Beauly
Fishery Board

2020 River Beauly Electro-fishing Report v2

		Date	Signed
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Approved by	Jock Miller, Chairman of the Board	19/01/21	Jock Miller

Many thanks to Ailsa McLennan and Electro-fishing volunteers: Ivar Campbell, John Murray, Lee Ashton, Mairi Nicolson, Murray Stark, Rachel Young, Rebecca Watts, Cat Owen-Pam, and Anthony Watkins (who also commented on the draft version of this report).

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1. Summary

22 electro-fishing surveys were completed over four weeks in September 2020. Overall, results taken in context with past surveys suggest that whilst much of the Beauly catchment has good or excellent salmon fry and parr densities, there are burns where densities are less than good. Taking site context and habitat into account, the Abhainn Deabhag (large tributary of the River Glass) appeared to be below carrying capacity although further work would be required to confirm this. There were also parts of the Farrar catchment (Uisge Misge and Allt Innis a' Mhuilt) that had less than good juvenile densities.

Trout were generally found in good-excellent densities where they were expected to be.

Potential habitat improvements were identified which may help improve fish densities.

2. Introduction

In September 2020 Beauly Fishery Board (BFB) carried out 22 electro-fishing surveys spread out across the R. Beauly and Beauly coastal catchments. These were all at existing survey sites to enable temporal comparison. This catchment-wide survey strategy enabled familiarisation with sites and several landowners. Nine volunteers (and contractor- Ailsa McLennan) were used. Out of the volunteers, three had previous electro-fishing experience, three were SFCC trained, and three were new to electro-fishing. Without these volunteers the electro-fishing surveys would not have been possible, and we are very grateful for their time and enthusiasm.

The Beauly catchment previously saw stocking of fed fry above natural barriers and parr in the lower Beauly until 2009. This activity is currently not consentable by Marine Scotland due to the negative impacts it can have, but where this may have affected electrofishing results these are highlighted on the graphs within this report.

Fish surveys are a useful fishery management tool as they help identify trends and issues within the catchment. Fish survey results can make a good starting point for wider conversations about the river and can provide evidence to justify and monitor the effect of responsible management actions.

3. Method

Electro-fishing creates an electrical field in the water which attracts fish to the anode. Temporarily immobilised fish were captured in nets and held in holding tubs. Surveyors moved methodically across the river and in an upstream direction. Processing involved mildly anaesthetising the sampled fish with benzocaine to enable species identification, length measurement and scale sampling. Once recovered, fish were then released back into the river.

Sites were generally selected to be representative of the wider river with a natural upstream break to impede fish movement out of the site, and included juvenile salmon and trout habitat. The exception to this were the wide mainstem Beauly and Farrar sites where a representative 10 x 10m area of riffle was chosen to enable access to the mainstem river. Sites were mostly over 100m^2 but a few sites were slightly smaller than this.

The Ness and Beauly Fishery Trust backpack kit was used for all surveys; this kit has a three-second delay safety feature. A twin-tailed cathode for use in low conductivity water was also used at most sites. SFCC protocol was followed.

3.1 Semi Quantitative electrofishing

Semi-quantitative/ one run electrofishing enables minimum fish density estimates to be made. A measured area (m^2) is electro-fished once. This was the most common type of survey used by BFB in 2020.

3.2 Fully Quantitative electro-fishing

Fully quantitative/ three run electro-fishing involves using stop nets to enclose a measured stretch of river. The stretch is electro-fished multiple times to significantly reduce the population size with each successive sampling run. This enables a total fish population estimate to be made based on the number of fish caught. Fully quantitative

electro-fishing was carried out at one site, Eskadale burn- ESK1- to get a capture efficiency applicable to other sites. Ideally more surveys would have been fully quantitative, as has been historically the case on the Beauly however they take more time than semi-quantitative surveys and there was more value this year in covering a larger number of sites.

More information about electro-fishing methods can be found in the SFCC Team leader Manual [3].

3.3 Data analysis

There are various classification systems that can be used but as sufficient quantitative data has been gathered for the River Beauly catchment, an updated classification scheme has been produced using data stored in the SFCC database from all accessible, previously non-stocked sites in the catchment. As past National Electrofishing Programme for Scotland (NEPS) surveys involved a different site selection process and were generally focused in two discrete areas in the catchment this data was left out. Please note that as most data used is from the recent decline period in adult returns it should only be used for classifying data from this period.

Where fully quantitative sites had been surveyed in the past, the data from the first run only was used. The classification created using minimum density estimate data provides a context for the minimum density estimates gathered this year. Please note past classifications were produced to provide context for fully quantitative data (total fish density estimates) so classification boundaries appear lower this year compared to previous Ness and Beauly electro-fishing reports.

Table 1: Classification boundaries for assessing 2020 electro-fishing data (Minimum fish per 100m2)

	Salmon fry	Salmon parr	Trout fry	Trout parr
Poor	0-3	0-6	0	0
Moderate	4-17	7-14	1-4	1-2
Good	18-47	15-22	5-12	3-6
Excellent	48-215	23-78	13-196	7-43

To check the probability of capture rate, one fully quantitative site was surveyed. From the depletion given (Carle and Strubb estimate) this gave an indication that 51% of total estimated fish in the site were caught in the first run. This is compared to 50% at the same site in 2017 with the previous long-standing team. Luckily this is a similar capture rate and lends support for comparisons to be made between data generated by the different teams. A more in-depth analysis of this may be done. It is hoped that in future years more sites are fully quantitative to get more data points 'on the curve' to provide good calibration of one run sites, and to ensure robust data collection.

For reference, the 'benchmark' (expected salmon density under relatively un-impacted conditions) using data from the combined 2018 and 2019 NEPs surveys came out as 0.148 salmon fry per m^2 and 0.06 salmon parr per m^2 (total density) for the Beauly catchment overall. This would be equivalent to just 7 salmon fry per $100m^2$ and 3 salmon parr per $100m^2$ when compared to the classification used in the table above, but it is important to note that the disparity in figures is because this is as an average for the accessible parts of the catchment and applies to all habitats present (some not particularly suitable for juvenile salmon). The Beauly catchment came out well under the 2018 and 2019 NEPS classification and was classed as 'Category 1' (above the benchmark) for both salmon fry and parr in both years. See Appendix 1 for more information.

Age classes of fish were determined from the length-frequency distributions and with reference to past data. As scales were taken from a sub sample of surveyed fish, these can be read in the future if necessary.

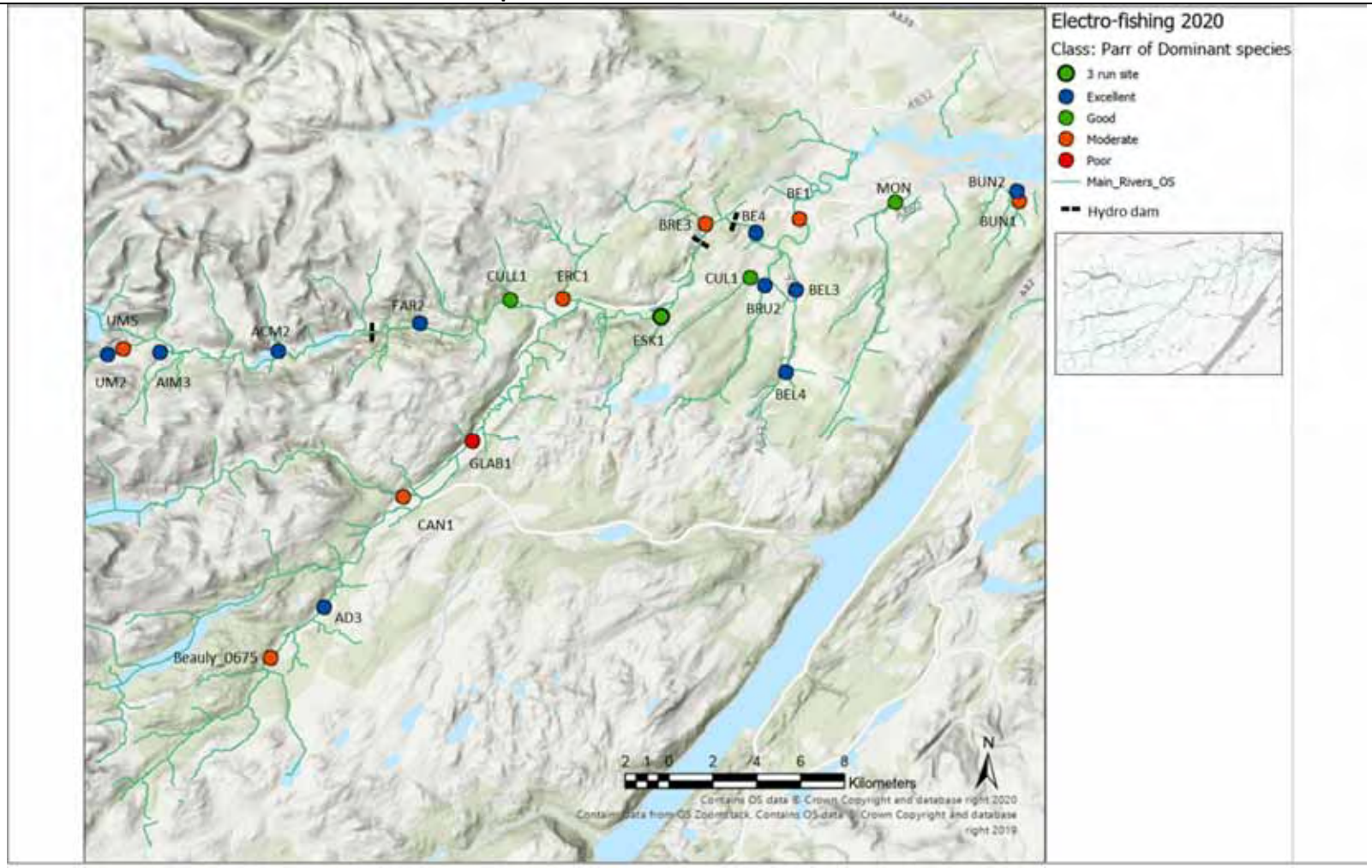
4. Results

Map 1 shows the site locations and results for the dominant parr classification. The parr results have been presented here as densities tend to be more stable, whereas fry densities tend to vary widely. The parr life stage is also the older of the two juvenile stages and is most relevant in the context of smolt output of the system. The classifications for salmon and trout of both life stages are given in Appendix 2. Site photos are provided in Appendix 3. Please note

that no account of habitat or other environmental variables have been made in the classification so where salmon densities look to be 'poor' this may be because salmon would not be expected to be naturally present at that site (e.g. in small burns). Conversely, for trout densities, 'poor' classifications may occur on big rivers.

Please note that all fish densities obtained for the 2020 surveys are provided in this report as minimum density estimates.

Map 1: Site locations with Classification of Dominant parr



4.1 Strathfarrar

The Farrar is a large river, and tributary of the Beauly. The six sites surveyed in Glen Strathfarrar are all above three hydro dams.

4.1.1 Uisge Misge

The Uisge Misge is at the top of the Farrar and is one of the main spawning areas at the top of the catchment (along with the Abhainn Deabhag on the Glass). SSE reduced the flows going down the Uisge Misge in 2019 so they are at more natural levels. Both sites surveyed in 2020 on the Uisge Misge are more than 10m wide which makes them more suitable for salmon than trout.

UM2 is predominantly salmon parr rather than fry habitat. Salmon fry were found for the first time at this site at moderate density (5 per 100m^2), with salmon parr found at excellent density (24 per 100m^2). These improved numbers may be a result of the managed lower flows. There appeared to be four age classes of salmon at UM2 (fry, 1+, 2+ and a single 3+ parr). UM2 was the only site surveyed in 2020 that may have contained the age class 3+. This would be due to a combination of the site's altitude (180m- the highest fish-accessible survey site in the Beauly catchment), the cool abstracted water, and low food availability. Slow growth rates mean that juveniles have to spend longer in the system to reach the length required to smolt. Scales should be read to confirm the presence of this age class. See Figure 1A and 1B.

Figure 1A: Minimum density of juvenile salmon and trout per 100m2 at UM2

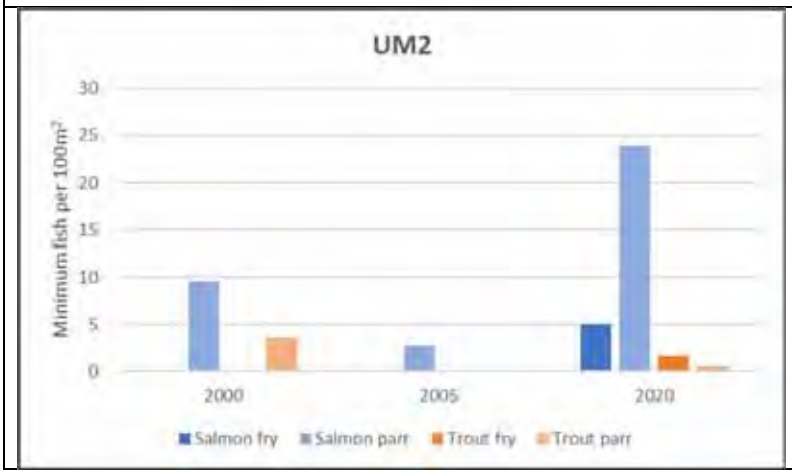
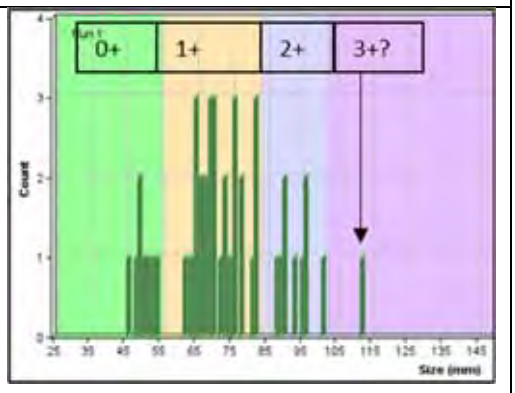


Figure 1B: Length Frequency histogram of salmon at UM2



UM5 (1.3km downstream of UM2) was shallower with a good mix of substrate. This was reflected in the good salmon fry density (20 per 100m^2). Moderate parr numbers (9 per 100m^2) were found but this is above average for the site (6 per 100m^2) and shows continued improvement from the poor parr recruitment seen between 2011-2015. Overall there are less fry at the site than eleven years ago so it will be important to see if this larger trend continues. See Figure 2A and 2B.

Figure 2A: Minimum density of juvenile salmon and trout per 100m2 at UM5

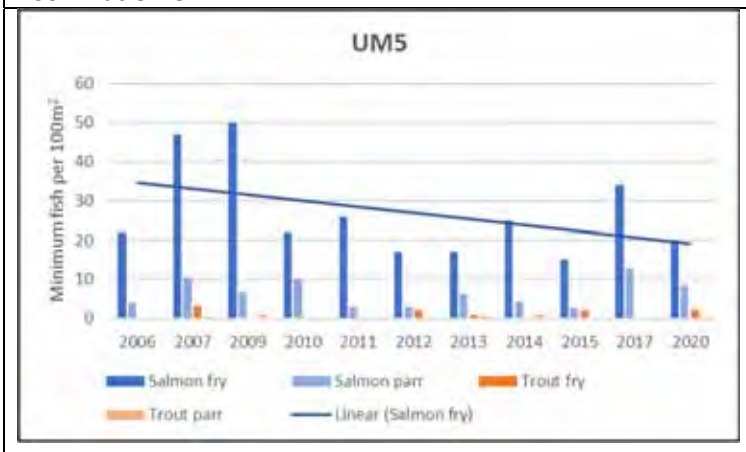
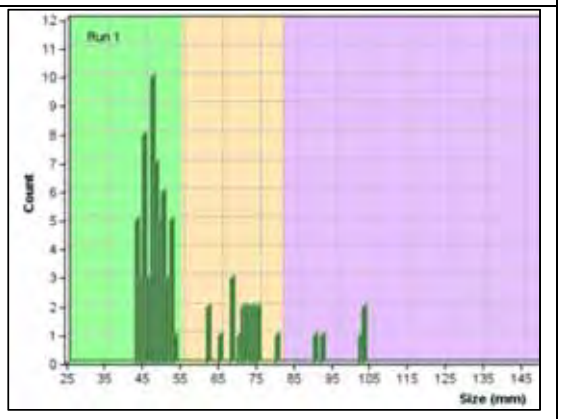


Figure 2B: Length Frequency histogram of salmon at UM5



Overall, results from these two sites suggest that the flow modification has helped fry and parr recruitment but there is still room for improvement. Riparian tree planting could benefit the Uisge Misge by improving nutrient availability. Sediment management should continue at 'the spout' and at intakes to ensure continued availability of spawning and juvenile habitat in this river and further downstream.

4.1.2 Allt Innis a' Mhuilt

Allt Innis a' Mhuilt is a tributary near the top of the Farrar and is abstracted to provide water to Loch Monar. AIM3 is situated 600m above the confluence with the Farrar and is an average of 4m wide at the site.

Salmon fry were found to be at poor densities (1 per 100m^2) which is not unusual for the site. Salmon parr, trout fry and trout parr were found at excellent densities (23, 13 and 7 per 100m^2 respectively). Spawning appears to only happen sporadically at this site. As habitat for both age classes was prevalent, the higher parr numbers compared to fry numbers might indicate that parr are moving into this site from elsewhere. Further assessment is required to investigate the reasons for the very low salmon fry numbers. It is not clear from the distribution if 2+ were present at this site.

The improved trout fry and parr numbers is encouraging and were the best trout densities found in the Farrar catchment. They show that this site provides important trout habitat. See Figures 3A and 3B.

Figure 3A: **Minimum density of juvenile salmon and trout per 100m2 at AIM3**

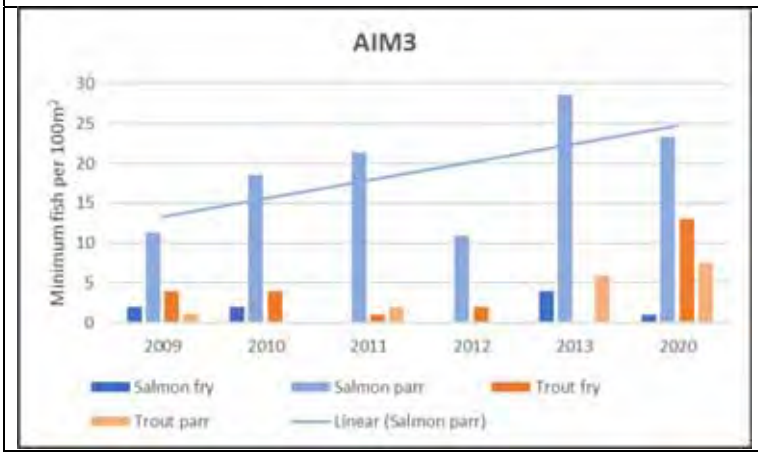
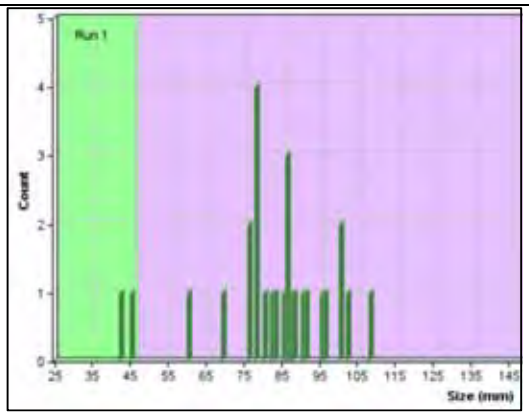


Figure 3B: Length Frequency histogram of salmon at AIM3



4.1.3 Allt Choire Mhuillidh

Allt Choire Mhullidh is a tributary of the Farrar and is abstracted to provide water for Deanie power station. The 'scoop' intake is designed to minimise sediment hold-up at the intake. The burn was re-watered about twenty years ago.

Both salmon fry and parr densities were found to be excellent, with the highest densities for the site being recorded (52 per 100m^2 and 24 per 100m^2) respectively. This is well above the past densities found (with occasional absence of salmon fry) and shows the potential for this burn. Although there will be differences between individual surveyor assessment and flows between 2015 and 2020 habitat appears to have improved for spawning and fry. Water depths were significantly shallower and there has also been a 20% increase in peb/ cob substrate (conversely a reduction in boulder substrate). Trout fry were also found at moderate (4 per m^2) density, and trout parr at good density (3 per m^2). Unfortunately a minnow (non-native) was also found at this site which is the first time this species has been found here. See Figures 4A and 4B.

Figure 4A: **Minimum density of juvenile salmon and trout per 100m2 at ACM2**

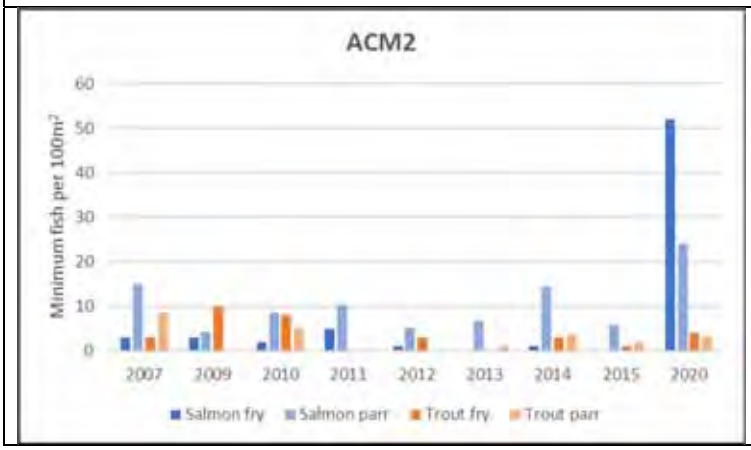
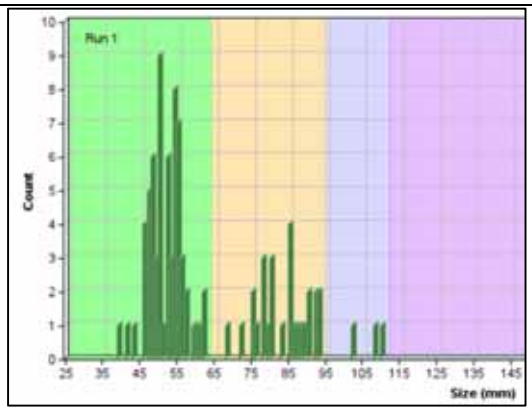


Figure 4B: Length Frequency histogram of salmon at ACM2



4.1.4 Culligran burn

Culligran burn is a tributary of the Farrar. Salmon fry and parr densities were found to be good (27 and 15 per 100m^2 respectively) and about average for the site. The improved fry density suggests spawning has improved at the site compared to previous years. Access to Culligran burn may be affected by the alluvial fan at the confluence with the Farrar. Parr numbers have been relatively stable in recent years which suggests that habitat is being maximally utilised at the parr stage. Both 1+ and 2+ parr were found and this shows salmon smolt at 2+ (after three summers) from Culligran which is in line with past surveys and the Farrar catchment.

Trout fry were also found in good densities (5 per 100m^2). Trout parr were not found which is unusual for the site as they usually occur in low numbers. One minnow was also found which is only the second time since 2006. See Figures 5A and 5B.

Figure 5A: Minimum density of juvenile salmon and trout per 100m2 at CULL1

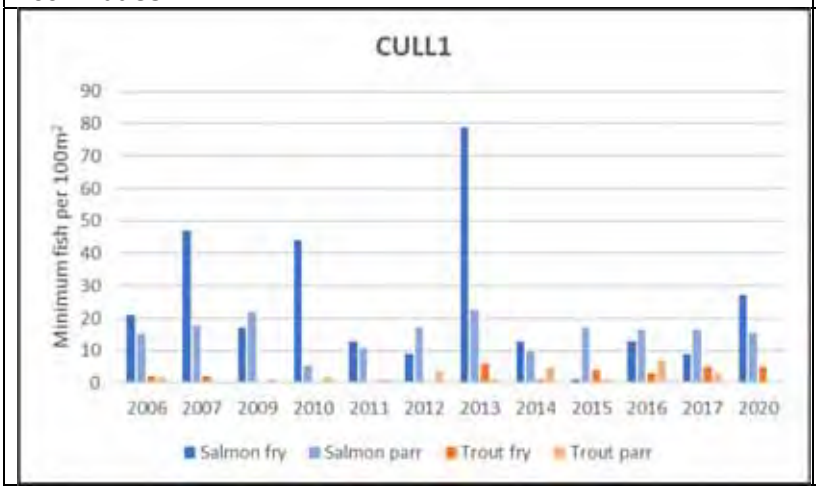
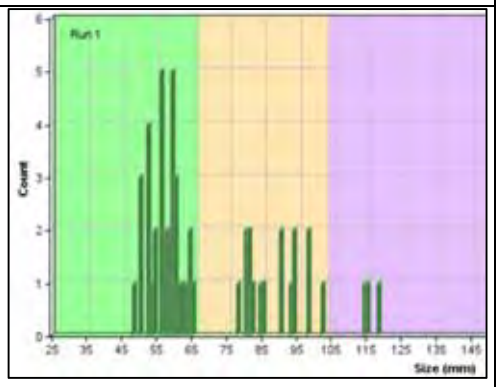


Figure 5B: Length Frequency histogram of salmon at CULL1



4.1.5 Farrar mainstem

The wide, riffly and fast nature of the river (c25m) at FAR2 makes this a salmon site. A representative 10 by 10m2 square of mid-riffle was surveyed. Salmon fry and parr were both found at excellent densities this year (64 and 27 per 100m^2 respectively). Fry were well above average and parr were slightly above the average (23 per 100m^2) for the site. This suggests that spawning occurred close to the site in Autumn 2019 with suitable flows seen at time of spawning and over the winter of 2019. The fry numbers are further evidence of an improvement from the reduced fry recruitment seen 2011-2014. Three year classes of salmon were found (0+, 1+, and 2+) and also an eel (315mm long) which is the furthest they were found up the system in 2020. See Figures 6A and 6B.

Figure 6A: Minimum density of juvenile salmon per 100m2 at FAR2

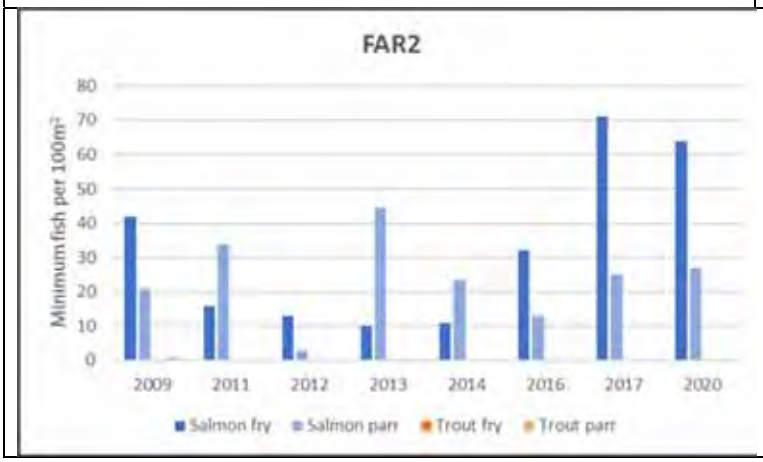
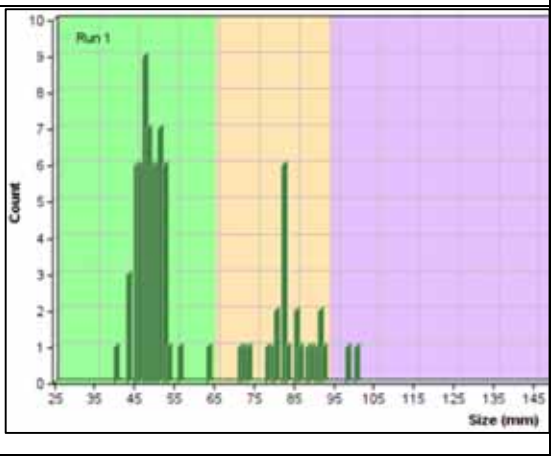


Figure 6B: Length Frequency histogram of salmon at FAR2



4.2 River Glass

The River Glass starts where the R. Affric and Abhainn Deabhag meet and flows down to the Farrar confluence. The R. Cannich is a large tributary of the Glass.

4.2.1 Abhainn Deabhag

The A. Deabhag is an important spawning river in the catchment.

Beauly_0675 is a NEPS site and was chosen for survey due to its proximity to the natural limit to migration (the waterfall adjacent to Plodda, c1km upstream). Being wide (13m) with predominantly run-glide flows, habitat was most suited to juvenile salmon parr rather than salmon fry or trout.

The fish densities found at this site should be treated as an underestimate as nine fish were knowingly missed from just moderate densities (26% of total fish). The survey was efficient enough to be included here, but this compares to an average of 5 missed fish at the other sites. Water conductivity was similar to other sites.

Densities of 4 salmon fry per 100m^2 and 7 parr per 100m^2 were found, representing the bottom of the moderate class boundaries. Spawning substrate, and fry habitat would appear to be more prevalent 100m further upstream. It would be good to keep surveying this site in the future as sub-optimal sites are good for highlighting decreasing adult numbers. See Figures 7A and 7B.

Figure 7A: Minimum density of juvenile salmon and trout per 100m2 at Beauly_0675

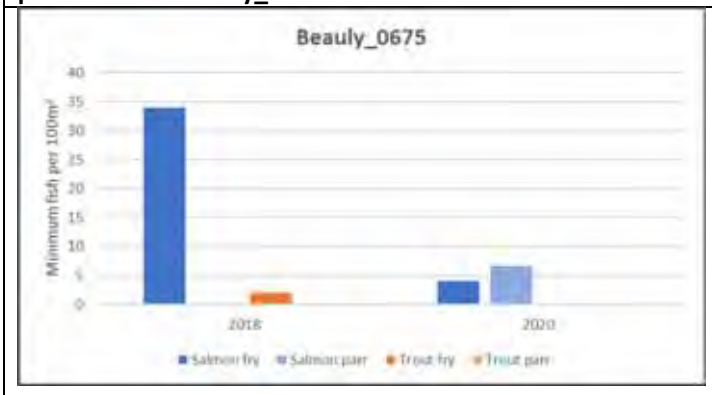
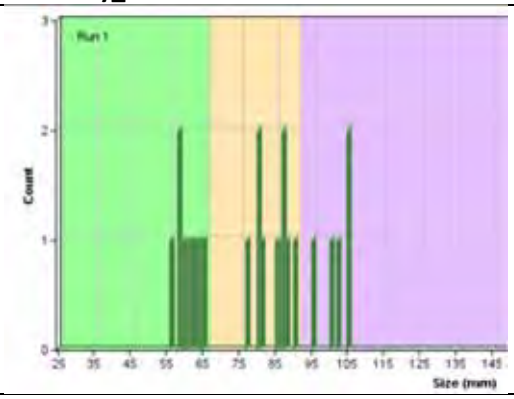


Figure 7B: Length Frequency histogram of salmon at Beauly_0675



In contrast, AD3 (4km downstream of Beauly_0675) had excellent numbers of both salmon fry and parr (61 and 37 per 100m^2 respectively), both densities being above average, with parr densities being the highest recorded for this site. This is likely to be because the site is predominantly run-riffle, and suitable for both salmon fry and parr. See Figures 8A and 8B.

Figure 8A: Minimum density of juvenile salmon and trout per 100m2 at AD3

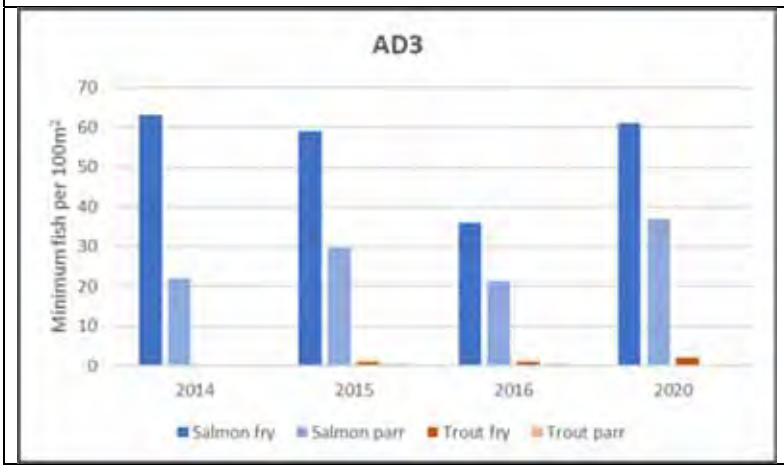
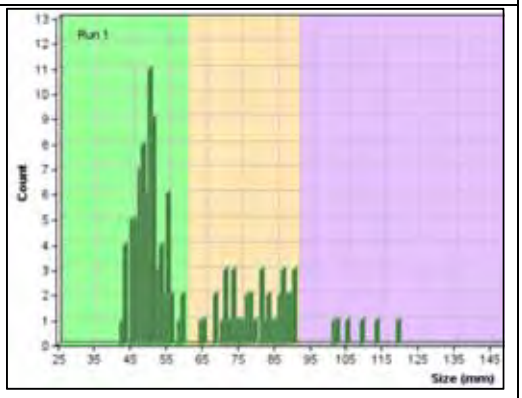


Figure 8B: Length Frequency histogram of salmon at AD3



0+, 1+ and 2+ age classes were found at both sites and is consistent with salmon smolting after their third summer.

Past NEPS survey data provides context for these findings. Please see Appendix 1 for 2018 and 2019 NEPS survey overview. The NEPS survey findings suggest that the Abhainn Deabhag is below carrying capacity. Habitat survey work may add to our understanding as to why this is.

4.2.2 Glass burn

The Glass burn is one of the few spawning tributaries of the R. Glass. At just 3m wide, with suitable substrate, the Glass burn provides valuable habitat for both salmon and trout, fry and parr. The bridge apron at the road (upstream of the GLAB1 site) is impassable most years and habitat is limited above it (two salmon parr were recorded above it in 2014).

Salmon fry numbers were found to be good (26 per 100m^2), whilst salmon parr numbers were found to be poor (6 per 100m^2; the lowest since 2007). Both salmon fry and parr densities vary widely at this site which suggests quite varied or patchy spawning activity and/ or flows around spawning time from year to year. Age classes of 0+ and 1+ salmon were found, suggesting that salmon either smolt from this burn after their second summer or drop into the mainstem.

By comparison, trout fry numbers were found to be good (7 per 100m^2), whilst trout parr numbers were found to be moderate (1 per 100m^2), although below average for the site, trout parr are occasionally absent (2008 and 2012). See Figures 9A and 9B.

Two eels (115 and 200mm) were also found.

Figure 9A: Minimum density of juvenile salmon and trout per 100m2 at GLAB1

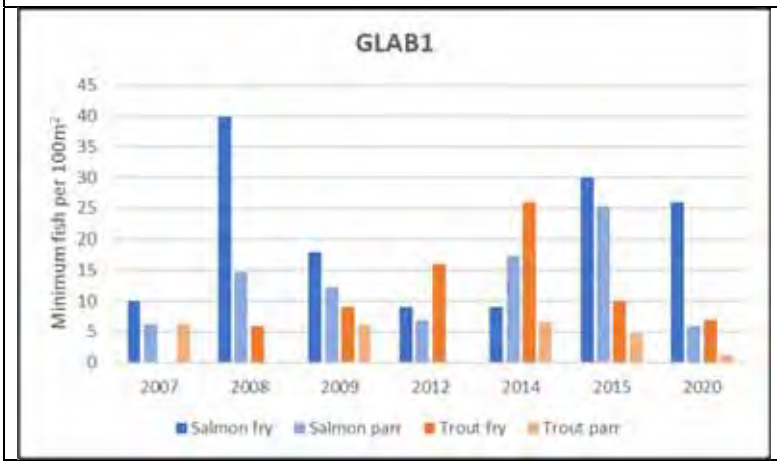
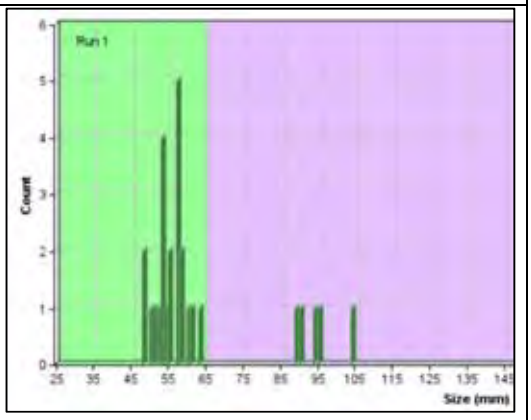


Figure 9B: Length Frequency histogram of salmon at GLAB1



4.3 River Cannich

The river Cannich is a large tributary of the Glass and is impounded at the top by SSE's largest (by cement volume) dam, Mullardoch.

4.3.1 River Cannich

CAN1 is c1.3km downstream of the natural limit to migration. It is a very stable site made up of predominantly boulder substrate.

Salmon fry (7 per 100m^2), salmon parr (13 per 100m^2) and trout fry (2 per 100m^2) were all found to be of moderate class, with salmon parr being found at the highest densities to date (including data not in the SFCC database). No trout parr were found. With limited juvenile habitat available, trout parr may have been pushed out into the slack areas out-with the survey site. The improved numbers for the site may be due to increased catch effort compared to previous years (a team of 3 was used this year compared to previous years where a team of 2 was used) as habitat does not seem to have improved over time. The lack of spawning substrate accounts for the limited spawning activity and low densities of fry seen over the years. See Figures 10A and 10B.

Figure 10A: Minimum density of juvenile salmon and trout per 100m2 at CAN1

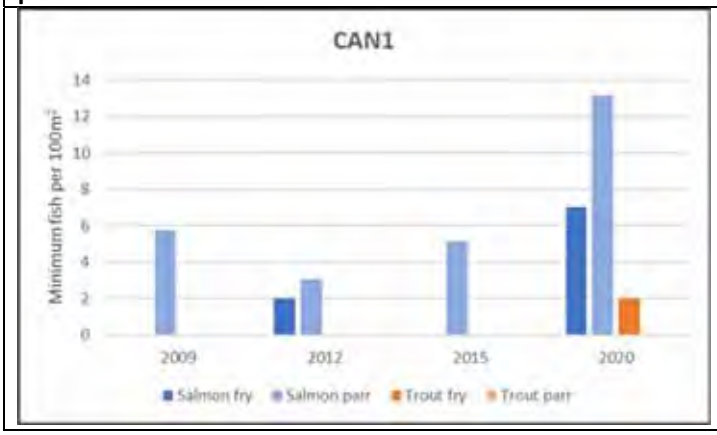
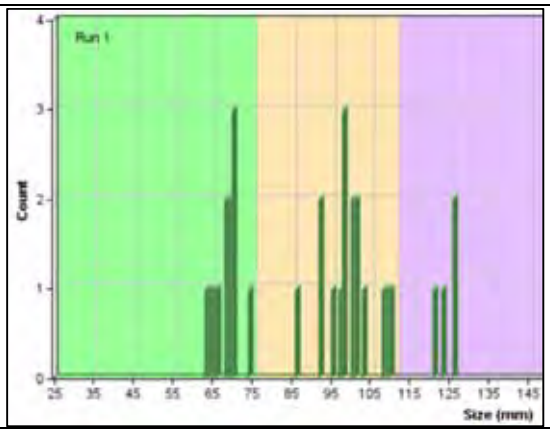


Figure 10B: Length Frequency histogram of salmon at CAN1



Due to the prevalence of boulder substrate sixteen eels were found (the most abundant site for eels) and were of varying lengths (170-320mm). Five minnows were found and this is likely due to the slow flowing nature of the site.

It is not clear if the lack of spawning substrate in the river is natural or not and further assessment should be made.

4.4 Upper Beauly

The Upper Beauly starts below where the R. Farrar meets the R. Glass and stretches downstream to Aigas. This section has two main spawning burn tributaries, the Eskadale and Erchless.

4.4.1 Eskadale burn

The Eskadale burn was previously stocked back in the 80s with fish of fish farm origin (i.e. fish not from the Beauly catchment). It is the first spawning burn above Aigas dam and flows into the slack area produced by water backed-up behind the dam.

ESK1 was used to do a 3 run (fully quantitative) survey to check capture efficiency for the season. With a bed width of 4m this burn is used by both salmon and trout.

Variable fry densities are normal for this burn which suggests quite sporadic spawning activity from year to year. Salmon may prefer to spawn in the mainstem as there is plentiful spawning area further upstream. This year, a moderate density of salmon fry (5 per 100m^2) was found with good densities of salmon parr (19 per 100m^2), trout fry (12 per 100m^2) and trout parr (4 per 100m^2). Salmon parr numbers are frequently higher than salmon fry numbers despite there being good habitat for both life stages at the site. This implies parr may be migrating to the site from elsewhere in the burn or from the mainstem into the burn. Trout fry and parr numbers were slightly above average. See Figures 11A and 11B.

Figure 11A: Minimum density of juvenile salmon and trout per 100m2 at ESK1

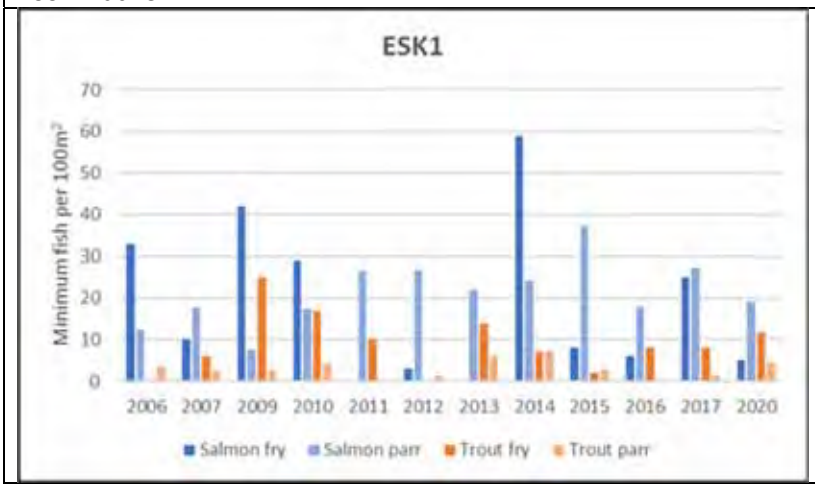
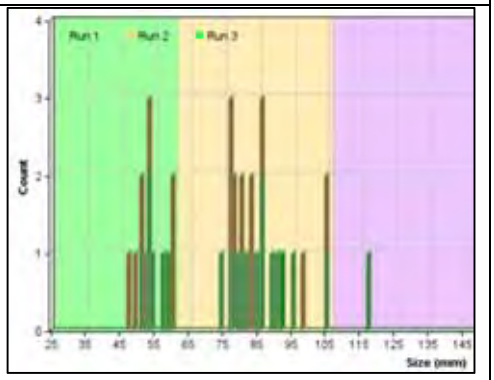


Figure 11B: Length Frequency histogram of salmon at ESK1



Five eels (125-320mm) were also present, and suggests eels are using the fish passes at the dams.

Beech trees provide a lot of shade along the burn and productivity of the burn could be improved with thinning a handful of these.

4.4.2 Erchless burn

ERC1 bed width averages 8m making this a burn suitable for both salmon and trout.

Salmon fry densities are variable at this site and were found to be moderate (7 per 100m^2) this year compared to an average of 24 per 100m^2. More importantly in terms of smolt output, salmon parr numbers were also moderate (7 per 100m^2). It will be good to keep an eye on parr numbers here to see if the drop from 2014 continues. Rhododendron is prolific along the burn and is causing overshading. Rhododendron control may improve productivity of the burn.

0+ and 1+ age salmon age classes were found, meaning that fish will smolt after their second summer from this burn.

Trout fry were found at good density (12 per 100m^2), and trout parr at moderate density (1 per 100m^2). See Figures 12A and 12B.

One eel and one minnow were also found.

Figure 12A: Minimum density of juvenile salmon and trout per 100m2 at ERC1

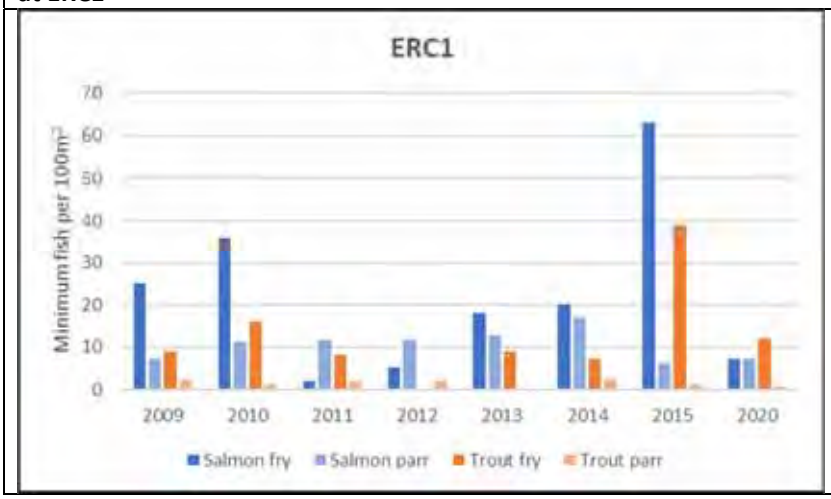
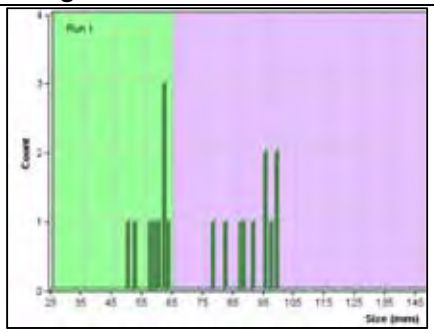


Figure 12B: Length Frequency histogram of salmon at ERC1



Both burns have good trout fry densities. Fish counter image analysis may help show if these could be the progeny of sea trout or not.

4.5 Middle Beauly

The middle Beauly is the mainstem stretch between Aigas and Kilmorack dams. This area is defined by slack, deep water.

4.5.1 Breackachy burn (Teanassie)

Breackachy burn is the only significant spawning tributary between Kilmorack and Aigas dams. BRE3 was selected to survey due to it being the furthest upstream site on the burn, and more representative of the burn as a whole. Water quality and food availability seemed very good on the burn as demonstrated by the numerous stonefly nymphs and caddis larvae (Perlodidae and Philopotamidae) found during the survey.

Breakachy burn has a reputation for having some of the highest salmon fry numbers in the catchment but limited parr numbers, 2020 was no exception. Salmon fry were found at excellent densities (76 per 100m^2) as in 2017 (84 per 100m^2). In comparison with past data from the other two sites on the burn, BRE2 and BRE1 have averages of 105 and 137 per 100m^2 respectively.

The smallest fry surveyed by BFB in 2020 was found at BRE3 and measured just 37mm. The small size is likely due to competition between fry.

Salmon parr were found at moderate densities (7 per 100m^2) with past averages of 19 and 10 per 100m^2 at BRE2 and BRE1. At all three sites parr numbers appear stable and suggest the burn is at carrying capacity.

0+ and 1+ salmon were found, meaning that salmon will smolt after their second summer.
See Figures 13A and 13B. Five eels (109-280mm) were also captured.

Figure 13A: Minimum density of juvenile salmon and trout per 100m2 at BRE3

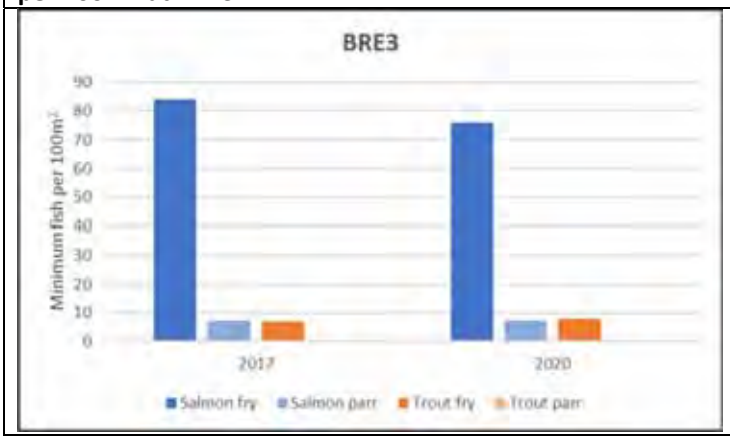
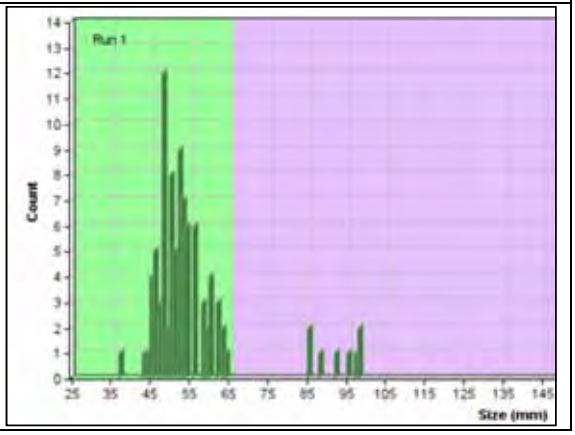


Figure 13B: Length Frequency histogram of salmon at BRE3



It would appear that there is less spawning habitat at BRE3 compared to BRE2, however it would be good to survey them both in the same year to make a direct comparison of habitat and juvenile numbers.

4.6 Lower Beauly

The lower Beauly is the stretch of the R. Beauly downstream of Kilmorack dam to the estuary at the Beauly firth.

4.6.1 Beauly mainstem

Two out of the four Beauly mainstem sites were surveyed this year. A representative 10 by 10m square of riffle was selected for each site. Given the wide, riffly and fast flowing nature of both BE4 and BE1 (with no edge habitat surveyed) trout were not expected to be present at either site.

BE4 is the first riffle downstream of Kilmorack dam (650m downstream) and Falls hut. Excellent salmon fry and parr densities were found here (52 and 29 per 100m^2 respectively) despite the very stable nature (evident from macrophyte growth) and limited spawning substrate immediately upstream of the site. Both fry and parr numbers were the best ever recorded at this site and suggest this area was well used by adults for spawning in 2019.

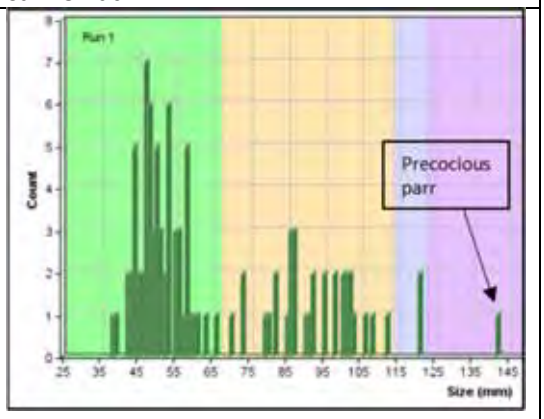
It was also interesting to find a precocious salmon parr. These males may eventually go to sea themselves.

Past surveys have found 0+ and 1+ age classes, however results from this survey suggest an additional age class might be present. It would be good to read the scales from this site. See Figures 14A and 14B.

Three eels were also found (105-128mm).

Figure 14A: Minimum density of juvenile salmon per 100m2 at BE4

Figure 14B: Length Frequency histogram of salmon at BE4



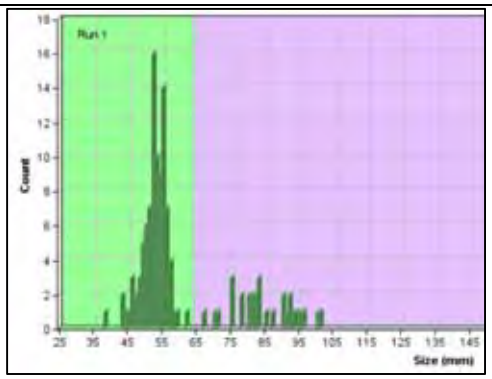
BE1 (4.4km downstream of BE4) is downstream of Minister's pool and is BFB's furthest downstream site in the catchment. Good salmon fry numbers were found (32 per 100m^2) but moderate parr numbers (10 per 100m^2). High fry densities suggest that spawning habitat was well utilised in 2019 and appear to be part of an upward trend. Parr numbers appear to be very variable. Parr numbers are sometimes greater than fry numbers at this site and surveying this site in consecutive years would give a better picture of recruitment.

0+ and 1+ age classes were found, pointing to salmon smolting after their second summer, this is in line with previous results. See Figures 15A and 15B.

Twelve eels of varying sizes were also found (range 70-105mm). These were the smallest (and youngest) found during the surveys. Larger (and predominantly female) eels are usually found higher up the catchment.

Figure 15A: Minimum density of juvenile salmon per 100m2 at BE1

Figure 15B: Length Frequency histogram of salmon at BE1



4.6.2 Belladrum burn

Belladrum burn runs into the R. Beauly and being near the bottom of the catchment is the first tributary above the normal tidal limit. Apart from the coastal burns, being 3.5- 4m wide, this burn and its tributaries is seen as the main sea trout burn in the catchment. The upper reaches of Belladrum burn were stocked with salmon fry prior to 2009. BEL4 is situated c2.5km above the 'pot and kettle'. The pot and kettle is the natural limit to migration for salmon but perhaps not for sea trout as reflected in the high trout fry and parr densities. A single salmon parr was captured during timed surveys in 2012 above the falls but that is the only record of salmon naturally occurring there. Trout densities were excellent with fry at 39 per 100m^2 and parr being the best of all the 2020 BFB surveys at 21 per 100m^2. See figures 16A and 16B.
Lamprey ammocoetes and a transformer were also found.

Three age classes of trout were found. It is possible that an age class of trout are missing or that trout parr are fast growing at this site.

Figure 16A: Minimum density of juvenile salmon and trout per 100m2 at BEL4

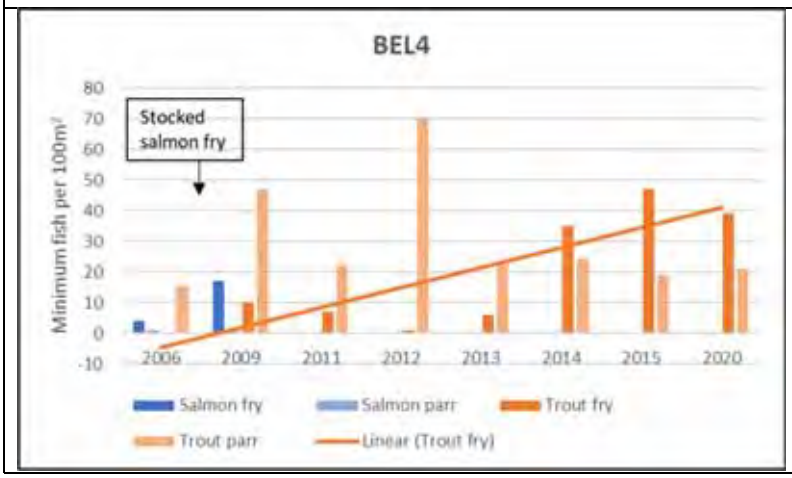
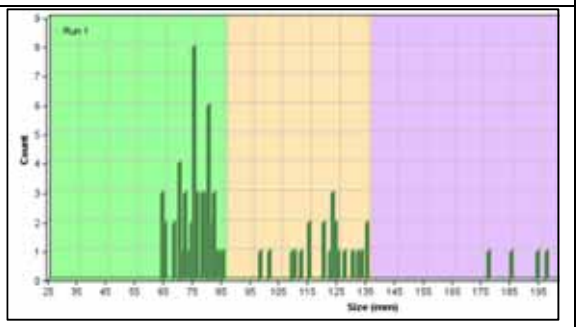


Figure 16B: Length Frequency histogram of trout at BEL4



BEL3 is c1km downstream of the pot and kettle. Excellent numbers of both salmon and trout, fry and parr were found at BEL3, making this the best all round site of the BFB's 2020 surveys. Salmon fry were found at 52 per 100m^2 and salmon parr at 32 per 100m^2. Trout fry were found at 73 per 100m^2 and trout parr at 12 per 100m^2. All of these results are above average for the site. Trout fry occurred in lower densities than in 2017 which may reflect there was less sea trout spawning in 2019 compared to 2016, or less favourable flows over the winter/spring of 2019/20. Trout parr densities are generally better than they were prior to 2014. 0+, 1+ and 2+ age classes were found for both salmon and trout. The salmon 2+ cohort was represented by a single fish and this differs from previous years where parr have been represented only by 1+. See Figures 17A and 17B.

An eel (105mm) was also found.

Figure 17A: Minimum density of juvenile salmon and trout per 100m2 at BEL3

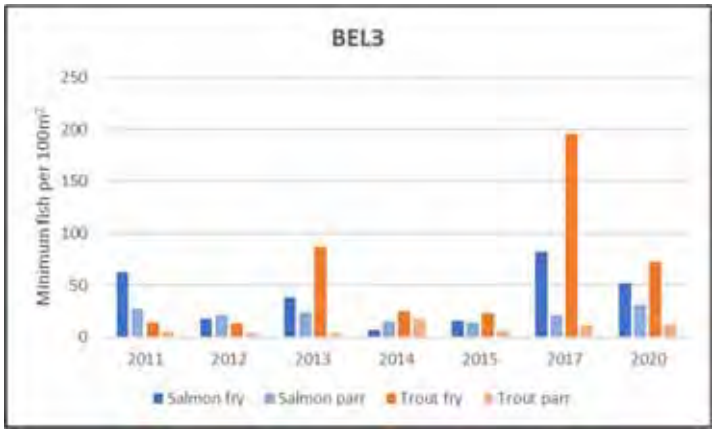
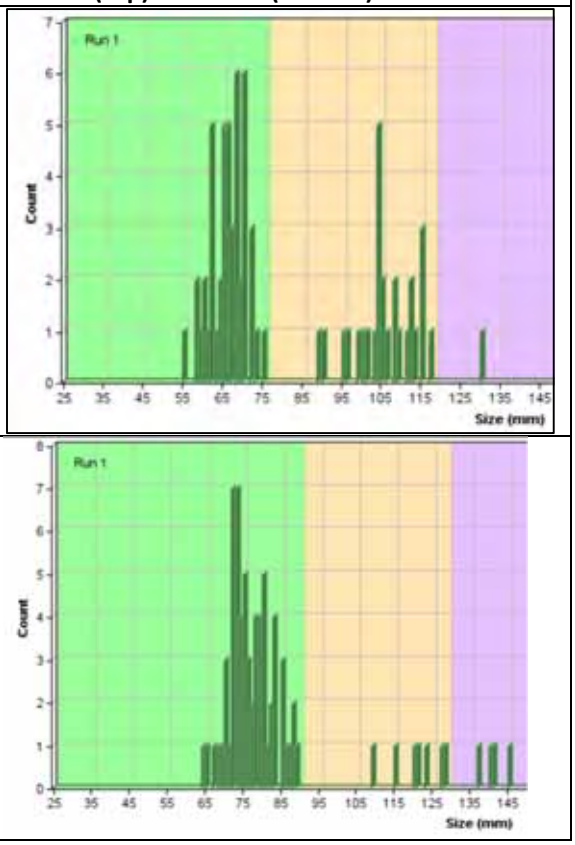


Figure 17B: Length Frequency histogram of salmon (top) and trout (bottom) at BEL3



4.6.3 Bruiach burn

The Bruaich burn is a tributary of the Belladrum burn.

BRU2 had the highest salmon parr numbers of all BFB sites surveyed in 2020 and appears to be part of a trend of improving salmon parr numbers on the burn. Salmon parr density at this site was the highest recorded since 2009. Parr survival seems to have been good on the Bruiach with parr density being just short of fry density. Both salmon fry and parr densities were excellent (64 and 59 per 100m^2 respectively).

0+ and 1+ age classes were found showing that salmon smolt after their second summer.

Trout fry and parr densities were both good at 8 and 6 per 100m^2 respectively. Trout fry densities can be quite variable, and this may indicate variable sea trout utilisation, but this does not seem to affect trout parr densities which have been consistent over the last nine years. Sea trout are known to use the burn further upstream too. The BRU3 site in Boblainy forest c5km further upstream was not visited this year due to high flows but past data suggests sea trout spawning is more prevalent up there than salmon.

The wide spread of trout parr lengths may imply that trout parr are migrating into the site from other areas. Age classes 0+, 1+ and 2+ were present. See Figures 18A and 18B.

Three eels were also found at BRU2 (180-400mm).

Figure 18A: Minimum density of juvenile salmon and trout per 100m2 at BRU2

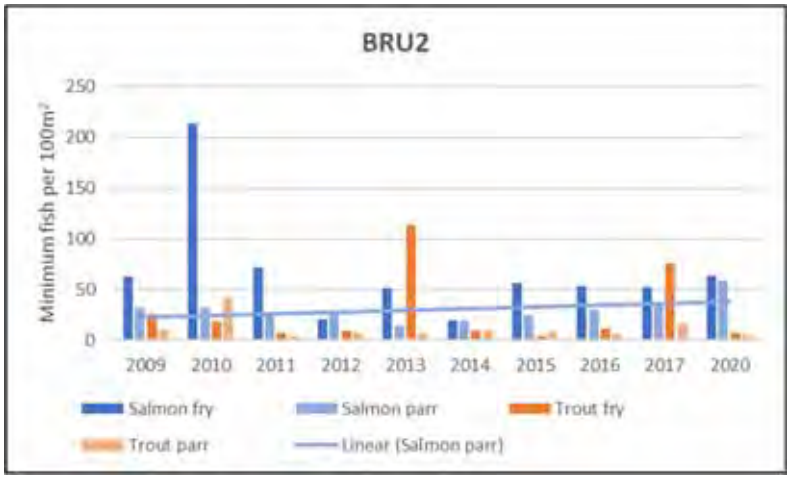
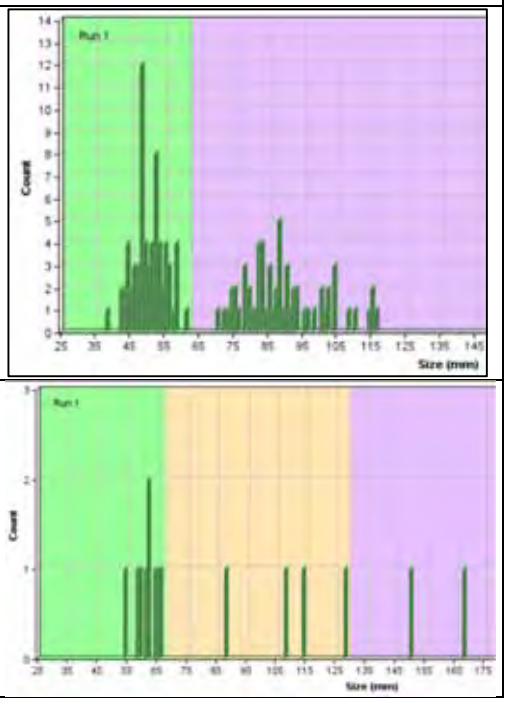


Figure 18B: Length Frequency histogram of salmon (top) and trout (bottom) at BRU2



4.6.4 Culburnie burn

Culburnie burn is a tributary of the Bruiach burn. A man-made barrier 600m upstream of CUL1 was eased in 2014.

Salmon fry and salmon parr numbers were found to be moderate (11 and 7 per 100m^2 respectively), with parr density being near the bottom of the range. Salmon parr density seems to fluctuate quite widely (range 6-36 per 100m^2) at this site. Salmon spawning appears to be variable and sometimes absent at the site whereas trout spawning is more consistent. This is likely due to the burn being quite small (less than 3m wide) and more suited to sea trout.

Trout fry density was found to be excellent (41 per 100m^2), and trout parr density was found to be good. Trout parr density also fluctuates at this site but less so than salmon parr (range 0-28 per 100m^2). See Figures 19A and 19B.

Figure 19A: Minimum density of juvenile salmon and trout per 100m2 at CUL1

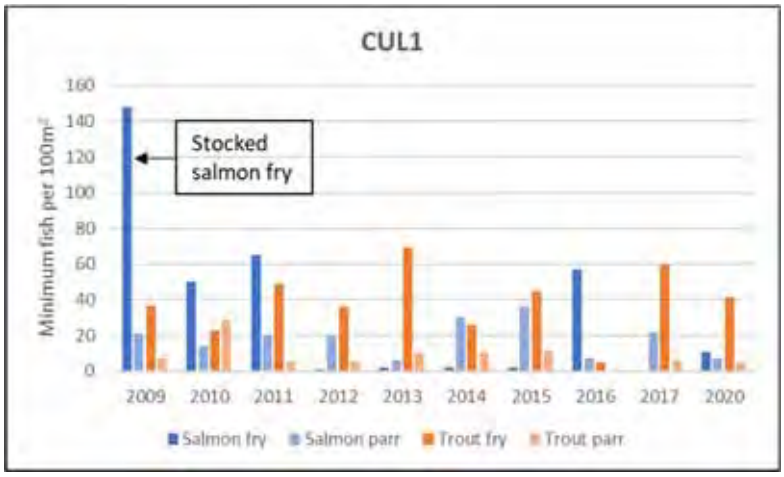
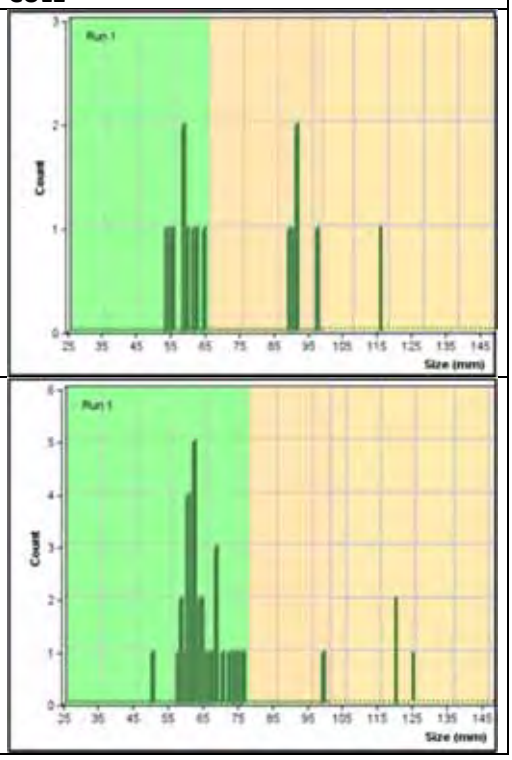


Figure 19B: Length Frequency histogram of salmon (top) and trout (bottom) at CUL1



Excluding the coastal burns, water conductivity was found to be joint highest with BRU2 (110µs). This was significantly higher than other sites surveyed (averaged 37µs [range 20-60µs]). This may be due to forestry activity, septic tank issues or the most likely reason; the natural geology of the area (softer sedimentary rather than metamorphic bedrock). There was a report of dumped fertiliser on Culburnie burn in June 2019 which would have the potential to affect conductivity but this does not seem to have significantly affected salmonid parr numbers. It will be good to keep an eye on the water conductivity in future years to see how this varies.

4.7 Coastal burns

Two coastal burns were surveyed this year. The Firth's coastal burns provide valuable spawning habitat for sea trout and brown trout.

4.7.1 Moniack burn

Moniack burn is the largest of the Beauly Firth's coastal burns. The MON site is situated 200m upstream of the Kirkhill sewage treatment works (STW). Previous surveys were timed rather than quantitative so comparison with past data has not been made.

The predominantly pebble/ gravel substrate at the site made this suitable for sea trout and brown trout spawning. Excellent densities of trout fry were found (17 per 100m^2) and good densities of trout parr (3 per 100m^2). A single salmon fry, and no salmon parr were found indicating that the burn may be rarely utilised by salmon.
Two flounder, six eels (85-184mm) and five lamprey were also found, with the largest juvenile lamprey in the process of transforming. This range of species made this the most diverse site surveyed by BFB in 2020. See figures 20A and 20B.

Figure 20A: Minimum density of juvenile salmon and trout per 100m2 at MON

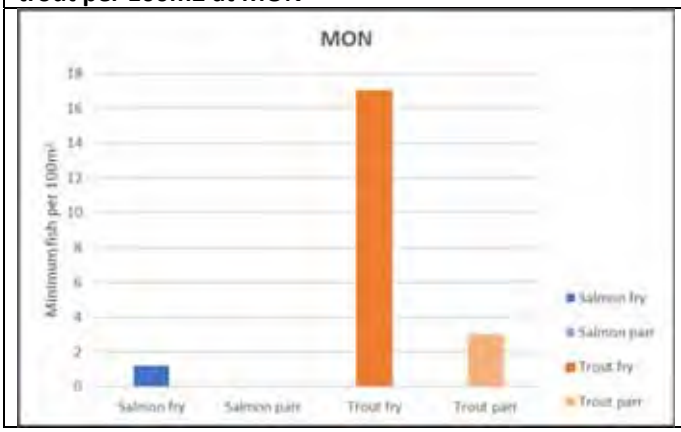
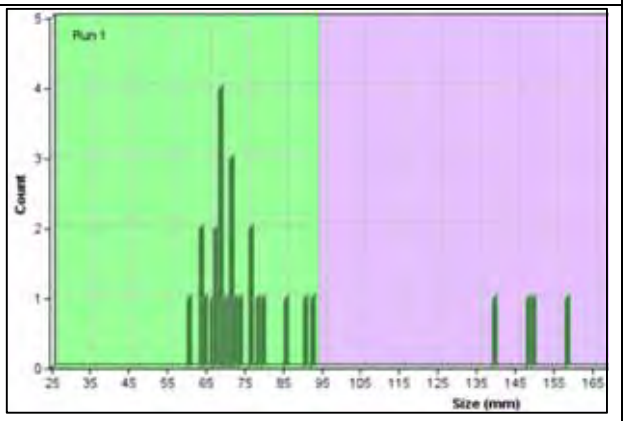


Figure 20B: Length Frequency histogram of trout at MON



In future years it would be ideal to add a quantitative survey site downstream of the STW and a couple further upstream in Reelig glen to monitor changes in fish populations in relation to potential pollution or changes to woodland management.

4.7.2 Bunchrew burn

A bridge apron associated with the A862 appears to be a low impact barrier to migration (at low flows). Surveys this year were conducted upstream (BUN1) and downstream (BUN2) of it to assess what fish populations were like.

Salmon were absent from both sites. Trout fry at BUN1 were found at excellent densities (14 per 100m^2), and trout parr were found at moderate densities (2 per 100m^2). The lower site (BUN2), yielded good densities of trout fry (8 per 100m^2) and excellent numbers of parr (7 per 100m^2). It would appear that the bridge apron was not a barrier to sea trout or brown trout in the autumn of 2019, but the low parr numbers at the upstream site may suggest spawning was less successful in the autumn of 2018. See Figures 21A and 21B. Further monitoring and a SNIFFER2 assessment of the bridge apron is required as the landowner would be willing to do some green engineering downstream of the barrier to improve its passability if necessary.

A single eel was also found at BUN2 (145mm).

Figure 21A: Minimum density of juvenile trout per 100m2 at BUN1 and 2

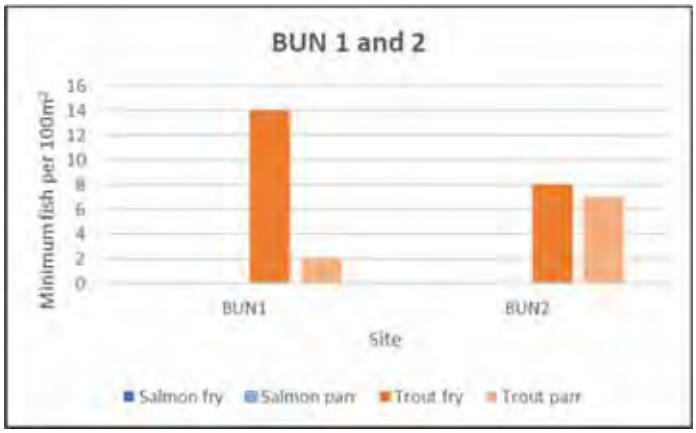
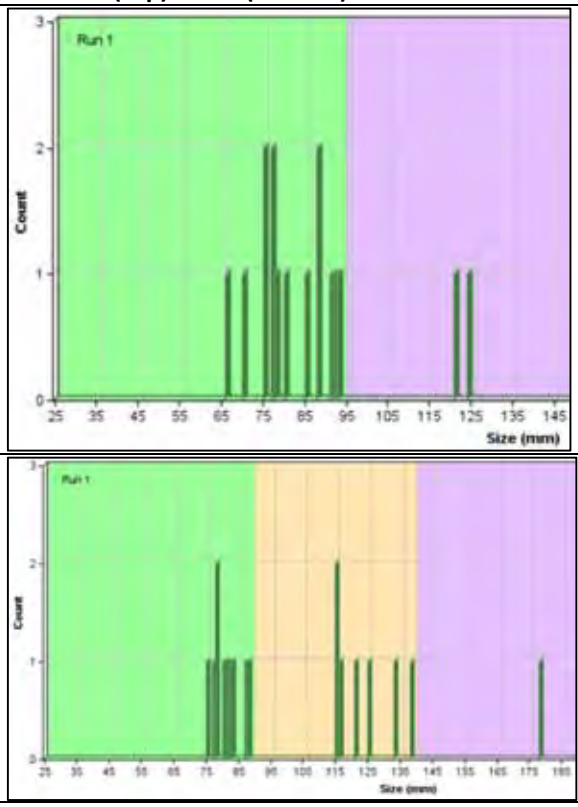


Figure 21B: Length Frequency histogram of trout at BUN 1 (top) and 2 (bottom).



5. Catchment as a whole

Existing minimum estimate data from the eleven historic sites is used here. As not all sites were surveyed at the same time the average is based on between 8-11 of these sites for each year. The sites included are: UM5, ACM2, FAR2, CULL1, GLAB1, ERC1, ESK1, BRE2/3, BRU2, CUL1, BEL3. The main limitations are that this is a small number of sites and also the key spawning arm of the Glass (the Abhainn Deabhag), is not included. Trends may be deduced from the information provided in this section but not absolute densities as the data is not fully quantitative and does not take into account associated capture efficiencies. See figures 22 and 23.

Figure 22: Temporal changes in average salmon fry and parr densities at historic sites. Fish survey months annotated.

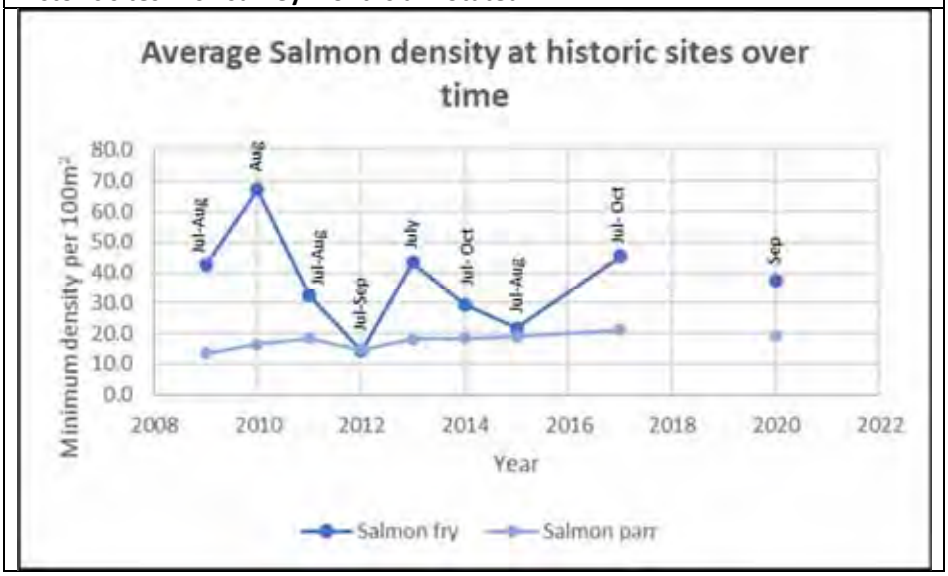
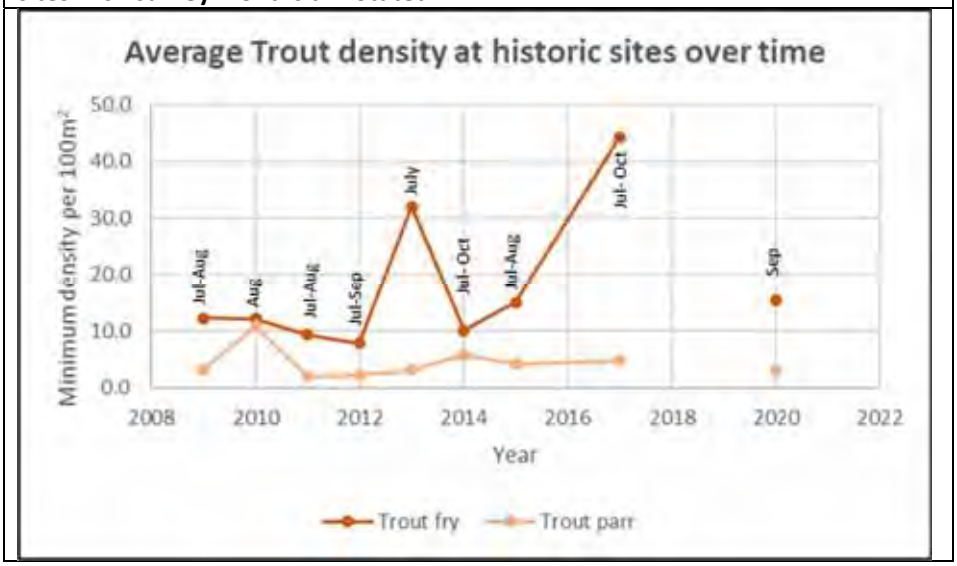


Figure 23: Temporal changes in average trout fry and parr densities at historic sites. Fish survey months annotated.



It is apparent that 2020's salmon and trout fry densities are within the historic ranges with fry numbers varying widely year on year. This will be due to many factors. Apart from actual variations in fry densities caused by the varying numbers of adult spawners and flows throughout spawning and the incubation period; survey timing will also have a part to play. Fry numbers drop over the course of the summer, due to natural mortality, with successful fry able to hold down feeding territories, so higher fry numbers are likely to be found at the beginning of the

summer. Other factors that can account for the variation of fry densities can include varied wetted widths and capture efficiencies.

Analysis of the relationship between the number of adults and juvenile densities would be beneficial to see how recruitment varies.

It is valuable to look at parr densities as these are more stable and are more closely associated with smolt output. Figures 24 and 25 show average parr densities over time with classification boundaries.

Figure 24: Average Salmon Parr density at historic sites over time, with classification boundaries.
P/M= Poor/ Moderate, M/G=Moderate/ Good, G/E=Good/ Excellent.

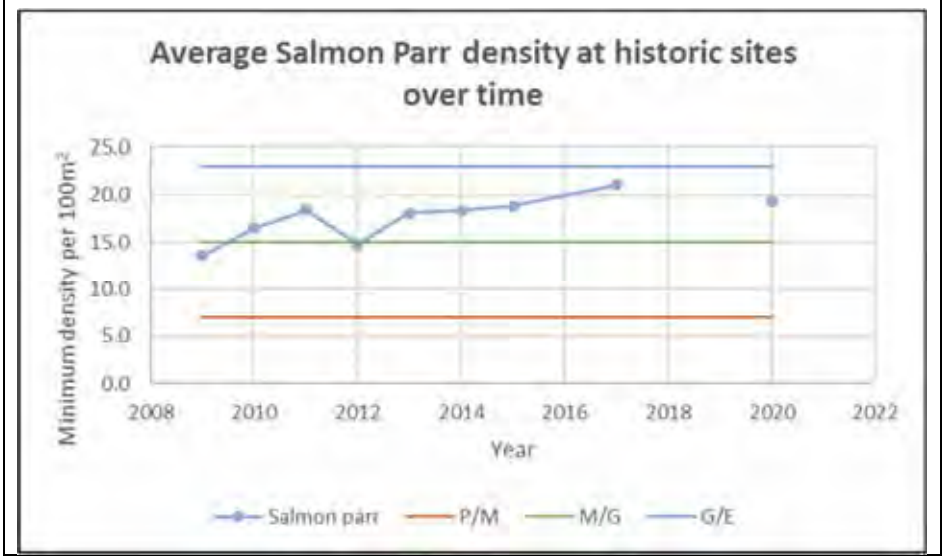


Figure 25: **Average Trout Parr density at historic sites over time, with classification boundaries.**
P/M= Poor/ Moderate, M/G=Moderate/ Good, G/E=Good/ Excellent.

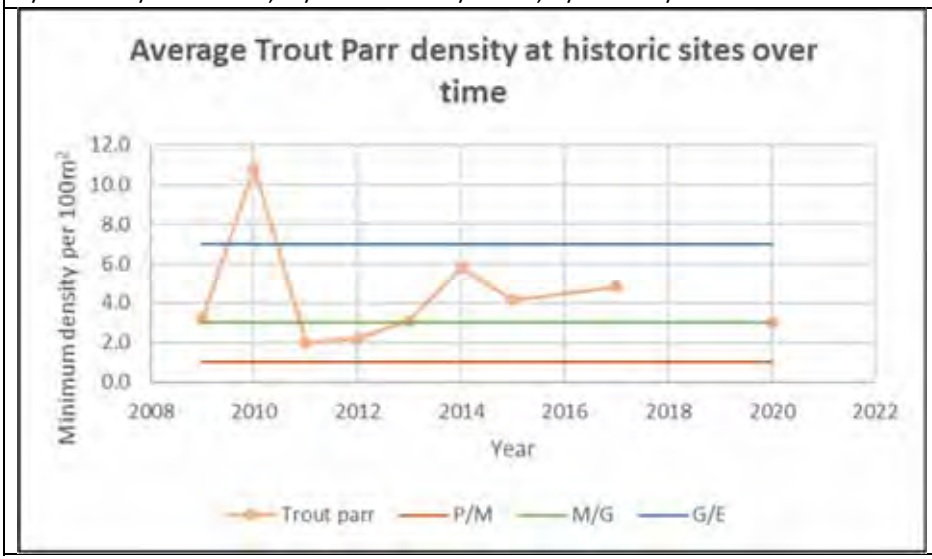


Figure 24 shows a general trend of increasing salmon parr numbers which is very encouraging. It would appear that the Beauly catchment has relatively stable salmon parr numbers and is near the top of the 'Good' class however it is not possible to know how far this is off potential historic highs.

Figure 25 shows that the catchment is currently on the 'Moderate/ Good' boundary for trout parr, and that there was a trend of improving trout densities seen between 2011-2017. The exceptionally high trout parr densities in 2010 shows the potential for the catchment. The fluctuating nature of the trout parr densities may be down to more varied adult sea trout movements in the wider Moray Firth.

This summary also masks varying parr densities found at individual sites, and those not included in the average. For example, the Abhainn Deabhag is not represented amongst the sites included here, and as previously discussed would appear to be below carrying capacity. It should also be borne in mind that what may appear to be increasing densities may be an artefact of a survey team who have worked together and improved with practice.

6. Conclusions and Recommendations

6.1 Conclusions and Recommendations by Sub-catchment

Strathfarrar

Generally, the R. Farrar and its tributaries had average or improved salmon fry densities in comparison with previous survey years. This continued improvement was especially evident in the Uisge Misge and Farrar. The Allt Choire Mhuillidh also had its best numbers of fry and parr which is likely due to increased adult spawning in this tributary. The variable parr numbers seen at a site level do not seem to be directly related to the previous year's fry numbers but point to parr habitat being inconsistently utilised, so it will be good to see if the general improvement is sustained over the coming years. Culligran burn shows the most stable parr numbers of the Farrar tributaries. An eel was found on the Farrar mainstem, this was the furthest up the catchment they were found this year. **Poor fry numbers were found on the Allt Innis a' Mhuilt. The reasons for the sporadic absence of fry are unknown and further work is needed here. Riparian tree planting and continued sediment management is recommended on the upper Farrar to improve habitat and ensure continued spawning substrate availability.**

R. Glass

The moderate densities of juvenile salmon found in 2020 and past NEPs surveys (despite the presence of good habitat) on the Abhainn Deabhag suggest that it is below carrying capacity. **It will be essential to keep an eye on this important spawning river through surveying a wider range of sites. Habitat and pressures survey work may improve our understanding of the patchy juvenile salmon distribution.**
Although small, the Glass burn continues to provide important spawning and fry habitat for both salmon and trout.

Cannich

The lower Cannich has historically absent or poor fry densities. Despite there being just moderate numbers of salmon fry and parr found in 2020, this was a relatively good result for the site. **Further work is required to see if the stable nature of the lower Cannich (and lack of spawning substrate) is natural or not.**

Upper Beauly

Moderate salmon fry densities were found on both the Eskadale and Erchless burns. Salmon parr numbers dropped in 2015 on Erchless burn and have not recovered. Eskadale burn appears to be naturally more suited to trout than salmon. **Grant support to help the estate control the spread of Rhododendron along Erchless burn should be found to help against overshading**. Eskadale is also over-shaded.

Middle Beauly

Salmon fry densities were excellent and salmon parr densities are stable.

Lower Beauly

The good and excellent fry numbers at the mainstem Beauly sites suggest that salmon spawning in 2019 was more prevalent at these sites compared to previous years. Trout fry and parr densities on the Belladrum, Bruaich and Culburnie burns were good-excellent. Salmon fry and parr were also found at excellent densities on the Belladum and Bruaich burns. Salmon fry numbers are variable and sometimes absent on Culburnie burn but this is likely due to the small size of the burn.

Coastal

Moniack burn was found to have excellent densities of trout fry and parr as well as being the most diverse site of BFB's 2020 electro-fishing surveys. **The bridge apron at Bunchrew burn requires a SNIFFER2 assessment to check its passability for sea trout.**

6.2 General Conclusions and Recommendations

-An increased spread of minnows was found compared to past years.

-Analysis of fish count data (photos) may help identify whether sea trout are using the Upper Beauly and wider catchment above Aigas dam.

-Scale reading work would be useful to clarify the presence of age classes, especially at UM2, BEL4 and AIM3.

-Plotting adult fish count data against juvenile densities may help identify where we are on the stock recruitment curve.

-The three-second delay safety feature on the back-pack kit may have reduced fish capture efficiency and it is recommended that either the kit is used differently (i.e. hover the anode out of the water for the first 3 seconds), the safety feature is removed, or new kit is acquired for next season.

-If safe to do so, more mainstem sites should be added as coverage is currently patchy (e.g. on the Upper Beauly). Sites could also be added to include more sub-optimal sites, and areas downstream of hydro-dams so that issues of low adult return rates and the effect of any management changes can be monitored.

-Some of the older electro-fishing data (pre-2007) does not seem to be in the SFCC database and time needs to be put aside for re-locating this data.

References

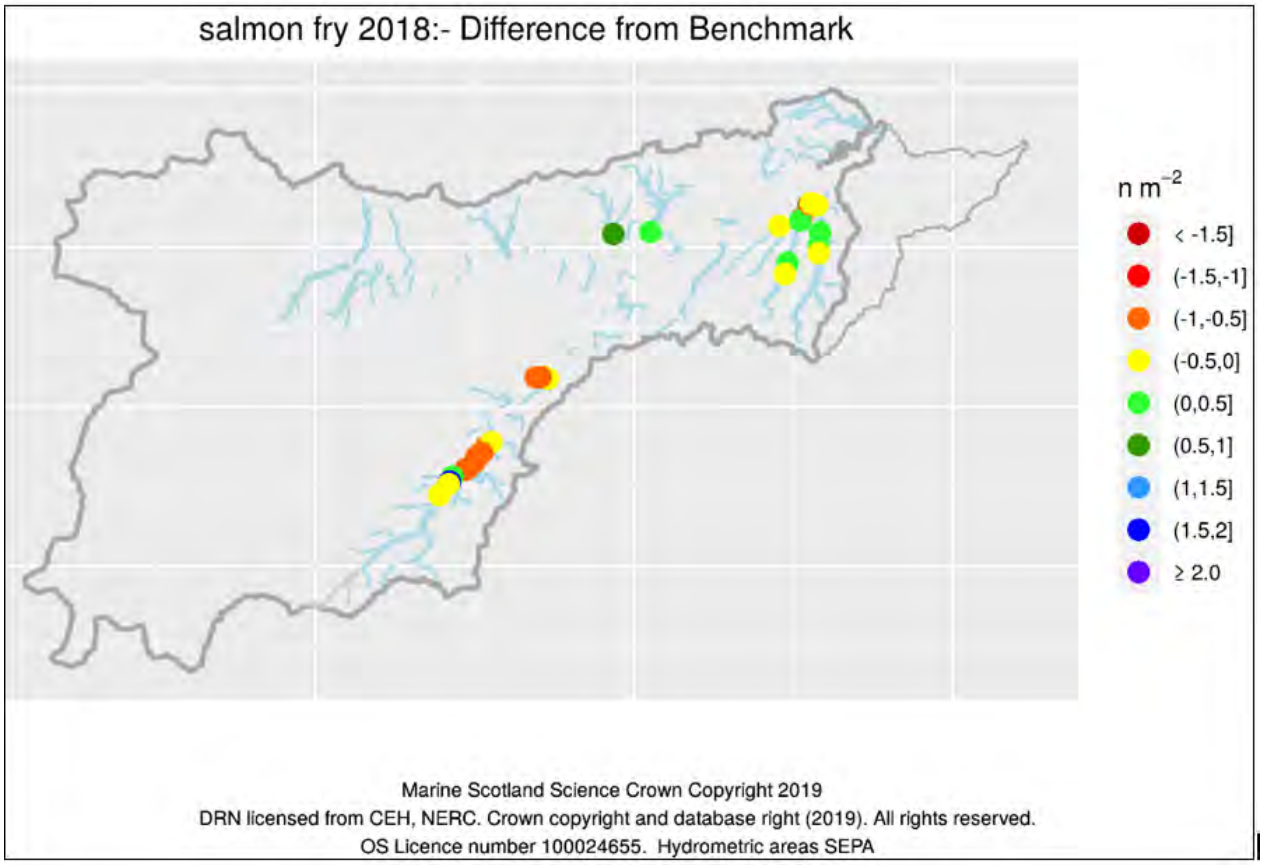
[1] Glover R.S et al (2020) Quantifying the relative importance of stock level, river temperature and discharge on the abundance of juvenile Atlantic salmon (Salmo salar). Ecohydrology. ISSN: 1936-0592.

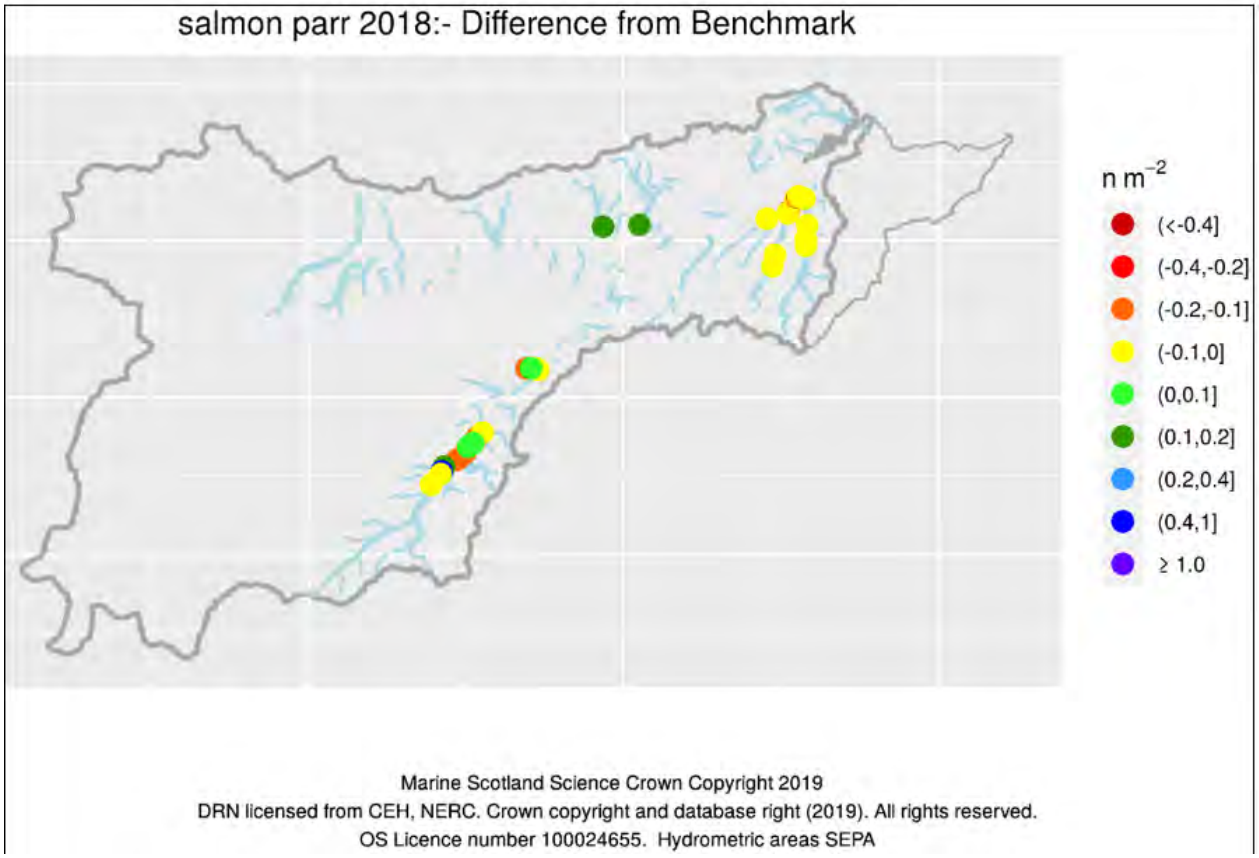
[2] Data derived from I A Malcolm, K J Millidine, F L Jackson, R S Glover and R J Fryer. (2020). The National Electrofishing Programme for Scotland (NEPS) 2019. Scottish Marine and Freshwater Science Vol 11 No 9. Crown Copyright 2020. https://scotland.shinyapps.io/sg-national-electrofishing-programme-scotland/

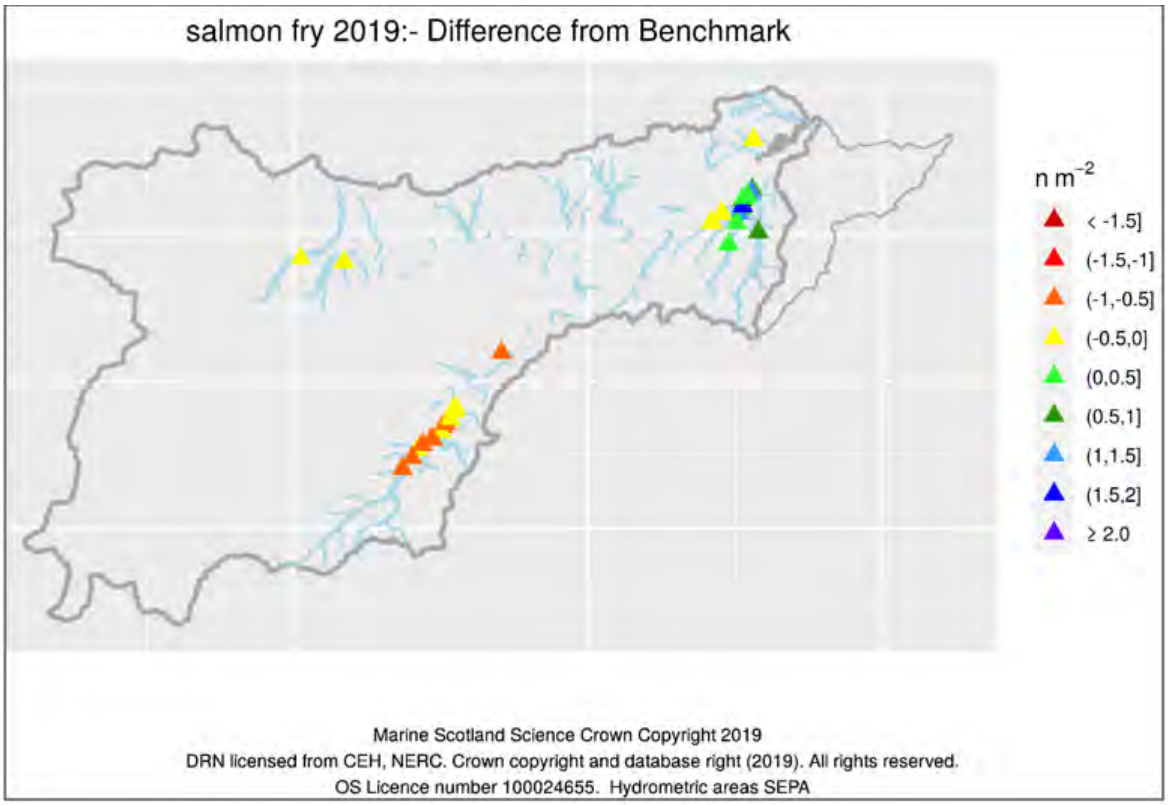
[3] SFCC Electro-fishing Team Leader Training Manual (2007)

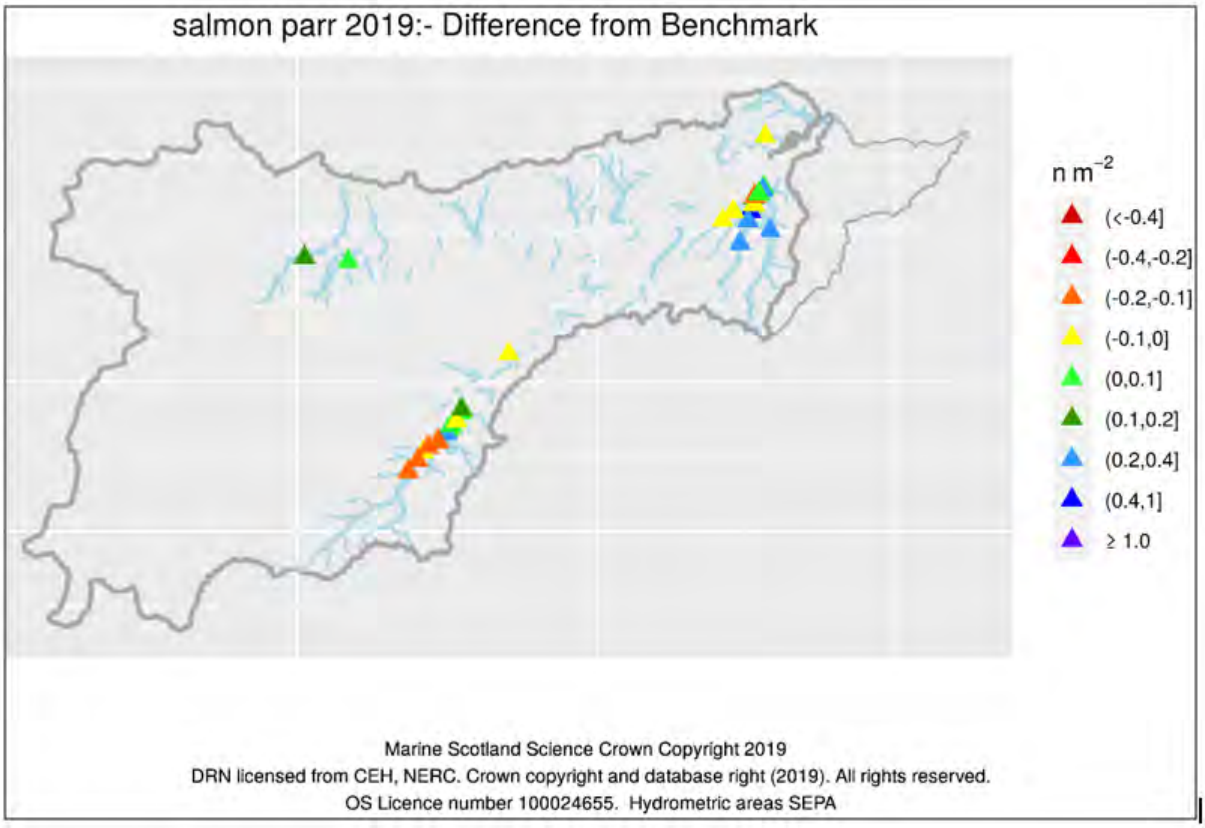
Past Ness and Beauly Fishery Trust Electro-fishing reports

Appendix 1- National Electrofishing Programme for Scotland (NEPS), 'Difference from Benchmark' results.

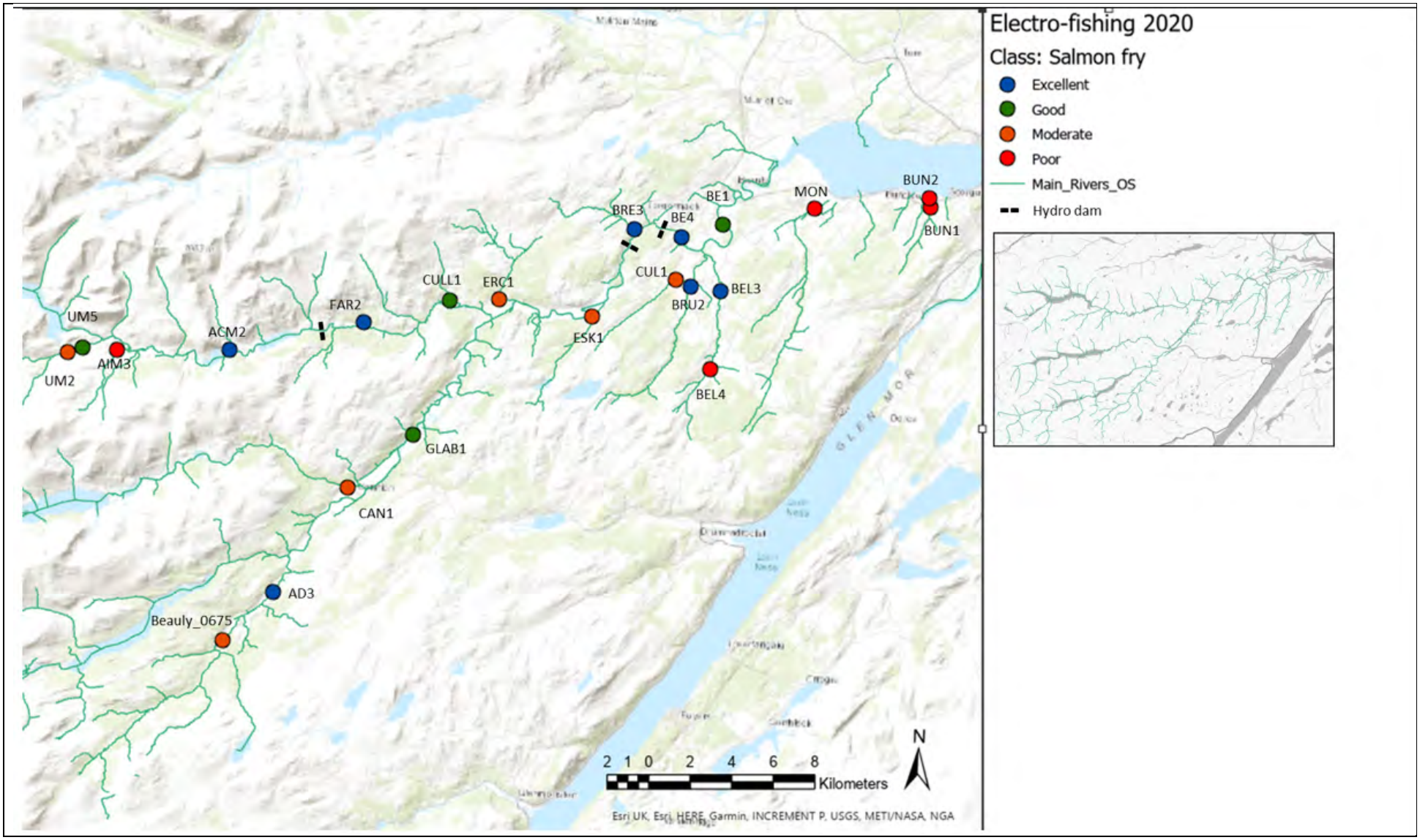


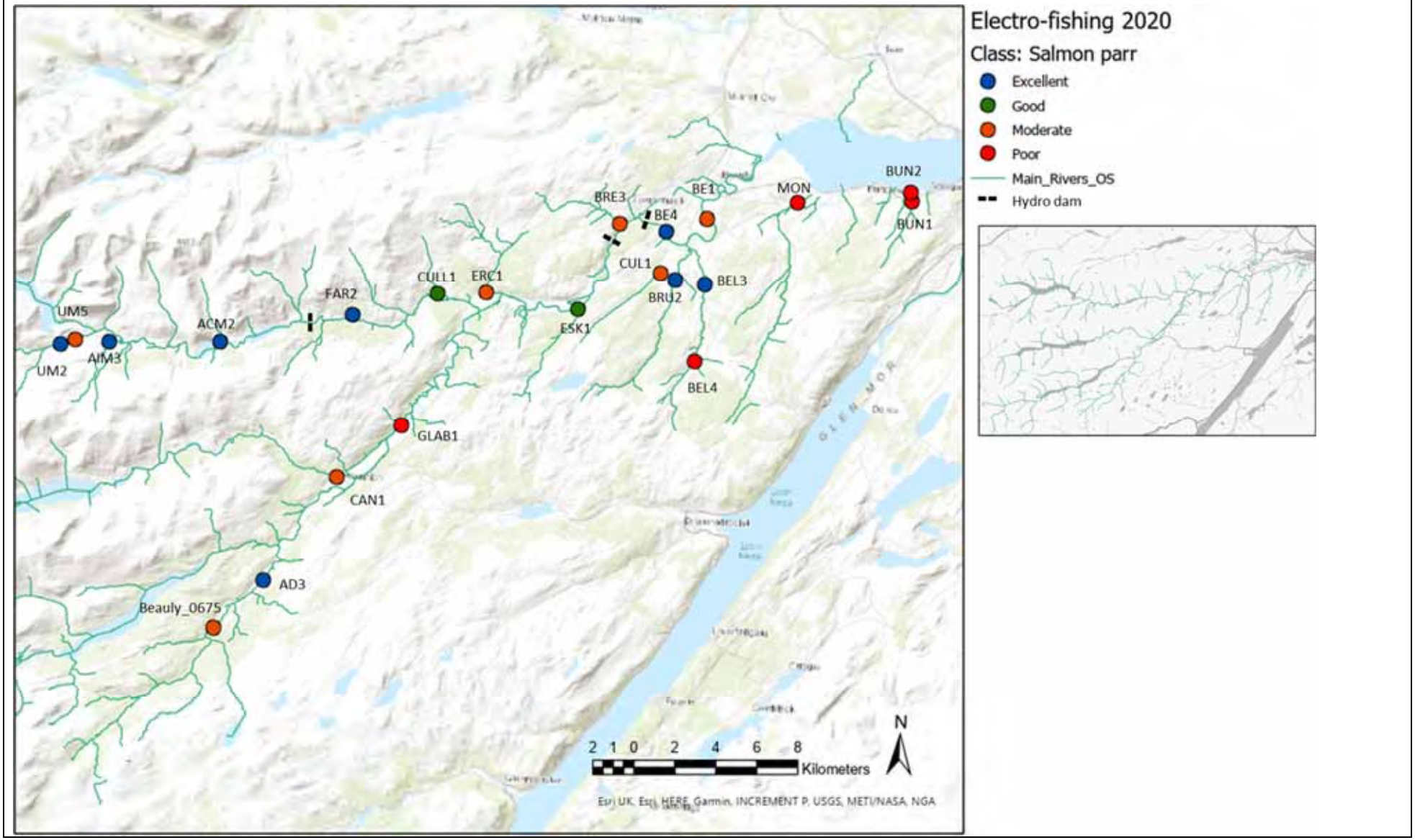


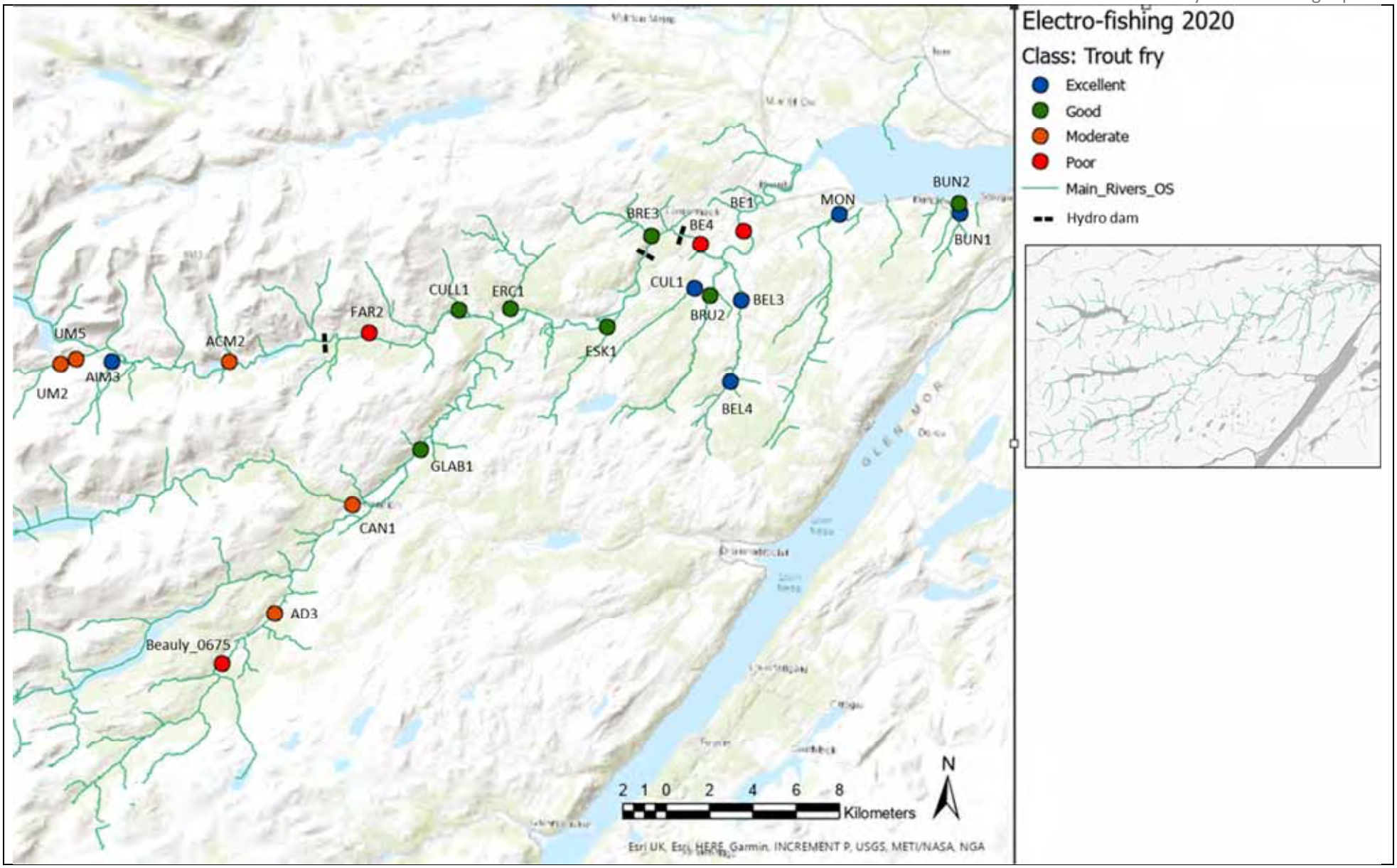

salmon fry 2019:- Difference from Benchmark
n m^{-2}
< -1.5]
(-1.5,-1]
(-1,-0.5]
(-0.5,0]
(0,0.5]
(0.5,1]
(1,1.5]
(1.5,2]
≥ 2.0
Marine Scotland Science Crown Copyright 2019
DRN licensed from CEH, NERC. Crown copyright and database right (2019). All rights reserved.
OS Licence number 100024655. Hydrometric areas SEPA

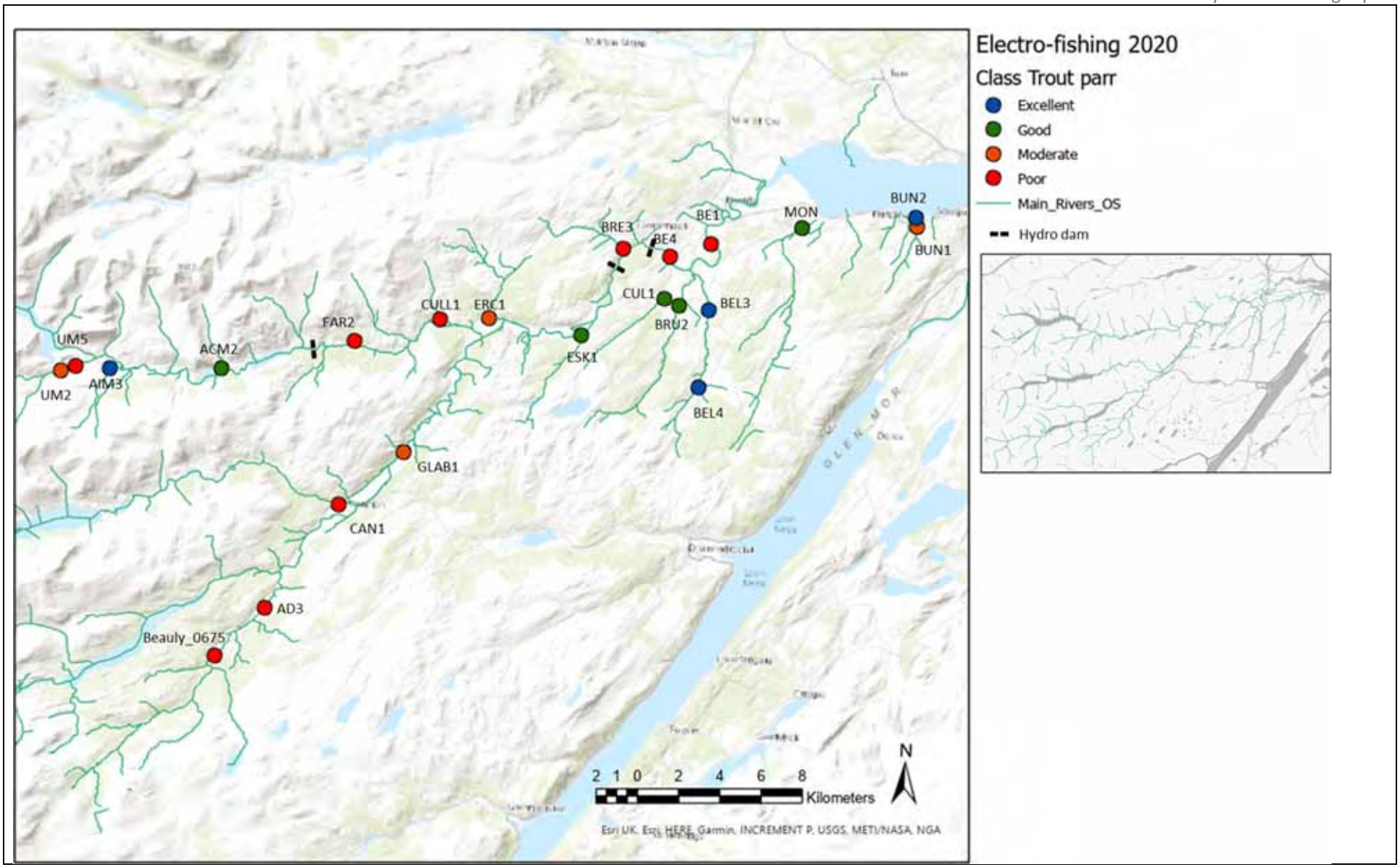

salmon parr 2019:- Difference from Benchmark
n m^{-2}
(<-0.4]
(-0.4,-0.2]
(-0.2,-0.1]
(-0.1,0]
(0,0.1]
(0.1,0.2]
(0.2,0.4]
(0.4,1]
≥ 1.0
Marine Scotland Science Crown Copyright 2019
DRN licensed from CEH, NERC. Crown copyright and database right (2019). All rights reserved.
OS Licence number 100024655. Hydrometric areas SEPA

Appendix 2- Classification results by age class and species




Electro-fishing 2020
Class: Salmon parr
Excellent
Good
Moderate
Poor
Main_Rivers_OS
Hydro dam
BUN2
BUN1
MON
BE1
BRE3
BE4
CUL1
BEL3
BRU2
CULL1
ERC1
FAR2
ESK1
ACM2
UM5
UM2
AIM3
BEL4
GLAB1
CAN1
AD3
Beauly_0675
2 1 0 2 4 6 8
Kilometers
N
Esri UK, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, NGA


Electro-fishing 2020
Class: Trout fry
Excellent
Good
Moderate
Poor
Main_Rivers_OS
Hydro dam
BUN2
BUN1
MON
BE1
BRE3
BE4
CUL1
BEL3
BRU2
BEL4
CULL1
ERG1
FAR2
ESK1
ACM2
UM5
AIM3
UM2
GLAB1
CAN1
AD3
Beauly_0675
2 1 0 2 4 6 8
Kilometers
N
Esri UK, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, NGA


Electro-fishing 2020
Class Trout parr
Excellent
Good
Moderate
Poor
Main_Rivers_OS
Hydro dam
UM5
UM2
AIM3
ACM2
FAR2
CULL1
ERC1
ESK1
BRE3
BE4
BE1
CUL1
BRU2
BEL3
BEL4
MON
BUN2
BUN1
GLAB1
CAN1
AD3
Beauly_0675
2 1 0 2 4 6 8
Kilometers
N
Esri UK, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, NGA

Appendix 3- Site photos

R. Farrar> Uisge Misge> UM2

R. Farrar> Uisge Misge> UM5

R. Farrar> Allt Innis a' Mhuilt> AIM3

R. Farrar> Allt Coire Mhuillidh > ACM2

R. Farrar> Culligran burn> CULL1

R. Farrar > FAR2

R. Beauly> Breackachy burn> BRE3	R. Beauly> Bruiach burn> BRU2
Site photo not taken	
R. Beauly> Bruiach burn > Culburnie burn> CUL1 (Upstream end of site looking downstream)	**R. Beauly> Belladrum burn> BEL4**
	

R. Beauly> BE1

Moniack burn> MON

Bunchrew burn> BUN1	Bunchrew burn> BUN2