FISHERIES MONITORING OF THE RIBBLE CATCHMENT 2021

The Ribble Rivers Trust

ABSTRACT

2021 marks the 14th year of the Ribble Trusts inter-annual fisheries monitoring programme. Results and observations from this work helps inform the trust on the productivity of sub-catchment fisheries and where to direct conservation efforts.

Adam Wheeler
Fisheries and Projects Officer

Fisheries Monitoring of the Ribble Catchment

Ribble Rivers Trust
C/O Hanson Cement
Ribblesdale Works
Clitheroe
BB7 4QF

Phone: 01200 444452
E-mail: admin@ribbletrust.com

Report title: Fisheries Monitoring of The Ribble Catchment 2021

Report reference: RRT_ Electric_Fishing _2021_Report

Report version: 1.0

Date: 01/11/2021

Prepared for: Ribble Rivers Trust

Authored by: Adam Wheeler - Fisheries and Projects Officer

Checked by: Mike Forty – Head of River Conservation

Table of Contents

Acknowledgments

The core fisheries monitoring of the Ribble catchment has been supported and funded by Ribble Rivers Trust and its members.

The Ribble Trust is grateful to all landowners for their permission to land-access and look forward to continued cooperation for future work. In addition, RRT wishes to thank the staff and volunteers for their continued hard work and contributions to this year's fisheries programme: Ellie Brown, Robert Cooper, Mike Forty, Susie Kinghan, Christi Lloyd, Kate Morgan, Helen Smith, Leanne Tough (Ribble Rivers Trust); Mike Duddy, Sam Gibson (Mersey Rivers Trust); Bruno Besbas, Sam Boothman, Chris McWilliam, Josh Morris (Electric Fishing Volunteers).

Executive Summary

The Ribble Rivers Trust (RRT) concluded its 14th year of electric fishing surveys on the Calder, Hodder and Ribble catchments. From 12th June until 7th of October 2021, a total of 283 sites were surveyed by Ribble Rivers Trust with an additional 27 sites fish by the Environment Agency as part of their monitoring programme.

The methodologies applied to the Ribble Rivers Trust fisheries programme are adapted from Crozier and Kennedy's – 'Application of Semi‐quantitative Electrofishing to Juvenile Salmonid Stock Surveys' (1994) and Zippin's – 'Removal Method of Population Estimation' (1958). National Fisheries Classification Scheme (NFCS) grades are then used as a metric for the standardisation of results which are comparable to national datasets. Outputs are used to support and identify future works on the catchment as well as monitoring the long-term impacts of river restoration schemes.

Brown Trout

With river conditions during egg development and emergence being more favorable than the previous two years, 2021s recruitment of brown trout fry on all catchments has been greatly improved. 70.5% of sites surveyed have increased in fry numbers (Figure 1), however, the observed number of trout parr was very low (Figure 2). This was expected and reflects the 2019 and 2020's poor fry results and their high mortality rates of their first year in river. With a boost to this year's trout population the number of 1year+ trout in 2022 surveys is expected to improve and will also be reflected in rod catch numbers.

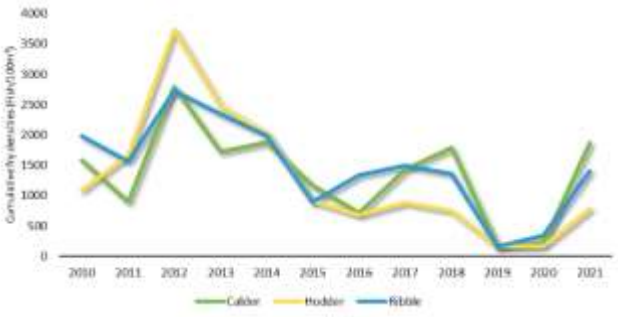


Figure 1: Brown trout fry densities on the Calder, Hodder and Ribble catchments for 138 sites fish 2010 – 2021

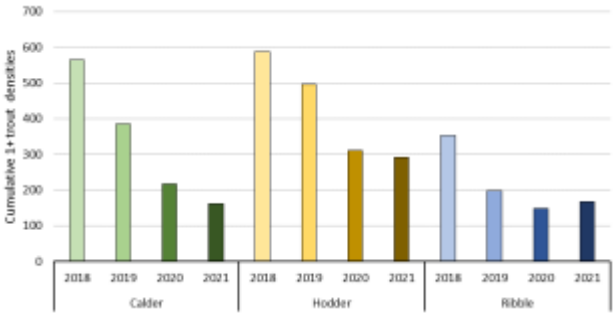


Figure 2. Cumulative brown trout parr densities of sites fished 2018-2021 on the Calder, Hodder, and Ribble Catchments

Atlantic Salmon

The recruitment of Atlantic salmon fry on all catchments has seen little improvement for 2021 (Figure 3). Given the more favorable spawning and development conditions of the winter months this year's results are concerning, especially considering the increase in trout fry densities. Results from this year show limited areas across the catchments where Atlantic salmon are spawning, and many sites are absent of fry or are returning poor densities. However, the sites surveyed on main stem rivers appear to have produced better numbers than the tributaries which are known to hold good nursery habitat.

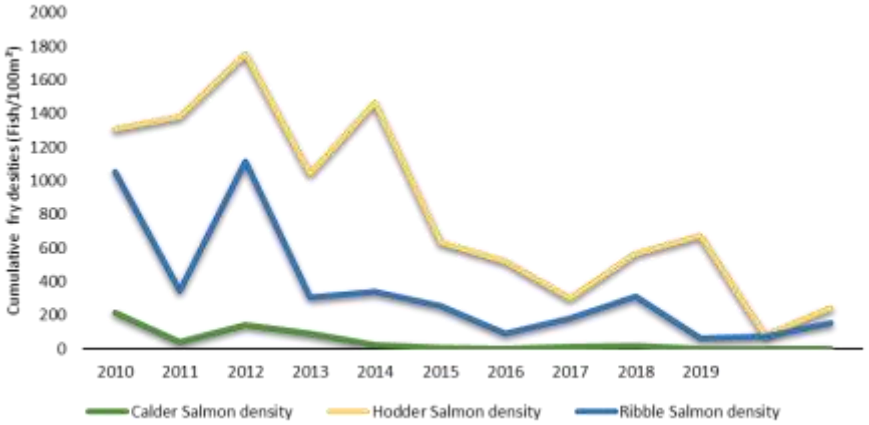


Figure 3: Cumulative Atlantic salmon fry densities for the 138 sites fish on the Calder, Hodder and Ribble catchments between 2010 – 2020 including 5 year moving average.

This is the 3rd year where salmon fry have not been recorded on the Calder catchment despite all indications of good habitat and water quality when looking at brown trout fry. With dwindling numbers of Atlantic salmon, it is looking likely that the Calder population could be classed as highly unsustainable. On the Ribble catchment if the degradation of Atlantic salmon population continues at this observed rate, it may lead to an unsustainable population by the end of the decade, with localised extinctions on its sub-catchments.

If the goal is for salmon populations to be restored, we first need to identify the problems, and then take action to solve them. Salmon are good colonizers and to see a return to a robust self-sustaining population on our catchment, the right management and improvement strategies for water and habitat quality need to be applied. Ideally, we would avoid the need for restoration in the first place as prevention is favoured, by proactively delivering protection to sustainable populations as much as possible.

1.0 Introduction

The Ribble Rivers Trust (RRT) has been directing habitat restoration, improving river connectivity and facilitating improved land management for over twenty years in the Ribble Catchment. With more than 6,000 kilometers of watercourses the ultimate aim of the RRT is to preserve a resilient system in which there is habitat and resources to support and sustain fish and wider animal populations and increase biodiversity.

Principally, our continuing aims are to: -

1. Assess the overall status of the juvenile population of salmonids (salmon and trout).
2. Monitor the inter-annual variations of the salmonid young of year population.
3. Determine underperforming areas and direct improvement works.
4. Capture the effectiveness of previous habitat improvement works.
5. Generate data and evidence in support of and to report on grant bids and applications.
6. Generate knowledge of rare species to inform responsible development.
7. Locate ecological threats posed by invasive species.
8. Derive future research questions

The Ribble Rivers Trust concluded its 14th year of electric fishing surveys on the Calder, Hodder and Ribble (Figure 1.1). A total of 283 sites were surveyed with priority given to those with a long-term data series or were considered to have higher conservational importance.

1.1 Sub-Catchment Map

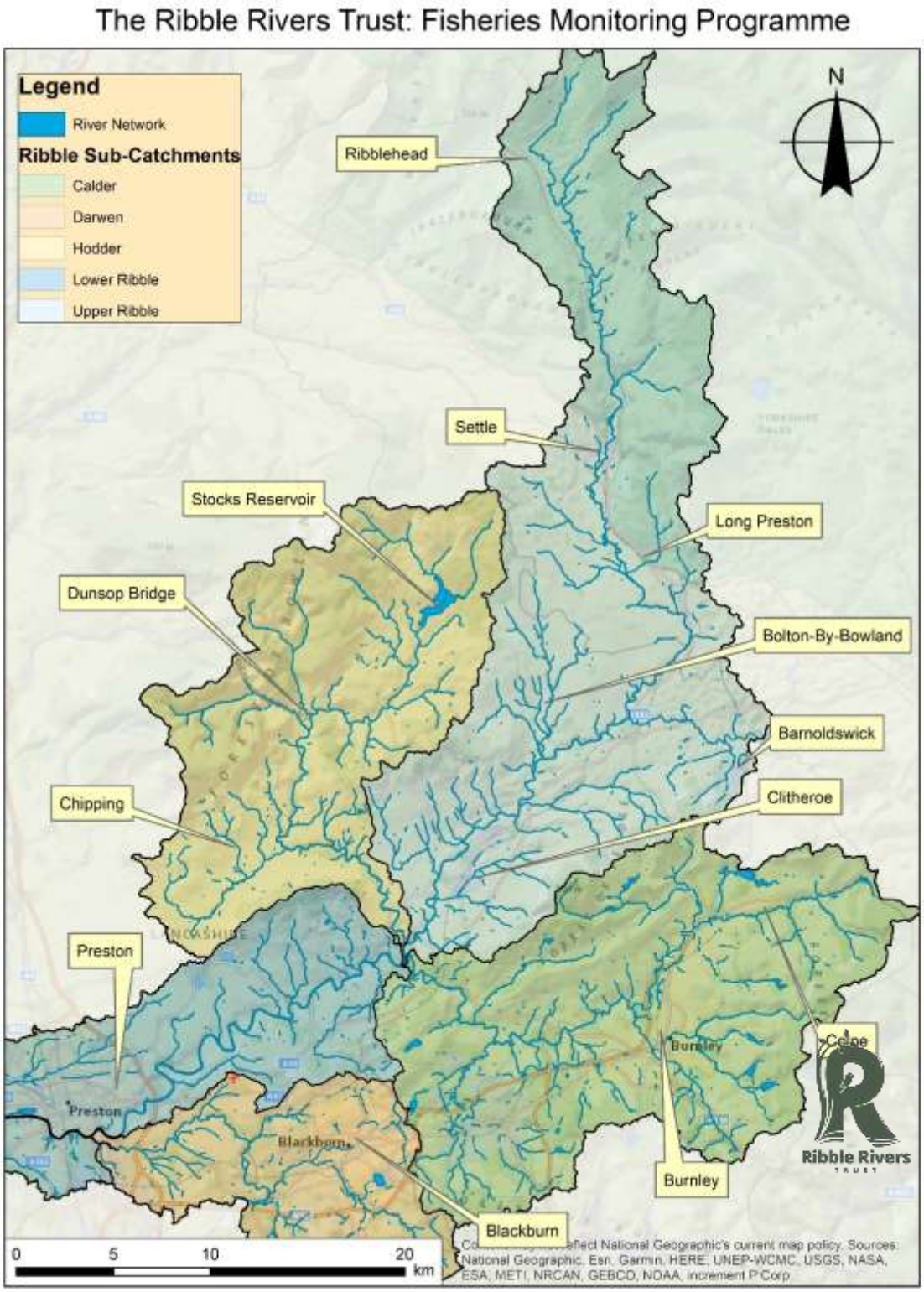


Figure 1.1: River Ribble catchment map displaying sub-catchment boundaries and reference locations.

2.0 Methodologies

2.1 Electric fishing Surveys

The Trusts applies an adapted Crozier and Kennedy (1994) methodology which has been operated since 2008. Riffle/pool habitat is targeted to capture both the young of year (+0) and the >0+ populations of Atlantic salmon and brown trout using an electric fishing backpack system. Two types of survey are undertaken: semi-quantitative, where the river is actively fished for five minutes covering a measured un-isolated area; and quantitative, where an isolated area of river is sampled over several depletive passes. The fork length of salmonids is recorded (mm) at each location and the abundance of other species is noted.

For 2021, sites identified for surveying were those holding the most significant data set, with nine or more years of continuous data or in key locations for monitoring restoration works. The survey team worked between 12th June until 7th of October, with a total of 283 sites completed.

From the above activities the young of year are determined by establishing a maximum fork length discerned from the frequency-length distribution of the species. This method is applied to each major catchment individually to reflect the temporal and spatial differences in fry as the electric fishing season progresses (Appendix B.1 – B.7). Quantitative surveys provide fry densities per 100m² from the depletion of a known measured area, these densities are generated from Zippin's (1956; 1958) K-Pass Removal method using the FSA package in R version 3.1.0 (R core Team, 2019), whereas, semi-quantitative results are calculated from the number of fry captured in an active five minutes. The equation applied to the semi- quantitative results is formed from the quantitative fry population relationship between a 5-minute fry capture in the first pass and the total electric fishing result (fry per 100m²) (Appendix C.1 and C.2). Data used must reflect the variation in fishing results based on the constant effort of the electric fishing team for each site surveyed. This relationship uses quantitative data collected as well as the addition of a zero, zero point to represent a total absence of salmonids. The resulting equation is taken from the fitted linear regression for 0 + salmonids where:

$$ln(y + 1) = a + b\ ln(x + 1)$$

The densities of trout and salmon fry per 100m² are allocated a grade-score (Table 2.1) which standardises the Trust's field observations with those of the National Fisheries Classification System (NFCS).

Table 2.1: National Fisheries Classification System for trout and salmon fry density per 100m²

Grade	Description	Trout fry per 100m²	Salmon fry per 100m²
A	Excellent	>38	>86
B	Good	17 – 38	45 – 86
C	Fair	8 – 16	23 – 44
D	Poor	3 – 7	9 – 22
E	Very Poor	1 – 2	1 – 8
F	No Fish Present	0	0

Graded results are transferred to a map layer using ArcGIS 10.8.1 to display catchment scale results. Within the result section the inter-annual comparison of data is based on sites which hold 12 years of consecutive data, and the grade change evaluation is the comparison of all sites fished in both 2020 and 2021. Grade results have been organised within the analysis of this report according to geographical coverage determined by sub-catchment.

3.0 Monitoring Results

3.1 Brown Trout (*Salmo trutta*)

During the 2021 survey season a total of 3,813 brown trout fry, parr and adult fish were captured over 283 electric fishing sites. The density estimations from sites containing the young of year ranged between 1 - 346 fry/100m² with a mean density of 23.9 fry/100m². This is an improvement on 2020s results where sites had a narrower range of 1 – 67 fry/100m² and the mean density of trout fry was 5.7 fry/100m². The recruitment of brown trout fry on all catchments has been greatly improved for 2021 (Figure 3.1.1), with 70.5% of sites surveyed increased in fry numbers. Brown trout were found present in 78.1% of sites, with brown trout young of year present in 76.0% of sites.

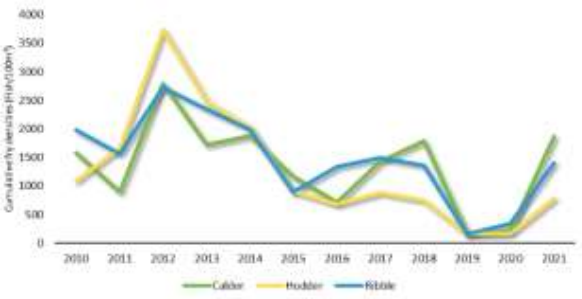


Figure 3.1.1: Brown trout fry densities on the Calder, Hodder and Ribble catchments for 138 sites fish 2010 – 2021

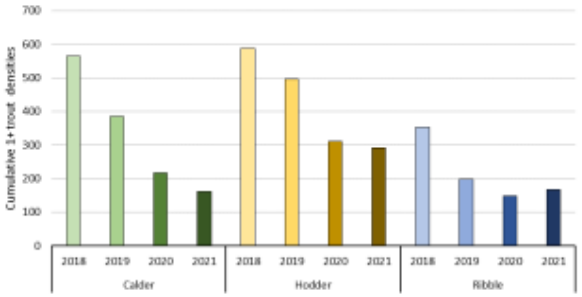


Figure 3.1.2: Cumulative brown trout parr densities of sites fished 2018-2021 on the Calder, Hodder, and Ribble Catchments

The observed number of trout parr in 2021 was very low reflecting 2019 and 2020's poor fry results (Figure 3.1.2) with parr density averaging 3.98 parr/100m² in 2021 in comparison to an average of 7.43 parr/100m² in 2018. In 2019, results showed a decrease in brown trout fry presence with only 42% of sites producing the young of year and 54% of sites in 2020.

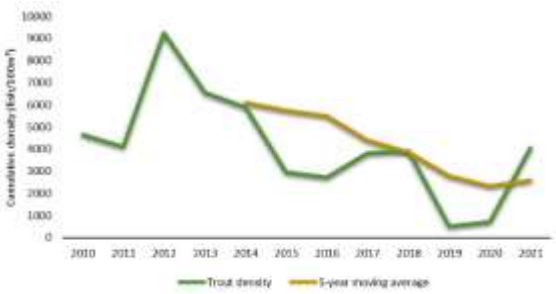


Figure 3.1.3: Cumulative brown trout fry densities on the Ribble catchment for 138 sites fish 2010 – 2021 including 5 year moving average.

With results of 2021 showing an improvement in recruitment of trout on the catchment (Figure 3.1.3), and river conditions during egg development and emergence being more favorable than 2019/2020, this year's fisheries map can be used to highlight problem areas on the catchment (Figure 3.1.4). The absence of trout fry will always be of concern, especially in areas where they have previously been documented. However, not all areas are suitable nursery habitat for trout, for example there are many sites on the main-stem Ribble that are recorded as F-Grades (Figure 3.1.4).

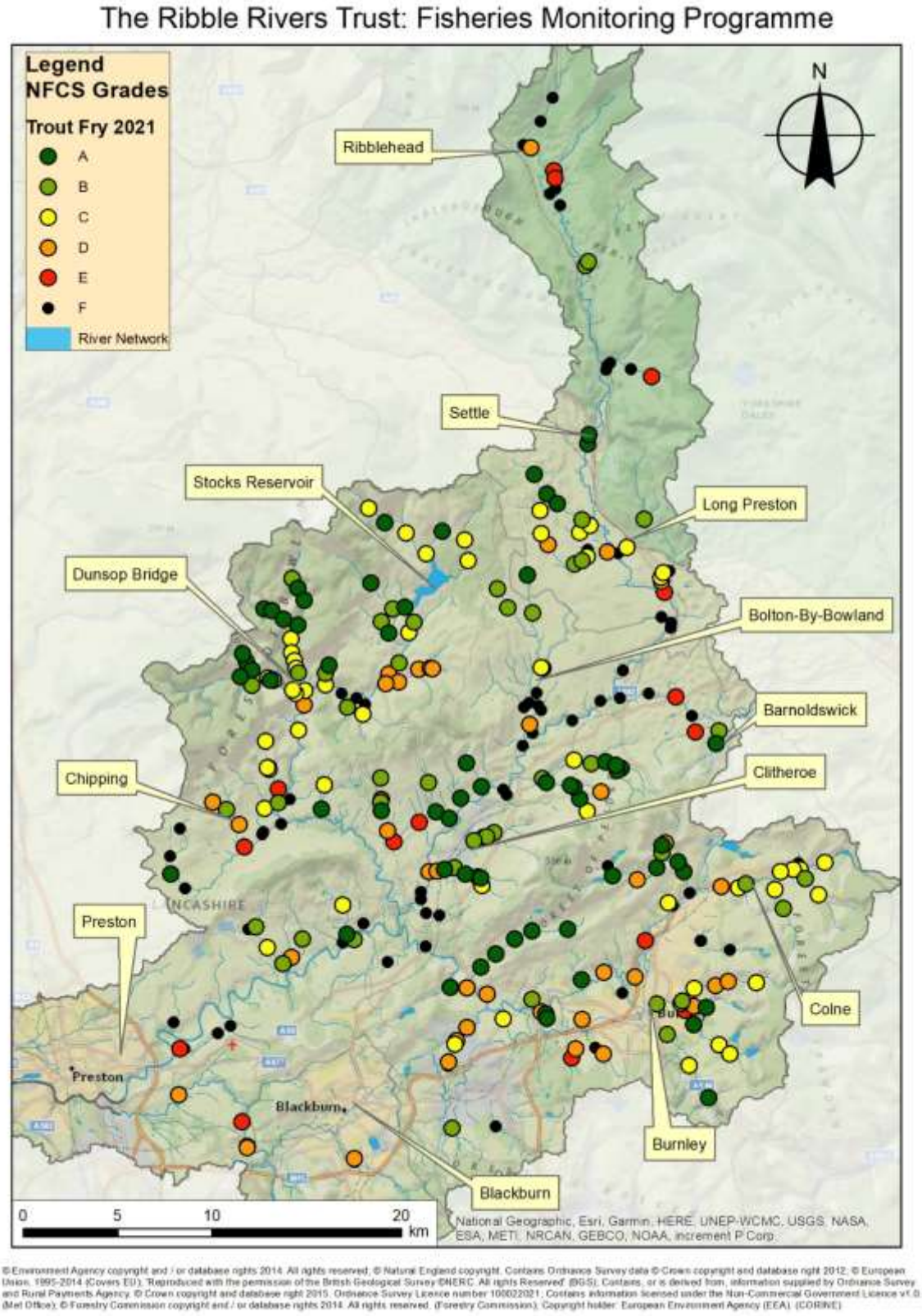


*Figure 3.1.4: Catchment map [1:250,000] showing brown trout fry NFCS grades from **283** surveys undertaken by RRT in 2021 and 5 EA sites. Green to red points indicate higher to low grades. Black indicates an absence of trout fry.*

3.1.1 Calder Brown Trout

In comparison to 2020, 79.4% of sites surveyed have improved in trout fry NFCS grade score on the Calder Catchment (Figure 3.2.5). The density estimations from sites containing the young of year ranged between 2.8 – 135 fry/100m² with a mean density of 29.8 fry/100m². This is a significant improvement on the last two years (Figure 3.2.6).

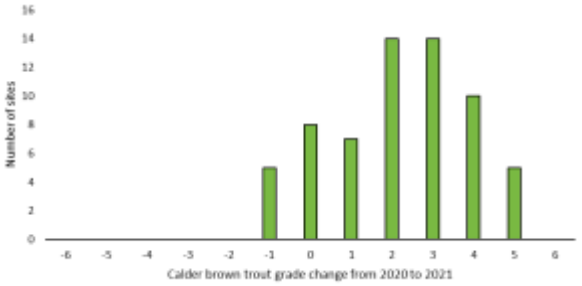


Figure 3.1.5: NFCS grade change comparison of brown trout on the Calder catchment 2020 to 2021 (0 = no change).

Walverden Water and Catlow Brook have produced no fry this year (Figure 3.2.8), at times this waterbody has yielded some good densities near its confluence with the River Calder. However, with degraded habitat and other anthropogenic pressures and modification, its trout fry densities on average are poor. The Green Brook Waterbody (GB112071065080) has again struggled in 2021, with Very Poor trout fry densities recorded. In the past this waterbody has been flagged for pollution issues, as well as physical modification, urban development and industry impacting water quality and river connectivity up to the headwaters of Habergham and Hapton Clough.

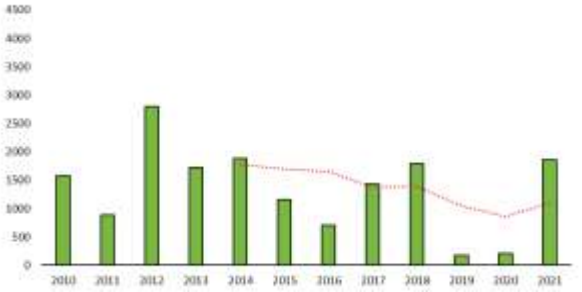


Figure 3.1.6: Cumulative brown trout fry densities on the Calder catchment for 50 sites fish 2010 – 2021 including 5 year moving average.

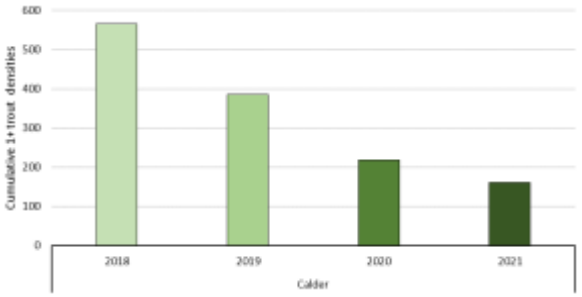


Figure 3.1.7: Cumulative brown trout parr densities of sites fished 2018-2021 on the Calder

The headwaters of Pendle Water (Figure 3.2.5) prior to the confluence with Colne Water have produced Excellent densities, with Sabden Brook and Castle Clough Brook further down the Calder producing some of the highest densities of the year with well over 100 fry/100m² in many of their sites. Sabden Brook achieved five A-grade sites out of the 6 surveyed, marking itself as an excellent tributary for brown trout spawning and recruitment for the wider catchment. Away from its head waters the River Calder is recording poor densities, however spawning and nursery habitat on these main stem sites are pocketed.

The observed density of parr on the Calder catchment are down in comparison to 2018 (Figure 3.2.7) with a site average of 3.1 parr/100m², with sites containing trout parr ranging from 0.3 - 51 parr/100m². In 2018, site averages were 8.3 parr/100m² with a wider range of 0.4 – 73 parr/100m².

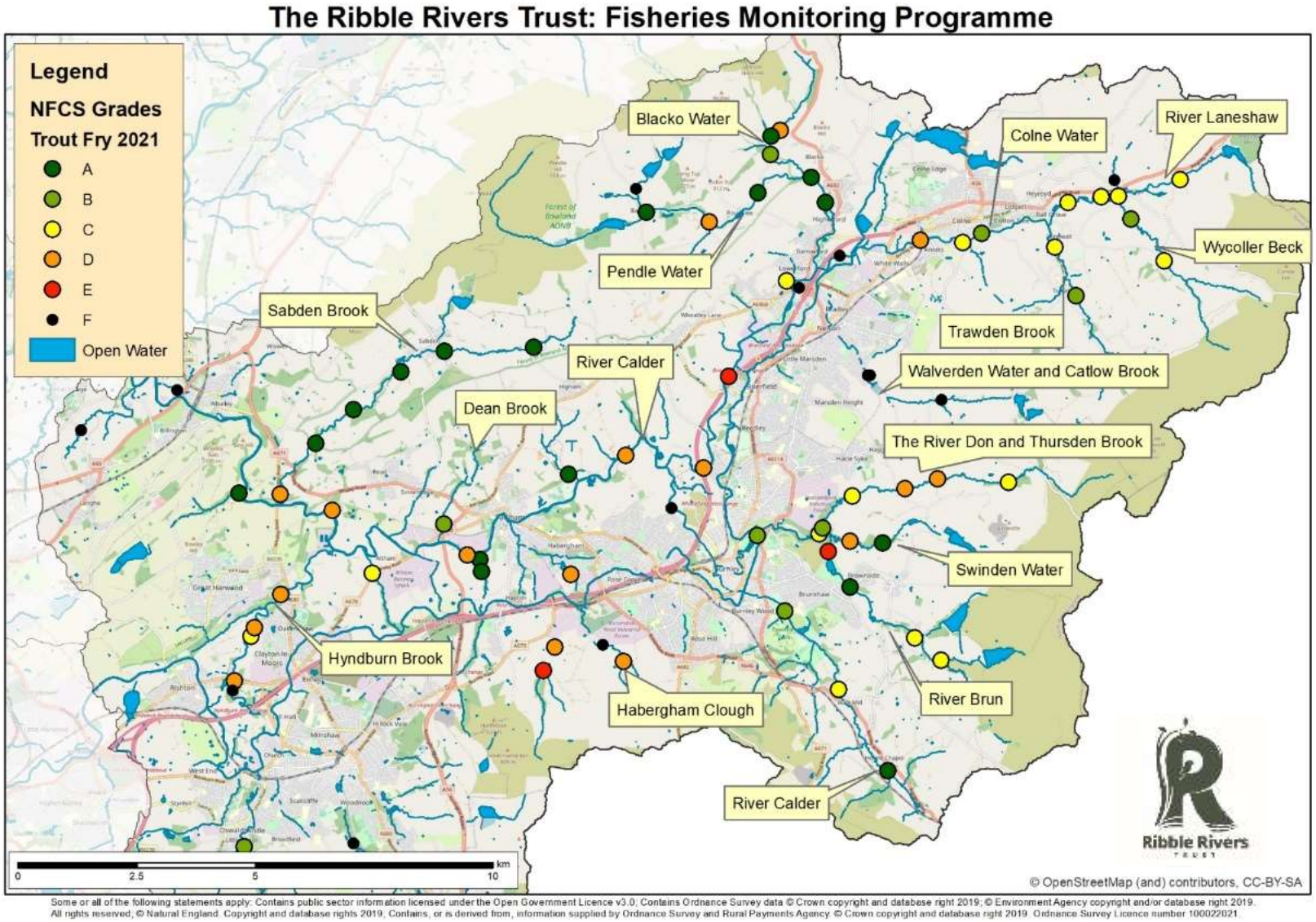


Figure 3.1.8: Brown trout fry NFCS grades from Calder catchment surveys undertaken by RRT in 2021

3.1.2 Hodder Brown Trout

In comparison to 2020, 66.7% of sites surveyed have improved in trout fry NFCS grade scores on the Hodder Catchment (Figure 3.1.9). The density estimations from sites containing the young of year ranged between 2.8 – 332 fry/100m² with a mean density of 26.7 fry/100m². This is a significant improvement on the last two years (Figure 3.1.10).

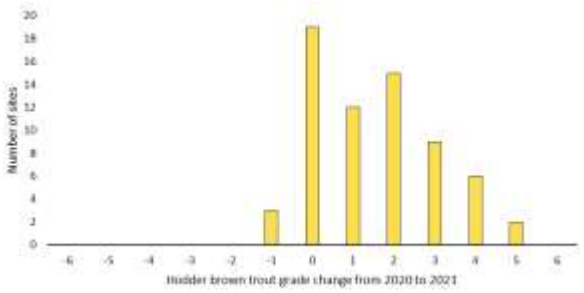


Figure 3.1.9: NFCS grade change comparison of brown trout on the Calder catchment 2020 to 2021 (0 = no change).

Poor trout fry densities on Greystoneley Brook this year are concerning as they have been observed alongside uncharacteristically low abundance and diversity of other minor coarse fish species. Lees Beck (Figure 3.1.13) remains absent of salmonids and minor coarse fish species. At times fry have been found near the confluence, however this tributary regularly runs dry over the summer months, and its upper reaches are fragmented from the main stem Hodder.

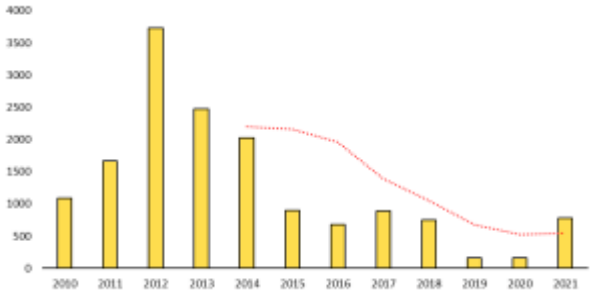


Figure 3.1.10: Cumulative brown trout fry densities on the Hodder catchment for 44 sites fish 2010 – 2021 including 5 year moving average.

On the River Loud five out of the six sites surveyed did not produced trout fry. However, one site did record its highest ever density at 56.8 fry/100m². Good recruitment on the Loud catchment is intermittent and most sites remain continuously poor or absent, with the average fry density being 2.5 fry/100m² over 14 years of surveys.

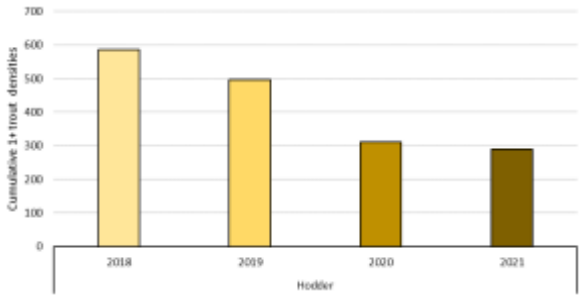


Figure 3.1.11: Cumulative brown trout parr densities of sites fished 2018-2021 on the Hodder

Many of the upper reaches of the Hodder catchment are within the upper boundaries of the NFCS grades. The Losterdale, Brennand and Whitingdale water bodies have provided some of the best brown trout fry densities on the Hodder catchment. The River Dunsop has not matched its headwaters in grades. However, there are pockets of brown trout spawning within the River Dunsop giving Fair NFC grades, though most of its length has larger substrate which is more optimal for Atlantic salmon.

Like other sub-catchments, brown trout fry has been recorded in poor densities on the main stem. These main stem Hodder sites are not optimal for brown trout spawning and provide little nursery habitat and cover.

The observed density of parr on the Hodder catchment are down in comparison to 2018 (Figure 3.1.11) with a site average of 7.7 parr/100m², with sites containing trout parr ranging from 1.9 - 69 parr/100m². In 2018, site averages were 10.1 parr/100m² with a smaller range of 1.7 – 45 parr/100m².

Figure 3.1.12: Electric fishing surveys on the River Dunsop 2021

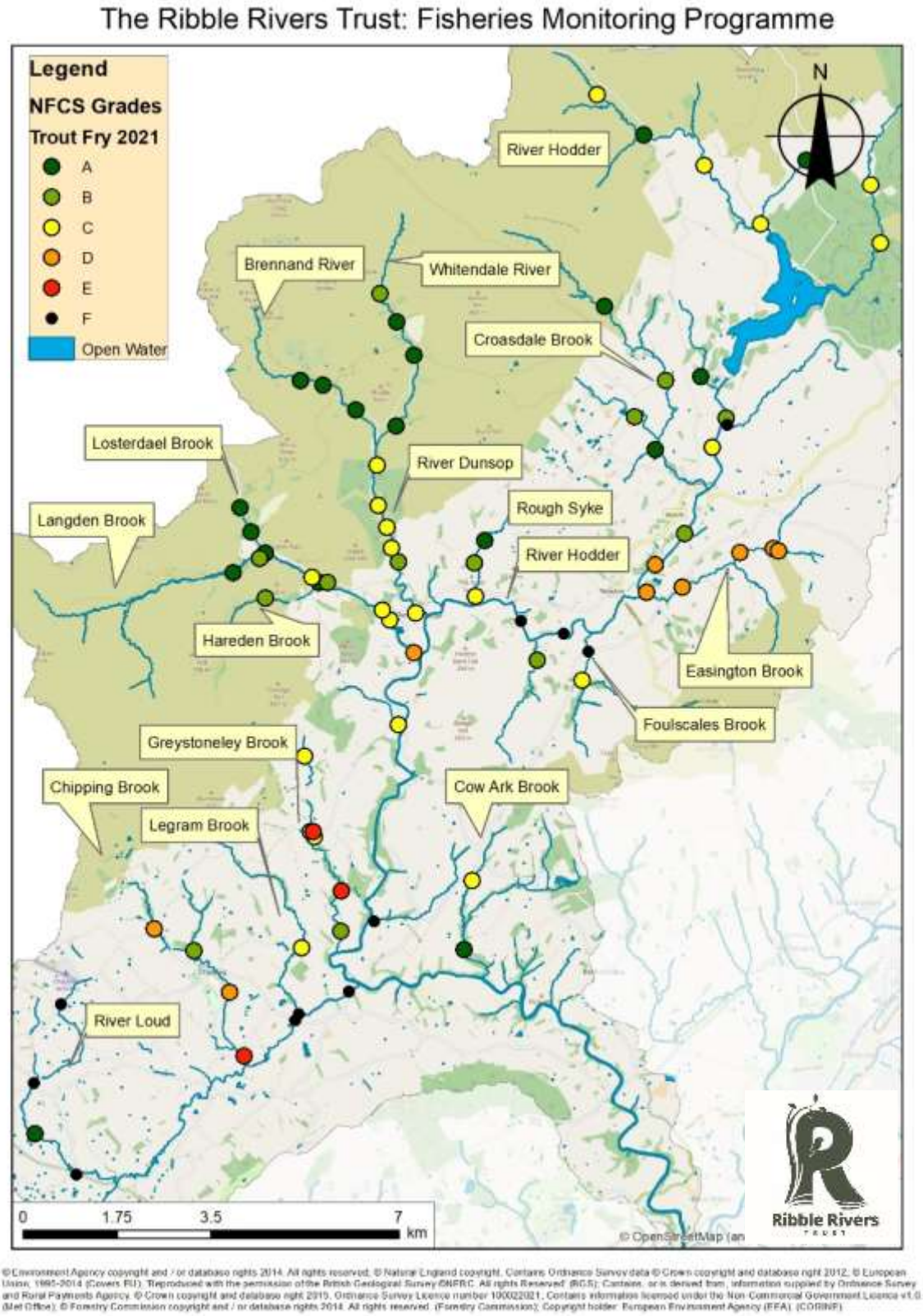


Figure 3.1.13: Brown trout fry NFCS grades from Hodder catchment surveys undertaken by RRT in 2021

3.1.3 Ribble Brown Trout

The density estimations from sites containing the young of year ranged between 1 – 122fry/100m² with a mean density of 20.4 fry/100m². This is a significant improvement on the last two years (Figure 3.1.14).

The observed density of parr on the Ribble catchment is slightly improved from 2019s figures with a site average of 2.4 parr/100m², with sites containing trout parr ranging from 0.6 – 11.9 parr/100m². However, numbers are down in comparison to 2018 (Figure 3.1.15) where site average were 5.5 parr/100m², with sites containing trout parr ranging from 0.6 – 39.6 parr/100m².

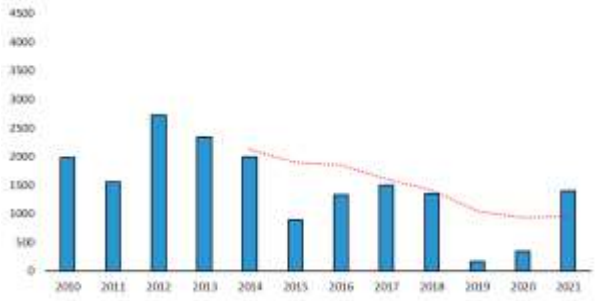


Figure 3.1.14: Cumulative brown trout fry densities on the Mid and Upper Ribble catchment for 44 sites fish 2010 – 2021 including 5 year moving average.

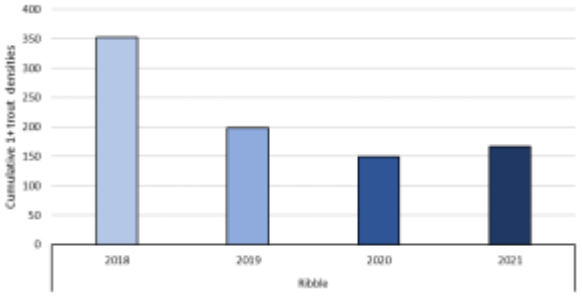


Figure 3.1.15: Cumulative brown trout parr densities of sites fished 2018-2021 on the Ribble

Mid-Ribble

Like other sub-catchments, brown trout fry have been recorded in poor densities on the main stem. These main stem sites are restrictive for trout spawning, providing little habitat and cover for the young of year.

For the Mid-Ribble, 50% of sites surveyed were within the A-B NFSC grade boundaries (Figure 3.1.16). However, Holden Beck, Bier Beck, and Skirden Beck have struggled to produce young of year. These sites have intermittently produced some high densities but struggle due to water quality issues. Stock Beck is another problem area on the Mid-Ribble, with poor land management being a major contributing factor to poor water quality.

Upper Ribble

On the Upper Ribble catchment (Figure 3.1.17) Rathmell Beck and Tems Beck have performed well in 2021 with good to excellent densities. Brow Gill Beck was the only site to drop 2 NFCS trout fry grades (D to F), this survey site intermittently fails to produce the young of year having been affected by lower flows in summer months. Cam and Gayle Beck, at the top of the Ribble Catchment, has also struggled to produce high densities of brown trout fry and rarely get above a NFCS D-Grades. This area is known to have degraded habitat quality and river management and restoration projects are ongoing.

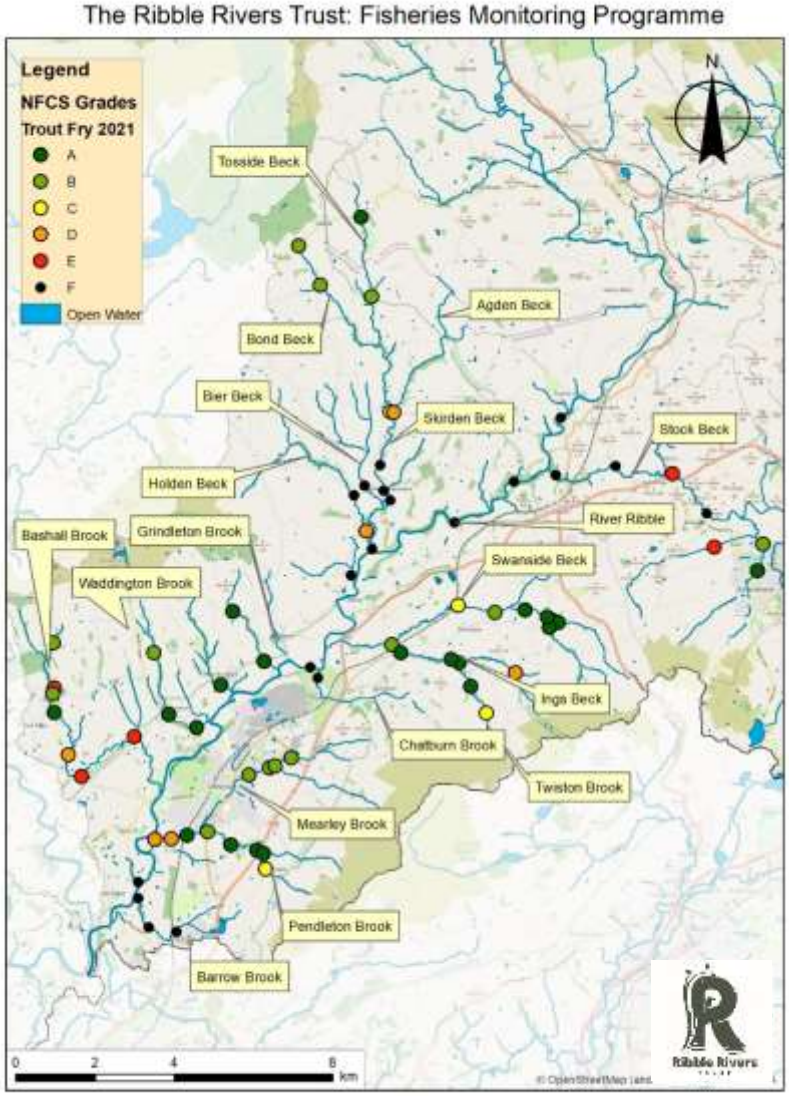


Figure 3.1.16: Brown trout fry NFCS grades from mid-Ribble catchment surveys undertaken by RRT in 2021

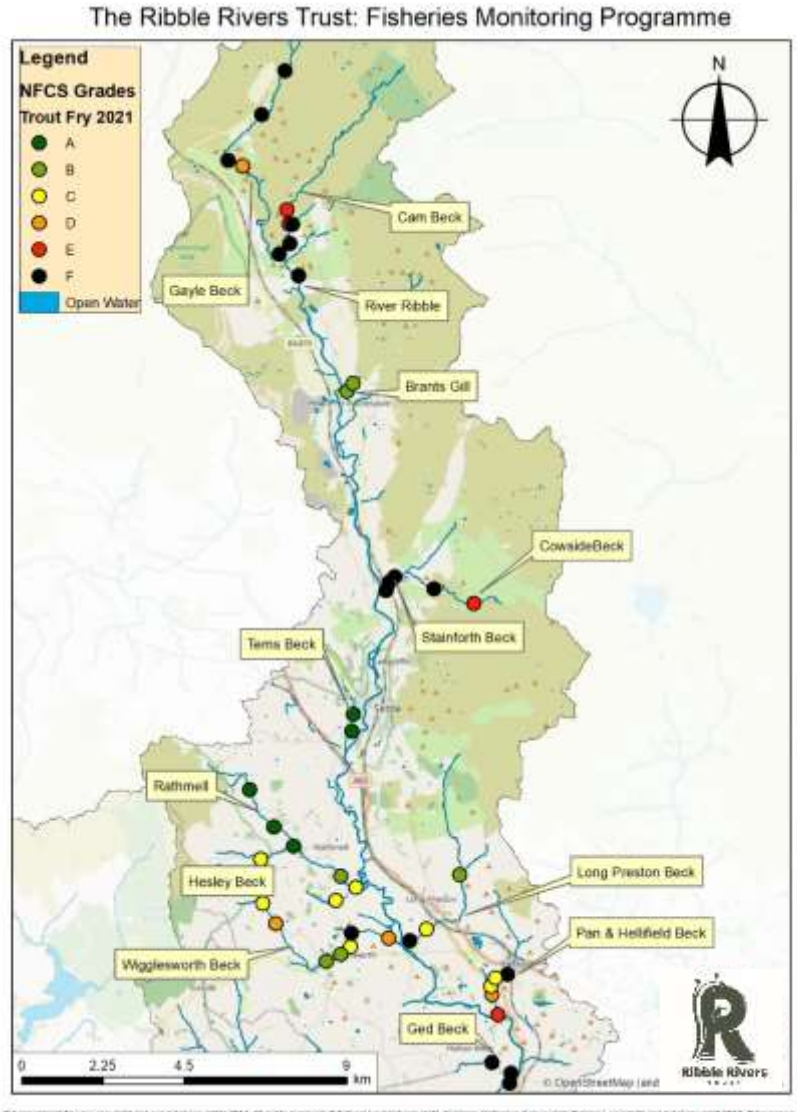


Figure 3.1.17: Brown trout fry NFCS grades from upper-Ribble catchment surveys undertaken by RRT in 2021

3.2 Atlantic Salmon (*Salmo salar*)

During the 2021 survey season a total of 564 Atlantic salmon fry and parr were captured over 283 electric fishing sites. The recruitment of Atlantic salmon fry on all catchments has seen little improvement for 2021 (Figure 3.2.1), and salmon have only been recorded in 18% of sites surveyed. The density estimations from sites containing the young of year ranged between 1.5 – 271 fry/100m² with a mean density of 23.8 fry/100m². This is an improvement on 2020s results where sites had a narrower range of 1.6 – 23 fry/100m² where the mean density of salmon fry was at 5.9 fry/100m².

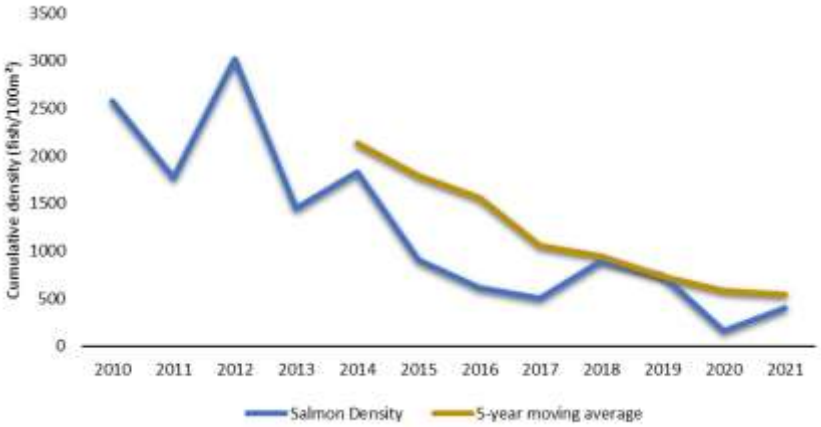


Figure 3.2.1: Cumulative Atlantic salmon fry densities for the 138 sites fish 2010 – 2020 including 5 year moving

With results of 2021 showing little improvement in salmon recruitment on all sub-catchments (Figure 3.2.2). This year's results are concerning, especially considering the improvements seen in trout fry densities and given the more favorable spawning and development conditions of the winter months.

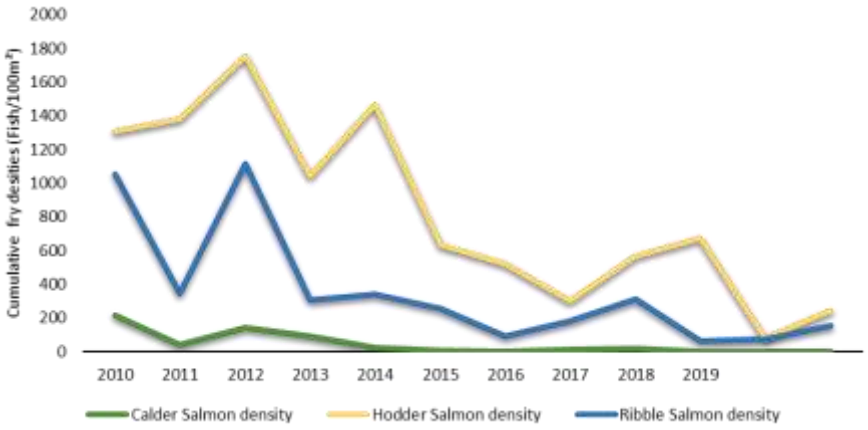


Figure 3.2.2: Cumulative Atlantic salmon fry densities for the 138 sites fish on the Calder, Hodder and Ribble catchments between 2010 – 2020 including 5 year moving average.

The fisheries map (Figure 3.2.3) shows limited areas in the catchment where Atlantic salmon are spawning, and many sites are in the lower NFCS grade boundaries. The reduction in the range of spawning sites will always be of concern, especially in areas where they have previously been documented in good densities.

Where fry have been found, sites surveyed on main stem rivers appear to have produced better densities than the tributaries which are known to hold good nursery habitat. A single salmon fry was captured in Bailey Brook on the Lower Ribble, this is the first time since 2013 that RRT has recorded the young of year on the Lower Ribble.

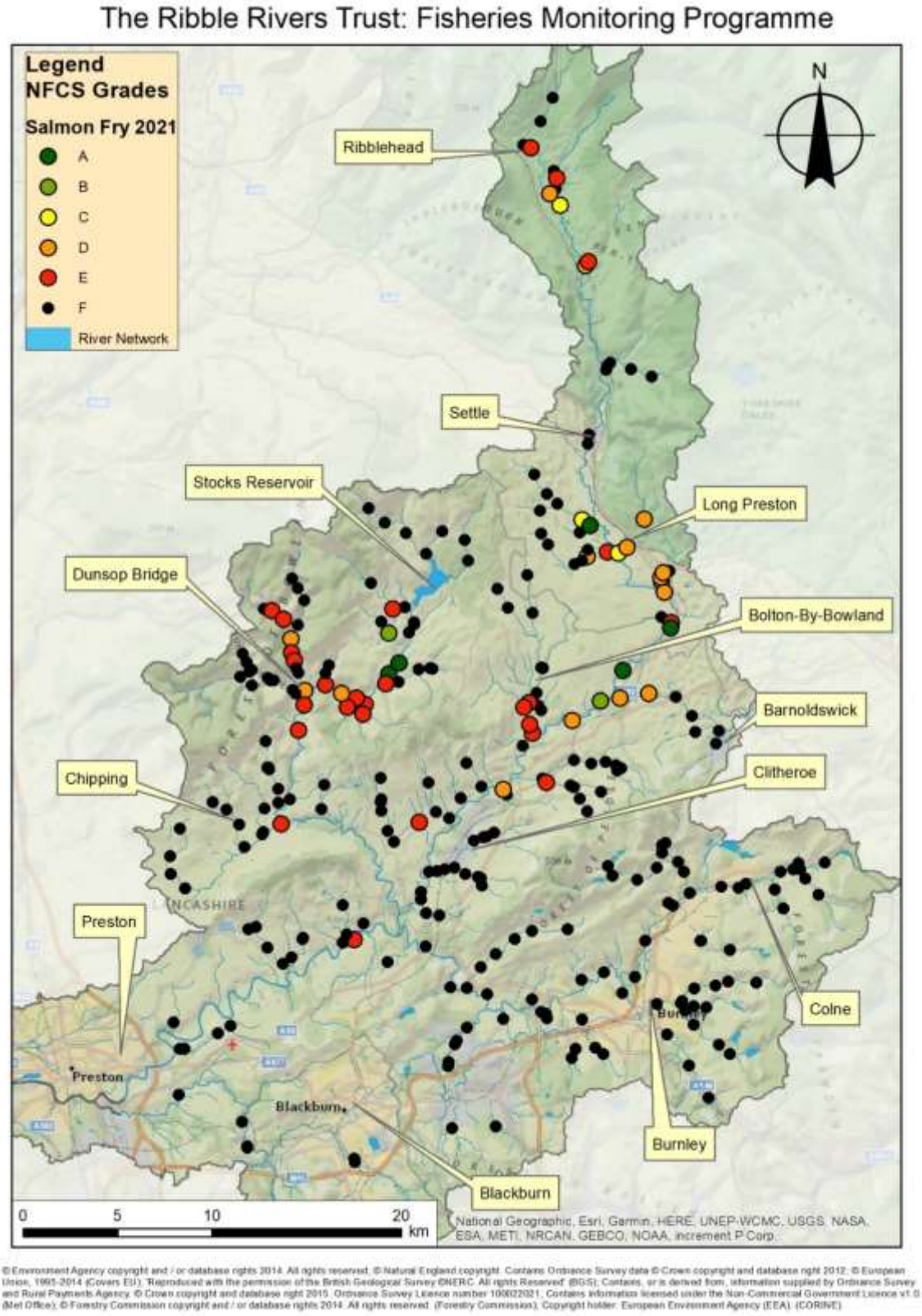


Figure 3.2.3: Catchment map [1:250,000] showing Atlantic salmon fry NFCS grades from 283 surveys undertaken by RRT in 2021 and 5 EA sites. Green to red points indicate higher to low grades. Black indicates an absence of trout fry

3.2.1 Calder Atlantic Salmon

The Calder catchment has recorded NO salmon fry or parr in 2021 (Figure 3.2.4) and since 2013 there have been no sites above a NFCS D grades. This is the third consecutive year where salmon fry have not been recorded on the Calder catchment and the 1st year where parr have also been absent.

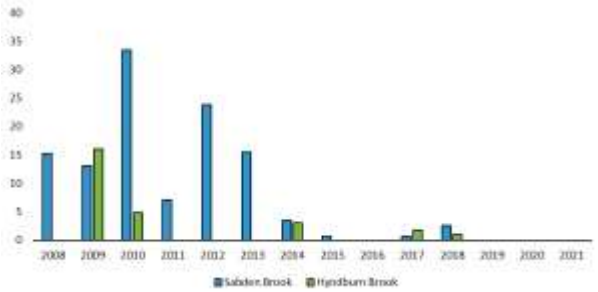


Figure 3.2.4: Average Atlantc salmon fry densities on Sabden and Hyndburn Brook fish 2008 – 2021 including

Limited waterbodies and sites on the Calder catchment yield regular fry results with Sabden and Hyndburn Brook being the only two tributaries in which salmon were being repeatedly recorded. Previously, in 2015, salmon fry were recorded on the River Brun above Townley park and at Carry Bridge on Colne Water. However, as yet there has not been a return to this area.

From the 14 years of Ribble Trust data, 2010 is the only year that salmon fry have recruited A and B grade NFCS densities below Sabden village. From 2014 the distribution became limited to the lower reaches of the brook, and over the past 7 years there have been minimal recruitment observed despite brown trout densities indicating good water quality and habitat.

Hynburn Brook has always produced lower densities of salmon fry and more intermittently than Sabden Brook (Figure 3.2.5). Fish passage was one limiting factor on the Brook, however most of the major barriers to fish migration have been addressed by the Ribble Trust.

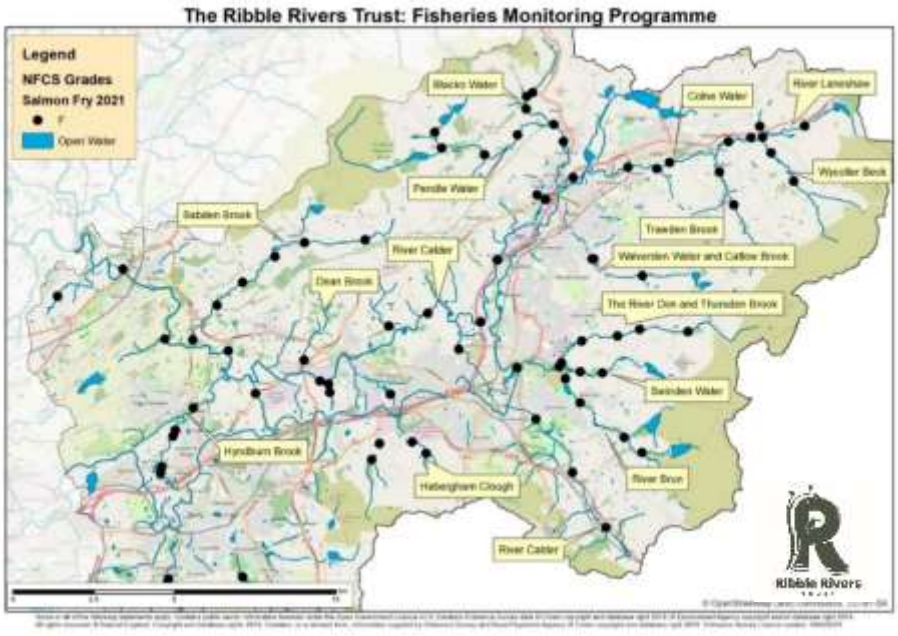


Figure 3.2.5: Atlantic salmon fry NFCS grades from Calder catchment surveys undertaken by RRT in 2021

3.2.2 Hodder Atlantic Salmon

In comparison to the Calder and main Ribble catchments, the Hodder catchment has seen a greater increase in salmon fry densities in 2021. In comparison to 2020, 10.6% of sites surveyed have increased in fry NFCS grade scores on the Hodder Catchment (Figure 3.2.6). 74.2% of sites have seen no change in fry densities, many of which are absent of salmon fry (Figure 3.2.7). Sites that have seen a reduction in the number of young of year are on Brennand, Whitendale and River Dunsop where numbers were always considered to be consistently Good.

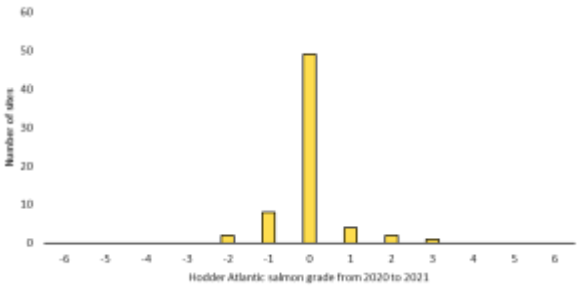


Figure 3.2.6: NFCS grade change comparison of Atlantic salmon on the Hodder catchment 2020 to 2021 (0 = no change).

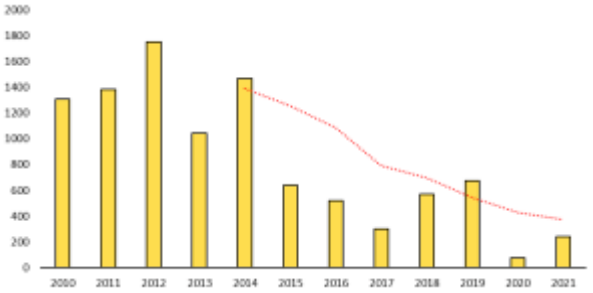


Figure 3.2.7: Cumulative Atlantic salmon fry densities on the Hodder catchment for 44 sites fish 2010 – 2021 including 5 year moving average.

For the sites that held fry in 2021, the density estimations ranged between 1.5 – 122.8 fry/100m² with a mean density of 20 fry/100m². Despite the increase in salmon recruitment for 2021 the five-year moving average shows a downward trend. Calculating an average at specific intervals smooths out the data by reducing the impact of fluctuations in short term data. This makes it easier to see overall trends, and this downward trend in fry densities is concerning.

The highest densities of salmon fry were again recorded on the main stem Hodder below Slaidburn Village and on the lower reaches of Croasdale Beck. However, all other sites returned poor to very poor NFCS grades on the catchment despite many areas holding excellent trout fry grades, indicating good habitat and water quality.

Figure 3.2.8: Atlantic salmon parr caught on the Hodder Catchment, River Dunsop – Size 205mm (2021)

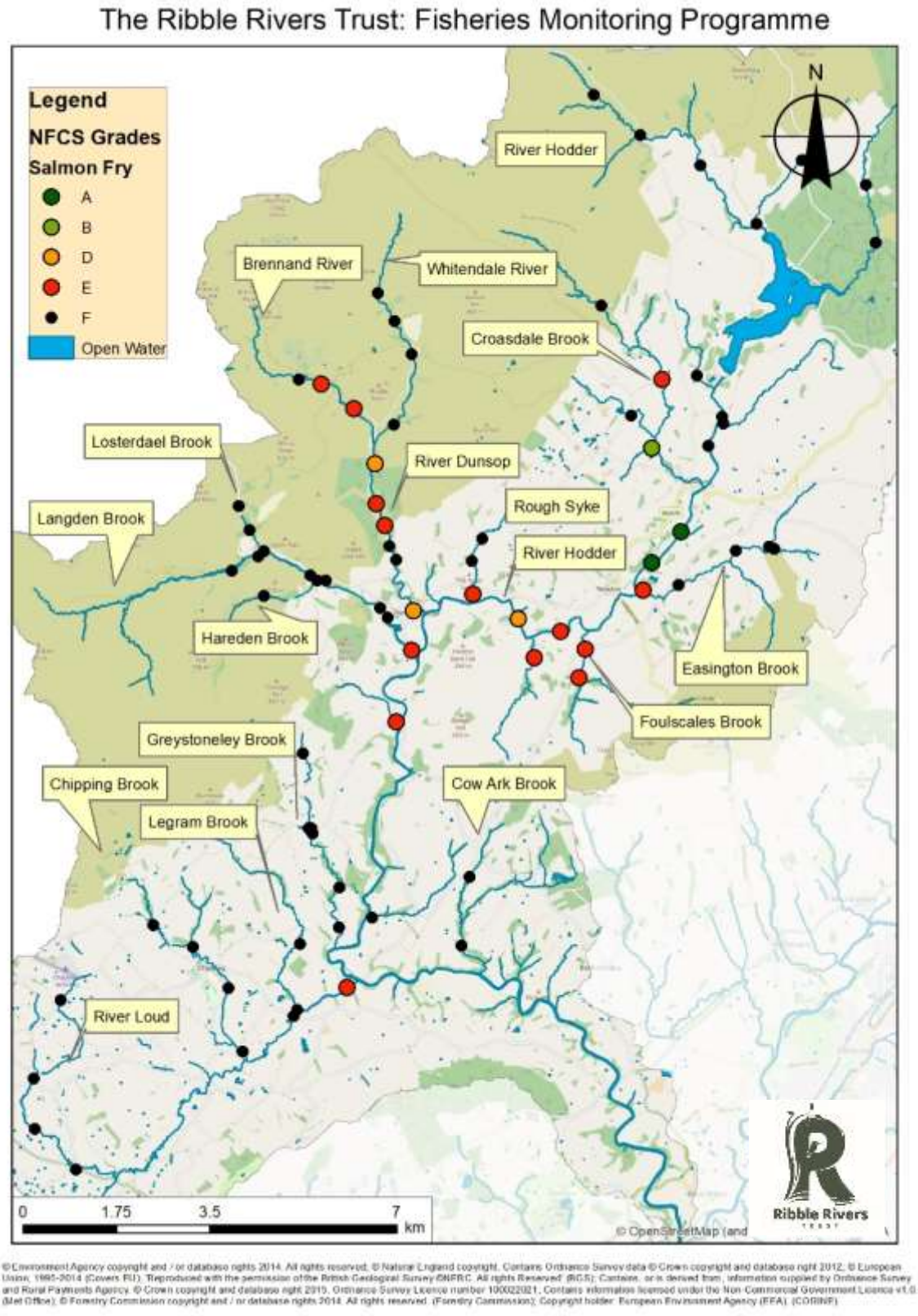


Figure 3.2.9: Atlantic salmon fry NFCS grades from Hodder catchment surveys undertaken by RRT in 2021

3.2.3 Ribble Atlantic Salmon

In comparison to 2020, 17.2% of sites surveyed have increased in fry NFCS grade scores on the Mid and Upper Ribble Catchment (Figure 3.2.10). 75% of sites have seen no change in fry densities, many of which are absent of salmon fry (Figure 3.2.11). Sites that have seen a NFCS Grade reduction are on Wigglesworth Beck and Pan Beck.

For the sites that held fry in 2021, the density estimations ranged between 1.5 – 171 fry/100m² with a mean density of 27.0 fry/100m². Despite the increase in salmon recruitment for 2021 the five-year moving average shows a downward trend.

The highest densities of salmon fry were again recorded on the main stem Ribble at Nappa and above Gisburn. Like 2020, Rathmell Beck produced some of the highest densities on the catchment, but only on its lower reaches. Most other sites returned poor to very poor NFCS grades despite many areas holding excellent trout fry grades, indicating good habitat and water quality.

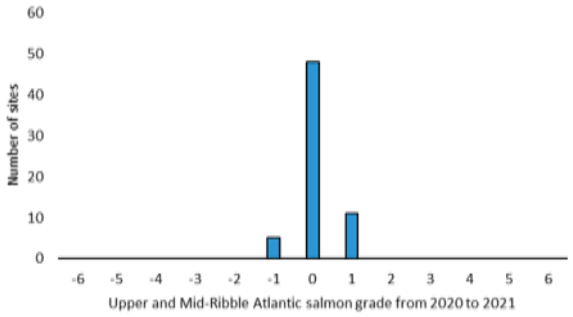


Figure 3.2.10: NFCS grade change comparison of Atlantic salmon on the Mid and Upper Ribble catchment 2020 to 2021 (0 = no change).

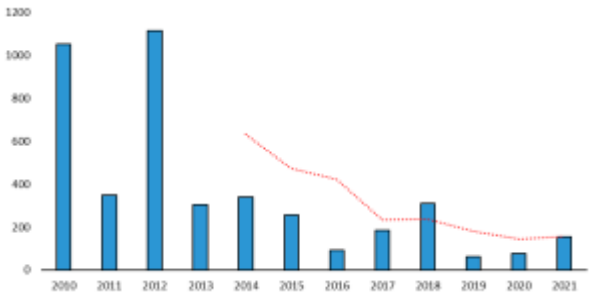


Figure 3.2.11: Cumulative Atlantic salmon fry densities on the Ribble catchment for 44 sites fish 2010 – 2021 including 5 year moving average.

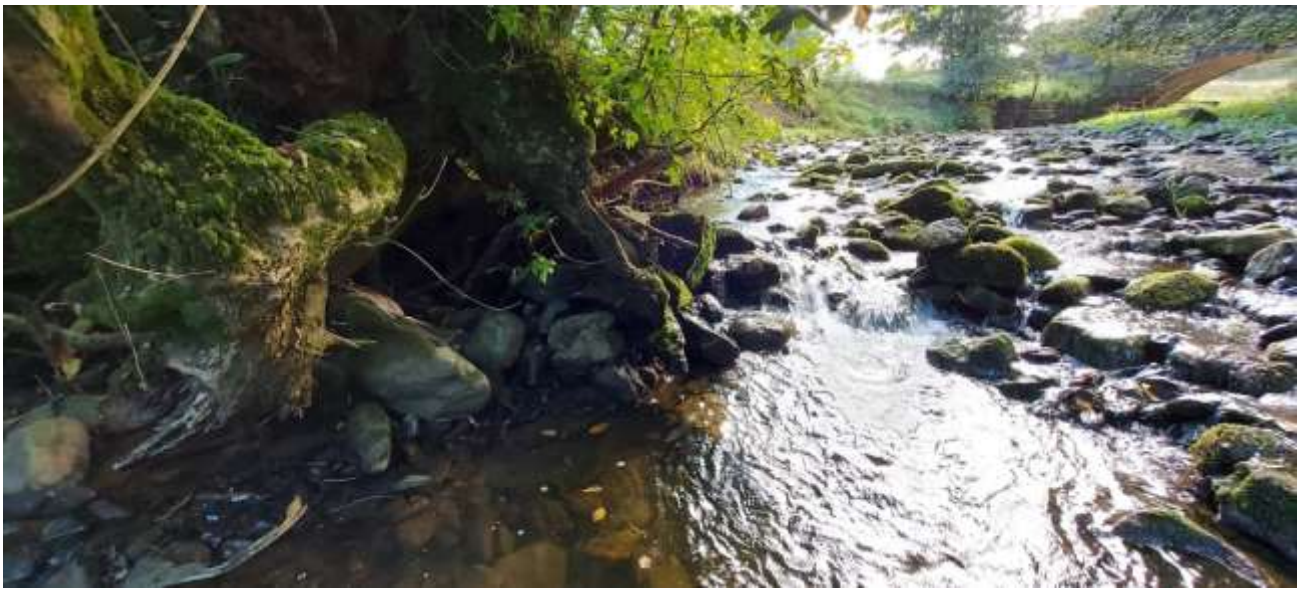


Figure 3.2.12: Ings Beck on the Mid-Ribble catchment - surveys undertaken by RRT in 2021

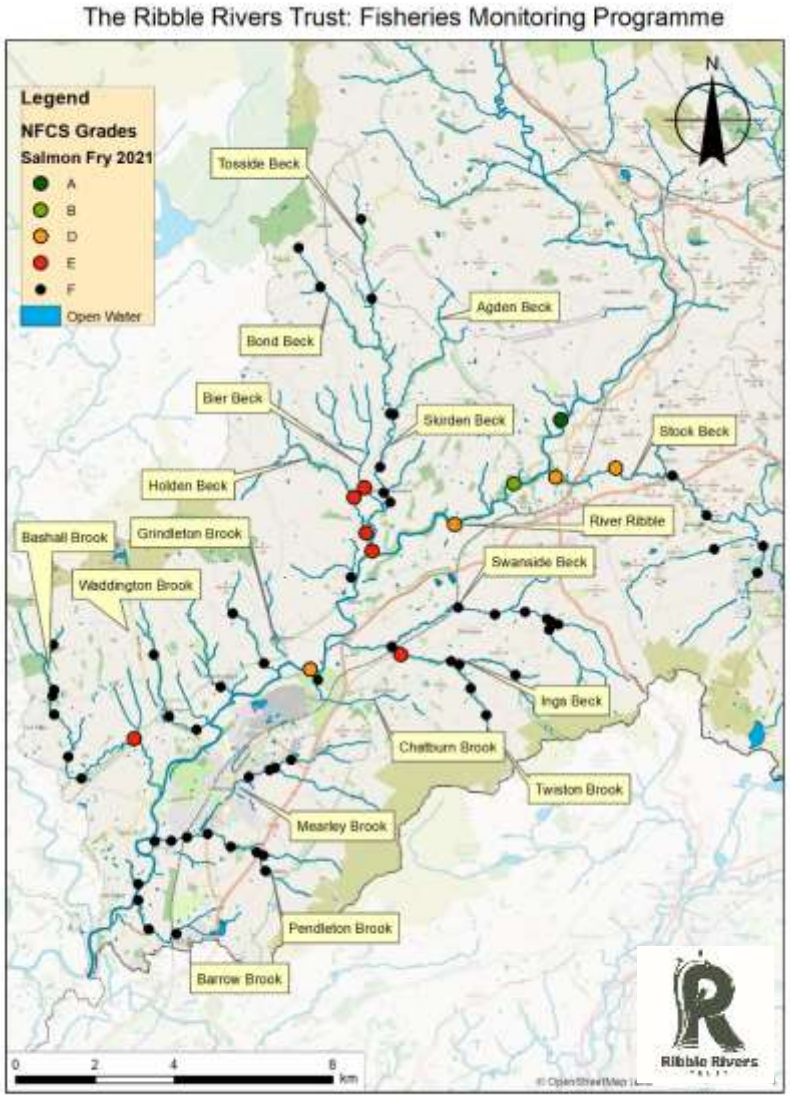


Figure 3.2.13: Atlantic salmon fry NFCS grades from Mid-Ribble catchment surveys undertaken by RRT in 2021

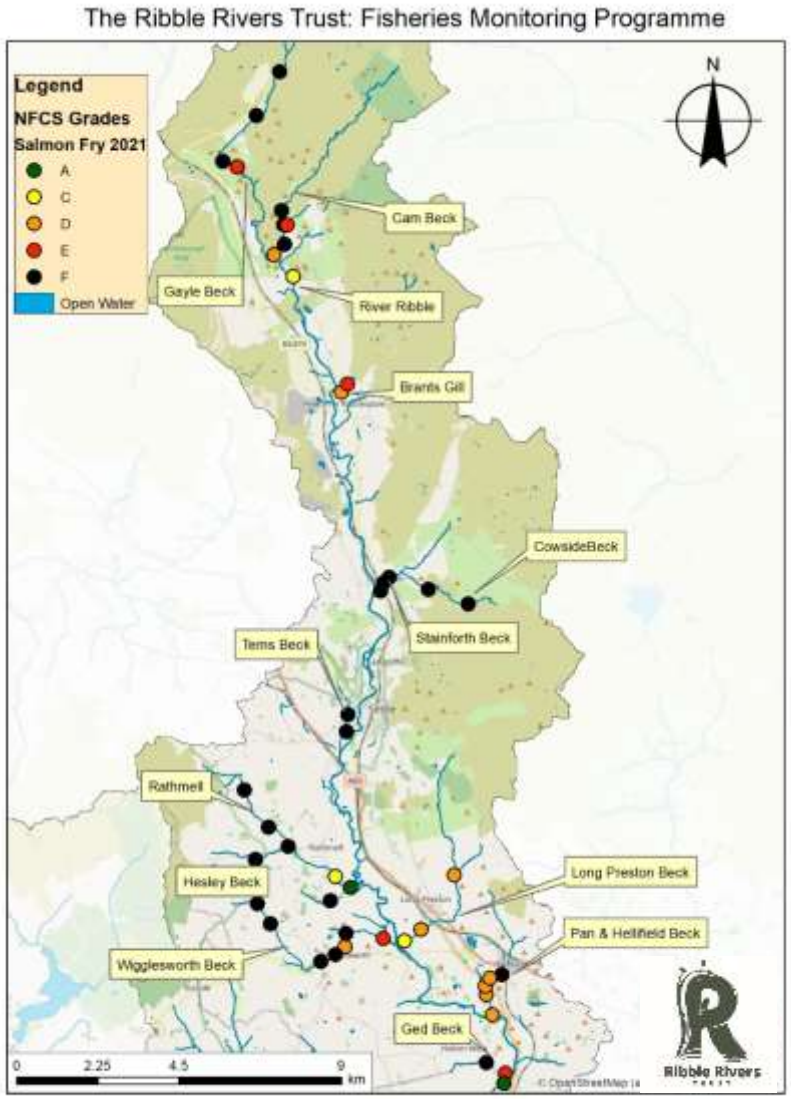


Figure 3.2.14: Atlantic salmon fry NFCS grades from Upper Ribble catchment surveys undertaken by RRT in 2021

3.3 Other Species

Bullhead (*Cottus gobio*) remain the dominant non-targeted species on the catchment found within 85.0% of sites (Figure 3.3.1 and 3.3.2). Stone loach (*Barbatula barbatula*) have been recorded in 50.5% of sites and common minnow (*Phoxinus phoxinus*) in 35.2% of sites. A total of 12 non-salmonid fish species have been caught in survey sites since 2016, with 8 being caught in 2021 (Figure 3.3.1 and 3.3.2).

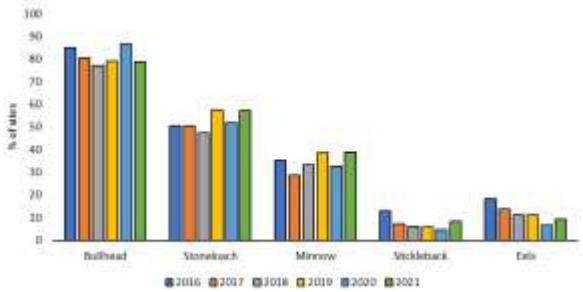


Figure 3.3.1: Dominant by-catch by species % presence of sites from 2016 to 2021.

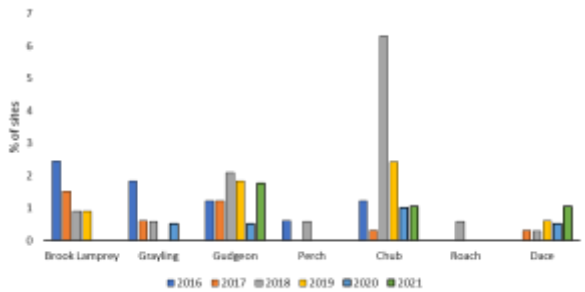


Figure 3.3.2: Accompanying by-catch by species % presence of sites from 2016 to 2021.

3.3.1 An Interesting Specimen

An interesting European eel specimen was captured on the Calder catchment at the confluence of the River Brun and the River Don. Paul Coulson FIFM, Institute of Fisheries Management Director of Operations, provided insight on this colour morph through his contacts in the eely world. Robert Rosell of Agri-Food and Biosciences Institute (AFBI, NI) commented that it is a form of genetic colour determination defect, but not total albinism. Dependent on the missing gene or gene function and the three-pigment system, European eels can be normal yellow/brown, or more rarely a bluish (Conger like) colour. But the yellow/gold coloration is even more rare . Fisherman can be superstitious about catching them, but you would need to go through hundreds of thousands of eels to see one.

Figure 3.3.3: Golden European eel captured 20/06/2020 on the River Brun.

4.0 Discussion

With winter river conditions of 2020 and into 2021 being more favourable for salmonid spawning, egg development and emergence; there has been a significant lift in the densities of brown trout recorded on the Calder Hodder and Ribble Catchments. With such a positive increase in trout densities it is concerning that Atlantic salmon have seen minimal change.

Despite there being a slight improvement in salmon production on the catchment in comparison to the past two years, only 51 in 283 sites produced salmon fry, of which 80% were classed as Poor or Very Poor in densities. In 2021 surveys, spawning sites on the main-stem rivers (or close to their tributary confluences) were where the Good and Excellent salmon fry sites were recorded. These sites are appearing to be more favoured over historic sites further up tributaries. As adult salmon returns have dropped over time the recorded distribution of spawning on the catchment has reduced and the densities of their young of year is taking a downward trend.

The decline of salmon has been geographically widespread and is well documented, but there are many unknowns about their ocean stage of their life cycle. Once Atlantic salmon have left freshwater, we know little about where they are at any given time, what stressors they are encountering and to what degree they are impacting populations. With climate driven change in the marine ecosystem, the ocean is not an environment that we can have effective management over to maximise adult returns. However, what is in our control is to emphasise the importance of freshwater management and habitat restoration, to ensure that the number of fish that survive to smolt in good condition are sufficient to mitigate against ocean losses. Ideally, we would avoid the need for restoration in the first place as prevention is favoured, by proactively delivering protection to sustainable populations as much as possible. On the Ribble catchment, if the goal is for salmon populations to be restored, we first need to identify the problems, and then take action to solve them. Salmon are good colonizers and to see a return to a robust self-sustaining population on our catchment, the right management and improvement strategies for water and habitat quality need to be applied. If the degradation of Atlantic salmon population on the Ribble catchment continues at this observed rate, it may lead to an unsustainable population by the end of the decade, with localised extinctions on its sub-catchments.

With such low densities of brown trout fry recorded in 2019 and 2020 community composition has been altered and the observed numbers of parr has been reduced in 2021. This was expected, as mortality rates in the first year of life are typically approaching 90% or greater. However, the juvenile habitat for parr is highly

density dependent, with reduced competition and resource availability this may allow for a greater chance of survival. The number of 1year+ trout in 2022 surveys is expected to improve and will also be reflected in rod catch numbers.

Given the reduction in Atlantic salmon distribution on the Ribble catchment and spending much of its life cycle at sea, it is considered that brown trout can provide the best insight into the freshwater health of the catchment. As the most widespread indicator species the majority of the population will spend its complete lifecycle residing within the river system. As such brown trout tend towards being a more direct indicator of the status of the freshwater environment than its counterpart. With this year's improvements in fry densities, problem areas on the catchment have been highlighted in the sections below. Not all areas on our system are optimal for spawning and nursery habitat, and we look at the results in this context.

The Calder Catchment

The Calder catchment is a recovering industrial catchment that has been extensively influenced and impacted by the cotton industry. Many of its headwaters have been affected by the construction of reservoirs to feed, the canal system, industry, and to provide drinking water. Many water bodies are heavily modified, with sections of river channelised, and many redundant weirs remaining fragmenting river habitat.

Waterbodies of concern

For 2021, locations recorded as having no trout fry on the catchment have been observed in areas with low or poor spawning potential and have a long-term absence. Walveden Water is one of the water bodies that is highly impacted by loss of spawning gravels from two reservoir impoundments and is also impacted by heavy modification, culverting, in river structures and other human pressures. It is unlikely that we would see short term improvement on this tributary due to the extent of the issues. However, there are other water bodies on the catchment that have the potential to be improved with investigation and investment. Hyndburn Brook is a waterbody that has the potential to be a more productive tributary of the Calder. Many of its connectivity issues have been addressed by the Trust, however focus must be drawn towards its water quality which is impacted by industry and agriculture. Salmon fry were regularly recorded on the brook, however the question of its long-term sustainability is dependent on seeing these improvements. Another consideration would be The River Don and Thursden Brook, where we have seen fluctuations in brown trout populations over the years. High fluvial events have been one cause of disruption to fry densities but in other years it has produced some of the best densities on the catchment. Reasons for not achieving good status from the Environment Agency Catchment Data Explorer is physical modification with barriers to ecological discontinuity, however these have been addressed by the trust with the instillation of fish pass solutions. Poor land management may be a factor of the waterbody not being able to maintain the Good to Excellent classification year on year.

Positive outcomes for 2021

Despite historic influences on the catchment and other ongoing human pressures from agriculture and industry, there are many tributaries that provide prime habitat for salmonid and coarse fish spawning. In 2021 the Calder Catchment saw an improvement in trout fry in comparison to 2020, with 79.4% of its sites increasing in densities. The headwaters of Pendle Water prior to the confluence with Colne Water have produced Excellent densities, with Sabden Brook and Castle Clough Brook further down the Calder producing the highest densities of the year with well over 100 fry/100m^2 in many of their sites.

Salmon on the Calder

Sabden Brook is one of the few tributaries of the Calder in which salmon fry have previously been recorded. This is the 3rd year where salmon fry have not been recorded on the tributary despite all indication of good habitat and water quality when looking at brown trout fry. Limited waterbodies and sites on the Calder catchment yield regular fry results with Sabden and Hyndburn Brook being the only two tributaries in which salmon were being repeatedly recorded. Previously, in 2015, salmon fry were recorded on the River Brun above Townley park and at Carry Bridge on Colne Water. However, as yet there has not been a return to this area. **With dwindling numbers of Atlantic salmon, it is looking likely that the Calder population could be classed as highly unsustainable.**

The Hodder Catchment

The River Hodder rises on White Hill and flows to join the River Ribble near Great Mitton. The Hodder drains much of the Forest of Bowland Area of Outstanding Natural Beauty and the upper reaches of the river feed Stocks Reservoir. It has upland moorlands and rural farming mainly comprising sheep and cattle grazing. The Hodder has a mixture of rural diffuse and point source pollution issues as well as point source pollution and abstraction from water industry.

The state of salmon populations on the Hodder

The Hodder sub-catchment has been considered the Ribble's stronghold for salmon spawning, however, Since the start of the fisheries monitoring in 2008 there has been an observed reduction of salmon fry distribution, with sites lost on the Lower Loud, Easington Brook and Langden Brook waterbodies. In 2021 spawning sites on the main-stem Hodder below Slaidburn and at the bottom of Croasdale Brook were the only sites that produced good densities, the remaining salmon sites were Poor to Very Poor. There is additional concern of fry density reductions on Brennand, Whitendale and River Dunsop where numbers were always considered to be consistently Good. These areas must be protected and an increase in conservational efforts must be applied to improve habitat and water quality for the long-term sustainability of this species.

Stocks Reservoir

When discussing the need to protect and improve areas of good salmon spawning, it would be remiss to mention the main-stem Hodder suffers from the impoundment of Stocks Reservoir. When access to spawning, nursery and important foraging habitat is restricted, it contributes to bottlenecks that increase competition and mortalities, with reduced condition in the different life stages. Alongside the loss of spawning habitat, the interruption to supply of spawning gravels and the altered hydrological regime the river will be experiencing are potentially limiting salmonid productivity on the Hodder catchment. Mitigation against the loss of gravel supply is currently being investigated by the Trust and angling clubs in coordination with United Utilities, but this is at very early stages.

Waterbodies of concern

The spawning of salmon on Easington Brook has been less consistent in the past 5 years in comparison to the period 2008-2016. The abundance of trout fry across all sites surveyed on the Easington waterbody, on average, remains low. Poor trout fry densities on Greystoneley Brook this year are of a concern because they have been found alongside an uncharacteristically low abundance and diversity of minor coarse fish. Without an obvious reason for this, the brook will be evaluated again next year to identify if further investigation is required. As a sea trout run it would be expected that there will be boom and bust years in the higher densities, despite numerical dominance of resident adults. However, the number of minor coarse fish species recorded was also minimal. These waterbodies have been flagged for investigation. The River Loud is another target area for the Ribble Trust with much of its work focused on improving land management to improve water quality. Despite one of its six site surveyed being at its highest ever recorded density (2021), many sites do not yield young of year and its only intermittently that numbers are better than Poor.

The Ribble Catchment

The Ribble between Stainforth and the Calder confluence becomes more populated as it flows downstream. There are many smaller villages on the river and its tributaries with larger towns such as Settle and Clitheroe, with Barnoldswick on Stock Beck. These urban pockets bring their own influences on the river environment. Additionally, there are water company sewage treatment works, storm sewer overflows and surface water drains contaminated with household foul drainage. In the upper reaches of the Ribble Cam and Gayle Beck make up the headwaters. This is a high gradient area with typical upland streams draining peat moorland, which are also fed by limestone aquifers. The moors at the top of the catchment have been drained by grips, causing changes in the runoff through peat and changes to water chemistry. There has also been a loss of trees to make way for agriculture and therefore creating habitat homogeneity, unstable riverbanks and river widening leading to increased water temperature in the summer. Along the length of the Ribble there are many manmade structures linked to fishing clubs, industry and river gauging that disrupt natural river connectivity and processes. Improvements in these headwaters will have environmental benefits for the full catchment downstream in terms of water quality and flood risk.

Works on the upper-Ribble

The Ribble Trust is working in the head waters of the Ribble to improve water quality through grip blocking, restore woodland and creating heterogeneity within the river channel to improve habitat quality. On Gayle Beck (2020) the Ribble Trust installed large woody material in the channel and along the banks to improve habitat, create in-channel complexity and encourage the natural river flow processes which create good habitat for fish spawning. In 2021 surveys salmon and trout fry were found around these berm structures (figure 4.0.1). The narrowed channel has seen improvements in flow complexity and improved riffle habitat

Figure 4.0.1: Berm features installed by Ribble Rivers Trust - Gayle Beck 2020

whereas other sites along this reach did not produce young of year. Additional tree planning has also taken place along the south bank of the river, providing much needed shade to a highly exposed reach.

Waterbodies of concern

On the Upper Ribble Stainforth Beck does not return good densities of salmonid fry, spawning habitat within the beck is limited due to its natural bedrock geomorphology and larger substrate sizes. There are also naturally isolated populations of brown trout above Catrigg Force which are vulnerable to rapid change. Pan and Hellifild Beck have been highlighted for investigation, sites can produce poor to fair Atlantic salmon densities and fair to excellent trout densities. There are opportunities for stock exclusion, but investigation would be directed towards water quality on the sub-catchment, especially with the presence of industrial farms on the waterbody. Another tributary that is struggling on the Upper Ribble is Ged Beck, some habitat restoration works have already been planned, however further investigation into land management and diffuse pollution on the waterbody would be welcomed.

Works on the Mid-Ribble

On the Mid-Ribble, Mearley brook has benefited from the installation of a new fish pass as part of the Primrose Lodge Blue and Greenway Project. This project has reconnected the upper reaches of the waterbody to the main stem Ribble for the first time in 230 years. Survey results from pre-construction set a trout baseline of fair to excellent densities above Primrose Lodge. For site downstream of Primrose Lodge pre-fish pass surveys show that densities on average are lower than those isolated above the weir. The view is that habitat degradation is more prevalent, where urban pressures, agricultural accumulation, industrial and sewage treatment works are impacting the downstream spawning potential. Salmon are regularly captured below Primrose lodge and have been previously recorded in good densities and radio tracking of brown trout has proved that the fish pass is functioning in migrational flows.

Due to poor recruitment within the last two years the abundance of brown trout of a taggable size were in low numbers, upstream of the weir only 5 fish were captured (March 2021) within a 1km section of the brook. Of these fish, 2 ascended the fish pass within the first 12 hours of displacement (Tag 1 & 32) and were located close to their capture point. A third fish was identified a day later (Tag 2) upstream of the nature reserve, adjacent to St James Primary School. Tag 30 was deemed undetectable within the first week of surveys; Mearley Brook was walked 2km downstream to the main stem of the River Ribble and 2.5km upstream to the confluence of Worston Brook. At this point Tag 30 is thought to be non-functioning, outside of the study area or the fish has been predated upon. Tag 6 remained in the weir pool until 1st June 2021, and a new transmission was observed upstream of the lodge pond. However, due to the similarities in code and proximity to other tagged fish, this new signal could not be differentiated by the receiver. No tags were detected on 7th July 2021 bringing the tracking to a close.

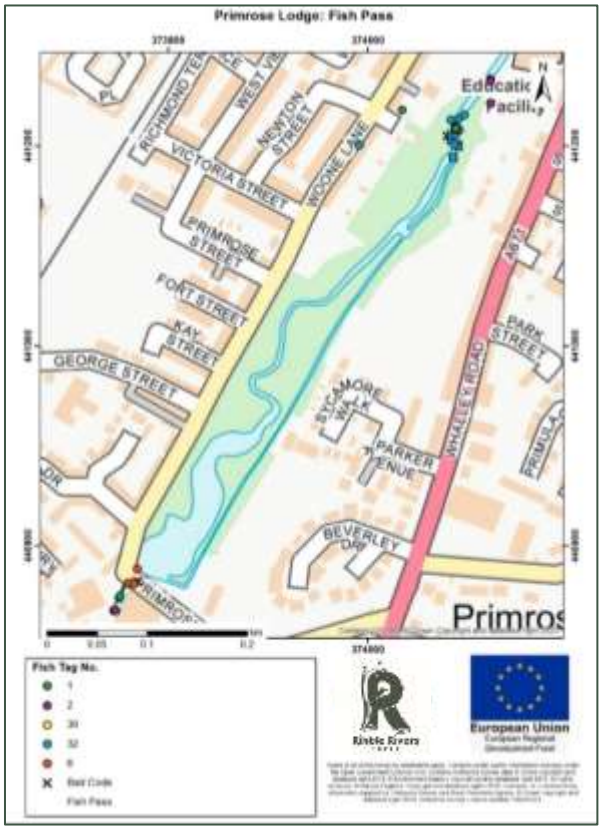


Figure 4.0.2: Tag detections of displaced brown trout on Mearly Brook

Mid-Ribble Waterbodies of concern

For investigation Bashallbrook has been flagged for water quality issues. Data from the Environment Agency catchment explorer has given point source pollution from water industry, as well as diffuse agricultural pollution, as reasons for not achieving good status. Stock Beck has also been highlighted as a problem waterbody for industrial farms and poor nutrients management. With Atlantic salmon spawning on its lower reaches, more needs to be done on this waterbody to improve land management. Skirden, Holden and Beir beck for improving spawning and nursery habitat for Atlantic salmon. Swanside Beck and Ings Beck were good spawning tributaries of Atlantic salmon and also hold excellent densities of brown trout fry. On the whole trout fry have fared well, however in the last 7 years (2015 – 2021) the average salmon density has been 4.3 fry/100m². This is a big drop from the 7 years previous (2008 – 2014) where the average density was 70.3 fry/100m².

5.0 References

Arevalo, E. et al., 2018. Effect of food shortage and temperature on age 0+salmonids: a contribution to predict the effects of climatechange. *Journal of Fish Biology,* pp. 642-652.

Armstrong, J. D., Braithwaite, V. A. & Fox, M., 1998. The response of wild Atlantic salmonparr to acute reductions in water flow.. *Journal of Animal Ecology,* Volume 67, pp. 292-297.

Baldigo, B. P. & Warren, D. R., 2008. Detecting the Response of Fish Assemblages to Stream Restoration: Effects of Different Sampling Designs. *North American Journal of Fisheries Management,* 28(3), pp. 919-934.

Caissie, D., 2006. The thermal regime of rivers: A review. *Freshwater Biology,* 51(8), pp. 1389-1406.

Crozier, W. W. & Kennedy, G. J. A., 1994. Application of semi-quantitative electrofishing to juvenile salmonid stock surveys. *Journal of Fish Biology,* 45(1), pp. 159-164.

Dugdale, S. J., Bergeron, N. E. & St-Hilaire, A., 2013. Temporal variability of thermal refuges and water temperature patterns in an Atlantic salmon river. *Remote Sensing of Environment,* Volume 136, pp. 358-373.

Elliott, J. M. & Elliott, J. A., 2006. A 35-year study of stock-recruitment relationships in asmall population of sea trout: assumptions, implications and limitations for predicting targets. In: G. Harris & N. Milner, eds. *Sea Trout: Biology, Conservation and Management.* Oxford: Blackwell Publishing, pp. 257-278.

Elliott, J. M. & Elliott, J. A., 2010. Temperature requirements of Atlantic salmon Salmo salar, brown trout Salmo trutta and Arctic charr Salvelinus alpinus: Predicting the effects of climate change. *Journal of Fish Biology,* 77(8), pp. 1793-1817.

Fredrich, F., Ohmann, S., Curio, B. & Kirschbaum, F., 2003. Spawning migrations of chub in the River Spree, Germany. *Journal of FishBiology,* Volume 63, pp. 710-723.

Fulton, T. W., 1904. The rate of growth of fishes.. *22nd Annual Report of the Fishery Board of Scotland,* Issue 3, pp. 141-241.

Gillson, J. P. et al., 2020. Can aspects of the discharge regime associated with juvenile Atlantic salmon (Salmo salar L.) and trout (S. trutta L.) densities be identified using historical monitoring data from five UK rivers?. *Fisheries Management and Ecology,* Volume 27, pp. 567-579.

Jacoby, D. & Gollock, M., 2014. *Anguilla anguilla. The IUCN Red List of Threatened Species 2014.* [Online] Available at: https://www.iucnredlist.org/species/60344/45833138
[Accessed 20 November 2019].

Jensen, L. F. et al., 2008. Local adaptation in brown trout early life-history traits: implications for climate change adaptability. *Proceedings of The Royal Society B,* 275(1653), p. 2859–2868.

Kennedy, B. P., Nislow, K. H. & Folt, C. L., 2008. Habitat-Mediated foraging limitations Drive Survival Bottlenecks For Juvenile Salmom. *Ecology,* 89(9), pp. 2529-2541.

Landergren, P., 2004. Factors affecting early migration of sea trout Salmo trutta parr tobrackish water.. *Fisheries Research,* Volume 67, p. 283–294.

Le Cren, E. D., 1951. The length – weight relationship and seasonalcycle in gonad weight and condition in the perch (Percafluviatilis). *Journal of Animal Ecology,* Volume 20, pp. 2-19.

Nira L. Salant, J. C. S. P. B. P. R. W., 2012. Unintended consequences of restoration: Loss of riffles and gravel substrates following weir installation. *Journal of Environmental Management,* Volume 109, pp. 154-163.

R core Team, 2019. *R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/..* s.l.:s.n.

Ricker, W. E., 1951. Chapter 9. Growth in Length and in Weight. In: W. E. Ricker, ed. *Computation and interpretation of the biological statistics of fish populations..* Ottawa : Fisheries Research Board of Canada, pp. 1-382.

Solomon, D. J. & Lightfoot, G. W., 2008. *The thermal biology of brown trout and Atlantic salmon,* Bristol: Environment Agency.

Team, R. C., 2019. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria..

Team, R. C., n.d. *R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.URL https://www.R-project.org/..* s.l.:s.n.

Thomas, S. M., Griffiths, S. W. & Ormerod, S. J., 2015. Adapting streams for climate change using riparian broadleaf trees and its consequences for stream salmonids. *Freshwater Biology,* 61(1), pp. 64-77.

Thomas, S. M., Griffiths, S. W. & Ormerod, S. J., 2015. Adapting streams for climate change using riparian broadleaf trees and its consequences for stream salmonids.. *Freshwater Biology,* 60(1), pp. 64-77.

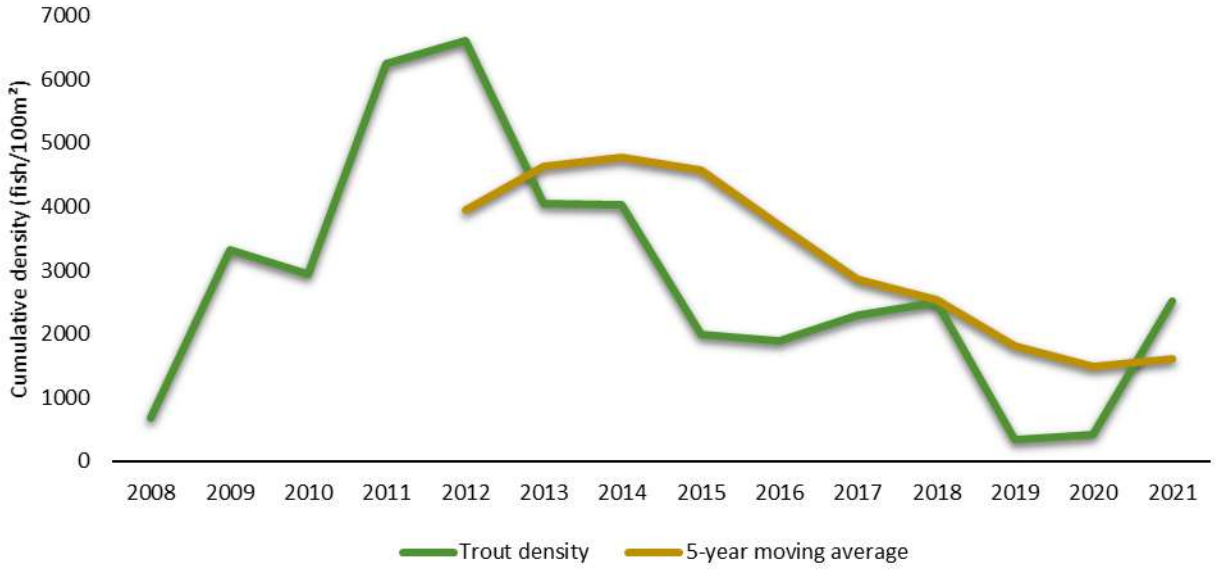
Warren, D. R., Mineau, M. M., Ward, E. J. & Kraft, C. E., 2010. Relating fish biomass to habitat and chemistry in headwater streams. *Environmental Biology of Fishes,* Volume 88, pp. 51-61.

Zippin, C., 1956. An evaluation of the removal method of estimating animal populations. *Biometrics,* Volume 12, pp. 163-169.

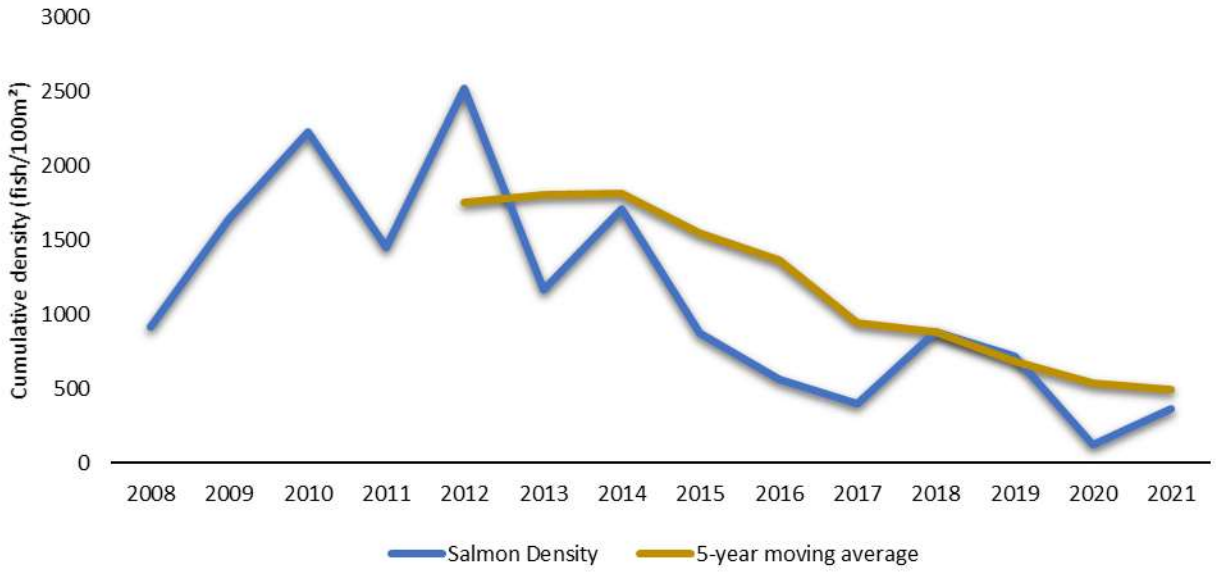
Zippin, C., 1958. The removal method of population estimation. *Journal of Wildlife Management,* Volume 22, pp. 82-90.

6.0 Appendices

6.1 Appendix A

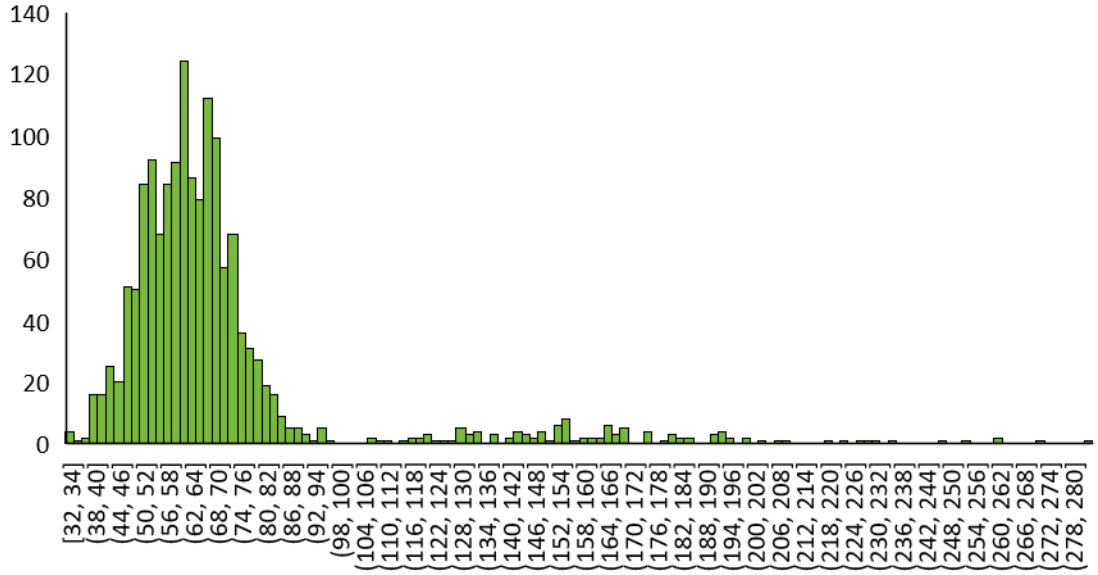


Appendix A.1 Cumulative brown trout fry densities on the Ribble catchment for 87 sites fish 2008 – 2021 including 5 year moving average.

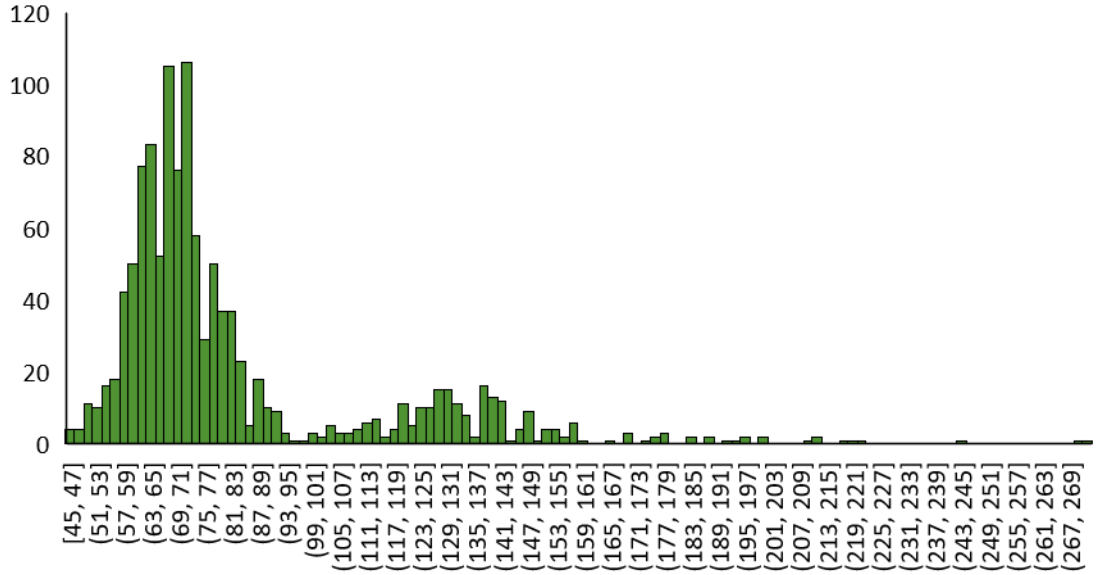


Appendix A.2 Cumulative Atlantic salmon fry densities on the Ribble catchment for 87 sites fish 2008 – 2021 including 5 year moving average.

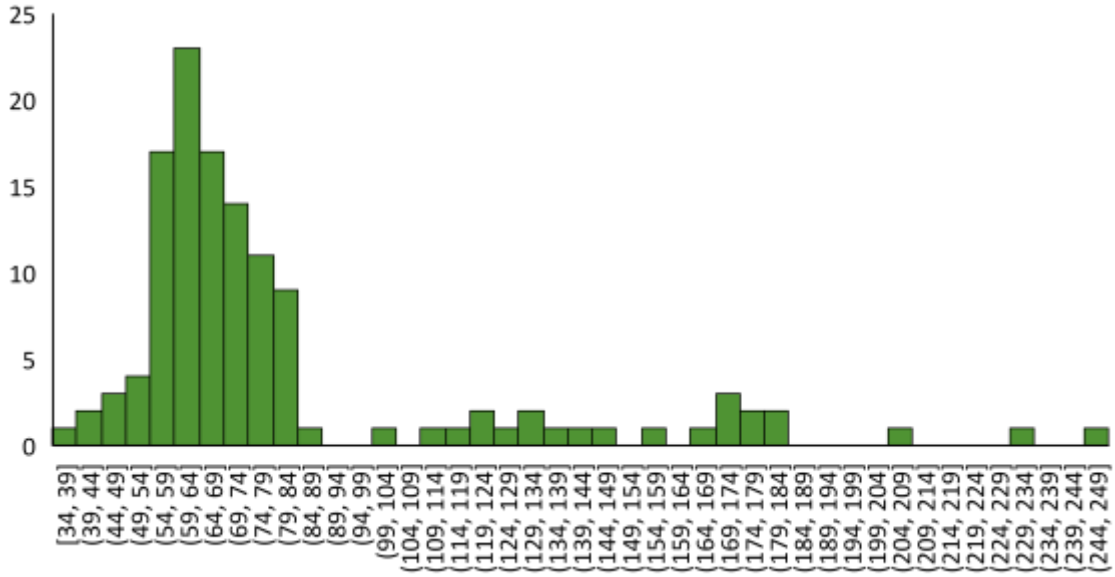
6.2 Appendix B



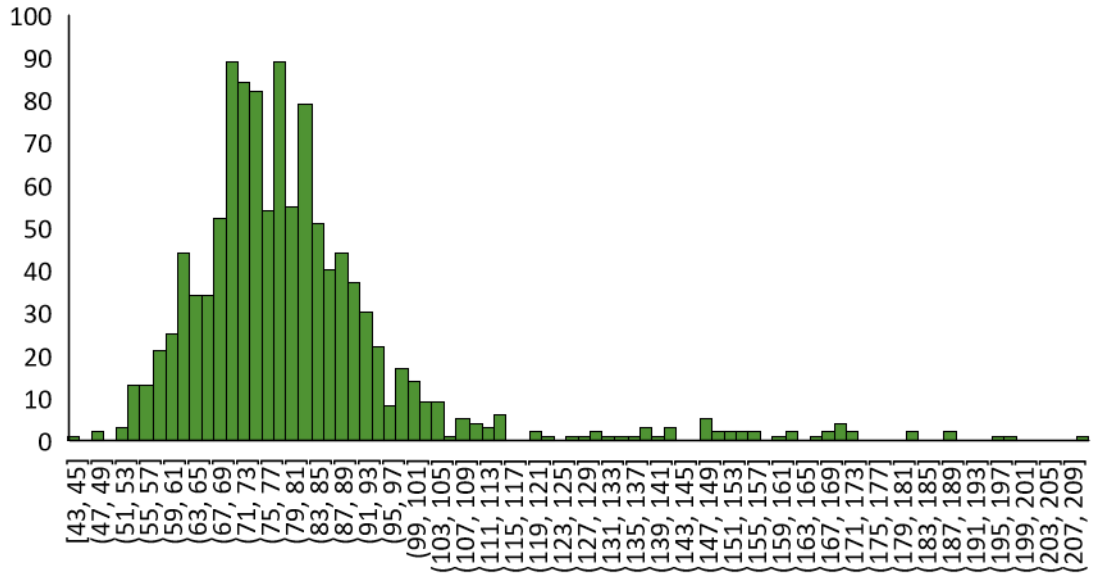
Appendix B.1 Fork length histogram of all brown trout captured on the Calder catchment 2021. Maximum fork length for 0-year trout = 98mm at time of survey



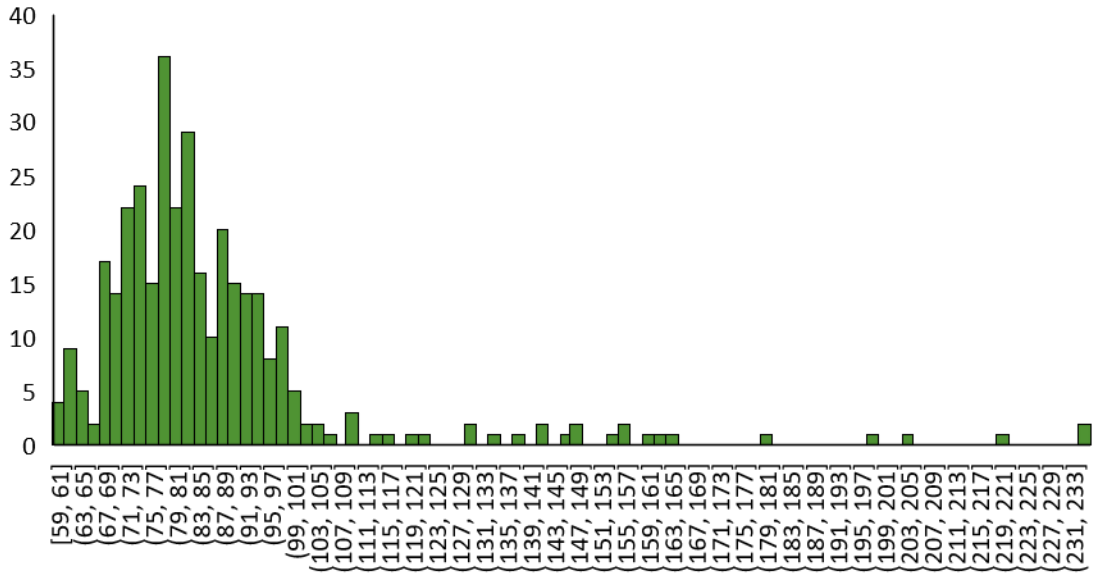
Appendix B. 2. Fork length histogram of all brown trout captured on the Hodder catchment 2021. Maximum fork length for 0-year trout = 98mm at time of survey.



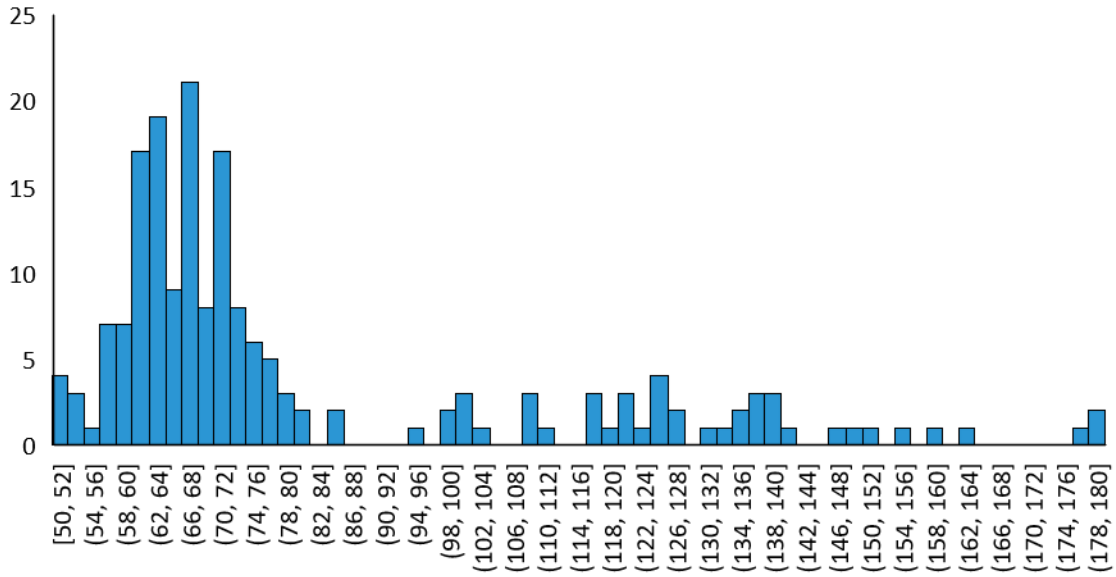
Appendix B. 3. Fork length histogram of all brown trout captured on the Lower-Ribble catchment 2021. Maximum fork length for 0-year trout = 86mm at time of survey.



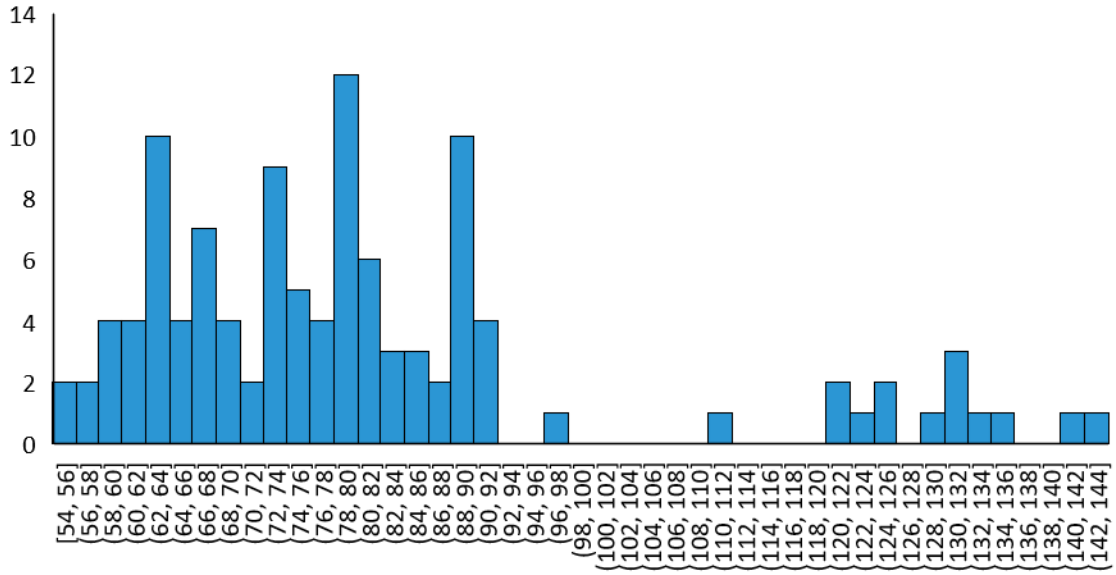
Appendix B. 4. Fork length histogram of all brown trout captured on the Mid-Ribble catchment 2021. Maximum fork length for 0-year trout = 100mm at time of survey.



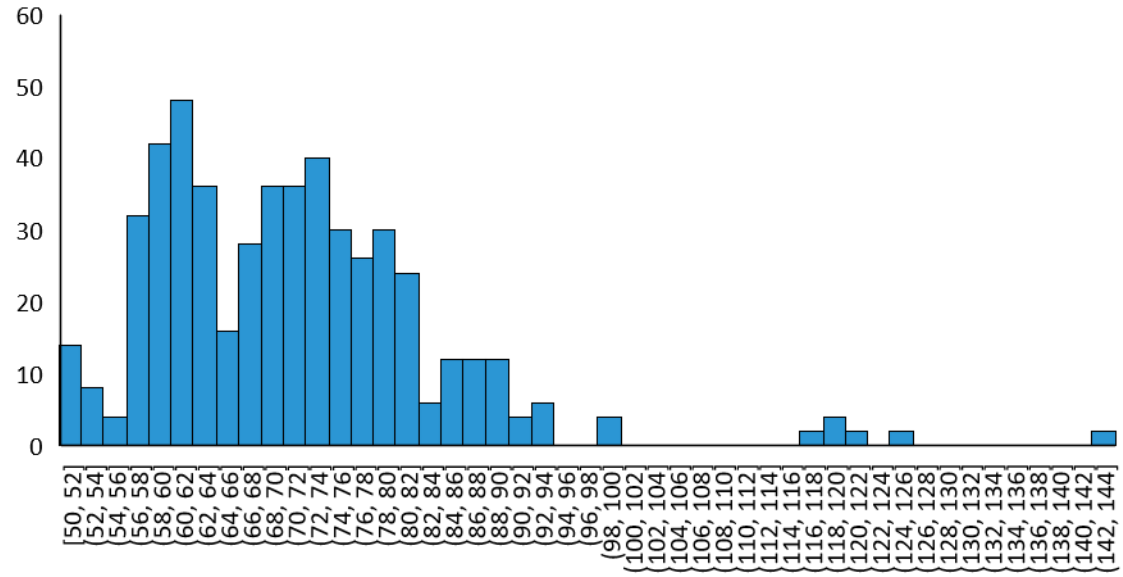
Appendix B. 5. Fork length histogram of all brown trout captured on the Upper-Ribble catchment 2021. Maximum fork length for 0-year trout = 102mm at time of survey.



Appendix B. 6. Fork length histogram of all Atlantic salmon captured on the Hodder catchment 2021. Maximum fork length for 0-year salmon = 98mm at time of survey

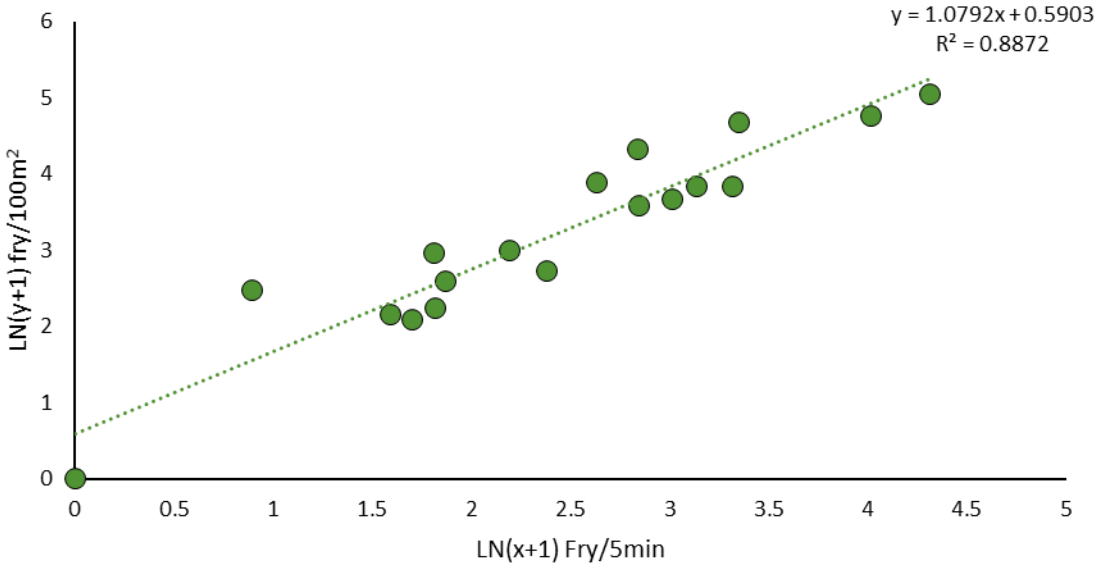


Appendix B. 7. Fork length histogram of all Atlantic salmon captured on the Mid-Ribble catchment 2021. Maximum fork length for 0-year salmon = 98m at time of survey

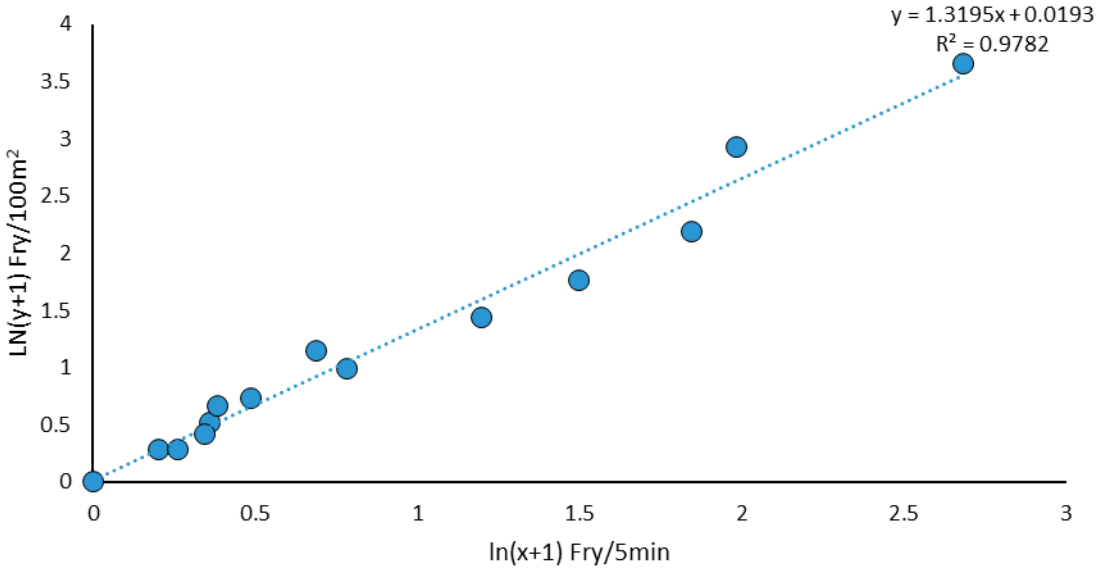


Appendix B. 8. Fork length histogram of all Atlantic salmon captured on the Upper-Ribble catchment 2021. Maximum fork length for 0-year salmon = 100mm at time of survey

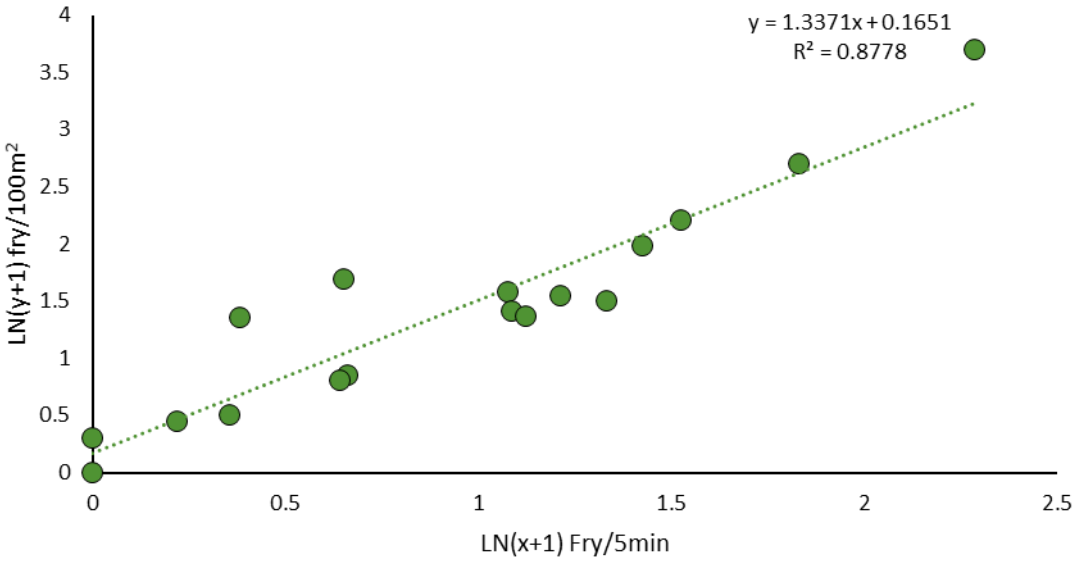
6.3 Appendix C



Appendix C. 1 Brown trout quantitative fry population relationship between semi-quantitative (5 minutes fry capture) and quantitative electric fishing results (Fry per 100 square) that is LN+1 transformed. Fitted linear regression for 0 + salmonids is produced where Ln (y + 1) = 0.5903 + 1.0792 Ln (x + 1)



Appendix C. 2. Atlantic salmon quantitative fry population relationship between semi-quantitative (5 minutes fry capture) and quantitative electric fishing results (Fry per 100 square) that is LN+1 transformed. Fitted linear regression for 0 + salmonids is produced where Ln (y + 1) = 0.0193 + 1.3195 Ln (x + 1)



Appendix C.3. Brown trout quantitative parr population relationship between semi-quantitative (5 minutes parr capture) and quantitative electric fishing results (Parr per 100 square) that is LN+1 transformed. Fitted linear regression for 0 + salmonids is produced where Ln (y + 1) = 0.1651 + 1.3371Ln (x + 1)