South Cumbria Rivers Trust
Electrofishing - 2019 Report

Catchment Based Approach
Partnerships for Action

A project funded by DEFRA under the Catchment Based Approach

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1. Introduction

South Cumbria Rivers Trust (SCRT) undertake annual fish surveys across South Cumbria using the electrofishing method. This is an important assessment of juvenile salmonid (salmon and trout) populations and to help understand trends over time. Alongside this it also helps to gather some basic habitat information and is an important engagement tool for people who are interested in learning more about their local becks. Salmonids are key indicators of freshwater health and general catchment functioning. Therefore, this monitoring provides evidence for catchment planning, data to support current projects and to inform the development of funding bids to deliver work on the ground. This information is used by the Becks to Bay catchment partnership and other local organisations such as the Environment Agency.

2. Project Aims

- Develop a robust scientific evidence base and on-going monitoring programme
- Investigate the effectiveness of habitat improvement work
- Assess trends in salmonid populations
- Inform the catchment plans and support Water Framework Directive monitoring
- Share data with the Becks to Bay partnership and wider public
- Identify opportunities for future habitat improvement work
- Engage public and partners with the issues facing our rivers

The project aims to undertake fish surveys on a three-year rolling programme across the five catchments covered by South Cumbria Rivers Trust. This will help to establish a baseline and monitor trends over time. However, fish populations are naturally extremely variable, both within rivers and through time, therefore individual surveys should be viewed at a catchment scale, particularly for migratory species such as salmonids. Additionally, part of the programme is designed to enable project sites to be monitored over consecutive years to assess the effectiveness of interventions.

The programme is run in conjunction with the Environment Agency's monitoring to ensure they are complimentary and do not duplicate effort. The Environment Agency has undertaken fish surveys for several decades and hold a large database of information which is accessible to SCRT. However, over recent years there has been less resource for monitoring, creating an evidence gap which SCRT aim to fill. SCRT have now been running an established electrofishing programme since 2016. Due to limited resource some surveys were undertaken prior to this, however these were on a smaller scale and not in the current programme format. Although SCRT have some records running back to 2011. It should also be noted that during 2018 a very limited programme was run due to the drought conditions experienced that year.

Therefore, the surveys in 2019 provide important evidence, both to understand the potential effects from the droughts and to continue to gather information on trends over time.

3. Methodology

3.1 Electrofishing Methodology

Electrofishing is a humane, non-lethal means of surveying fish populations. The technique applies a small electric current to the watercourse which acts to cause temporary incapacitation and taxis of the fish towards the operator, thus rendering the fish easier to catch for bankside analysis. At each site an E-fish 500W electrofishing back-pack was used to survey an un-netted 50m reach using a single pass. Sites were fished following a zigzag pattern in a upstream direction, ensuring continuous coverage of the riverbed. Prior to surveying, water quality parameters, including temperature and conductivity were measured. This enabled adjustment of the E-fish backpack to the appropriate settings for each site, to ensure the safety and wellbeing of the fish and operators. The output frequency on the backpack was set to 50hz at all sites as this is the most effective and safe setting for salmonids, ensuring the data is comparable. A team consisting of a minimum of three people at each site undertook each survey, one operating the backpack and two people netting the fish using hand held nets. The method used is semi-quantitative as no stop nets are employed and there is only a single pass of the reach. Therefore, it is inevitable that some fish are missed during the survey; this is accounted for when calculating the results. Semi-quantitative surveys can be calibrated against the more detailed but more time and resource intensive quantitative surveys (Farooqi & Aprahamian, 1993). The semi-quantitative method is the most resource efficient method, maximizing coverage across the catchment. This is also the recommended method in the UK TAG framework for Water Framework Directive monitoring.

Juvenile salmonids are the focus of the surveys. By recording the species and length we can gain an assessment of the size and age structure of the populations. Other fish species are recorded, but not measured, if caught; these include eels, bullhead, stone loach, minor, lampreys and sticklebacks. Further information on the river and surrounding habitat is also recorded to gain a more holistic picture. This includes details such as vegetation cover, bed substrate, water depth and basic water chemistry. This can then be used to inform the development of habitat improvement projects for fish spawning.

Surveys in this report are undertaken between July and September 2019 so as not to disturb fish spawning, under licence from the Environment Agency and with permissions from local landowners. Surveys record both salmonid fry and parr, which are caught and analysed on site. Fry hatch from eggs spawned in the Autumn and then emerge out of gravels during April/ May. Parr are fish which are one year or older; most salmon parr leave the river the spring as smolts when they are around 12cm in length. Trout parr will either migrate down into the main river to become brown trout or undergo smoltification and move out to sea as Sea Trout. Typically, juvenile salmon and trout spend between 1 and 3 years in freshwater before migrating to the sea as smolts. During the surveys the number of fish are recorded and the

length of each individual is measured to the fork in the tail (to the nearest 0.5cm). All fish are then returned to the water, unharmed. On rare occasions, a very small number of fish do not withstand the process and unfortunately mortalities do occur. South Cumbria Rivers Trust keeps a record of fish mortalities, and this is reviewed to allow assessments of methods and surveyor technique. To date, fish mortalities have never exceeded 0.5% of the survey catches.

Within England and Wales it is an offence to electro-fish without an appropriate licence from the Environment Agency (EA). All licences from the EA and access permission from riparian landowners and fisheries owners were gained and granted prior to surveying.

3.2 Site Selection

During 2019 SCRT were granted a permit from the EA to undertake surveys across the whole of South Cumbria. In previous years we had submitted a list of proposed sites in advance and then needed to reapply for another permit if we wished to make any changes to the programme. Therefore, having a permit for the whole of South Cumbria gave us more flexibility, enabling us to be more adaptive and respond to changes such as where we experienced difficulties in obtaining landowner permissions or if there was a new site of particular interest. A programme of sites was established prior to the electrofishing season to incorporate project specific sites and 'generic' baseline sites. This was based on the 2018 programme. During 2018 only 4 sites were surveyed due to the drought experienced during this year. Therefore, the original 2018 programme was transferred and adapted for 2019 with some additions to reflect new projects and changes during 2019.

Table 1. Full list of sites electro-fished by SCRT across South Cumbria in 2019.

Number	Site Name	Catchment	Grid Reference
1	St Sundays Beck	Bela	SD54043 88342
2	Greenholme Lower	Crake	SD28749 89096
3	Greenholme Upper	Crake	SD28640 89101
4	Hoathwaite	Crake	SD30266 95374
5	Langholme Beck	Crake	SD29082 86471
6	Smithy Beck	Crake	SD27613 87109
7	Torver Beck	Crake	SD28543 93531
8	Yewtree Lower	Crake	NY32158 00119
9	Yewtree Upper	Crake	NY32209 00644
10	Appletreeworth Beck	Duddon	SD24167 92162
11	Black Sike Beck	Duddon	SD21120 94766
12	Goblin Beck	Duddon	SD22583 95955
13	Lickle at Croglinhurst	Duddon	SD21436 89834
14	Long House Gill	Duddon	SD23551 97169
15	Old Park Beck	Duddon	SD22036 95863
16	Gilpin at Crosthwaite	Gilpin	SD43574 91595
17	Gilpin Mill	Gilpin	SD343906 90959
18	Dubbs Beck	Kent	NY42339 01362

19	Gowan at Ings	Kent	SD45339 98600
20	Hall Beck	Kent	SD47024 99082
21	Colwith	Leven	NY33173 03036
22	Fitz Steps	Leven	NY31738 02977
23	Great Langdale Beck	Leven	NY29596 06310
24	Troutbeck	Leven	NY40901 03024
25	Gleaston Beck	Minor Catchment	SD26043 71014
26	Pennington Beck	Minor Catchment	SD26366 77354
27	Wood Farm	Winster	SD41192 91520
28	Spannel Beck	Winster	SD41578 86940

Please see Appendix I for the full list of proposed sites. Those not surveyed will be reviewed and incorporated into the 2020 survey schedule.

3.3 Calculating the classification

Electrofishing surveys provide data on the number of fish present within a reach, this can then be converted to a density of fish. Once the density of salmonids per 100m^2 has been obtained each site can be graded based on the National Fisheries Classification Scheme (NFCS). This scheme has been used by the Environment Agency to classify fish populations since 1997. Following discussions with the Environment Agency the results obtained here have been calibrated and classified using the same method. This involves using a pre-calculated conversion factor to make the fish densities obtained from semi-quantitative surveys comparable to those generated from quantitative surveys (Farooqi & Aprhamian, 1993). These values can then be assigned to one of 6 classes; 5 classes based on quintiles and 1 one for absent see Table 2. These are absolute classifications meaning they aren't related to sites with a similar habitat but rather just related to all sites and therefore they only give a broad indication. Prior to calibration against quantitative surveys, semi-quantitative surveys will give a minimum density of fish present at each site. Converting these values to the national system allows for comparison of abundance over a wider geographical area.

Salmonid fry and parr classes were separated based on fish sizes deduced from length abundance graphs. Fish grow at different rates depending on the site conditions, it is therefore difficult to assign one value for all sites. However, at sites where only a small density of fish are caught it can be difficult to determine the break in age categories, a best estimate based on nearby sites is made.

During surveys, the number of individuals of any other fish species caught are also recorded. Bullhead and lamprey are not routinely surveyed by the Environment Agency and do not form part of the classification scheme, therefore only broad assumptions on presence/ absence can be deduced. Furthermore, the E-fish backpack is set to be most effective for salmonids and therefore numbers of other species caught may not be entirely representative.

Table 1. Classification boundaries as provided by the Environment Agency

Salmonid abundance

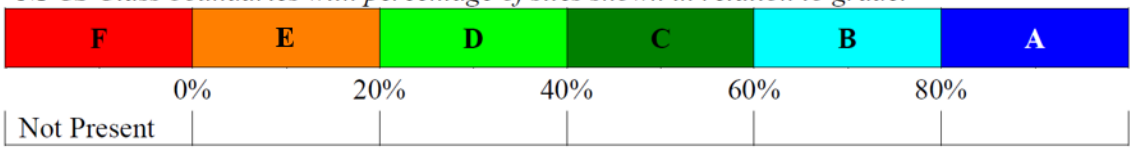
(Values are No. per 100m^{-2})

Species group	CLASS				
	A →	← B →	← C →	← D →	← E	F
LEVEL ONE					
0+ Brown/sea trout	38	17	8	3	0
>0+ Brown trout	21	12	5	2	0
0+ Brown trout	86	45	23	9	0
>0+ Salmon	19	10	5	3	0
>0+ Rainbow trout	2	0.5	0.2	0.1	0
LEVEL TWO					
Brown/sea trout parr equivalents	47	28	15	6	0
Salmon parr equivalents	36	23	13	5	0
Total >0+ salmonids	31	18	11	4	0
>0+ Rainbow trout	2	0.5	0.2	0.1	0
LEVEL THREE					
Total salmonid parr equivalents	62	43	31	18	0

Table 2. National Fisheries Classification Scheme classes

Grade	Fish Density
A	Excellent
B	Good
C	Fair
D	Poor
E	Very Poor
F	No Fish Present

NFCS Class boundaries with percentage of sites shown in relation to grade.



4. Results

4.1 Overview

During 2019 surveys were successfully undertaken across all 5 of the main catchments covered by South Cumbria Rivers Trust, these are the Duddon, Crake, Leven, Kent and Bela. However, the number of surveys was limited by the weather and on several occasions, surveys were either called off due to high water levels or were less representative because of the faster flowing water; these sites are highlighted in the information below. Figure 2 to Figure 5 shows the results from the surveys, a full list of sites and the results can be found in Appendices I and II.

Across the catchment's salmon abundance was low and often entirely absent. However, in comparison to previous years there are some sites which are showing a positive trend. One such site is at Yewtree Beck (below the tarn) in the Crake catchment, which was the only site surveyed to be classed as 'good' or higher for salmon fry, see Figure 2. Fry are the least mobile stages of a salmonid's life cycle and therefore it is valid to assume that their population is strongly influenced by local conditions (Dugdale *et al.,* 2006), suggesting that local conditions at this site may be improving. Similarly, there were 2 sites which recorded 'excellent' populations of salmon parr; this is a positive trend in comparison to previous years. However, this is only at a number of sites and in general populations of salmon are still low. Figure 6 highlights potential barriers to migration, these could have an influence on salmon as a migratory species. It provides useful context as there may be some sections of watercourse where we would not expect to find salmon, such as a above a waterfall, and therefore the absence of salmon is not necessarily a reflection on the health of the local system. However, where the barrier to migration is artificial this could be preventing or reducing the number of salmon reaching their spawning grounds in the upper tributaries; these sites can then be identified and could form part of future work to improve populations.

As per other years trout populations for both fry and parr were more variable, ranging from absent to excellent across all sites, suggesting the influence of other local factors such as habitat quality. Results are discussed further within the catchment sections below. Furthermore, all results and comparisons should be viewed with a degree of caution as there are several potential sources of error which are discussed in section 3.2.

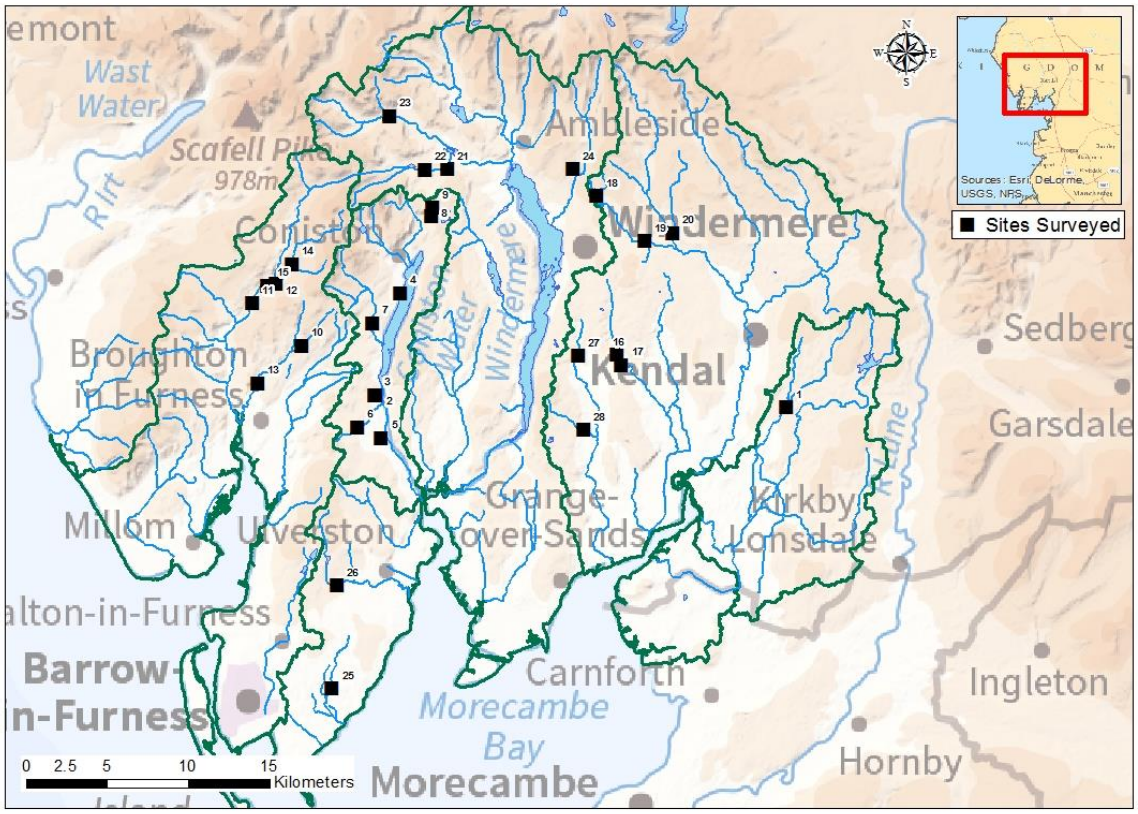


Figure 1. Sites surveyed by South Cumbria Rivers Trust during 2019. Numbers refer to the sites listed in Table 1.

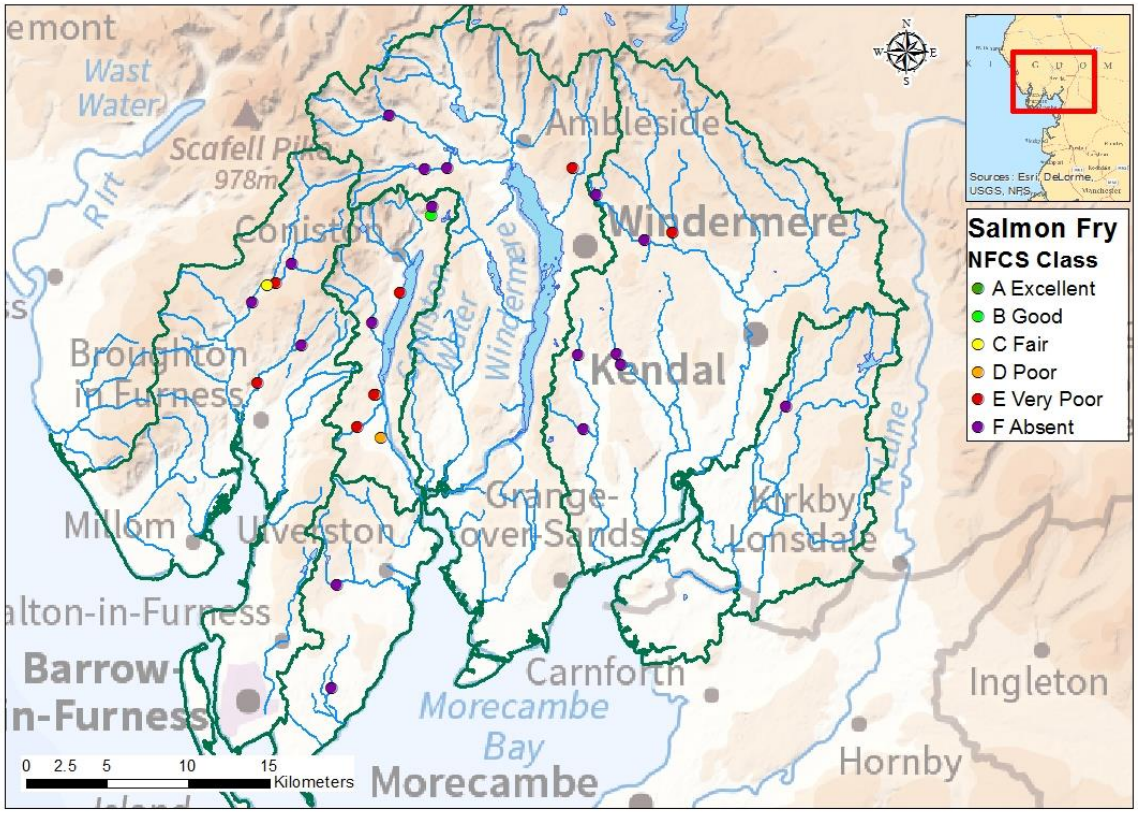


Figure 2. Salmon fry abundance as classified under the National Fisheries Classification Scheme (NFCS) at sites surveyed across South Cumbria in 2019.

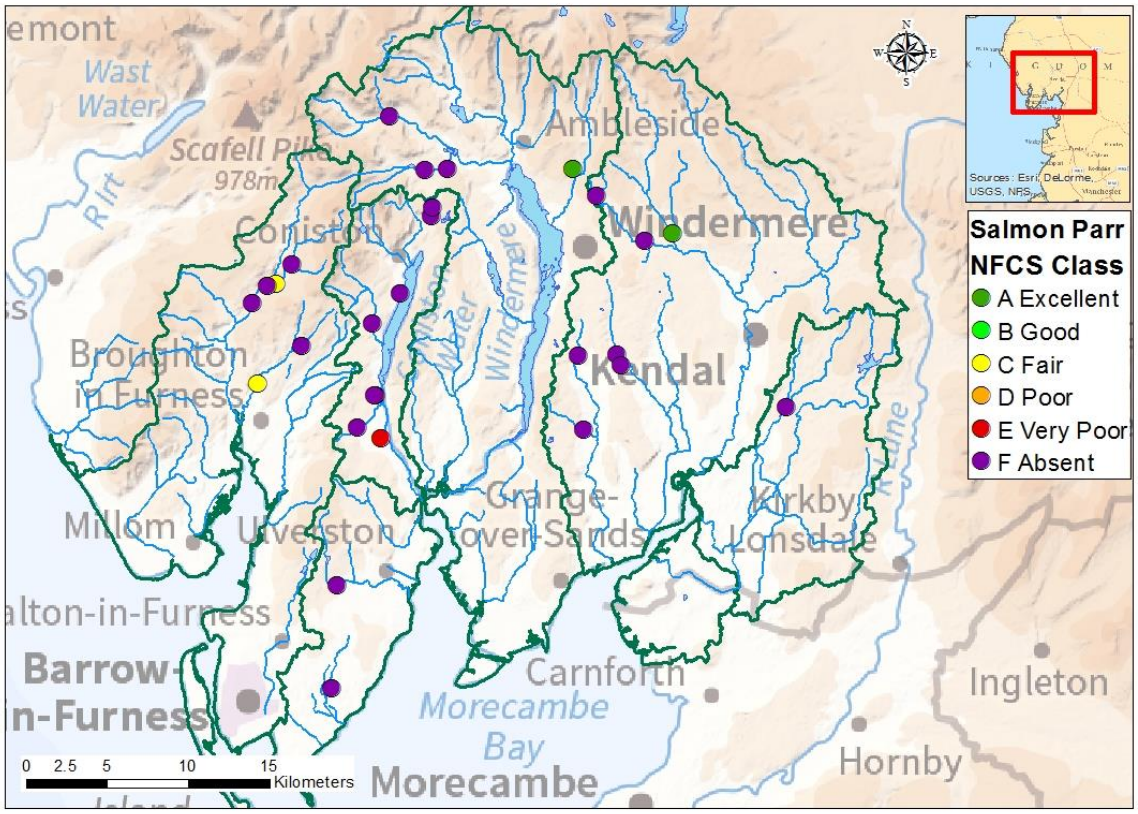


Figure 3. Salmon parr abundance as classified under the National Fisheries Classification Scheme (NFCS) for sites surveyed across South Cumbria in 2019.

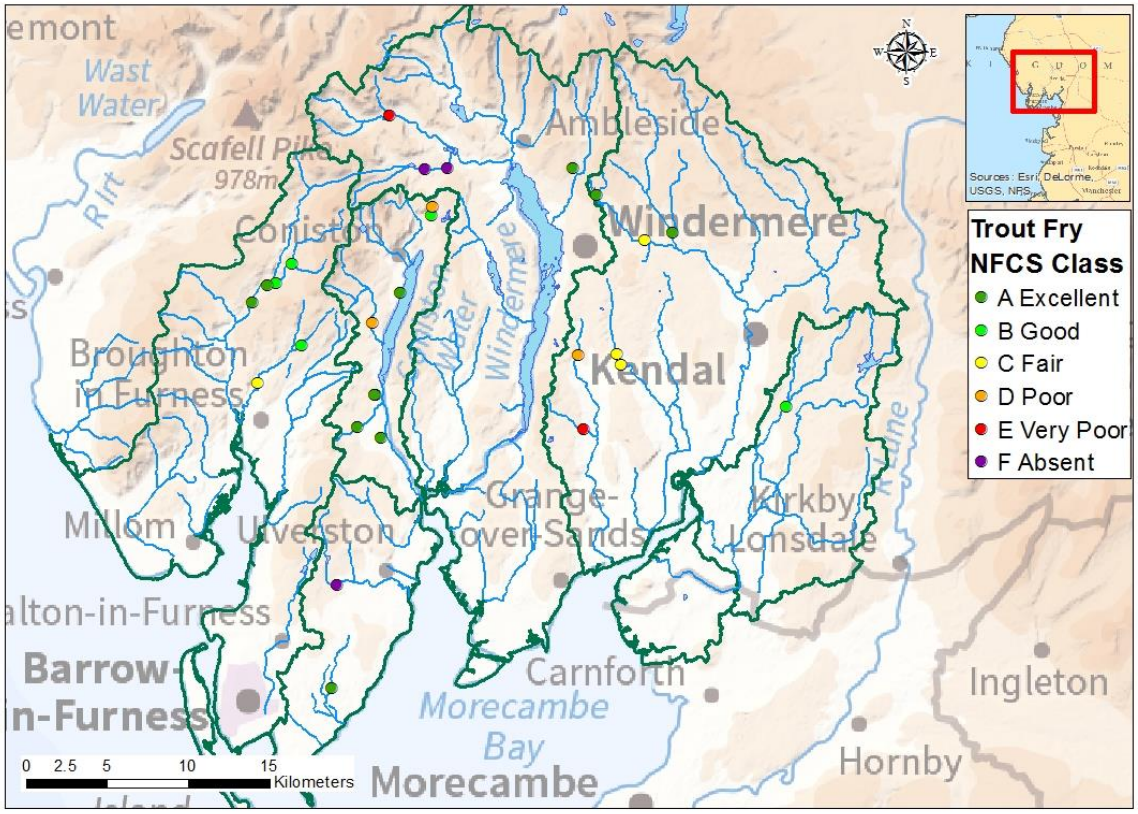


Figure 4. Trout Fry abundance as classified under the National Fisheries Classification Scheme (NFCS) for sites surveyed across South Cumbria in 2019.

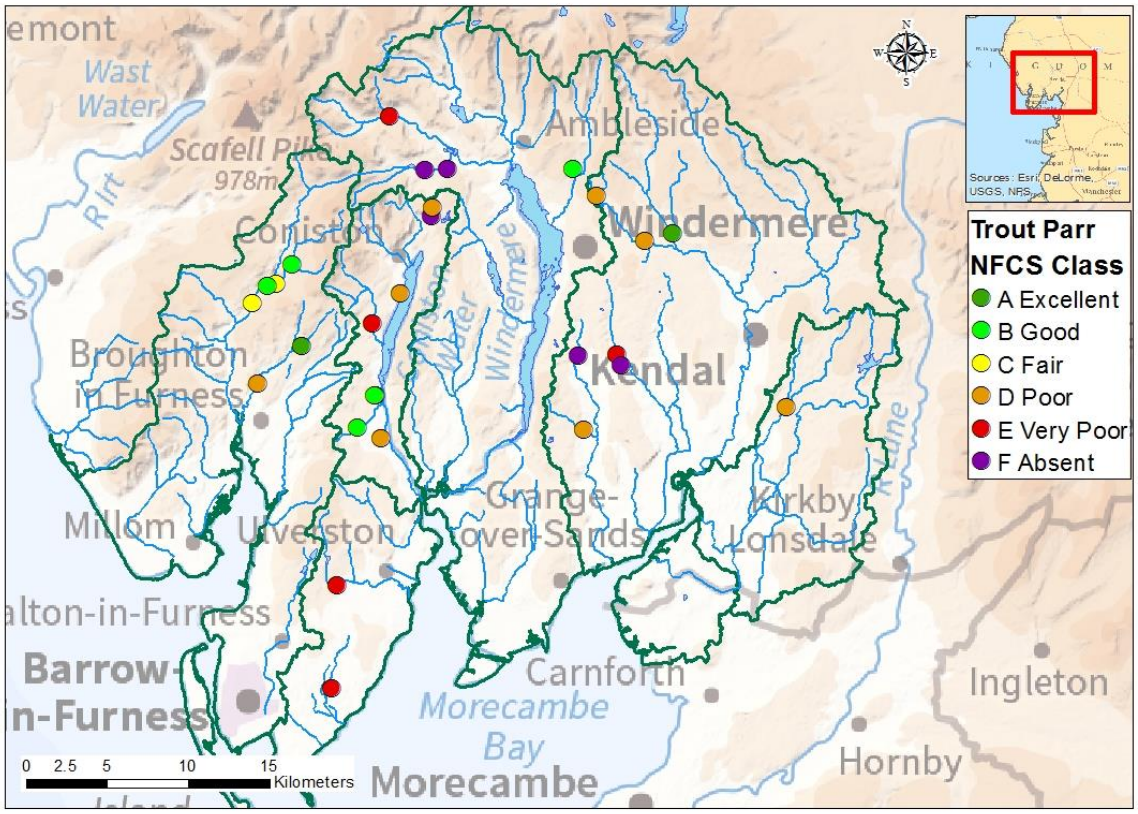


Figure 5. Trout Parr abundance as classified under the National Fisheries Classification Scheme (NFCS) for sites surveyed across South Cumbria in 2019.

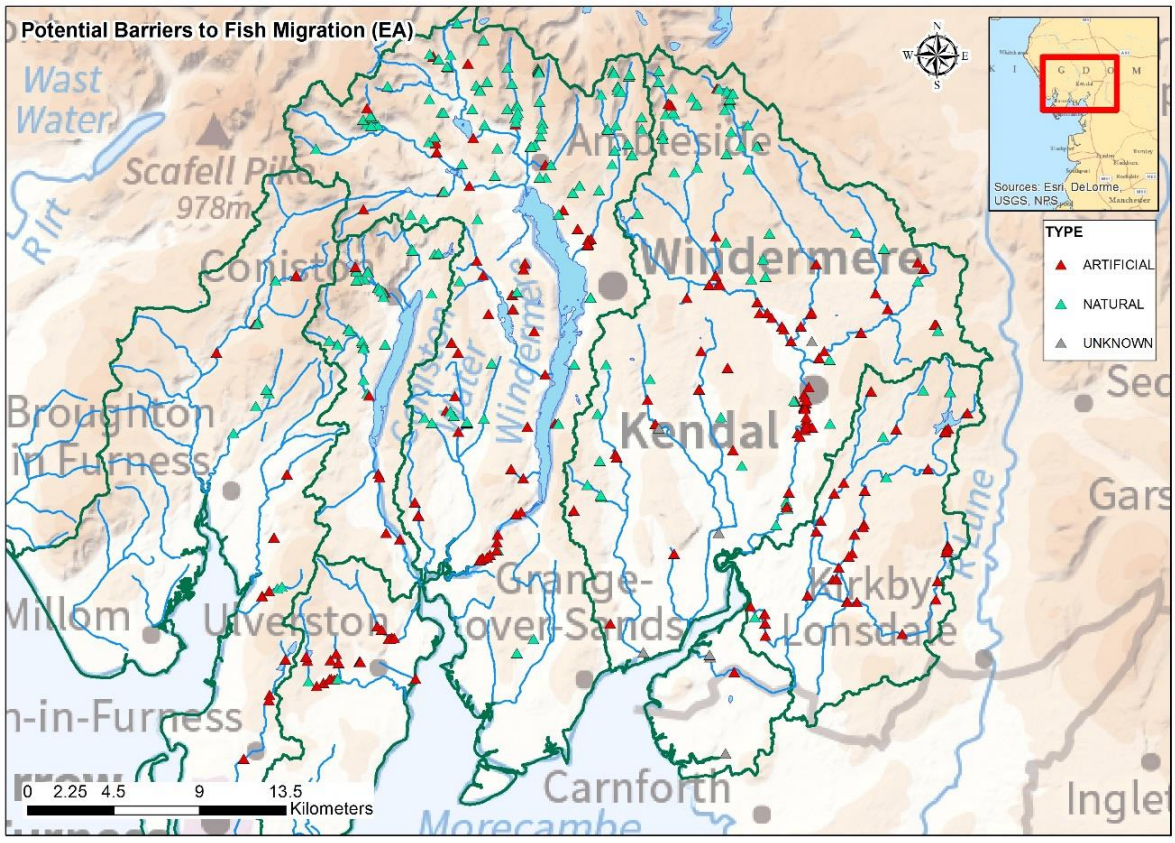


Figure 6. Potential barriers to fish migration across South Cumbria

4.2 Duddon

Due to adverse weather SCRT haven't undertaken any surveys in the Duddon catchment for the past two years. However, during 2019 6 sites were successfully surveyed. This was also the first year in which SCRT undertook fish surveys on the River Lickle.

Salmon were present at some of the sites in the catchment, including Goblin beck and the Lickle at Croglinhurst. Goblin beck dried up during the period of drought in summer 2018 and consequently dead fish were observed at the time. Therefore, it was encouraging to record a positive result for both salmon and trout.

Trout were present at all sites surveyed, with Black Sike beck and Old Park beck being classed as 'excellent'. SCRT last surveyed Black Sike beck in 2016 when populations of trout fry and parr were also classed as 'excellent'. Comparatively, populations of trout fry and parr were classed as 'fair' and 'poor' respectively on the Lickle at Croglinhurst Bridge, some salmon were identified but at low densities. The in-river habitat and flow diversity here is limited and it is a relatively wide stretch of river which has been revetted, however, there is some habitat along the banks in the form of over-hanging trees and roots. Additionally, the survey had been conducted following a period of rain when water levels were slightly higher and faster than 'normal'. The EA haven't surveyed this site in the past, however they have surveyed sites within the catchment which recorded results of 'fair' to 'excellent' for trout in 1993 and 1995. Salmon were largely absent but were recorded at Broughton in Furness in 1993 and 2005.

4.3 Coniston & Crake

Since October 2017 SCRT have been running the Conserving Coniston and Crake project throughout the Coniston catchment. Therefore, several of the sites surveyed are project sites where work has been undertaken or is planned. These surveys provided important evidence for evaluation and the development of potential projects.

In total 8 sites were surveyed in the Coniston catchment. Several of the sites had salmon fry present, with Yewtree beck (lower) being the only site surveyed across South Cumbria in 2019 to record a population classed as 'good' or above. Salmon parr were only recorded at 2 out of the 8 sites, Greenholme lower and Langholme Beck. Trout fry populations were mainly 'excellent', with Yewtree lower being 'good' and Yewtree Upper and Torver Beck being 'poor', likely due to a lack of access and

Figure 7. Greenholme beck reconnection. Photo by Aerial Artwork.

poor habitat quality. Trout parr populations were generally lower, with Yewtree and Torver becks again having low densities.

During September 2019 Greenholme Beck was reconnected to its historic channel, see Figure 7. The fish surveys were carried out before this date, with results showing that below the weir salmon were present (classed as 'Fair' and 'Very Poor', for fry and parr respectively) and although this is still a low classification Greenholme beck (lower) was one of the better sites surveyed across South Cumbria. However, above the weir no salmon parr were found and only 2 salmon fry (classification: very poor); suggesting that the weir here was a barrier to migration. Surveys in future years will help to show if this has opened up more of the beck to salmon. Trout populations both above and below the weir were relatively good, however, as trout don't always migrate and therefore resident populations are less likely to be affected by the weir.

4.4 Windermere & Leven

Four surveys were undertaken in the Leven catchment during 2019, and the majority of the these were in Langdale valleys. Despite recent habitat improvement work, fish populations in this valley are still low. In Little Langdale no salmonids were recorded during the survey (although other fish species were present). In Great Langdale 'very poor' populations of trout were recorded. This is likely due to the lack of habitat for fish in this system; the watercourse here is heavily modified being straightened and revetted along both sides. Furthermore, in both these valleys the conductivity of the water is low, and despite the backpack being adjusted to take this into account fishing conditions are still difficult.

Figure 8. Bucket of fish from fish surveys on Troutbeck, September 2019

Comparatively, Troutbeck on the eastern side of Windermere had some of the best populations of salmon recorded during the surveys; salmon fry were classed as 'very poor' however, salmon parr densities were 'excellent'. It was also believed that some fish were missed during this survey (above what would normally be expected) and therefore populations could actually be higher. Repeat visits in future years should help to identify this. Figure 9 and Figure 10 show the Environment Agency's 2019 results for this waterbody; in their surveys (which were at slightly different locations within the system) salmon parr were recorded at similar densities however, greater densities of salmon fry were observed.

4.5 Kent & Winster

Only 3 sites were surveyed within the Kent catchment itself and these were focused on the Upper Kent and Gowan systems. Hall Beck was one of the only sites to record 'Excellent' populations of salmon parr, trout fry and trout parr; salmon fry were present but classed as 'Very Poor'. The habitat here was varied and there was good vegetation cover, however, the substrate tended to be larger and spawning gravels were limited, which could be linked to the

lower populations of salmon fry. Dubbs beck and the River Gowan at Ings have both been surveyed by SCRT in the past. Results from 2019 showed a similar pattern to previous years, however, populations of trout parr at both sites were lower in 2019. The Gowan at Ings is quite different to most other sites across South Cumbria, being influenced by the limestone bed it flows over, the section is abundant in macrophytes which provide good habitat but can make surveying difficult meaning a higher proportion of fish may be missed during the surveys.

High flows affected a number of the surveys on the Winster & Gilpin, in particular those at Spannel beck and Gilpin Mill. At both of these sites survey conditions were harder making results less representative furthermore at Gilpin mill a shorter section was undertaken to accommodate this, however, this is accounted for when calculating the density. Salmon were absent from all surveys where trout were found at all sites, however, densities were generally low.

4.6 Bela

Only 1 site (St Sundays beck) was surveyed on the Bela system. Other sites had been prioritized following poor results from the surveys in 2018, however, high water levels cancelled the scheduled surveys on a number of occasions. Furthermore, water levels were high at the survey on St Sundays beck which made conditions difficult and could affect the results; it also affected the reaches which could be surveyed as some were too deep and fast flowing to survey safely, consequently only a 40m reach was surveyed. Salmon weren't observed, but 'good' densities of trout fry and 'poor' densities of trout parr were found.

4.7 Environment Agency Classifications

Partnership working with the Environment Agency (EA) means data and evidence can be shared to provide a more holistic picture of the fish populations across South Cumbria. SCRT work with the EA prior to the survey season to understand their priorities for the year and ensure sites aren't duplicated. During 2019 the EA surveyed 18 sites across South Cumbria, again being hindered by high flows during the season.

Results from the EA surveys, (Figure 9 to Figure 12) tend to be slightly higher than those collected by SCRT, this could be because the EA undertake some surveys where they fish to depletion (SCRT only do semi-quantitative surveys). They also undertake some surveys on deeper and wider sections, whereas SCRT largely focus on smaller tributaries in the upper catchments. Furthermore, the EA survey team is also likely to be more experienced, being comprised of staff who undertake fish surveys on a regular basis. Comparatively, SCRT rely heavily on volunteers and although the back-pack operator is consistent this does introduce some variation and potential lack of experience. Aside from the sites at Troutbeck, which are discussed in this report, most of the EA's results are at different locations to SCRT's, thereby helping to expand the dataset. Results from the EA show that some of the sites in the upper Leven catchments had relatively good populations of salmon fry and parr, whereas in the lower reaches of the catchment they were often absent altogether. Similarly, in the upper reaches of the Kent on the River Gowan salmon fry and parr were absent; the main rivers Kent and Sprint also showed relatively low numbers of salmon and trout.

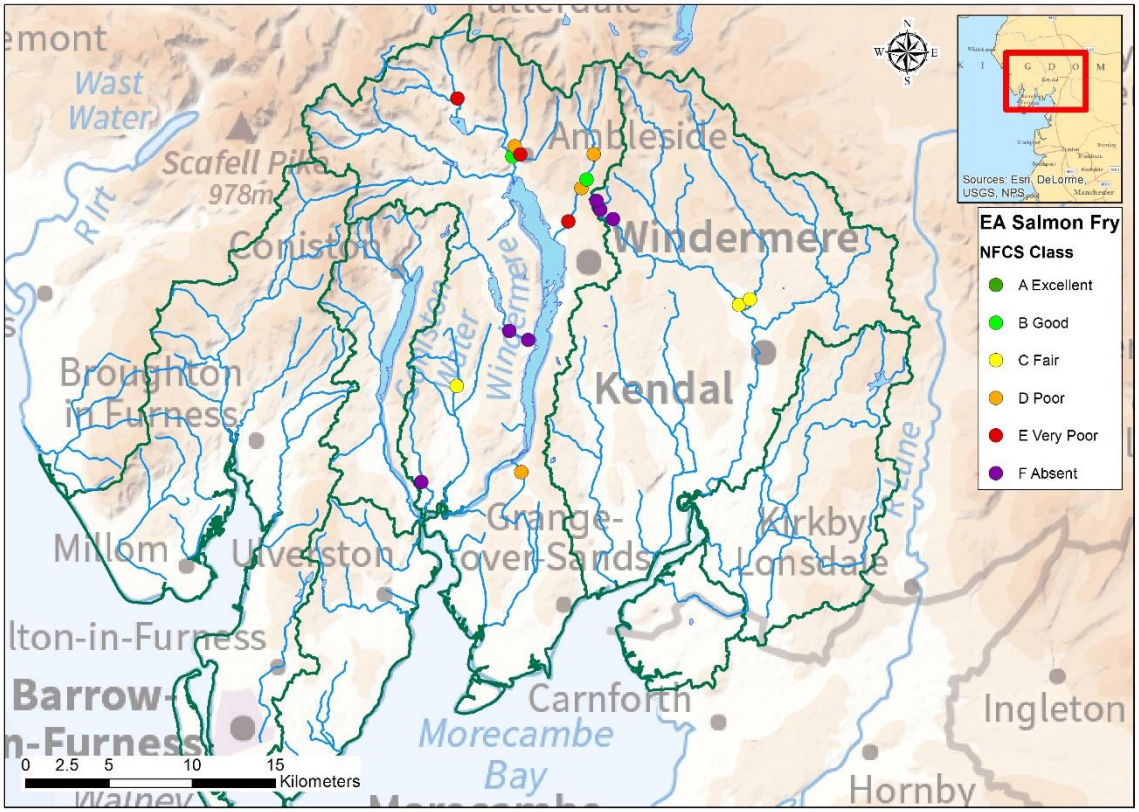


Figure 9. Environment Agency National Fisheries Classification for Salmon Fry in South Cumbria in 2019.

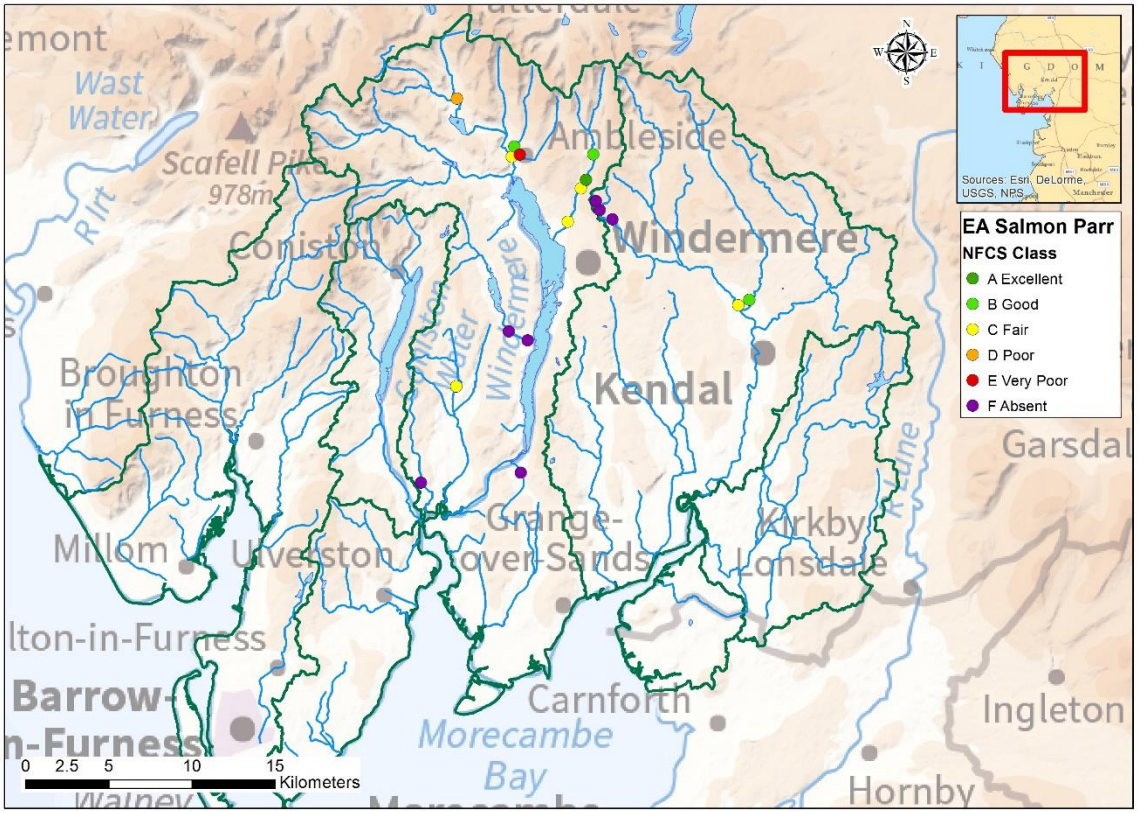


Figure 10. Environment Agency National Fisheries Classification for Salmon Parr in South Cumbria in 2019.

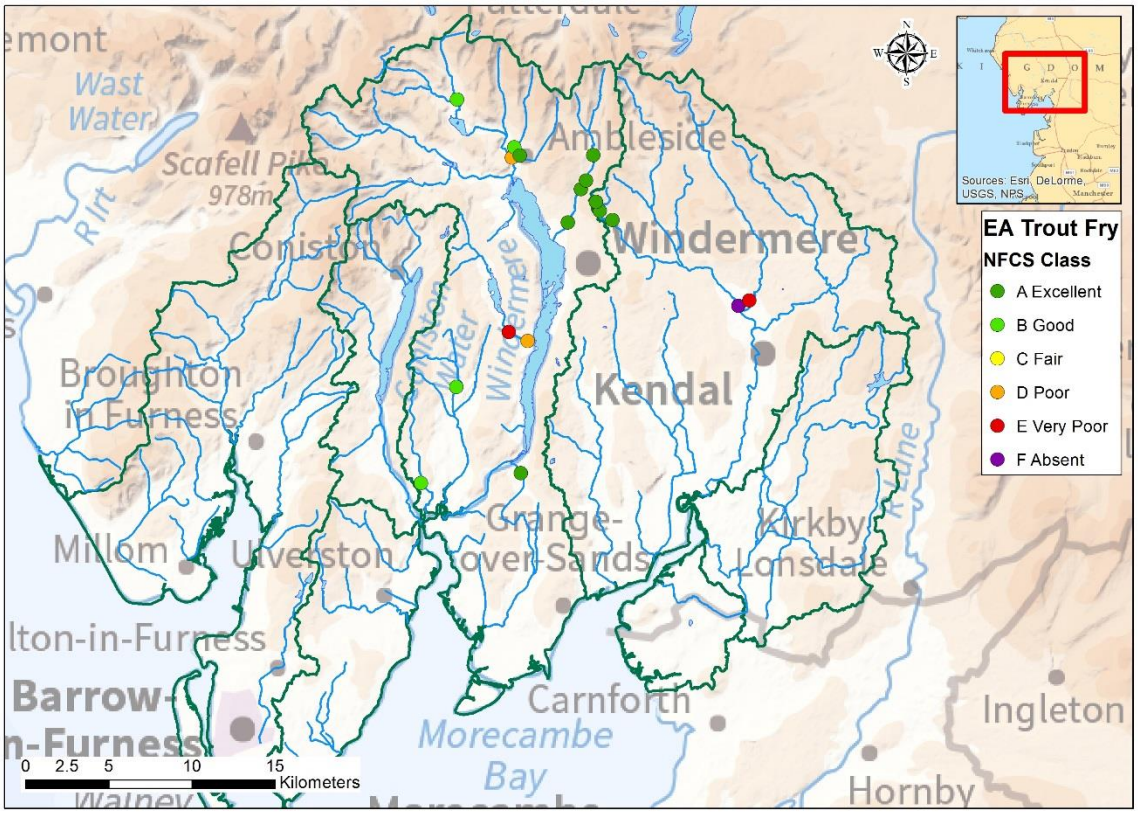


Figure 11. Environment Agency National Fisheries Classification for Trout Fry in South Cumbria in 2019.

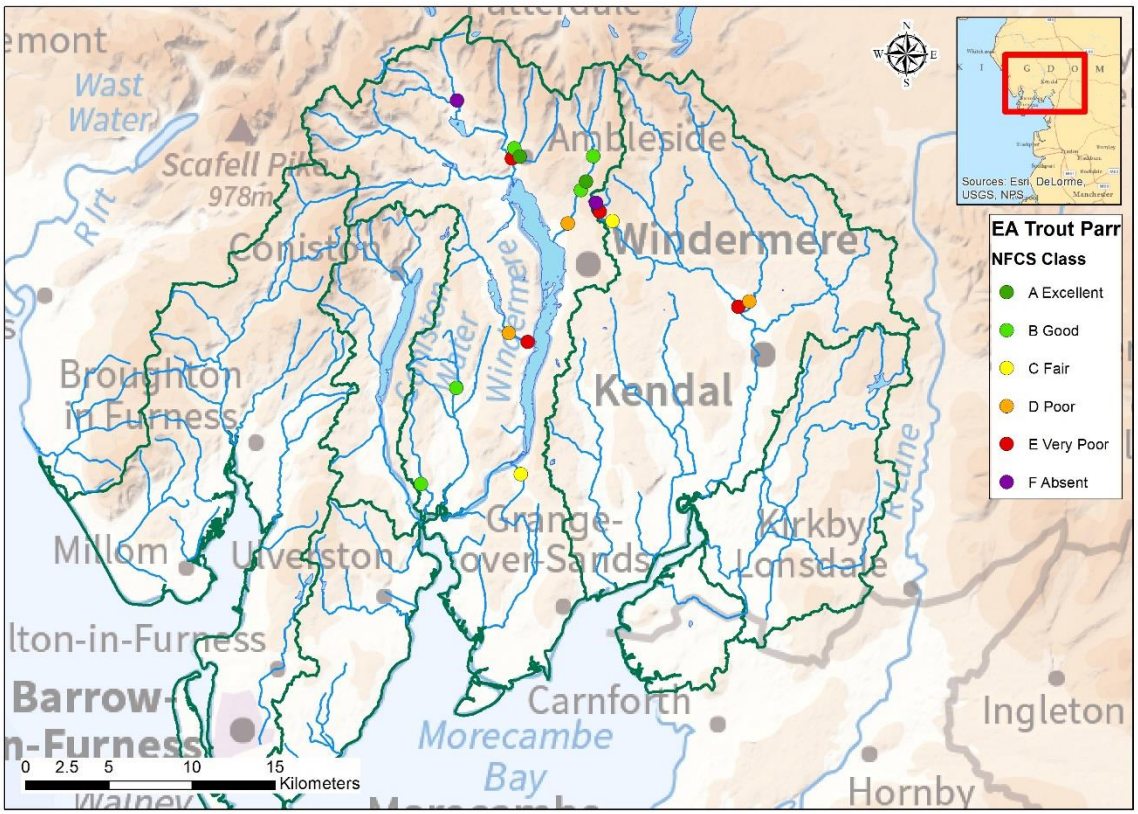


Figure 12. Environment Agency National Fisheries Classification for Trout Parr in South Cumbria during 2019.

4.8 Sources of Error

Although every effort is made to reduce sources in error it is inevitable that some occur. Firstly, as a small organisation, SCRT are not able to use the same team of people for each electrofishing survey and are reliant on the support of volunteers. The monitoring officer is present during all surveys which helps to ensure consistency however, there is naturally variation between different people both in terms of experience and technique. Furthermore, there can also be changes with time as surveyors become more used to the technique and potentially better at catching fish.

Caution should also be taken when comparing SCRT and EA data, as although the basic methodology employed is there are some differences in sampling location, team size and general implementation of the method. For example, the EA carry out both semi-quantitative surveys and quantitative surveys where they undertake a catch-depletion method supported by a larger survey team. Comparatively, SCRT only undertake semi-quantitative surveys focused on the smaller spawning becks and upper tributaries.

The same back pack and the same set up method is used at every site to help reduce variation in results. However, the conductivity of the water varies naturally, and although the back pack can be adjusted to take this into account, there are a number of sites across South Cumbria where the conductivity of the water is relatively low, thereby reducing the catch efficiency. Similarly, habitat and flow variation can also impact catch efficiency, typically overhanging branches and tree roots are good habitat for fish but can also hinder the netting. To minimize this SCRT use a number of different nets appropriate to the stream type, for example a banner net is more practical in faster flowing, deeper sections whereas a small hand net is more appropriate in a small stream with variable bed substrate.

5. The National Picture

Annual reports on the status of salmon stocks and fisheries in England and Wales have been produced by the Centre for Environment, Fisheries and Aquacultures Science (Cefas) and the EA since 1997. The latest report is from 2018. Over the last decade many rivers have seen a marked decline in the numbers of returning salmon with returning stock estimates and counts for 2018 being below the values recorded in 2017 for all but one of the rivers where this data exists.

Across England and Wales, 64 rivers are classified as ‘principle salmon rivers’, between 2013 and 2018 in England and Wales, 67% of these were in the lowest two classes (E: very poor to F: absent) under the NFCS, see Figure 13. In South Cumbria the Kent, Leven, Crake and Duddon are all listed as ‘principal salmon rivers’; a salmon action plan is in place for these rivers.

As an anadromous species (one which is born in fresh waters but then spends most of its life at sea before returning to freshwater to spawn), salmon are particularly vulnerable to pressures in the marine phase of their lifecycle. Evidence from monitored rivers around the

North Atlantic indicates that the survival of salmon during the marine phase of their lifecycle has declined in recent years (Cefas, 2019). However, New regulatory provisions were approved in England in December 2018 and it is believed that these will substantially reduce the exploitation of salmon from 2019, these measures can be found within the report (Cefas, 2019).

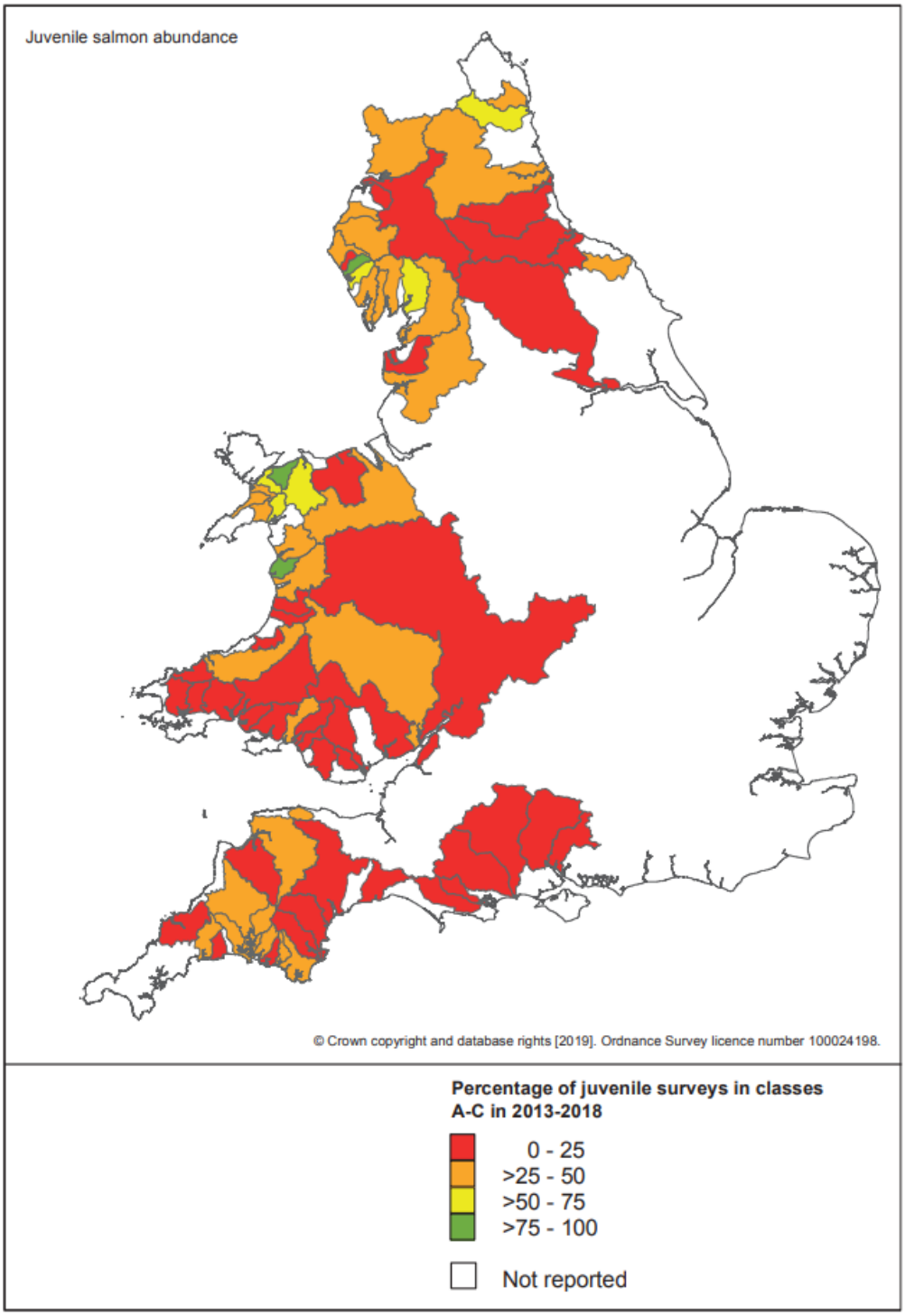


Figure 13. Juvenile salmon abundance indices for each catchment, presented as a percentage of surveys in NFCS classes A (excellent) to C (fair) only, between 2013 and 2018.

6. Other Species

Native fish including bullhead *(Cottus gobio),* European eels *(Anguilla Anguilla),* brook lamprey *(Lampetra planeri),* minnow *(Phoxinus phoxinus),* stickleback *(Gasterosteidae)* and stone loach *(Barbatula barbatula)* were recorded during the surveys. However, because the electrofishing surveys are targeted at salmonids and the backpack is set to be most effective for these, the results for other fish species may not be a true representation. For example, the frequency the backpack is set to is on the outer edges of the range which is effective for European eels, meaning catch efficiency is lower. The Environment Agency do not hold data on density for 'other fish' species so it is only the salmonid data which can be converted to take into account those missed during a semi-quantitative survey, however, the 'raw' density of fish per 100m^2 can be recorded. Figure 14 shows the abundance of all fish species caught at each site and the total density of fish per 100m^2; the raw data is provided in Appendix III. Langholme beck recorded the highest density of fish per 100m^2 and Great Langdale Beck recorded the lowest.

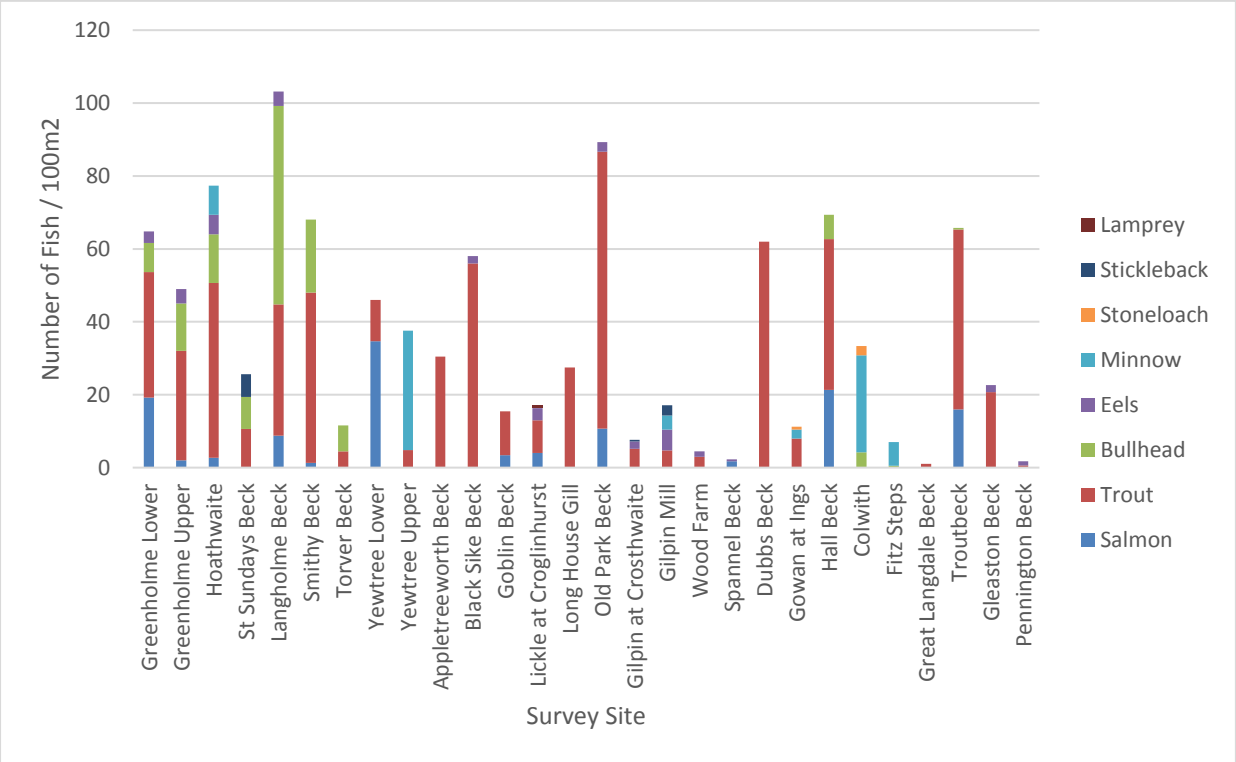


Figure 14. Abundance of all fish species recorded during 2019 electrofishing surveys. Note this has been adjusted for density however it has not been adjusted to take into account that these were semi-qualitative surveys.

6.1 European eel

The European eel is critically endangered on the IUCN Red List of threatened species following a significant decline in populations over recent years. However, observations made during the 2019 surveys suggest that 2019 has been a relatively good year for eels. European eels were recorded at 13 of the sites surveyed, observed but not caught at a further 3 sites and were absent from the surveys at 12 sites.

6.2 Bullhead

Bullhead are widespread through the England and Wales but are less common in Scotland and across Europe. They are found in fast flowing streams and rivers with hard stony substrates. On the River Kent, bullhead are a qualifying (but not primary reason) for its designation as a Special Area of Conservation. Bullhead were recorded at one out of the three sites surveyed on the Kent, however this is most likely because the local conditions weren't suited to bullhead. Additionally, as a bottom dwelling fish, bullhead tend to hide under stones and cobbles and therefore have a reduced catch efficiency. Some sites such as Langholme beck had relatively high densities of bullhead. Bullhead weren't recorded in the Duddon catchment.

7. Next Steps for 2020

SCRT have now undertaken three full years of fish surveys (excluding 2018 due to the period of drought). Therefore, during 2020 we propose to review the sites surveyed in previous years to repeat some of the baseline surveys as part of our three-year rolling programme. Additionally, there are some other key sites which haven't been surveyed in recent years or were postponed due to the adverse weather in 2019. These include, Leighton Beck, Bannisdale, River Bela, River Mint and River Sprint, which will be added to the 2020 programme.

The surveys also record some habitat information, however, ahead of the next survey season this will be reviewed to look at including habitat assessment scores to provide a more informative assessment of fish populations which will help identify potential habitat improvements.

Investigations will also be made to put the survey data online so that it is interactive and accessible to a wider range. This will make it easier for people to query the data and will help inform catchment management.

8. Acknowledgements

SCRT would like to acknowledge and thank Defra for the support of the CaBA funding which enables this monitoring to take place. Thanks also needs to go to all the volunteers who helped out on these surveys, without volunteers gathering this wealth of information would not be possible. Similarly, thanks to Enviro-tech and the Conserving Coniston and Crake teams for their support and the Environment Agency for their on-going support and co-ordination through these surveys. Finally, thanks must also go to the landowners who kindly granted us permission to access the becks and rivers on their land.

9. References

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Appendix I

List of sites proposed for survey during 2019. Those highlighted in bold were surveyed during 2019.

Site No.	Site Name	Catchment	SSSI
1	**Black Sike Beck**	**Duddon**	**No**
2	**Goblin Beck**	**Duddon**	**No**
3	**Long House Gill**	**Duddon**	**No**
4	Quarry Gutter	Duddon	No
5	**Old Park Beck**	**Duddon**	**No**
6	Blea Beck	Duddon	No
7	**Appletreeworth Beck**	**Duddon**	**No**
8	Kirkby Pool @ Steers Pool	Duddon	No
9	Gill House Beck @ Soutergate	Duddon	No
10	**Croglinhurst Bridge**	**Duddon (Lickle)**	**No**
11	Whitcham Beck (1)	Duddon	No
12	Whitcham Beck @ Po House Chapel	Duddon	No
12 b	Whitcham Beck @ Haverigg Pool	Duddon	No
13	Sarah Beck	Leven	No
14	Mill/Poaka Beck	Leven	No
15	**Gleaston Beck**	**Leven**	**No**
16	Grizedale Beck @ Low Bowkerstead	Leven	No
17	Ashes Beck: Rusland Pool	Leven	No
18	Dale Park Beck	Leven	No
19	**Colwith Bridge, Little Langdale**	**Leven**	**No**
20	**High Birk Howe, Little Langdale**	**Leven**	**No**
21	**Great Langdale Beck**	**Leven**	**No**
22	River Rothay @ Tongue Gill	Leven	No
23	Blake Beck near Skelwith	Leven	No
24	**Troutbeck @ Limefitt**	**Leven**	**No**
25	Bell Beck, Troutbeck	Leven	No
26	Miller Beck - Lower	Leven	No
27	Miller Beck - Upper	Leven	No

Site No.	Site Name	Catchment	SSSI
28	Newlands Beck near Newland Bottom	Leven	No
29	Newlands Beck near Bowstead gates	Leven	No
30	**Pennington Beck**	**Leven**	**No**
31	Cunsey Beck	Leven	No
32	Hall Beck	Leven	No
33	Black Beck Near Hawkshead	Leven	No
34	**Dubbs Beck**	**Kent**	**Yes**
35	**Hall Beck**	**Kent**	**Yes**
36	Kent near Staveley	Kent	Yes
37	Bannisdale Upper	Kent	Yes
38	**Gowan at Ings**	**Kent**	**Yes**
39	**Yewtree Upper**	**Crake**	**No**
40	**Yewtree Lower**	**Crake**	**No**
41	**Hoathwaite Beck**	**Crake**	**No**
42	Sunny Bank Mill	Crake	No
43	**Park Ground, Torver**	**Crake**	**No**
44	Colton Beck @ Bandrake Head	Crake/ Colton	No
45	**Greenholme Beck - Upper**	**Crake**	**No**
46	**Greenholme Beck - Lower**	**Crake**	**No**
47	**Smithy Beck**	**Crake**	**No**
48	**Langholme Beck**	**Crake**	**No**
49	Ellers Meadow *Actual site surveyed: SD50527 79802*	Bela	No
50	Hang Bridge	Bela	No
51	Burnside Farm	Bela	No
52	Badger Gate	Bela	No
53	Overthwaite	Bela	No
54	Rowell Bridge	Bela	No
55	**St Sundays Beck**	**Bela**	**No**
56	**Winster near Wood Farm**	**Winster & Gilpin**	**No**
57	Arndale Beck near High Birks	Winster & Gilpin	No
58	**Gilpin Mill**	**Winster & Gilpin**	**No**
59	**Spannel Beck**	**Winster & Gilpin**	**No**

Appendix II

No	Site Name	Catchment	Grid Reference	No. Salmon Fry	Salmon Fry NFCS	No. Salmon Parr	Salmon Parr NFCS	No. Trout Fry	Trout Fry NFCS	No. Trout Parr	Trout Parr NFCS	Downstream Barrier to Fish Migration?
1	Greenholme Lower	Crake	SD28749 89096	23	C	1	E	39	A	4	C	No
2	Greenholme Upper	Crake	SD28640 89101	2	E	0	F	23	A	7	B	Yes
3	Hoathwaite	Crake	SD30266 95374	2	E	0	F	35	A	2	D	No
4	St Sundays Beck	Bela	SD54043 88342	0	F	0	F	15	B	2	D	Yes
5	Langholme Beck	Crake	SD29082 86471	10	D	1	E	44	A	2	D	No
6	Smithy Beck	Crake	SD27613 87109	1	E	0	F	30	A	5	B	No
7	Torver Beck	Crake	SD28543 93531	0	F	0	F	8	D	2	E	Yes
8	Yewtree Lower	Crake	NY32158 00119	52	B	0	F	17	B	0	F	No
9	Yewtree Upper	Crake	NY32209 00644	0	F	0	F	3	D	3	D	No
10	Appletreeworth Beck	Duddon	SD24167 92162	0	F	0	F	22	B	39	A	Yes
11	Black Sike Beck	Duddon	SD21120 94766	0	F	0	F	26	A	2	C	Yes
12	Goblin Beck	Duddon	SD22583 95955	2	E	4	C	16	B	5	C	No
13	Lickle at Croglinhurst	Duddon	SD21436 89834	1	E	11	C	18	C	9	D	No
14	Long House Gill	Duddon	SD23551 97169	0	F	0	F	31	B	16	B	No
15	Old Park Beck	Duddon	SD22036 95863	8	C	0	F	49	A	8	B	No

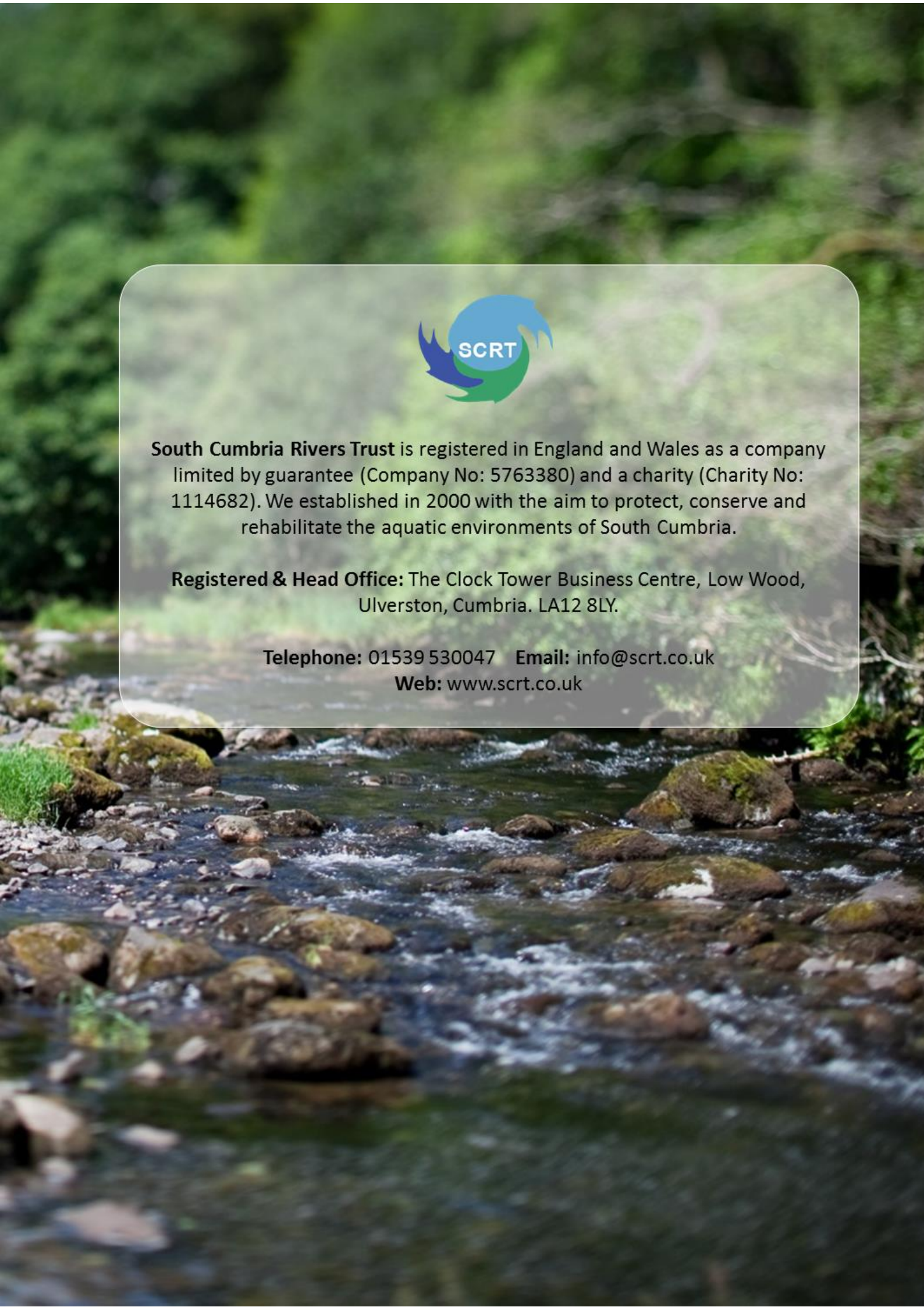
16	Gilpin at Crosthwaite	Gilpin	SD43574 91595	0	F	0	F	12	C	1	E	Yes
17	Gilpin Mill	Gilpin	SD343906 90959	0	F	0	F	5	C	0	F	Yes
18	Wood Farm	Winster	SD41192 91520	0	F	0	F	6	D	0	F	Yes
19	Spannel Beck	Winster	SD41578 86940	0	F	0	F	1	E	2	D	No
20	Dubbs Beck	Kent	NY42339 01362	0	F	0	F	30	A	1	D	Yes
21	Gowan at Ings	Kent	SD45339 98600	0	F	0	F	16	C	4	D	No
22	Hall Beck	Kent	SD47024 99082	2	E	14	A	20	A	10	A	No
23	Colwith	Leven	NY33173 03036	0	F	0	F	0	F	0	F	Yes
24	Fitz Steps	Leven	NY31738 02977	0	F	0	F	0	F	0	F	Yes
25	Great Langdale Beck	Leven	NY29596 06310	0	F	0	F	1	E	1	E	Yes
26	Troutbeck	Leven	NY40901 03024	7	E	29	A	87	A	25	B	No
27	Gleaston Beck	Minor Catchment	SD26043 71014	0	F	0	F	30	A	1	E	No
28	Pennington Beck	Minor Catchment	SD26366 77354	0	F	0	F	0	F	1	E	Yes

Appendix III

Densities of all fish species caught during the fish surveys. Note these are from semi-quantitative surveys and have not been converted to quantitative.

Site Name	Catchment	Salmon	Trout	Bullhead	Eels	Minnow	Stoneloach	Stickleback	Lamprey	Total
Greenholme Lower	Crake	19.2	34.4	8	3.2	0	0	0	0	64.8
Greenholme Upper	Crake	2	30	13	4	0	0	0	0	49
Hoathwaite	Crake	2.666667	48	13.33333	5.333333	8	0	0	0	77.33333
St Sundays Beck	Bela	0	10.625	8.75	0	0	0	6.25	0	25.625
Langholme Beck	Crake	8.8	36	54.4	4	0	0	0	0	103.2
Smithy Beck	Crake	1.333333	46.66667	20	0	0	0	0	0	68
Torver Beck	Crake	0	4.444444	7.111111	0	0	0	0	0	11.55556
Yewtree Lower	Crake	34.66667	11.33333	0	0	0	0	0	0	46
Yewtree Upper	Crake	0	4.8	0	0	32.8	0	0	0	37.6
Appletreeworth Beck	Duddon	0	30.5	0	0	0	0	0	0	30.5
Black Sike Beck	Duddon	0	56	0	2	0	0	0	0	58
Goblin Beck	Duddon	3.428571	12	0	0	0	0	0	0	15.42857
Lickle at Croglinhurst	Duddon	4	9	0	3.333333	0	0	0	0.666667	17
Long House Gill	Duddon	0	27.42857	0	0	0	0	0	0	27.42857
Old Park Beck	Duddon	10.66667	76	0	2.666667	0	0	0	0	89.33333
Gilpin at Crosthwaite	Gilpin	0	5.2	0	2	0	0	0.4	0	7.6
Gilpin Mill	Gilpin	0	4.761905	0	5.714286	3.809524	0	2.857143	0	17.14286
Wood Farm	Winster	0	3	0	1.5	0	0	0	0	4.5
Spannel Beck	Winster	1.714286	0	0	0.571429	0	0	0	0	2.285714
Dubbs Beck	Kent	0	62	0	0	0	0	0	0	62
Gowan at Ings	Kent	0	8	0	0	2.4	0.8	0	0	11.2
Hall Beck	Kent	21.33333	41.33333	6.666667	0	0	0	0	0	69.33333

Colwith	Leven	0	0	4.166667	0	26.66667	2.5	0	0	33.33333
Fitz Steps	Leven	0	0	0.5	0	6.5	0	0	0	7
Great Langdale Beck	Leven	0	1	0	0	0	0	0	0	1
Troutbeck	Leven	16	49.33333	0.444444	0	0	0	0	0	65.77778
Gleaston Beck	Minor Catchment	0	20.66667	0	2	0	0	0	0	22.66667
Pennington Beck	Minor Catchment	0	0.571429	0	1.142857	0	0	0	0	1.714286



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