Vale of Leven Wind Farm

Fish Survey Report

Technical Appendix 6.4

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Electro-fishing assessment of the salmonid fish assemblage in the Murroch Burn, West Dunbartonshire, Scotland. October 2022.

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Loch Lomond Fisheries Trust - on behalf of McArthur Green Ltd.

Contract No. 52364701

Summary

A semi-quantitative electro-fishing assessment of the salmonid fish assemblage in the Murroch Burn, West Dunbartonshire was carried out by the Loch Lomond Fisheries Trust (LLFT) in October 2022 on behalf of McArthur Green Ltd. The principal aims of this work were: (1) to ascertain if brown trout (*Salmo trutta*) and salmon (*Salmo salar*) were present in the burn; (2) record by-catch of non-target fish species; and (3) provide a brief overview and discussion of the structure of the salmonid fish populations. The Scottish Fisheries Coordination Centre (SFCC) protocol for 1-pass semi-quantitative electric fishing was used with the target species being brown trout and salmon. Electro-fishing surveys were conducted across a range of site characters (from source to mouth).

A total of seven sections were electro-fished, ranging from 152 m to 8 m elevation and the main findings were as follows:

- the survey showed that the burn contains populations of salmon and brown trout;
- brown trout were found in all fished sections whereas salmon were only found in three sections (41 m, 37 m and 8 m altitude);
- populations of salmon and brown trout have undergone recruitment in each of the last two years;
- where salmon was found, density was considerably less than what might be expected in ideal conditions;
- presence of potentially three (tentative) juvenile year classes attest to the position of the LLFT that this burn is an important spawning burn for salmonid fish;
- brown trout juvenile demography differed between fished sections showing, as expected that variation in habitat and meteorological processes impacting the utilisation of the burn by brown trout;
- the burn's spawning habitat is underutilised by salmon;
- there was a bycatch of European eel (*Anguilla anguilla*) in five of the seven sections;
- the lowest altitude section closest to the confluence with the river Leven also contained brook lamprey (*Lampetra planeri*) flounder (*Platichthys flesus)* and stickleback (*Gasterosterus aculeatus*).

These findings warrant further study and the LLFT will continue to monitor the salmonid assemblage in the Murroch Burn as part of routine electro-fishing. The LLFT are also undertaking riparian habitat improvement works on the Murroch Burn to help adult salmon reach the good quality spawning habitat the burn offers.

Contents

1. Aims of the contract work and this report

The Loch Lomond Fisheries Trust (hereafter LLFT) were contracted by McArthur Green to: (1) ascertain if brown trout (*Salmo trutta*) and salmon (*Salmo salar*) are present in the Murroch Burn, West Dunbartonshire, Scotland; (2) record by-catch of non-target fish species; and (3) provide a brief overview of the structure of the salmonid fish populations. The aim of this report is to present those data from the study and provide a brief discussion for context.

2. Introduction

The Murroch Burn (hereafter, MB) is located in West Dunbartonshire, Scotland and is a tributary of the River Leven (hereafter, RL) (see **Figure 1**). The source of the MB is in the Kilpatrick Hills above the town of Dumbarton. In its upper reaches the MB has an upland burn character (as shown in **Figure 2**) which is followed by a gorge character in its middle reaches. In its lower reaches the MB flows through agricultural and industrial land and has been artificially modified in recent history. The confluence of the MB with the RL is underneath the A82 road bridge (denoted in **Figure 1** (map) and shown in **Figure 2**). **Figure 2** (below) shows the physical and ecological characteristics of the MB in its intermediate reaches. The MB contains good salmonid spawning and juvenile habitat from the low-order narrow upland reaches to the lower reaches approaching its confluence with the RL; the LLFT have surveyed this burn in previous years and results from these surveys showed populations of salmon and brown trout to be present and recruiting.

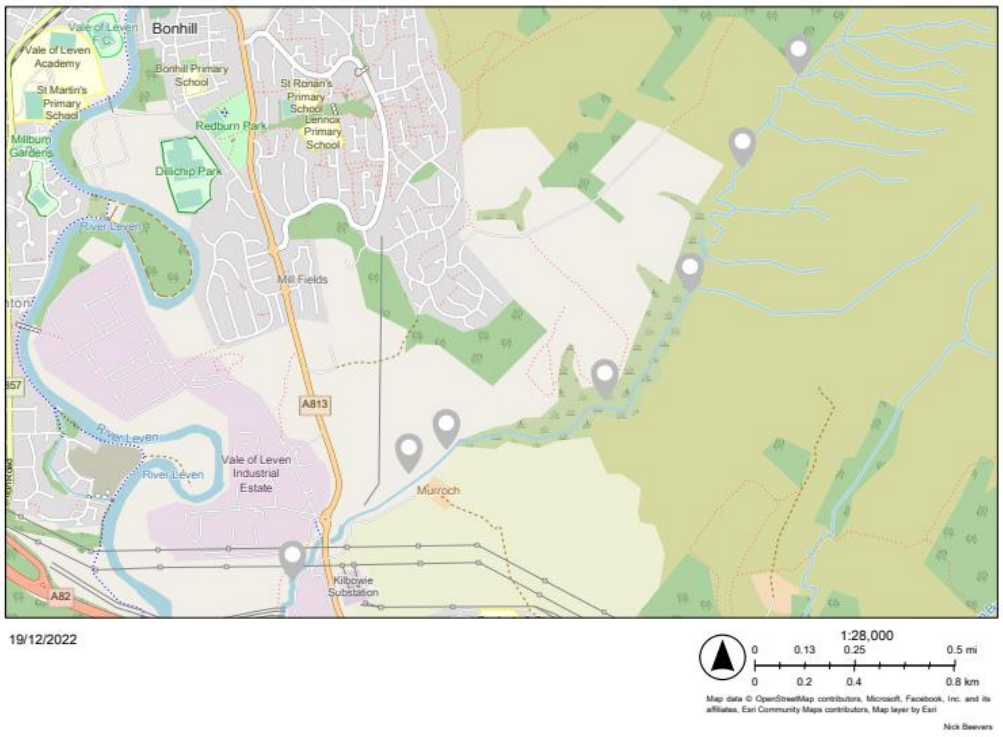

Figure 1. Map of the survey sites on the MB in this study. In total, 7 sites were fished from 8 m to 152 m elevation. The survey sites are presented as grey pins along the course of the MB; from right to left is west to east and water flow is upstream in this direction (see north arrow in key); sites increase in elevation from west to east; scale bar = 0.8km.

Materials and methods

The electro-fishing surveys were conducted in late October 2022 (see dates in **Table 1**) and survey sites were chosen to represent the different reaches of the MB as representatively as possible within the allotted time frame. Exact locations for electrofishing were selected by eye during walkover reconnaissance on the day of fishing. No site in this study has been fished by the LLFT previously. The target species were salmon and brown trout with expected (non-quantitative) bycatch recordings of European eel and other non-salmonid fish including, flounder and stickleback.

Figure 2. Plates 1 -8 showing (in sequence order) the seven sites on the MB electro-fished as part of this study and the confluence of the MB with the R (plate 8). Site 1 was at the highest altitude and had a distinct upland burn character. The middle reaches of the burn as shown in plates 3, 4 and 5 show the MB in its gorge character. Plates 1 -7 show the site from the bottom looking upstream; plate 8 is looking downstream from the A82 road bridge to the RL in the distance. Data for each site including altitude, geolocation and date fished are presented in Table 1.

A slight variation of the Scottish Fisheries Coordination Centre (SFCC) protocol for semi-quantitative electrofishing was used for this survey (SFCC, 2007). In brief - an approximately 10-minute timed survey was used in each of six sections of the MB, presented as a map in **Figure 1**, as pictures in **Figure 2**, and the site coordinates are presented in **Table 1**. A single electric fishing unit (E-fish 500W) was used on each section by a single operator, fished in an upstream direction, for 10 minutes active fishing time (not including stopping time for fish handling etc). All fish caught were netted, anaesthetised using an emulsion of clove oil and had their biometrics recorded (fork length, species; with the exception of European eel which were not anaesthetised); scale ageing was not undertaken. For each section fished, pH, temperature and conductivity of the stream water were measured using a hand probe (Hanna Instruments). Wet width and length of the fished sections were also recorded as well as altitude in metres which was taken from the OS MAP application (Ordnance Survey LTD) on a mobile phone. Riparian or in-stream habitat surveys were not undertaken.

Catch per unit effort (CPUE; fish caught per minute of fishing) and density (number per square metre) were calculated for salmon for each section they were caught; however, it should be noted that the methods used here only allow for a very approximate estimate of density as the study is not fully quantitative. Fish number and length data for salmon and brown trout were visualised using length-frequency histograms for the purposes of assigning tentative year

class cohorts according to standard methodologies. Empirical cumulative distribution function (ECDF) graphics were also used to compare the proportion of brown trout sizes in each section. No statistical analyses were undertaken.

Results

The MB contains populations of both brown trout and salmon. **Table 1** contains an overview of the data for each species in each section including the catch per unit effort and density data (CPUE) for salmon as well as species recorded as bycatch. The data for both brown trout and salmon show that spawning has successfully taken place in the MB as a whole for the last two and three years respectively (but this was not evident in every section - See **Figure 4**).

Brown trout were caught in all sections whereas salmon were only caught in sections one, two and three (the burns nearest to the confluence with the RL). A single salmon of 102 mm fork length was caught in section three. However, for the purposes of graphical clarity, this fish was excluded from exploration of the data in **Figure 3** and only those salmon caught in sections one and two are presented.

The salmon size data showed that individuals could be tentatively assigned (in the absence of scale age data) to two year classes (as shown in **Figure 3**): fry at between approximately 50 – 80 mm fork length; greater than approximately 80 mm fork length corresponded to one year old parr (1+). Therefore, in each of sections one and two there were two and three individuals in the 1+ cohort respectively. Salmon density estimates are presented in **Table 1**.

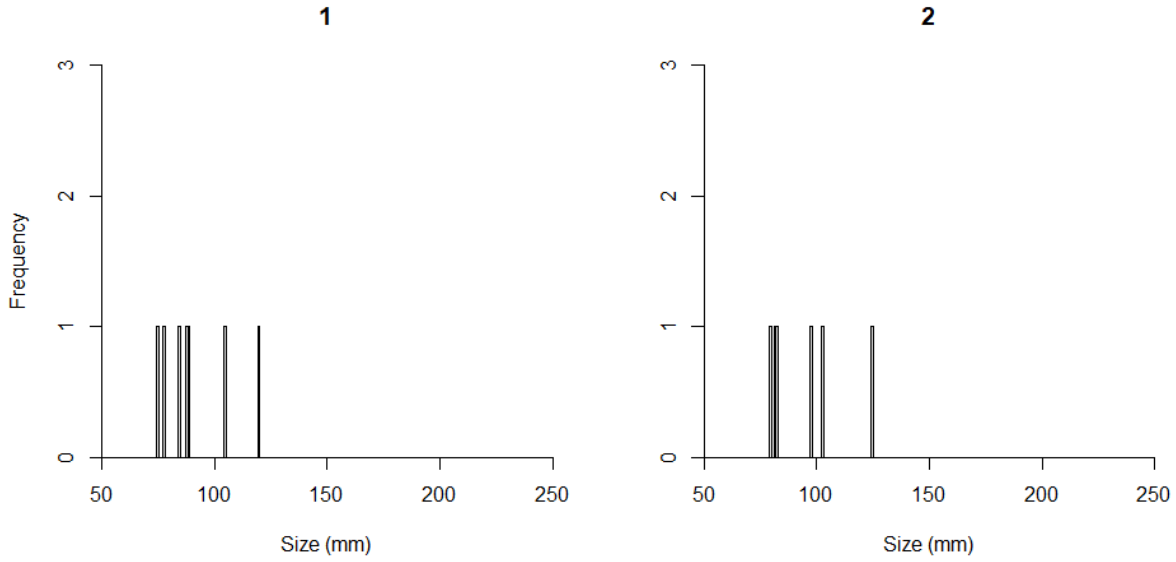

Figure 3. Length-frequency histograms for salmon length data from the Murroch Burn. Each plot header (1 & 2) corresponds to the fished section. Year class cohort allocation as follows: 0+ (fry) ~ 50 – 80 mm fork length; >80 mm fork length corresponded to >1 year. Both histograms share common axes.

Brown trout were much more numerous in the MB and were found in every section fished. Graphical analysis of the size data for brown trout (as shown in **Figure 4**) showed that individuals could be tentatively assigned to three classes as follows: young of year fry (0+) = approximately 50-100 mm; one year and older (1+) = approximately 100-125 mm and greater than 2 year old fish (2+) at greater than 125 mm (the 2+ age category will likely contain older fish than 2+ but it is outwith the feasibility of this study and the data collected to pursue further

cohort categorisation). As expected, the number of fish in each year class decreased with increasing age; notably, one brown trout was 350 mm in length (caught from section 4) but this fish was excluded from graphical exploration for the purposes of clarity.

Empirical cumulative frequency distribution (ECDF) comparison of length data for brown trout in individual fished sections (as presented in **Figure 5**) showed clear demographic differences between sections (i.e., numbers of fry and parr) and that these differences were most pronounced between sites 1, 5, 6 and 7 and sites 2, 3 and 4.

There was a bycatch of European eels in five of the seven sections and their sizes ranged from 95 to 350 mm (see **Table 1** below). The lowest altitude section closest to the confluence with the RL also contained flounder, brook lamprey and stickleback.

Table 1. Overview of the site and catch data for this study including: Site number (Site); Easting; Northing; Time Fished in minutes (Time (min.)); Altitude in metres (Altitude (M)); Site area in square metres (Site Area (sq. m)); Species caught in each section (Spec.); the number of *S. salar* caught per section (No. Sal); the catch per unit effort of *S. salar* per section each minute fished (Sal. CPUE); the density of *S. salar* per square metre in each section (Sal. Den.). For the species caught in each section (headed as Spec). - the following applies: s= *S. salar*; t = *S. trutta*; e = *A. anguilla*; l = *L. planeri*; fl = *P. flesus*; sb = *G. aculeatus*.

Site	Easting	Northing	Time (min.)	Altitude (M)	Site Area (sq. M)	Spec.	No. Sal	Sal. CPUE	Sal. Den.
1	239935	677248	11.1	8	127	s; t; e; l; fl; sb	7	0.63	0.06
2	240413	677668	10.12	37	129.86	s; t; e	14	1.38	0.11
3	240572	677761	11.1	41	115.52	s; t; e	1	0.09	0.01
4	241239	677934	10	74	181.24	t		0	0
5	241565	678362	10	86	N/A	t; e		0	0
6	241796	678872	10.21	119	133.3	t		0	0
7	242036	679223	10	152	125	t; e		0	0

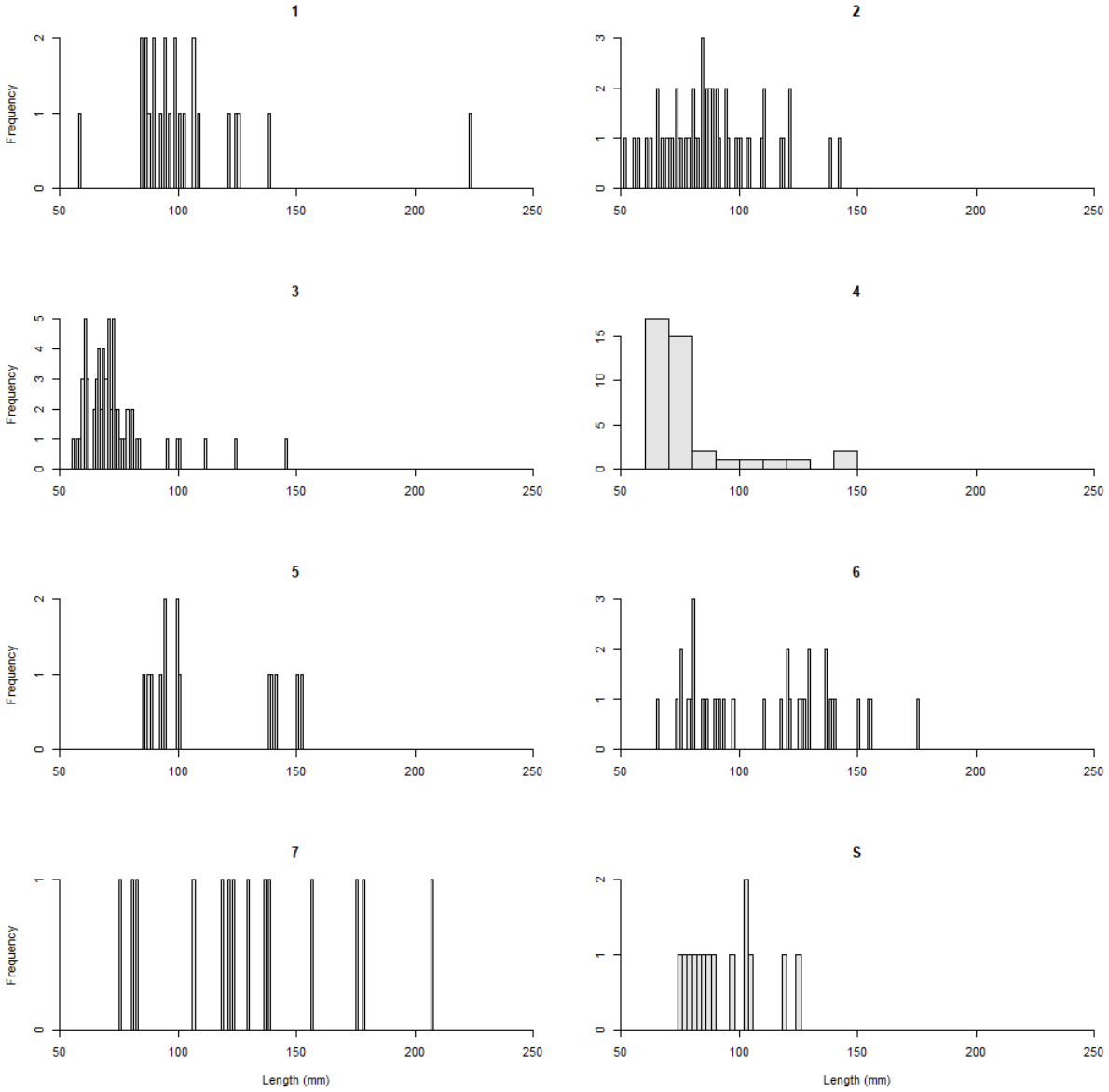

Figure 4. Length-frequency histograms for *S. trutta* caught in sections 1 - 7 (header corresponds to the fished section) from the Murroch Burn; the pooled *S. salar* data (bottom right, headed S which excludes the single salmon excluded from Figure 3) are included for comparison. The sections contain graphically derived tentative cohorts as follows: 1: 0+, 1+ and 2 +; 2: 0 +, 1+ and 2+; 3: 0+, 1+ and 2+;4: 0+, 1+ and 2+; 5: 0+ and 2+; 6: 0+, 1+ and 2+; 7: 0+, 1+ and 2+. Note that all histograms share a common X-axis scale but the Y-axis is allowed to vary for each plot for the purposes of resolution.

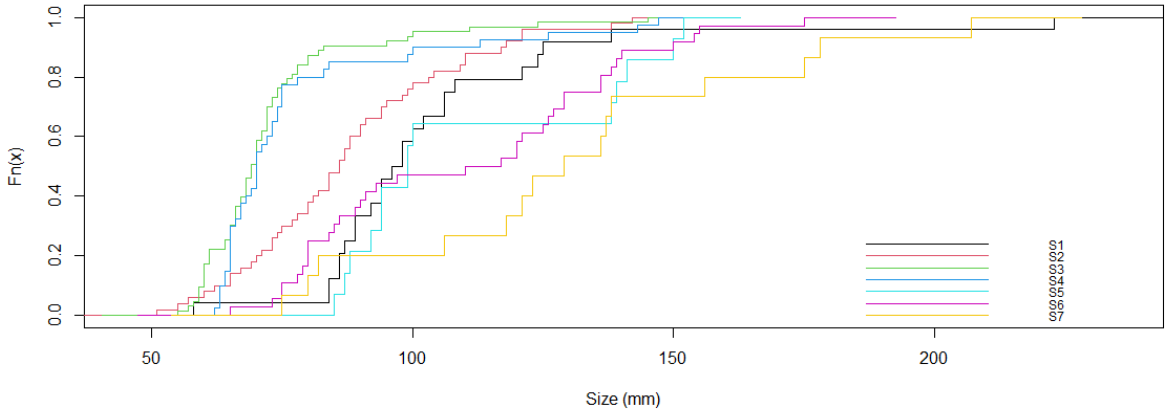

Figure 5. Empirical cumulative distribution function (ECDF) plot for *S. trutta* caught from the MB in this study. The proportion (Fn(x)) of fish is shown on the y axis and the size of the fish contributing each proportion can be seen on the x axis. Each site has a colour allocation as presented in the key in the bottom right. For example, site 7 (assigned colour yellow) contains relatively few *S. trutta* less than 100 mm (20%) compared to site 3 (assigned green colour) whereby nearly all the *S. trutta* fall below 100 mm.

Discussion & Conclusions

The LLFT can confirm that the MB contains populations of salmon and brown trout and that these species have undergone recruitment in each of the last two years. However, the low number of salmon in the MB is cause for concern and warrants further study. The physical habitats observed on the days of fishing in this study were suitable for juvenile salmon fry and parr, but only brown trout was found above section three. Additionally, for context the expected densities of juvenile salmon for this category of burn in this region (Clyde) under ideal conditions is considerably higher than what we observed in sites one to three of the MB in this study, for both fry and parr (Malcolm *et al.*, 2019). Whilst it is outside the scope of this report to discuss in detail the reasons for these low salmon numbers and whilst exercising caution in interpreting density estimates from this study, the LLFT regard the MB as underutilised by salmon and attribute the low numbers to a low number of returning adult spawning fish.

Brown trout were found in every section of the MB and at higher abundance than salmon. This further attests to the LLFT's assertion that the MB represents good salmonid habitat that is underutilised by salmon; the converse appears to be true for brown trout. The largest brown trout caught in the MB in this study was 350 mm fork length. Whilst the LLFT will avoid speculation as to the life-history of this fish we can tentatively conclude (in the absence of scale data and other ecological indices) the following: that the burn has a low carrying capacity for adult trout and that few adult trout permanently reside in the burn; and that recruits to the population are added primarily by sea trout (the anadromous form of *S. trutta*). Additionally, there was significant variation in brown trout fry and parr numbers between sites on the MB which indicates that typical ecological and meteorological processes are influencing habitat utilisation by brown trout juveniles and that the MB offers abundant and quality habitat to sustain them.

These findings warrant further study and the LLFT will continue to monitor the salmonid assemblage in the MB as part of routine electro-fishing. The LLFT are also undertaking riparian habitat improvement works on the MB to help adult salmon reach the good quality spawning habitat the burn offers.

References

Scottish Fisheries Coordination Centre (SFCC) (2007). FISHERIES MANAGEMENT, SVQ LEVEL 2: CATCH FISH USING ELECTROFISHING TECHNIQUES Inverness / Barony College.

Malcolm, A. J., Millidine, K.J., Jackson, F.L., Glover, R.S., Fryer, R.J. (2019). The National Electrofishing Programme for Scotland (NEPS) 2019, Scottish Marine and Freshwater Science Vol 11 No 9.