NESS & BEAULY FISHERIES TRUST

River Beauly Catchment

Electro-fishing Results 2018

Captured Salmon parr in the Beauly system. Photo C. Daphne

A document prepared by the Ness & Beauly Fisheries Trust

Version 1.2 (04/04/2019)

Ness & Beauly Fisheries Trust

DOCUMENT CONTROL

Created by	Date	Signed
Diego del Villar (Senior Fisheries Biologist, NBFT)	04/04/19	
Reviewed By	**Date**	**Signed**
Chris Conroy (Director, NBFT)	04/04/19	
Approved by	**Date**	**Signed**
Chris Conroy (Director, NBFT)	04/04/19	
File Reference	**Revision**	**Notes**
C:\Users\NBFT-1\Documents\Electrofishing\E Fishing 2018	Version 1.2	

Ness & Beauly Fisheries Trust
Corff House
Beauly
Inverness-shire
IV4 7BE

Telephone: 01463783505
Email: nessandbeauly@gmail.com

Table of Contents

Non-technical summary

This report examines salmon and trout juvenile stock performance at 33 sites in the Beauly system in 2018 and the historical time series for the Beauly system as a whole (years 2000-2018). This report serves to assess the conservation status of individual river stocks and helps to ensure that the NBFT has appropriate fisheries management measures in place for the Beauly catchment. The conservation status for each river is based on an existing classification scheme for the Beauly system (Baker, N., Electrofishing report 2017).

In 2018, overall good densities of salmon fry were recorded in the Bruiach burn, the Farrar and the Glass rivers with moderate densities recorded in the Erchless Burn and the Belladrum burn and absent at the only electrofished site in the Culburnie burn. Besides, Salmon parr densities in these rivers were generally low and ranged from poor to moderated. However, this finding may be more related with the random selection of the sites by MSS and not to the actual status of the sub-populations. For instance, in the river Glass salmon parr densities up to 99.91 parr/ 100 m^2 were recorded suggesting that there is excellent habitat for salmon parr within the river.

On the other hand, excellent trout fry densities were achieved at the Belladrum and Bruiach burns, confirming that these streams are suitable habitats for sea trout spawning. However in the river Glass, where the electrofishing effort was high, moderate numbers of fry and parr were recorded. Trout parr densities were high in the Culburnie burn (classed as excellent) and in the Belladrum Burn (classed as good). Moderated parr numbers were found in the Bruiach burn, Erchless burn and the river Farrar. Significantly low trout parr densities were recorded in the River Glass suggesting poor trout performance in this river.

The trends at the historical sites in the River Beauly (BE1, BE3: and BE4) show high densities of salmonids with clear positive trends at sites BE1 and BE3. Salmon densities at BE4 seem to vary more but ranging from moderate to good densities. These results suggest a good conservation status for the salmon sub-population in the river Beauly.

Finally, the historical trends for the Beauly system as a whole indicate that salmon fry densities are stabilized around 50 fry per 100 m^2 while salmon parr densities are significantly lower but constant around 25 parr per 100 m^2. Trout fry densities seems to be constant around 20 parr per 100 m^2. On the other hand, slightly negative trend is observed in Trout parr densities but generally 5 trout per 100 m^2 could be expected. Under the current classification scheme, the Beauly system could be classified as moderate to good in salmon fry densities and good in salmon parr densities. Trout fry and parr densities are classed to be good across the years in the Beauly system.

Steps should be taken to improve knowledge on real density estimates for each specific river and across the catchment and survival from fry to parr stage should be assessed across the Beauly catchment to rule out the possibility of negative factors affecting parr survival.

1 Introduction

- This report examines salmon and trout juvenile stock performance at 33 sites in the Beauly system in 2018.
- Site selection was carried out by Marine Scotland Science (MSS) by using a randomized sample design (Malcom *et al.,* 2018), thus comparisons with historical electrofished sites is not possible with the exception of three sites in the main stem of the river Beauly.
- This year's results will help MSS to develop a juvenile assessment method that can be used to determine conservation limits across Scotland. But, for the purposes of this report, fish densities collected in each of the electrofished rivers will be classified as: absent, poor, moderate, good and excellent based on an existing classification scheme for the Beauly district.
- This report includes an overall view of juvenile salmonid densities across years in the Beauly catchment. This is important to identify any negative trends in the salmonid stocks and to determine benchmarks for conservation.
- Electrofished sites differed in the quality to sustain salmonid juveniles thus comparisons between sites or between rivers is not possible at this stage until benchmark densities will be stablished by the Scotish Government.
- This report serves to assess the conservation status of individual river stocks and helps to ensure that the NBFT has appropriate fisheries management measures in place for the Beauly catchment.

2 National electrofishing programme 2018

In the summer and autumn of 2018, the Ness and Beauly Fisheries Trust (NBFT) undertook a programme of electro-fishing in the Beauly catchment as part of the national electrofishing survey. The overall aim of this program is to develop a juvenile assessment method that can be used to determine the status of salmon populations at a range of spatial scales, from individual electrofishing sites to catchments and regions. Ultimately, this program will enable MSS to consider approaches for deriving benchmark densities to assess the status of salmon and trout across Scotland.

A total of 30 sites were electrofished in the Beauly system as part of the National Salmon Monitoring Survey in 2018 (Fig. 2)

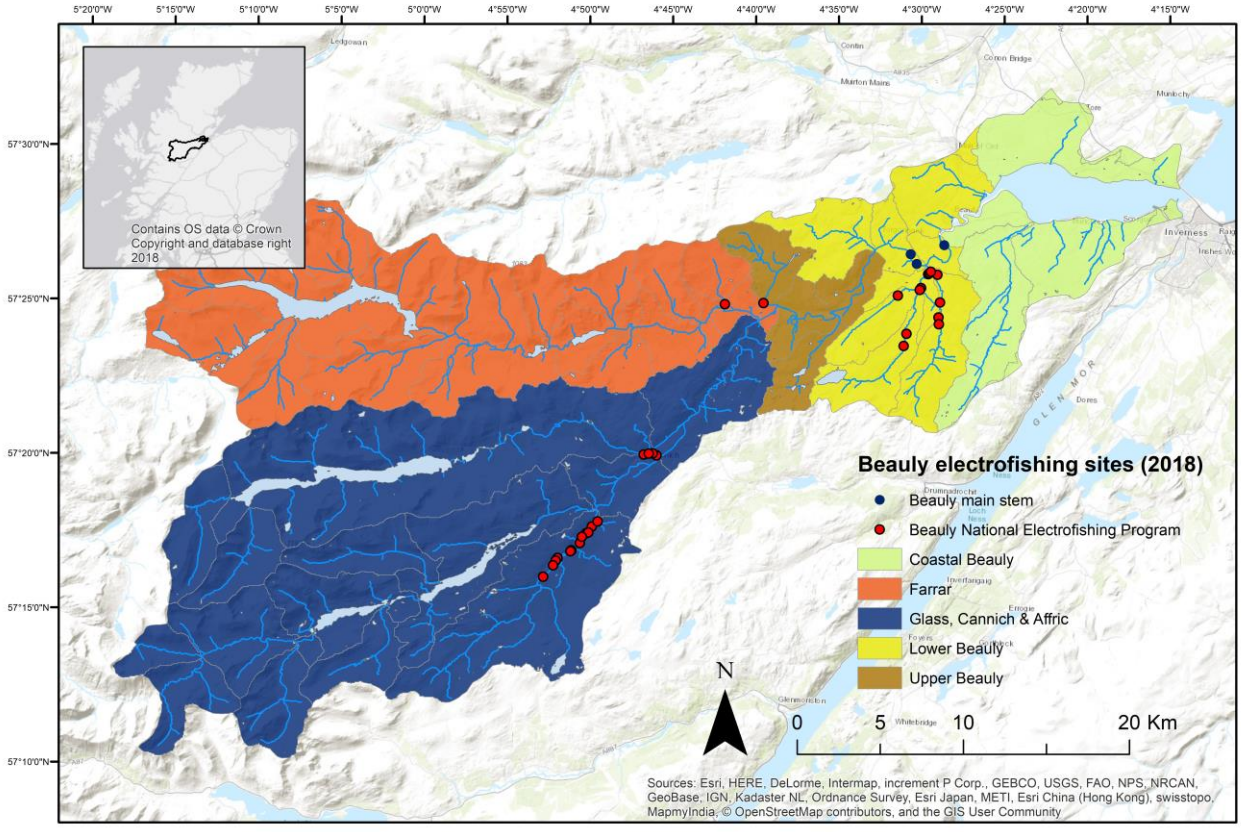

Fig. 2: Main stem and national electrofishing sites in the Beauly management units for the year 2018.

The selection of the electrofishing sites was conducted by MSS and followed a stratified, unequal probability, generalised random tessellation stratified (GRTS) sample design (Malcom *et al.,* 2018). This sampling methodology guarantees maintaining random site selection at finer spatial scales. Only rivers that had a high

chance of being sampled by wading and electrofishing were included in the sample design. Then large rivers, very small rivers and lochs were excluded. Moreover, rivers above impassable barriers for salmon were excluded from the design. In addition to this work, three extra sites were electrofished in the Beauly main stem at: **BE1**, **BE3** and **BE4**. This allows to continue the historical records in key sites of the river Beauly (Fig. 3).

Fig. 3: Location of the main stem sites in the Beauly for the year 2018 (B1 right corner, B3: middle, B4: left corner).

The national survey requested that all salmon and trout parr had scale samples taken. Added to this was genetic sampling in the form of fin clips from all salmon parr. Both the scale and genetic sample records were linked to each individual fish. This additional sample data was for age classification and genetic sampling to determine local age structure and genetic diversity. It would also serve as a legacy of sample data taken across the country using standardised techniques. Along with the fish data, the survey took information on the sampling site: flow types and vegetation, site dimensions and bank structure were also recorded. Count data was taken for all species of fish captured during the survey. In the Beauly area along with salmon (*Salmo salar*) and trout (*Salmo trutta*), minnow (*Phoxinus phoxinus*), European eel (*Anguilla Anguilla*) and lamprey spp. were all noted during the survey.

3 Electrofishing methodology

Back-pack electro-fishing equipment was utilised to capture juvenile salmonids in the Beauly system. Fully quantitative (3 passes) and single run pass surveys were carried out and recorded in accordance with the protocols established by the Scottish Fisheries Co-ordination Centre (SFCC). The degree of information obtained by these methods vary in detail from fully quantitative surveys that attempt to make an accurate population estimate with associated confidence limits, to minimum density estimates that describe the number of fish caught at a given site.

Before electrofishing, survey areas were isolated by placing stop nets at the upstream and downstream extent of the length to be fished to prevent fish from evading capture and escaping from the area. The survey area was fished through in a methodical and thorough manner, with fish being retained in water filled buckets. Captured fish were lightly anaesthetised in order to facilitate species identification and accurate fork length measurements (mm) and finally, released along the surveyed area.

4 Data analysis

For the national sites, juvenile Salmon density estimates were calculated as the number of fish per 100 metre square (wetted area) for fully quantitative and single run pass surveys based on a probability model developed by MSS (Malcom *et al.,* 2019). For the main stem sites (BE1, BE3 and BE4) Zippin values per 100 metre square (wetted area) were calculated. Currently, MSS has not yet developed a probabilistic model for trout and only minimum density estimates per 100 metre square were calculated for the national sites (for both fully quantitative and single pass surveys). Density classification of juvenile salmonids abundance is given in the table below (Table 1). This follows previous classification schemes on the Beauly Catchment (Baker, N., Electrofishing report 2017).

Table 1 – Historical density classification of Juvenile Salmonids on the Beauly Catchment.

	Salmon (counts/100m2)		Trout (counts/100m2)	
	Fry	Parr	Fry	Parr
Absent	0	0	0	0
Poor	0.1-17	0.1-11	0.1-2	0.1-1
Moderate	17.1-52	11.1-22	2.1-10	1.1-3
Good	52.1-92	22.1-37	10.1-24	3.1-9
Excellent	92.1-398	37.1-62	24.1-314	9.1-60

Boxplots are used in this report to visualize fish density values for each of the electrofished rivers (Fig. 4). They provide a useful way to show overall patterns within a particular river at different sites. To do that values obtained at each river site (fish densities) are plotted as dots in the graph and black lines represent the underlying distribution of each of the points within each of the quartiles. The middle part of the boxplot corresponds to the median value ie. separating the higher half from the lower half of a data sample. A red dashed line is also added on top of the box plot indicating the historical lower limit for a good density estimate.

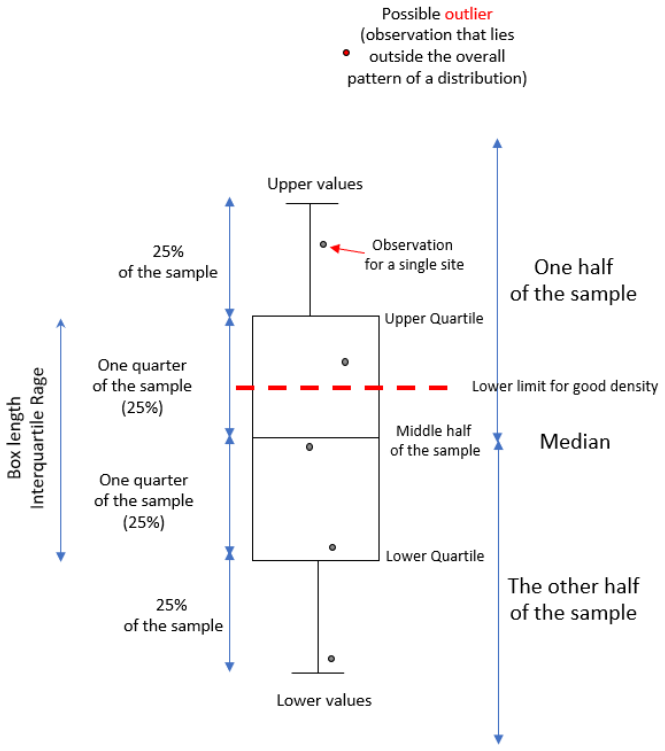

Fig. 4: Theoretical example of a Boxplot for a river.

5 Results

5.1 National electrofishing programme

Salmon densities

The following figure (Fig. 5) shows salmon fry (SF) and parr (SP) density estimates in the Beauly catchment in 2018. The red dashed line represents the historical lower limit for a good density estimate in the catchment based on exiting classification in the Beauly system (Baker, N., Electrofishing report 2017.). Note different scales for salmon fry and parr.

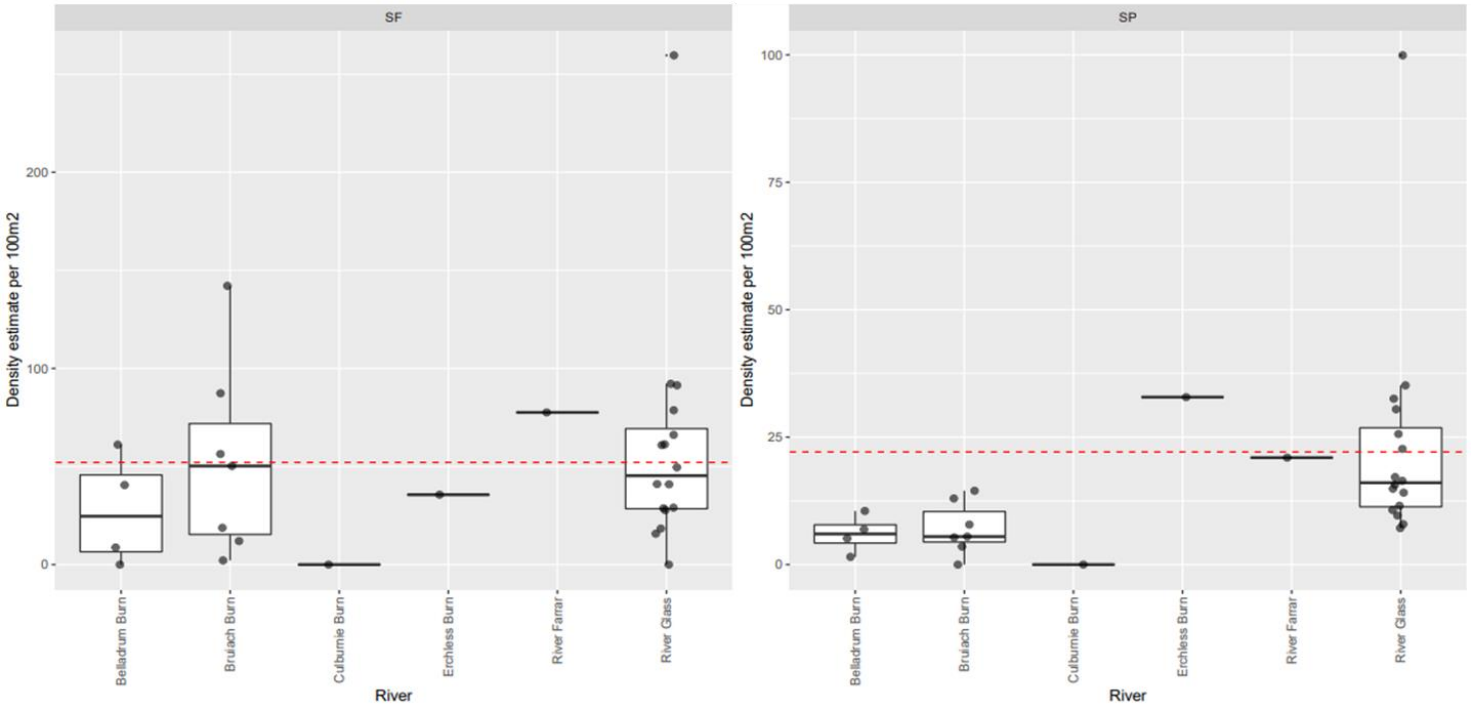

Fig. 5: Boxplots of juvenile salmon densities at six different rivers in the Beauly system in 2018. The red dashed line represents the historical lower limit for a good density estimate in the catchment.

In 2018, overall good densities of salmon fry were recorded in the Bruiach burn, the Farrar and the Glass rivers with moderate densities recorded in the Erchless Burn and the Belladrum burn and absent at the only electrofished site in the Culburnie burn (Table 2).

Table 2 – Summary table of Salmon fry density estimates and status in the Beauly system. Classification based on Baker, N., Electrofishing report 2017.

River	Number of sampled sites	Average	Min	Max	StdDev	Status
Belladrum Burn	4	27.60	0	61.14	28.35	Moderate
Bruiach Burn	7	52.71	2.13	142.08	49.29	Good
Culburnie Burn	1	0	0	0		Absent
Erchless Burn	1	35.63	35.63	35.63		Moderate
River Farrar	1	77.56	77.56	77.56		Good
River Glass	16	60.08	0	259.59	59.64	Good

Besides, Salmon parr densities in these rivers were generally low and ranged from poor to moderated at each of the sites (Fig.5, Table 3). However, the River glass also recorded a maximum density of 99.91 parr/ 100 m2 suggesting that there are also excellent sites for salmon parr within the river. Statistical work to be carried out by marine Scotland will allow a better status classification for each river system within the catchment and across Scotland.

Table 3 – Summary table of Salmon parr density estimates and status in the Beauly system. Classification based on Baker, N., Electrofishing report 2017.

River	Number of sampled sites	Average	Min	Max	StdDev	Status
Belladrum Burn	4	6.02	1.52	10.52	3.74	Poor
Bruiach Burn	7	7.09	0	14.48	5.14	Poor
Culburnie Burn	1	0	0	0		Absent
Erchless Burn	1	32.85	32.85	32.85		Moderate
River Farrar	1	20.98	20.98	20.98		Moderate
River Glass	15	22.61	7.16	99.91	22.89	Moderate

Finally, overall parr densities were significantly lower than fry across the Beauly the catchment. This may be due to a process of natural selection; but it could also indicate other pressures for parr survival in the catchment (e.g. pollution, habitat quality, etc).

Trout densities

The following figure (Fig. 6) shows trout fry (SF) and parr (SP) density estimates in the Beauly catchment in 2018. The red dashed line represents the historical lower limit for a good density estimate in the catchment. Note different scales for trout fry and parr.

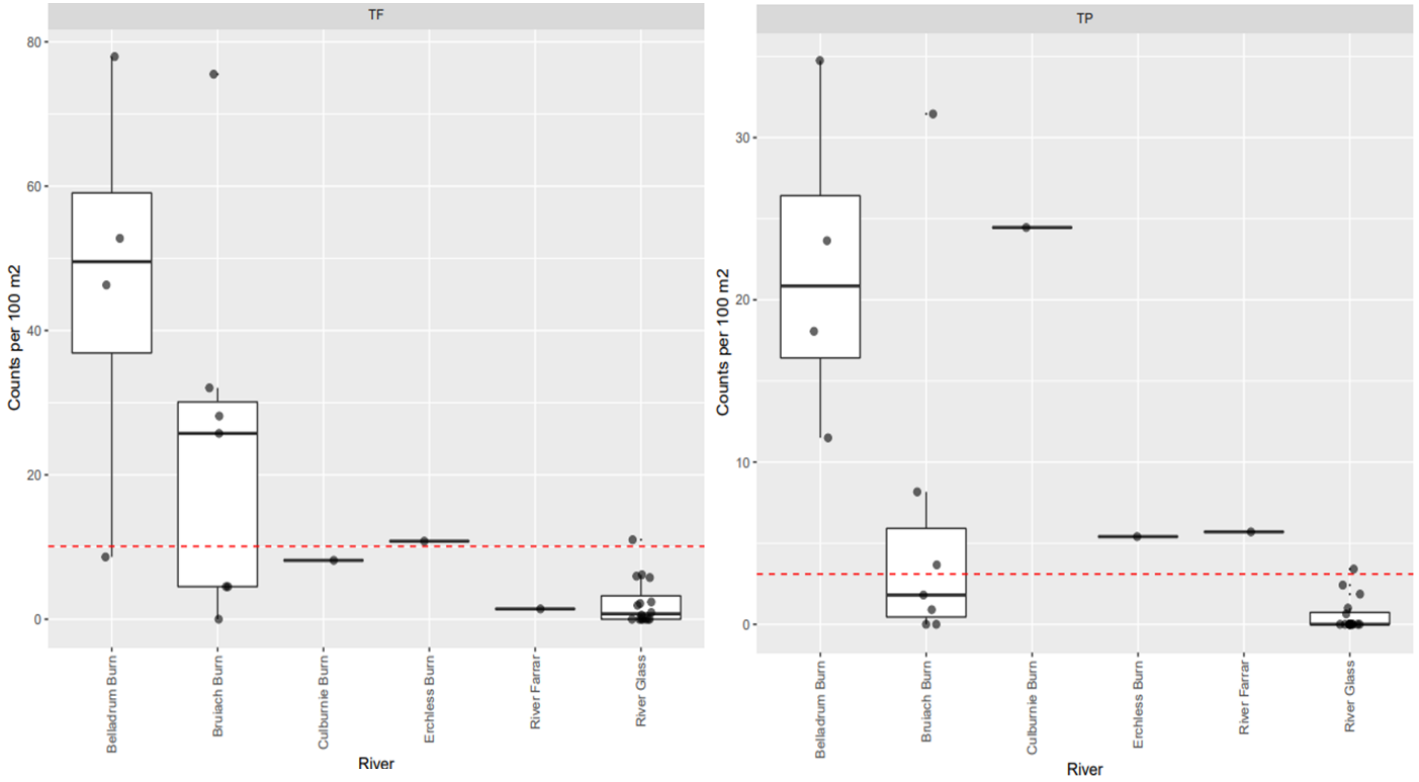

Fig.6: Boxplots of juvenile trout densities at six different rivers in the Beauly system in 2018. The red dashed line represents the historical lower limit for a good density estimate in the catchment.

As previously discussed for salmon there exists a large variability in the density values recorded within and between each of the studied sites. Thus, the results should be carefully interpreted in each case.

Based on the existing classification scheme for the Beauly (Baker, N., Electrofishing report 2017) excellent trout fry densities were achieved at the Belladrum and Bruiach burns, confirming that these streams are suitable habitats for sea trout spawning. However in the river Glass, where the electrofishing effort was high, moderate numbers of fry and parr were recorded.

Table 4 – Summary table of trout fry density estimates and status in the Beauly system. Classification based on Baker, N., Electrofishing report 2017.

River	Number of sampled sites	Average	Min	Max	StdDev	Status
Belladrum Burn	4	46.41	8.62	77.95	28.65	Excellent
Bruiach Burn	7	24.35	0	75.51	26.05	Excellent
Culburnie Burn	1	8.15	8.15	8.15		Moderate
Erchless Burn	1	10.81	10.81	10.81		Good
River Farrar	1	1.42	1.42	1.42		Poor
River Glass	16	2.31	0	11.01	3.25	Moderate

Trout parr densities were high in the Culburnie burn (classed as excellent) and in the Belladrum Burn (classed as good). Moderated parr numbers were found in the Bruiach burn, Erchless burn and the river Farrar. Significantly low trout parr densities were recorded in the River Glass suggesting poor trout performance in this river (See table 5).

Table 5 – Summary table of trout parr density estimates and status in the Beauly system. Classification based on Baker, N., Electrofishing report 2017.

River	Number of sampled sites	Average	Min	Max	StdDev	Status
Belladrum Burn	4	21.99	11.49	34.75	9.85	Good
Bruiach Burn	7	6.57	0	31.46	11.34	Moderate
Culburnie Burn	1	24.46	24.46	24.46		Excellent
Erchless Burn	1	5.41	5.41	5.41		Moderate
River Farrar	1	5.70	5.70	5.70		Moderate
River Glass	16	0.58	0	3.41	1.06	Poor

5.2 Main River stem

The following figure (Fig. 7) shows the minimum, average and maximum salmon density estimates in the river Beauly main stem across the different years of sampling (sites: **BE1**, **BE3** and **BE4,** See Fig. 3). In addition, the red dashed line represents the historical lower limit for a good density estimate in the catchment.

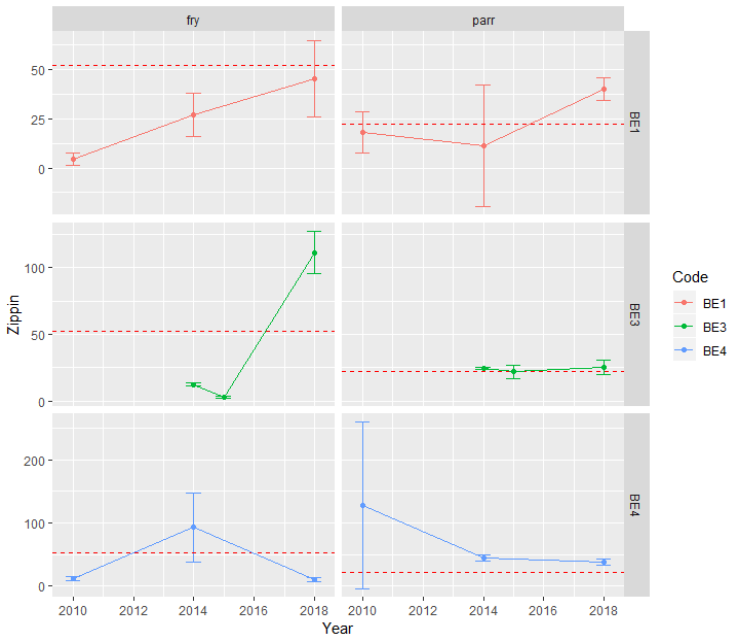

Fig. 7: Average, minimum and maximum Zipping estimates for the main stem sites in the Beauly.

Positive trends in salmon abundance were observed at sites BE1 and BE3 across the sampling years. In 2018, differing results were obtained when looking at salmon fry densities between the sites (Table 6) but high number of salmon parr were consistently recorded in all the sites (Table 7). Note that no trout was captured at the main stem sites in the year 2018.

Table 6 – Summary table of salmon fry density estimates and status in the main stem of the river Beauly. Classification based on Baker, N., Electrofishing report 2017.

Site code	Easting	Northin	Zippin	Lower	Upper	Status
BE1	251903	844415	45.48	26.10	64.86	Moderate
BE3	250251	843281	111.44	95.40	127.48	Excellent
BE4	249892	843867	10.90	7.58	14.22	Poor

Table 7 – Summary table of salmon parr density estimates and status in the main stem of the river Beauly. Classification based on Baker, N., Electrofishing report 2017.

Site code	Easting	Northin	Zippin	Lower	Upper	Status
BE1	251903	844415	40.03	34.10	45.96	Excellent
BE3	250251	843281	25.37	19.71	31.04	Good
BE4	249892	843867	38.18	33.56	42.80	Excellent

5.3 Other species

This year's electrofishing effort reveal the presence of many fish species within the Beauly catchment including eels, lampreys, pike and minnows.

6 Time series of juvenile densities in the Beauly catchment.

Overall in 2018, there is a decrease in salmonids densities comparing with previous years (Fig. 8, Table 8). However, this result should not be taken as definitive as this may have been caused by the randomized sample design by MSS (Malcom *et al.,* 2018). In the coming months, MSS will release a report clarifying benchmark densities across the Scotland and between different river catchments. This work will enable NBFT to develop a new network of sampling sites with the potential of providing reliable estimates of salmonid densities across the Beauly catchment.

Time series analyses in Beauly system using generalized additive models (GAM) indicate that salmon fry densities are stabilized around 50 fry per 100 m2 while salmon parr densities are significantly lower but constant around 25 parr per 100 m2. Trout fry densities seems to be constant around 20 parr per 100 m2.

On the other hand, slightly negative trend is observed in Trout parr densities but generally 5 trout per 100 m2 could be expected. Under the current classification scheme, the Beauly system could be classified as moderate to good in salmon fry densities and good in salmon parr densities. Trout fry and parr densities are classed to be good across the years in the Beauly system.

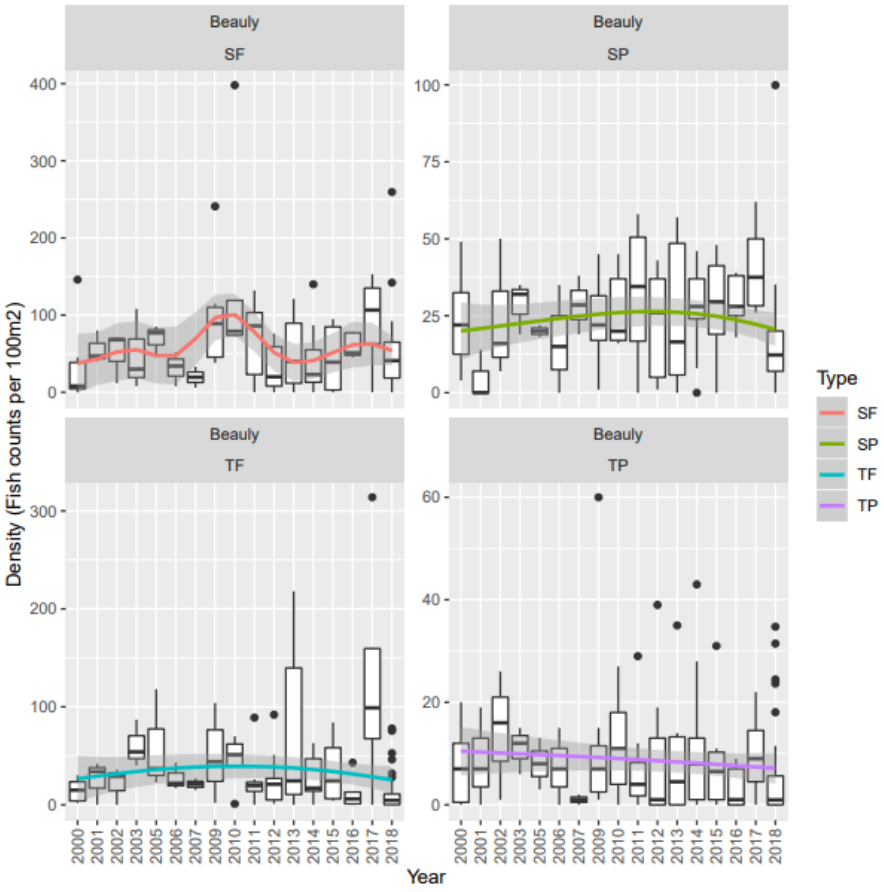

Fig. 7: Historical salmonid densities in the Beauly catchment.

Table 8 – Summary table of the historical and contemporary salmonid densities in the Beauly catchment.

	HISTORICAL				2018			
Type	Average density	Min	Max	Standard deviation	Average density	Min	Max	Standard deviation
Salmon Fry	52.2	0.0	398.0	61.2	51.8	0.0	259.6	51.7
Salmon Parr	21.6	0.0	99.9	16.3	16.6	0.0	99.9	18.5
Trout Fry	20.2	0.0	314.0	36.1	13.8	0.0	77.9	22.0
Trout Parr	5.5	0.0	60.0	8.8	6.0	0.0	34.7	10.0

7 Management response

- Steps should be taken to improve knowledge on real density estimates for each specific river and across the catchment. On those rivers projected to be at “poor” or “moderate” status voluntary measures to control exploitation should be promoted (e.g. on rod fisheries).
- Survival from fry to parr stage should be assessed across the Beauly catchment to rule out the possibility of negative factors affecting parr survival.
- Juvenile trout levels are low in the Glass river and further management actions should be considered.

8 References

Malcolm, I.A., Millidine, K.J., Glover, R.S., Jackson, F.L., Millar, C.P. and Fryer, R.J., 2019. Development of a large-scale juvenile density model to inform the assessment and management of Atlantic salmon (Salmo salar) populations in Scotland. Ecological indicators, 96, pp.303-316.

Barker N., 2017. Electro-fishing Results 2017: River Beauly Catchment. NBFT internal report.