 7: MWF4 Site photograph

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An area of 126.7m² was surveyed at grid reference **232492 – 813684**. The site was located in the lower reaches of the catchment downstream of a series of impassable waterfalls and approximately 20m from its confluence with the River Moriston.

Habitat within the site was predominantly pebble and cobble with boulder also present along with small pockets of gravel. The main flow type was run with areas of riffle and glide. This was a relatively shallow site with depths of 11cm – 30cm for the majority of its length. The stream was well shaded with a range of deciduous trees.

A total of 35 salmon fry (0+) were captured generating a minimum density estimate of 27.63/100m². This density can be classified as 'Moderate' under the SFCC classification scheme. The presence of salmon fry indicates that spawning had taken place in the vicinity and suggests the importance of this tributary as a potentially significant spawning stream for salmon given that similar streams are few within the Moriston catchment. The average length for salmon fry was 47mm.

A total of three salmon parr (1++) were captured generating a minimum density estimate of 2.3/100m² and can be classified as 'Low' according to the SFCC classification scheme. This was as expected due to the instream habitat being much more suited to fry with small substrates, shallow depths and gentler flows. The average length for parr was 89mm. A length frequency histogram for salmon is shown below in **Figure 8**. It is likely that three-year classes of salmon were present 0+ (fry) 1+ (one year old parr) and 2+ (two-year-old parr).

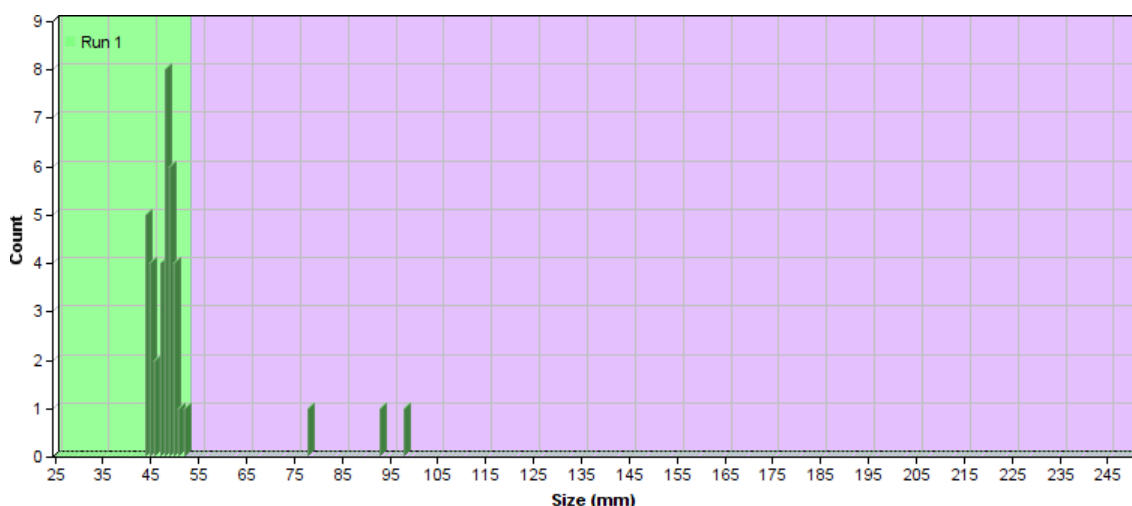


Figure 8: Length frequency histogram for juvenile salmon at MWF4

A total of five trout fry (0+) were captured generating a minimum density estimate of 3.95/100m² and can be classified as 'Low' under the SFCC classification scheme. Although densities are low it is clear

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that this area is also utilised by spawning trout, with smaller substrates being favourable. A single trout parr was captured giving a minimum density estimate of 0.8/100m² generating a classification of 'Very Low'. Average fry (0+) length was 54mm and parr (1++) was 140mm. In addition, a total of two minnows were captured. Minnows are thought to be non-native to the highlands and it is thought they have been introduced by anglers as bait. No other fish species were recorded.

Site MWF4 has been surveyed in the past, although not since 2011. The results from the previous surveys are shown below in Table 2. Salmon have been present during each survey, although fry were absent in 2008/09. The salmon fry density recorded in 2024 was the highest in the series. Salmon parr densities have been variable in the very low to moderate range, with the 2024 density the lowest in the series. Trout fry densities have declined since 2010.

Table 2: Electrofishing site history at Site MWF4, lower Allt Phocaichain. Results expressed as single-run density per 100m². Classification and colour coding in accordance with Table 1.

Date	Sal fry	Sal parr	Tr fry	Tr parr
29/07/2007	1.0	8.0	2.0	1.0
08/08/2008	0.0	3.5	7.0	0.0
23/07/2009	0.0	7.3	18.6	0.0
01/09/2010	16.5	9.3	26.8	0.0
05/07/2011	1.6	6.5	4.0	1.6
10/09/2024	27.6	2.3	4.0	0.8

The area from the Allt Phocaichain confluence, up to the impassable waterfalls, extends for approximately 1km and offers excellent juvenile salmonid habitat with areas of spawning and nursery habitat for both salmon and trout. This should be taken into consideration with regard to any developments. The area above the waterfalls offers excellent habitat also. However, salmon do not have access, but it provides important Brown trout habitat.

River Moriston

Site Code MWF3



Figure 9: MWF3 Site photograph

An area of 153m² was surveyed in the middle channel of a braided section on the River Moriston at grid reference **223708-811343**. This site is within an area that is affected by variable flows and heights due to hydro-electric operations. This area is a known, and important, spawning area for salmon.

Habitat within the site was mainly cobble and pebble providing an excellent spawning media whilst providing good instream cover for juveniles. The flows were predominantly run and riffle with some still marginal areas. Depths were fairly consistent with a range of 11cm-30cm.

A total of 176 salmon fry (0+) were captured generating a minimum density estimate of 115/100m². This density can be classified as 'Excellent' under the SFCC classification scheme. This indicates that the area is well utilised by adult spawners. This area of spawning habitat is important as spawning habitat is fragmented throughout the system due to loss of suitable gravels. Average salmon fry length was 50mm.

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A total of 17 salmon parr (1++) were captured generating a density of 11.1/100m² giving a 'Moderate' classification. This lower density reflects habitat suitability with substrates being more suited to fry. Average parr length was 95mm. It was noted that a number of parr captured here were mature males or 'precocious' the presence of milt confirmed this. These fish are an important component of breeding stock and are common in upland rivers and are a vital addition to the gene pool. They may act as 'natures safety net' in some cases where there is a lack of adult males.

A length frequency histogram for salmon captured at MWF3 is shown below in **Figure 10**.

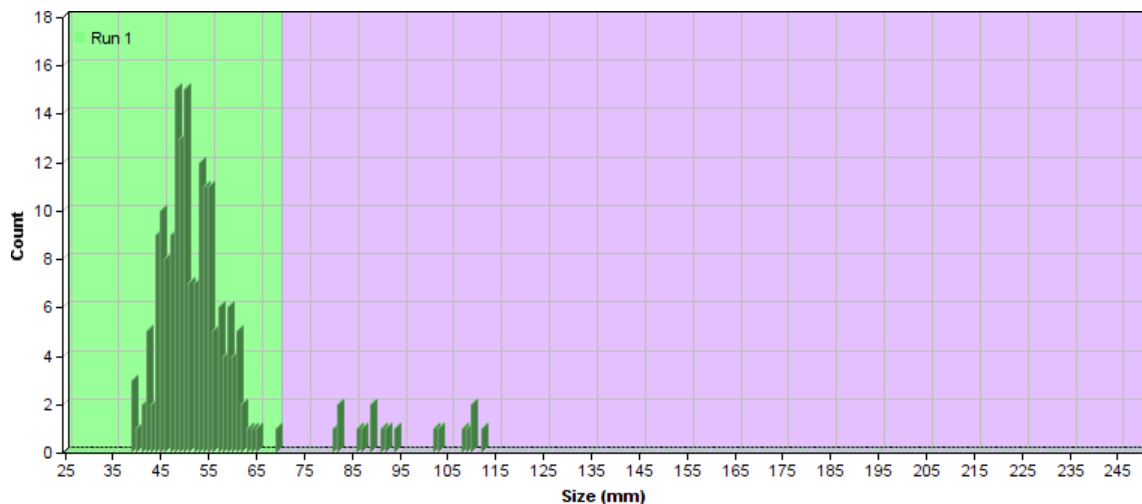


Figure 10: Length frequency histogram for salmon at MWF3

The size distribution indicates that three-year classes of salmon were present at this site. Fry (0+), one year old parr (1+) and two-year-old parr (1++). These older parr are likely to smolt next spring and migrate out to sea.

A single trout fry was captured measuring 73mm. Historical surveys suggest that this site is dominated by salmon with very few trout captured and this can be seen from the previous results shown in Table 3. Mainstem sites tend to be dominated by juvenile salmon with trout utilising the smaller tributaries to a greater extent.

Table 3: Electrofishing site history for Site MWF3. Results expressed as single-run density per 100m². Classification and colour coding in accordance with Table 1.

Date	SF	SP	TF	TP
30/07/2007	27.6	1.8	1.8	0.0
26/08/2011	70.8	19.5	1.6	0.0
21/09/2022	90.0	9.4	0.0	0.0
20/09/2024	115.0	11.1	0.7	0.0

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No other fish species were recorded at MWF3. It should be noted that the Ness DSFB have never recorded eels in any survey upstream of Dundreggan Dam. This is thought to be due to eel passage restrictions at Dundreggan Dam.

Allt Lundie

Site Code MWF1

Site MWF1 was located in the headwaters of Allt Lundie at grid reference **228337-808268**. This is a small upland burn that flows into Loch Lundie some 4.5km downstream. The outflow to the river Garry is the Aldernaig burn where historically salmon, trout and eels have been present in its lower reaches.

An area of 119.5m² was surveyed immediately downstream of a culvert where an access track crosses. Habitat within the site was good with regard to juvenile salmonids. The substrate was dominated by boulder and cobble with pockets of small pebble and gravel. Flows were mainly run, riffle and glide. Depths were fairly uniform with the main range being 11cm-30cm. A site photograph is shown below in **Figure 11**.



Figure 11: MWF1 Site Photograph

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All fish species were absent during this survey. The absence of fish is likely related to the steep gradients downstream, making the area inaccessible to salmonids, but many upland burns in the Ness catchment have been found to be fishless. Eels may access this area however none were captured. It was noted that the water temperature at time of survey was only 8°C which may account for this as eels tend to become dormant below 10°C. However, upland areas such as this are not ideal habitats for the species.

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Pearl mussels are present within the River Moriston, it is estimated that the population is circa 500,000 with 95% of the population found below Dundreggan dam. Survey results estimate that 40% of the population is composed of juveniles indicating that successful recruitment is taking place. This is the highest percentage recorded in any Scottish pearl mussel population.

The area above Dundreggan has a small population, however, anecdotal and historic evidence suggests that pearl mussels were abundant from the river's confluence with loch Ness up to Cluanie dam. The recent decline is due to illegal pearl fishing, habitat loss and a decline in salmon which are the main host species. NDSFB currently carry out artificial bankside encystment in this area in an attempt to reinstate populations.

Two sites were surveyed in the summer of 2024. Site one was located below the tributary Allt an Eoin and Site two was located directly below the tributary Allt Phocaichain.

Site One

Two 50mx1m transects were surveyed in area around the tributary's confluence. Habitat within the area was predominantly pebble and cobble with small gravels also present. Each transect started 1m out from the right bank and continued out to approximately 3m in a diagonal direction.

Each transect was then surveyed, in an upstream direction, using a glass bottomed bathyscope and all mussels observed were counted. A thorough search out with the transects was carried out in areas of suitable habitat and where depths allowed.

In addition, four random 1mx1m quadrat surveys were carried out. This involves placing a 1m² quadrat on the river bed. All visible mussels are counted and removed. Large stones are then removed and a search of the underlying substrate is made in order to identify any buried juvenile mussels.

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No mussels were found in any transect or quadrat at Site one. Despite this, a precautionary approach should be taken as mussels are likely to be present, in low density, in the immediate area and also upstream and downstream of the site.



Figure 12 Typical habitat at Site One



Figure 13 Staff carrying out Quadrat search

Site Two

A single 50mx1m transect survey was carried out on section of river directly below the Allt Phocaichain confluence. The location of the site was 1m out from the left bank and extended out to 3m in a diagonal direction. Habitat differed from Site One in that large areas of fine gravel/sand was present along with boulders. In addition, the transect contained a variety of instream vegetation. These areas were searched extensively where depth allowed.

Random searches were also carried out in the immediate vicinity where depths allowed. Two quadrat searches were implemented, however due to depth these were limited to the margins of the left bank.

No pearl mussels were found in all surveys and searches, however, as with Site One, it is likely that mussels are present within the vicinity and therefore a precautionary approach should be implemented.



Figure 14: Freshwater pearl mussel, Site Two photograph

Discussion and Recommendations

The key areas of interest with regard to any developments and potential impacts on salmon are the main River Moriston and the Allt Phocaichain, in particular the lower reaches below the waterfalls. Upstream of the falls there is a potential for impact on the resident trout population.

Allt Phocaichain

From the confluence up to the waterfalls, a distance of approximately 1km, the Allt Phocaichain offers excellent mixed juvenile salmonid habitat. It is clear from the survey that this is well utilised with both salmon fry and parr present. The lower density of parr observed in this survey is a reflection of the habitat within the site, however more suitable parr habitat along with good spawning areas make this an important stream with regard to salmon production given the paucity of good spawning tributaries within the River Moriston catchment.

The areas above the waterfall offer excellent spawning and mixed juvenile salmonid habitat, however this is limited to just trout due to the presence of the aforementioned waterfalls. Trout were present

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at the survey site albeit in relatively low densities, however this was to be expected due to the location. It is important to note that trout found above such waterfalls are likely to be a resident population and may be genetically distinct to those found below the waterfalls.

It is recommended that any developments within the vicinity and any works with regard to access tracks should account for these sensitive areas and should be carried out with the recommended spawning, incubation and emergence times.

In addition, the input of sediment and disturbance should be mitigated against. The input of fine sediments has the potential to smother and suffocate spawning areas which could impact juvenile recruitment within Allt Phocaichain, and potentially the River Moriston. It is recommended that suitable sediment/silt traps are in place before any works are carried out.

Should there be a requirement for culverts then these should be passable to any migrating species within the stream.

Allt Lundie

All fish species were absent from the survey carried out on Allt Lundie, however, as this stream feeds into Loch Lundie and subsequently Aldernaig burn (where salmon are known to be present), sediment management and pollution controls measures must be in place to mitigate potential harm on species present lower down in the catchment.

River Moriston

The River Moriston is a highly sensitive river, already highly impacted by hydro-electric operations with impacts on the habitats, and species found therein. The upper river is vital for the production of salmon with a number of important spawning and nursery habitats. Areas such as these are limited in the lower river due to loss of suitable spawning media. It is therefore, crucial that these areas are not impacted on further.

The river is an SAC for salmon and also freshwater pearl mussels and although the pearl mussel population is smaller in the upper river due to illegal poaching, habitat loss and a decline in the host species (salmon) it is crucial that both species are considered with regard to any developments taking place on adjoining tributaries.

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Salmon were present in 'Excellent' densities at the Moriston survey site, both fry and parr were observed in high numbers for the area surveyed. The site was representative of good juvenile habitat in the upper river. Similar surveys carried out by NDSFB staff in 2024 in other areas of good habitat found similar good salmon fry and parr densities.

No Freshwater Pearl Mussels were observed during the surveys carried out in 2024; however, it is known that there is a low-density population in upper river. Work is ongoing by NDSFB staff in an attempt to increase the population here through artificial bankside encystment and it is likely that juvenile mussels may be present throughout the upper river.

It is therefore recommended that any works in the upper catchment, including any tributaries, should be conducted to prevent the introduction of fine sediments, and pollution. These sediments have the potential to smother and suffocate freshwater pearl mussels. Additionally, any works should be carried out with the recommended spawning, incubation and emergence times thus minimising further disturbance.

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