Fisheries Monitoring of the Ribble Catchment

The Ribble Rivers Trust

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Contents

Acknowledgements

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Executive Summary

Over eight years of fisheries surveys, none have identified a wider dispersal of the catchment's salmon and white-clawed crayfish than this.

The movement of salmon further into the Calder system was made possible by the installation of fish easements on five weirs meaning that seventeen have been completed within this catchment. This is a major signifier of an improving habitat condition in the Calder system and a benefit to fish passage.

- Overwintering eggs and fry were subject to high flow events in December 2014 and May 2015.
- Significant results: Brown trout have successfully spawned on Showley brook within a new habitat improvement scheme.
- In follow up to the Spring salmon tracking study, main stem fish surveys were conducted to confirm the main river's importance to the Ribble catchment's population.
- The tributaries running off the main stem Ribble, provide valuable, readily accessible rearing habitat for parr, notably; Ged and Hellifield becks.
- The first discovery of signal crayfish in Trawden brook and further downstream along Long Preston beck presents an increasing risk to salmonid recruitment success.
- White clawed crayfish were discovered across a wider extent on Gayle beck and Waddington brook than the RRT has previously surveyed.
- 10 Fish rescues in support of in channel works were delivered this year.

Further survey work has been undertaken in to establishing the impacts of river restoration techniques employed by the RRT. The study is in its final year with the greatest effectiveness over a short time frame derived from barrier easement works. These finding will be presented by Mike Forty who has spearheaded the monitoring works as part of an on-going PhD thesis. Mike has helped with delivering the RRT survey programme throughout his PhD and has been an asset.

Introduction

As a long-term monitoring programme the objective is to identify trends, failures and successes and opportunities for new works. The planning of the 2015 programme led to an increased focus on conducting survey work upon the most repeatedly visited sites. Concurrent electrofishing surveys were conducted by the Environment Agency under their catchment wide monitoring project and their responsibilities toward monitoring the impacts abstraction of river water by United Utilities. All duplicate sites were identified prior to the start of the survey season to include EA survey data and by following the same methodology.

Principally, our continuing aims are to: -

- 1. Assess the overall status of the juvenile population of salmonids.
- 2. Monitor the inter-annual variations of the salmonid population.
- 3. Determine underperforming areas.
- 4. Capture the effectiveness of previous habitat improvement works.
- 5. Generate data 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.

Methodology

This year, the Ribble catchment's fish population was monitored by the Environment Agency in fulfilment of its obligations under the Water Framework Directive (2000). Prior to the survey programme the RRT co-ordinated with the EA to avoid a duplication of effort at the same locations. The applied methodologies are adapted from the Kennedy and Crozier method (1993) and have been employed by the Trust since 2008. All sites were fished upstream in a zigzag pattern over congruous riffle/pool habitats using an E-fish 500W electrofishing backpack system. Typically, two types of survey were undertaken: Semi-quantitative, where the river is fished for five minutes covering an undefined but recorded area; and Quantitative, where a netted area of river is sampled and re-sampled over another two runs. Quantitative surveys allow for the identification of capture efficiencies of each electro fisher, thus allowing more accurate results from semi-quantitative surveys to be presented.

Commencing from the 19th June and closing on the 2nd October. Nineteen (16 last year) quantitative sites were fished on the Calder, twelve (11) on the Hodder, with thirty-four (19) completed on the Ribble. A total of two-hundred-fifty-four (289) semi quantitative sites were also completed*.

The densities of trout and salmon from the above activities were calibrated and allocated a grade (see Table 1) to standardise our observations with those of the National Fisheries Classification System (NFCS). The system is based upon the number of fry capture per species. These were separable through establishing a maximum fork length for fry (Appendix 1). This is discernible by the two-peaked shape of the frequency-size distribution for all captures. Grades A – F are assigned by extrapolating the density of fry per $100m^2$ based upon the number captured in five minutes and using the capture efficiency of the electrofishing team. Capture efficiencies are obtained from measurements of the numbers of fish captured during the quantitative surveys. For the purpose of this report the grades provide a proximal estimate to the performance of the water course and the water course's health.

Table 1. NFCS gradings

Grade	Fish Density
A	Excellent
B	Good
C	Fair
D	Poor
E	Very poor
F	No fish present

Once graded the results were transferred to a map layer using ArcGIS 10 to display catchment scale results. This was also used to plot previous years' data for comparison. All graphs were reproduced in MS Excel. Inter-annual comparisons displayed through the charts in the Results Section are based on REPEATED SURVEY SITES ONLY. This ensures that similar sites of similar habitat types are being compared year on year and this is necessary for building a long-term record. Grade results have been averaged and organised within the analysis of this report according to geographical coverage. The boundaries of this coverage are determined by sub-catchment. The use of spot surveys partially embodies the wider outlook of the catchment's salmonid population, however additional tools (e.g. monitoring of later life stages and genetic composition of stocks) are required in order to establish precise estimates.

The maps outlined in Figures 1-3, 7, 8, 14, 15, 19, incorporate the following data files, under copyright:

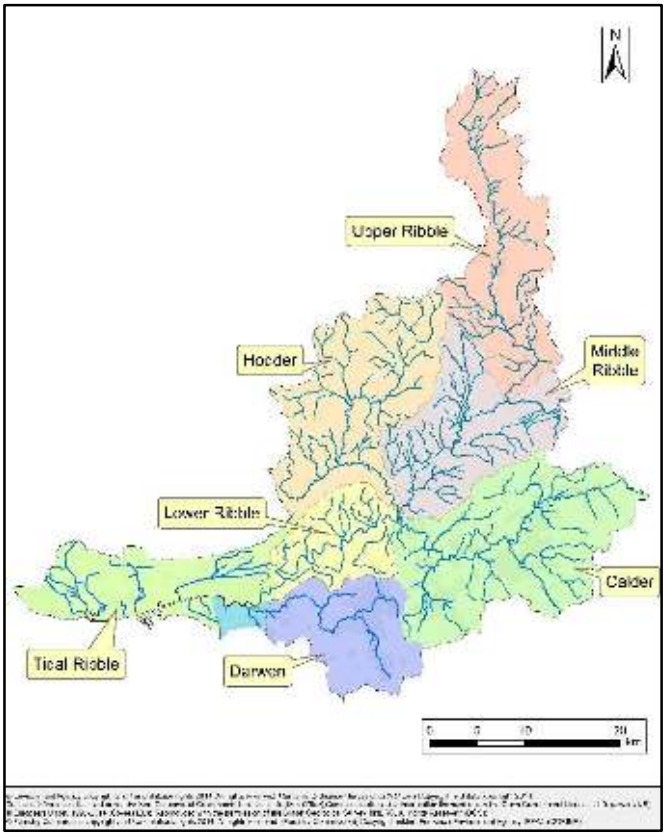

Figure 1 *Map of the Ribble Catchment outlining the subcatchment areas discussed in this report*

Results

Brown Trout

Brown trout (*Salmo trutta*) grades have seen a further drop within the lower Ribble area (Figure 1, 2), (except one site on Bezza brook) as well as the lower tributaries in the mid-Ribble area, specifically Mearley brook which runs through Clitheroe. The absence/drop in grade within these areas is further highlighted by the same trend in salmon (*Salmo salar*). The Hodder catchment has seen a small drop in trout grades, with more concerning areas including Easington brook and the tributaries feeding Stocks Reservoir.

The tributaries of the River Calder above Burnley have shown a good developmental year, with increased densities across the river Don, Thursden brook and upper Brun and Calder.

Noticeable changes in trout presence (see Figure 3) include movements further upstream in the tributaries around Bolton-by-Bowland (mid-Ribble) and those above Hapton clough (Green Brook, Calder).

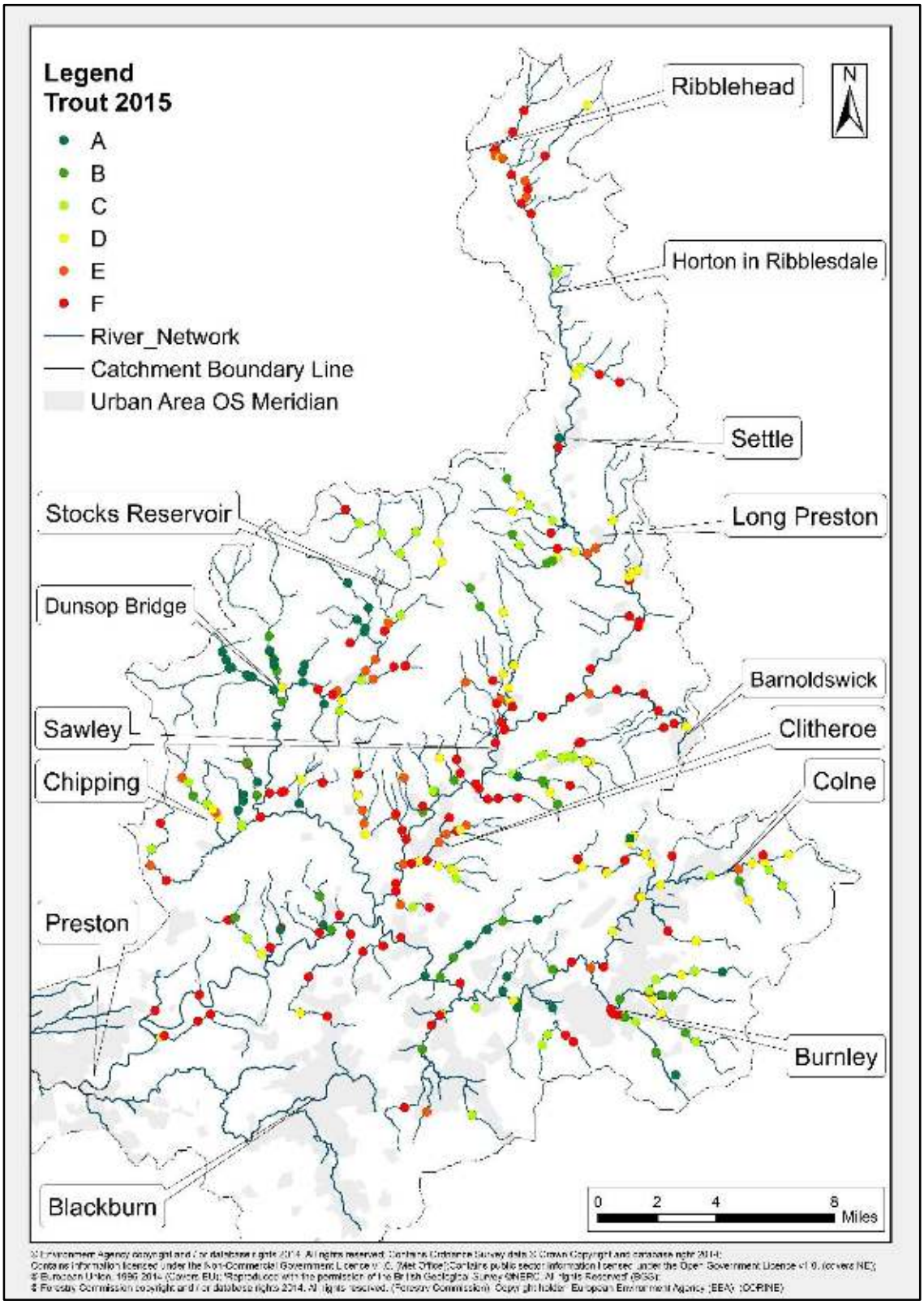

Figure 2 *Catchment map showing brown trout fry NFCS grades from surveys undertaken by RRT and the EA in 2015. Green points indicate higher grades and therefore higher trout densities, decreasing to orange. Red indicates an absence of trout fry*.*

**Data from RRT surveys that did not meet the required depletion rates is displayed as square points, all other data is displayed as circles.*

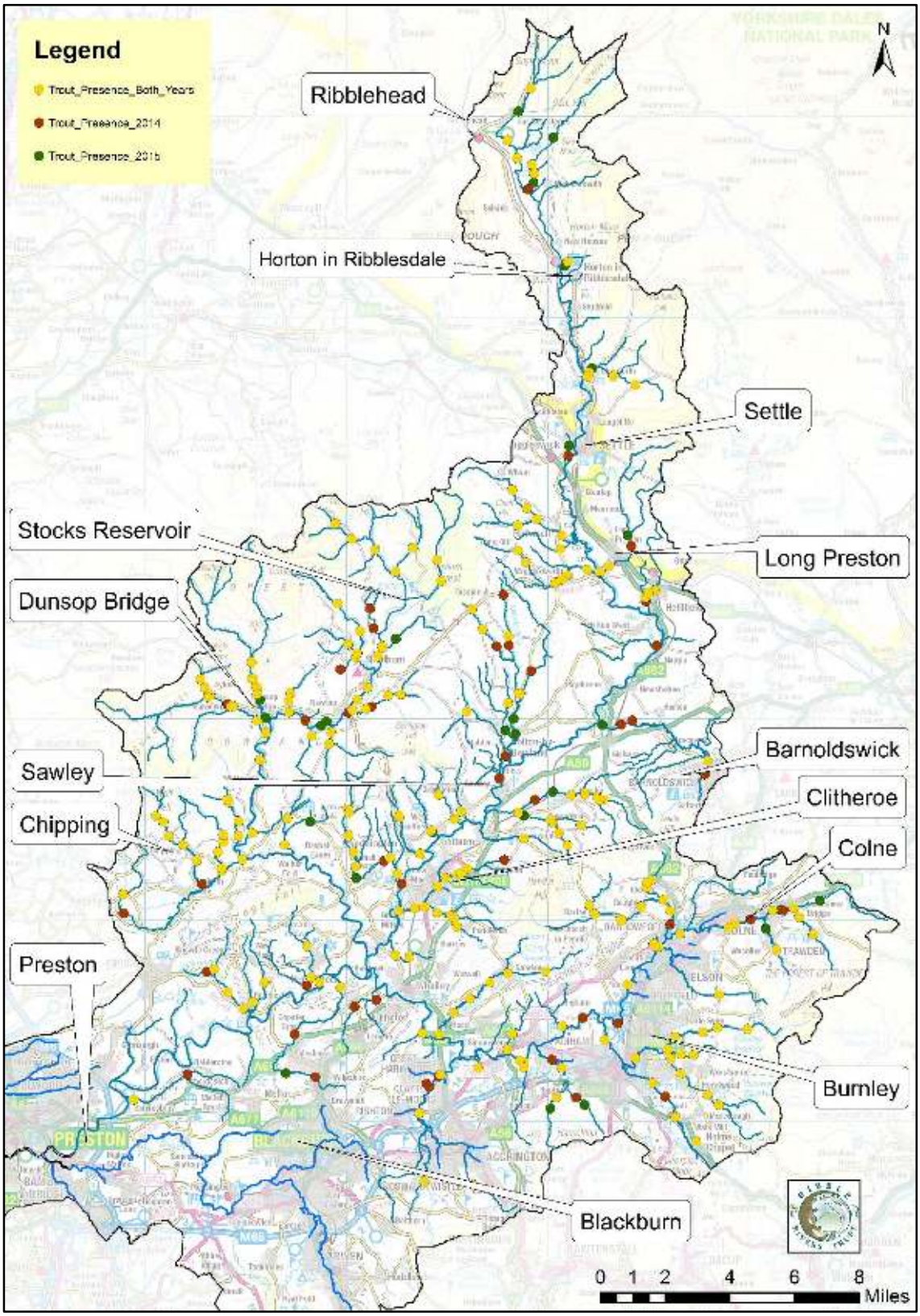

Figure 3 *Catchment map displaying the presence of brown trout (fry and parr) across the past two years. See legend for interpretation*

Figure 4 *Sea trout captured during a survey, 4th August, Leagram brook, R. Loud.*

Adult sea trout were encountered on Dunsop and Leagram brooks at the end of July and start of August respectively. Significantly, the Leagram sea trout was found by a Trust habitat scheme, within one of the project and target areas under the Catchment Restoration Fund (CRF).

The presence of sea trout within a recovering river system provides a positive indication that the habitat and water quality is improving. Similarly, the continued presence of salmon parr along the Hyndburn demonstrates that although recruitment conditions have been unfavourable this year, conditions within the river have not deteriorated.

Figure 5 *Two habitat schemes upon Easington brook showing excellent tree growth*

Easington had reached the aspirations of a sea trout worthy beck but has since fallen off track over the past two years. The riparian growth within the four habitat schemes along the brook are showing real promise. Indications from invertebrate monitoring in 2014 were that variations in the trout population over the last couple of years were offset with macroinvertebrate results, and that the change in macroinvertebrate life may be a factor limiting the tout population within the beck.

Showley brook, located along the lower Ribble has always failed to produce a good return (if any) of trout fry. The open poached banks, associated silts, and dense plant growth within the water course have all conspired against salmonid success. Last year a planting scheme was put in to place along the brook. This has excluded livestock from the brook and reduced the influx of silts. This summer

for the first time in five years of surveying the brook we found a trout fry. A sign of the improving water conditions, fit for salmonid spawning.

Figure 6 *A section of Showley brook before (left) and after (right) planting trees along the bank. The after picture was taken 5m downstream of the before picture.*

The upper, river Loud is another area that has shown increases in trout densities following the completion of the Diffusing the Issue Project, where the river Loud was a focus area. The improvement works within this area included farmer engagement and the installation of a fish easement (more positive news on this in the 'Salmon' section).

Salmon

Salmon grades have deteriorated across the catchment and even those sites that held 'A grades' are showing a drop in salmon fry density, such as Croasdale brook. The presence of fry in new locations and the continual movement of parr upstream into smaller tributaries should not be overlooked nor the significance underestimated (Figure 8).

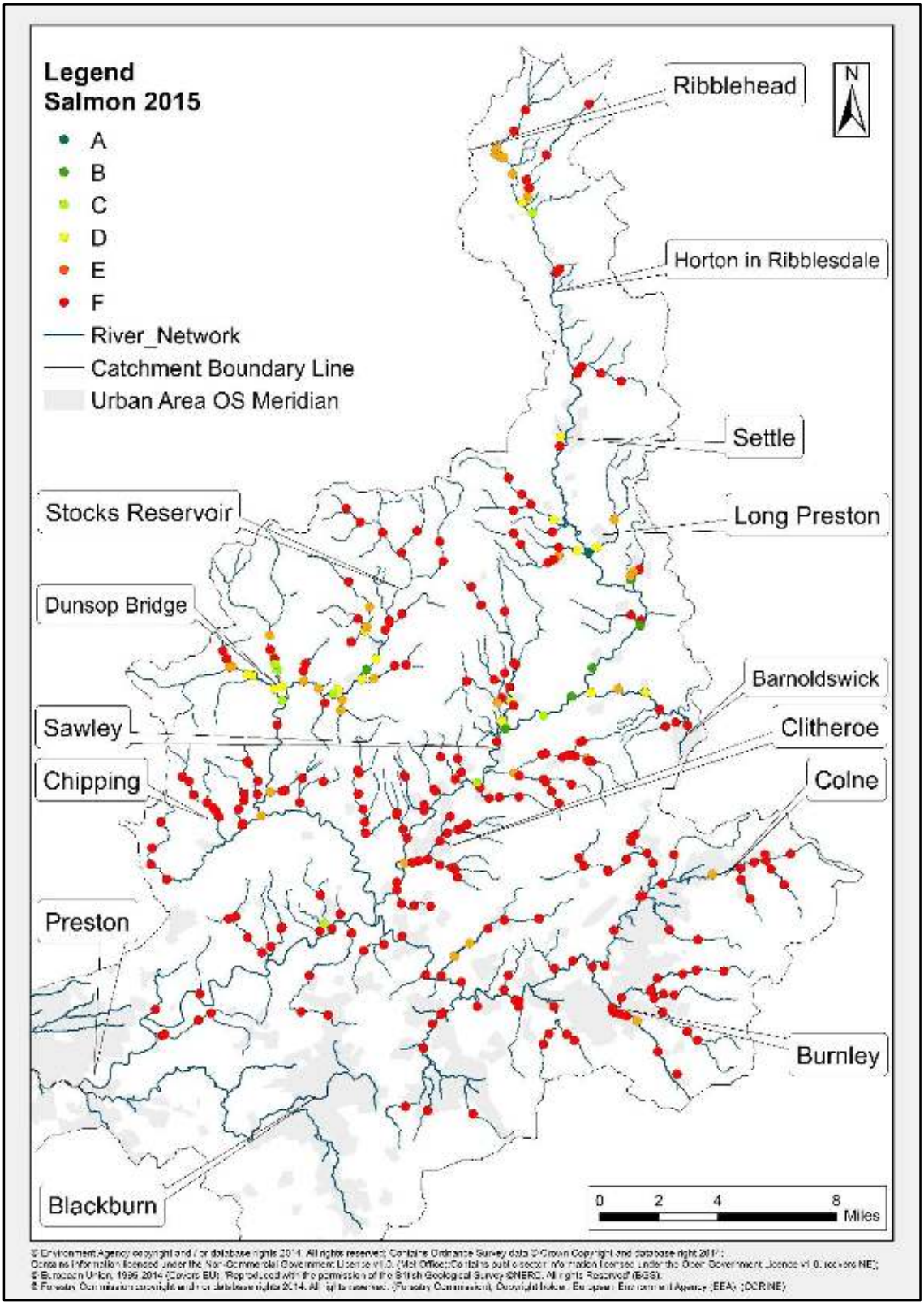

Figure 7 *Catchment map showing salmon fry NFCS grades from surveys undertaken by RRT and EA in 2015. Green points indicate higher grades and therefore higher salmon densities, decreasing to orange. Red indicates an absence of salmon fry*.*

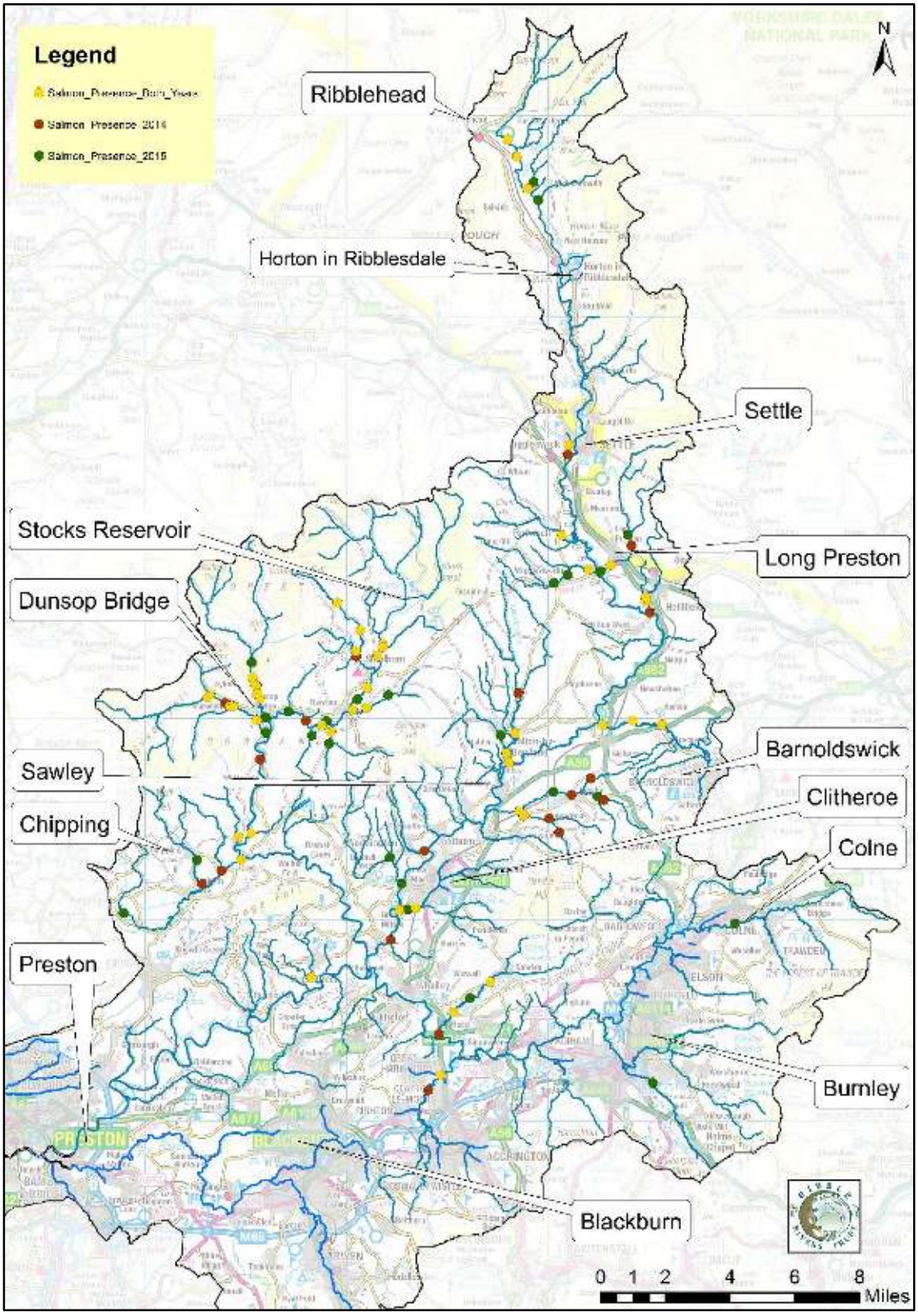

Figure 8 *Map showing the presence of salmon (fry and parr) from 2013 to 2015 as surveyed by the RRT.*

Last year saw a good developmental year for salmon, with the average parr size over 10mm longer than in previous years. Many areas across the catchment show parr moving into previously unutilised habitat (Figure 8). This may be linked to the excellent development year for parr in 2014 and a density driven shift in habitat use. This is more apparent in Bashall brook, Stock beck, Croasdale, Foulscales, Easington brook, Mear Gill, and River Loud headwaters.

In one of these areas on the River Loud during one of the surveys undertaken by Environment Agency (Figure 10), the fisheries team found a salmon parr 300m upstream of a fish easement that

was completed in August 2014. These remedial works were part of the 'Diffusing the Issue' project area within the broader Catchment Restoration Fund. This area of the Loud was a priority area working to reduce river pollution and run-off from agricultural land. The River Loud subcatchment was characterised as 'poor' ecological status in the 2013 WFD. Positive results from engagement with landowners, fencing out livestock from rivers and the installation of fish easements (Figure 9) can be seen soon after they are completed. It is hoped that the long term restoration; specifically, the growth of riparian woodland, and overall health of the rivers will continue to improve, with the continued presence of salmon and other species as indicators of this change.

Figure 9 *Photo's above show a fish easement solution of a previously impassable weir on the River Loud before (left) and after (right).*

Figure 10 *Andy Croft (survey and monitoring) holding the salmon parr that was captured on the River Loud*

Possibly, the most surprising salmon fry finds were those of the River Calder (near Towneley Park) and Colne Water (near Carry Bridge). The installation of fish easements along Colne Water was only just complete by the start of October last year. The immediate use of this unlocked habitat, (with adult salmon having to navigate five RRT managed fish easements), outlines the need for more spawning grounds and the lengths salmon with go to reach them.

Figure 11 *A trout fry (left) and salmon (right) caught below Carry bridge along Colne Water*

Figure 12 *Before (left) and after (right) photos of a fish passage solution on one of the weirs along Colne Water. One of five easements adult salmon would have had to ascended to spawn.*

The salmon fry from the river Calder was found above one weir removal and one technical fish pass. As part of the Urban River Enhancement Scheme (URES) sections of culvert were widened, deepened, enabling variable flow patterns to be achieved. The continued assessment and monitoring of these reaches (Burnley and Colne) has been undertaken by Mike Forty as part of his continuing PhD thesis with Durham University.

It is hoped that we will see more salmon return across the wider Calder system and that we. The stalwart of the Calder catchment has been Sabden brook, outlined as one of most important tributaries for salmon spawning. Last year saw improvements made to the spawning channel along Sabden brook to bring it back online; it was hoped that this creation of additional spawning habitat would see a boost in numbers of both trout and salmon. Unfortunately, the low number of salmon observed during the survey season and failure of the channel repair works mean the success of the channel is yet to be realised.

There are plans to make the two weirs within Sabden village passable to migratory fish with the hope of unlocking 5km of water upstream. in the same hope as the work conducted upon Colne Water. The most significant of these will be investigated under the RRT Heritage Lottery Fund project.

Analysis

Figure 13 presents the yearly comparison of juvenile trout captured during the summer survey season, at the same locations. The number of captures are calculated as a density and a grade is assigned to this value according to the National Fisheries Classification Scheme (produced by the Environment Agency). The information presented outlines a decline in trout grades, following on from the previous two years. Interestingly the average grade score for all three years has remained the same, hovering around the 'grade 4 i.e. C' mark. This is, in part, due to the large range of the grade boundaries and the level of decline in juvenile trout densities.

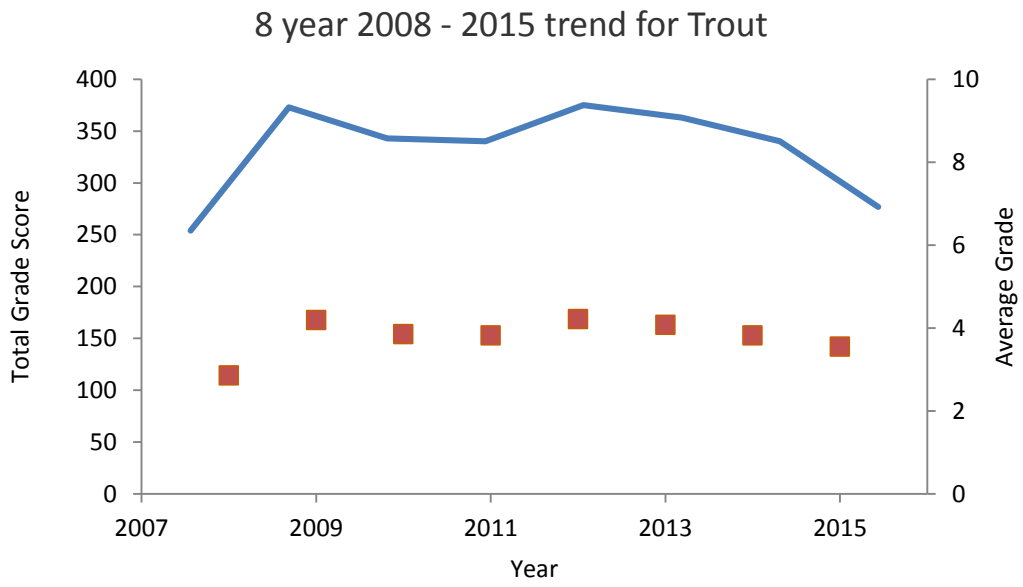

Figure 13 *Graph showing the total (blue line) and average (red square) grade scores for trout fry over the past 8 years.*

The percentage grade is a comparison between sites that were fished in 2014 and 2015. In total there were 273 sites that we fished across the two years. Of this number 256 contained trout fry and 126 salmon when compared across the full 8 years of data – note this included years that were not fished or did not include trout or salmon captures.

From this we can see that salmon fry have been found in three new locations, where they were not captured during the previous 8 years of surveys. Similarly, trout fry have been caught in two new locations (on Bezza brook and main stem, Hodder).

The table below provides a direct comparison between each site and does not include any new, previously unfished sites.

Table 2 *The percentage change in grade scores of trout and salmon between 2014 and 2015*

	TROUT FRY		**SALMON FRY**	
	2014	2015	2014	2015
INCREASE	22.9	**26.3**	16.5	**21.1**
NO CHANGE	30.5	**30.6**	56.5	**46.3**
DECREASE	46.6	**43.1**	27	**32.5**

The change in grade scores can be misleading as the same percentage grade change could be achieved with different densities of fry – this is due in part to the size of the density values within each grade boundary. Therefore, looking at the density, average grade and total grade is important in understanding the results.

Further to our Salmon Tracking Study (seehttp://ribbletrust.org.uk/page-title/current-projects/spring-salmon-tracking/) completed last year, new electric fishing sites were selected along the main stem of the Ribble between Sawley and Nappa. Their selection was to confirm findings that the offspring of the spring salmon mature within the main stem. The results from these sites have reinforced the findings. The total number of salmon fry found within 7 main river sites equated to 27% of the catchment total and 47% of the Ribble catchment total. These values were calculated from 256 semi quantitative catchment sites and 130 sub catchment sites.

Gravel substrate within a river catchment is in part linked to the number of spawning fish, where the point at which pool shallows become riffle provide the perfect location to 'cut' redds (nests) into gravel free of fine sediment. As this type of habitat is limited, safeguarding natural gravel transport processes is critical to spawning success, as is controlling sediment influx. Examining where bottlenecks to gravel transport exist within the main stem Ribble throughout of the Sawley to Nappa area and from associated tributaries would be a prudent management step.

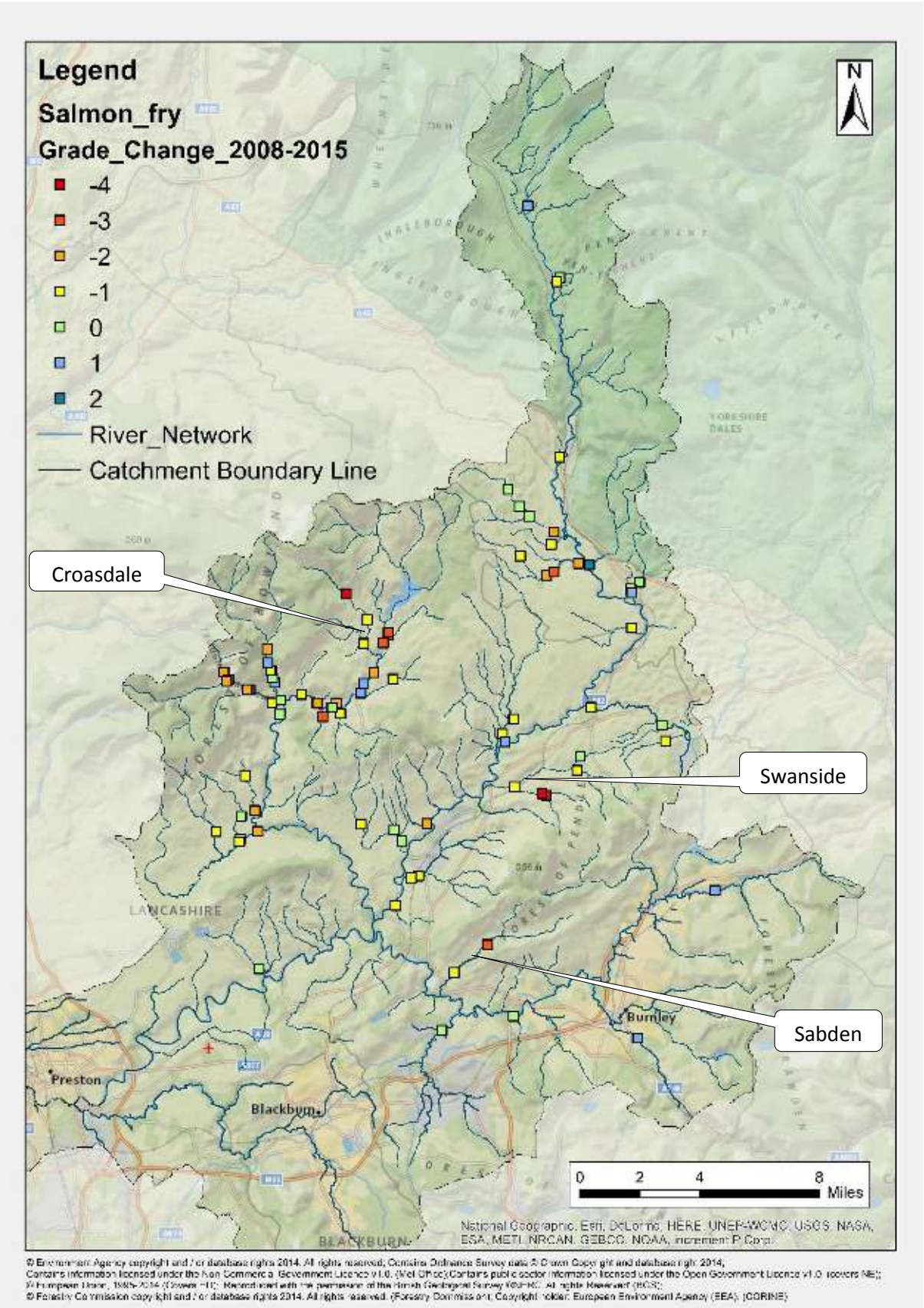

Figure 147 *Catchment map comparing NFCS salmon fry grades from 2008 and 2015 RRT surveys (80 sites). The change between grades is plotted. Areas of interest are labelled*

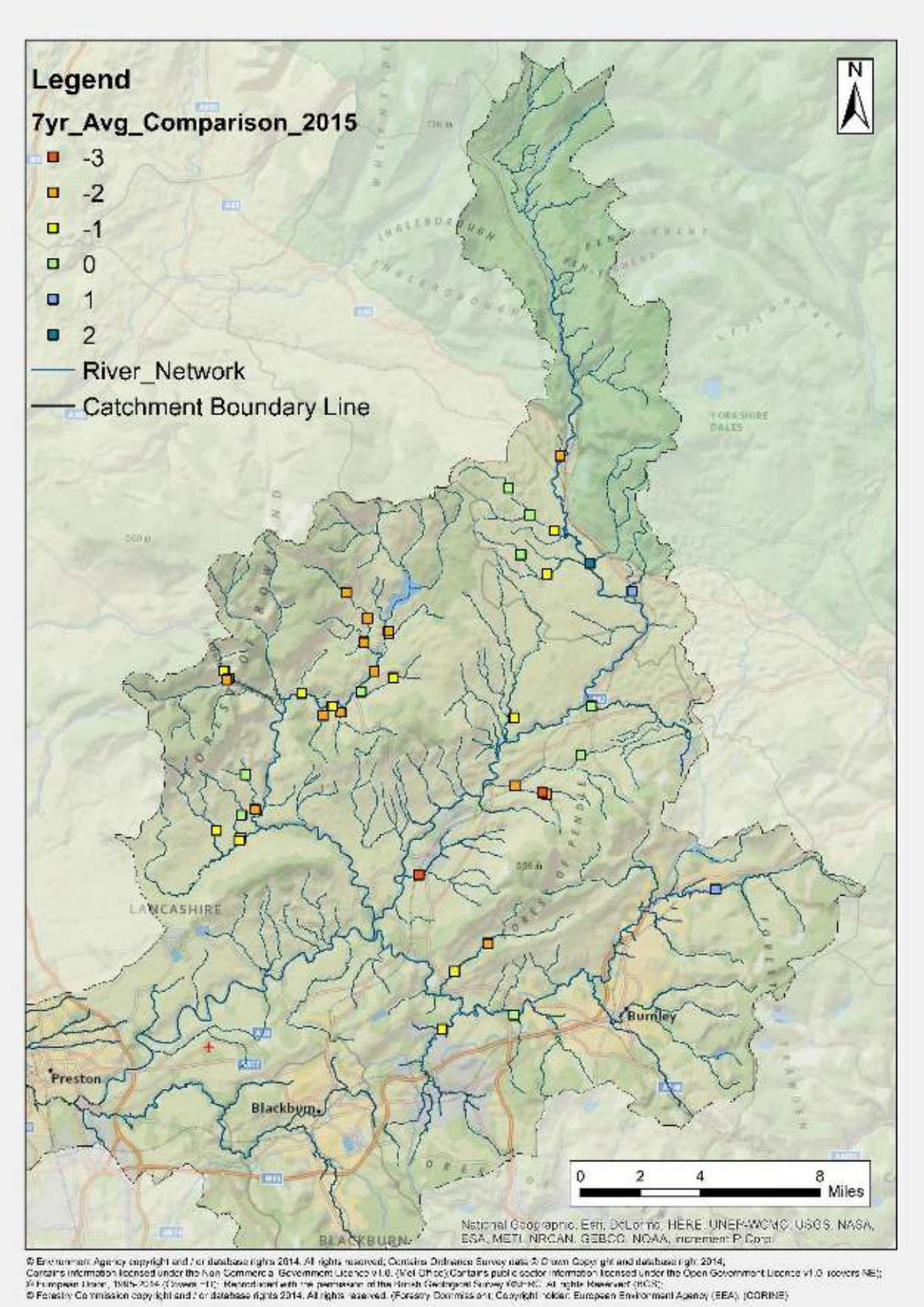

Figure 8 *Catchment map showing comparing the 7 year NFCS salmon fry grade average with the grades obtained from the 2015 RRT surveys. Only sites with a complete 8-year survey record are displayed (41 sites).*

Croasdale brook, Sabden brook, Swanside beck, and Ings beck continue to show good trout fry recruitment (Figure 2). This is worth highlighting in respect of the apparent absence of salmon fry within these waters (Figure 7). The presence of other species; salmon parr, juvenile white-clawed crayfish (*Austropotamobius pallipes*) (Swanside, Ings), and the geographical spread of these

tributaries leads us to believe that the absence is not due to poor habitat or water quality (Figure 14).

Year on year we have seen a shift in the movement and number of salmon parr, encountering them further upstream (Figures 7,8). There has also been a shift in the movements of white-clawed crayfish, and trout (of all age classes) are found in good numbers, all pointing to improving habitat conditions. There have even been a few new sites where salmon fry have been encountered for the first time. Howgill, at the top end of Swanside produced three fry following on from the success of a parr last year, after fish easements were installed along Swanside and Howgill.

A comparison of salmon grades in 2015 with 2008 and between the seven-year average grade and 2015 are presented in Figures 14 and 15. In both instances there is a noticeable decline in salmon densities (yellow-red points) over time. This leads us to believe that the decline in salmon fry is partly due= to factors affecting the movement of smolts through the system, the number/health of returning adults, or adverse weather conditions leading to poor recruitment of the fry (this year). The underlying issue with our analysis is a lack of data to explain what happens to the Ribble salmon once they make it to the sea. We do not capture data on smolts or returning kelts although these are said to make up around 3 to 6% of the spawning fish. Rod captures of salmon were said to have been disappointing in 2014 and similarly so in 2015 (excluding a big run of spring salmon early on in the season).

Importantly, all three brooks were previously excellent/key spawning tributaries that have shown a deterioration over a timescale outlasting that of a multi-sea winter fish. This must provide a trigger for greater urgency in interventions. This will only be effective where efforts are made to improve marine survival.

Weather series

During the spring the North West experienced low rainfall, with the sunniest period since 1929 being recorded between February and April. The dry/sunny period was followed by abnormally high rainfall events in May, the coldest May since 1996, with >200% the average rainfall for May (Met Office, 2015). The key point to note is the timing of these high rainfall events in relation to the development of salmon. It has been shown that the transitional period from yolk dependent alevin to free swimming fry is a critical period in the salmon development. If during the first month of independence the fry are not provided with slow-flowing habitats including cover within stream margins, the survival and subsequent strength of that years young may be severely reduced (J. Armstrong & K. Nislow, 2006), and may lead to an increase of alevin/fry death (Cattanéo et al., 2002). This hypothesis could explain the catchment wide reduction in trout and salmon fry densities compared to stream specific reductions.

The data below shows river flow per m^3 per sec for three gauging stations, each corresponding to a sub-catchment (Hodder=Hodder Place, Ribble=Henthorn, Calder=Whalley). The peak in flows around the 8th May, although not the largest, could still have had an impact on the emerging fry.

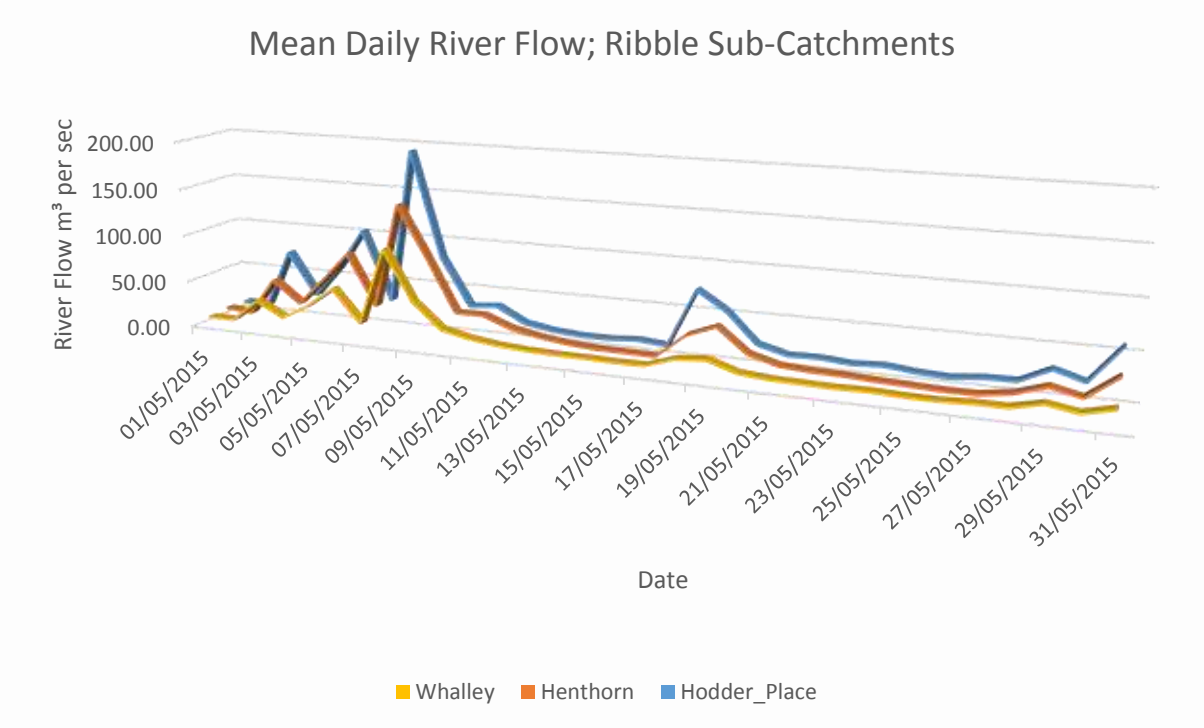

Figure 16 Graph showing the mean daily river flow at three river locations. Contains Environment Agency flow gauge data © Environment Agency and database right

Coarse Species

Overall, our results indicate a drop in coarse species abundance compared to last year with similar results to those of 2013. As a bycatch of our salmonid targeted survey activities. (Figure 18).

Figure 17 *Five perch were found at water meetings (left), with a mature gudgeon captured on Barley water (right)*

Decreasing trout fry numbers along the Pendle Water system contrasts to increasing coarse species abundance, notably of perch (*Perca fluviatilis*) and gudgeon (*Gobio gobio*). These are likely escapees from reservoirs further upstream. Perch are known opportunistic predators, focusing on benthic (river bed) prey items before moving on to open water ambush tactics as they mature. The benthic prey includes riverfly and fish larvae, including those of trout and salmon and the impact of this possible predation on the local salmonid population is unknown and it is likely that other factors have contributed to the drop in salmonids densities. Although adult perch have yet to be discovered during this survey programme their discovery further downstream and in larger condition indicates that they rearing successfully.

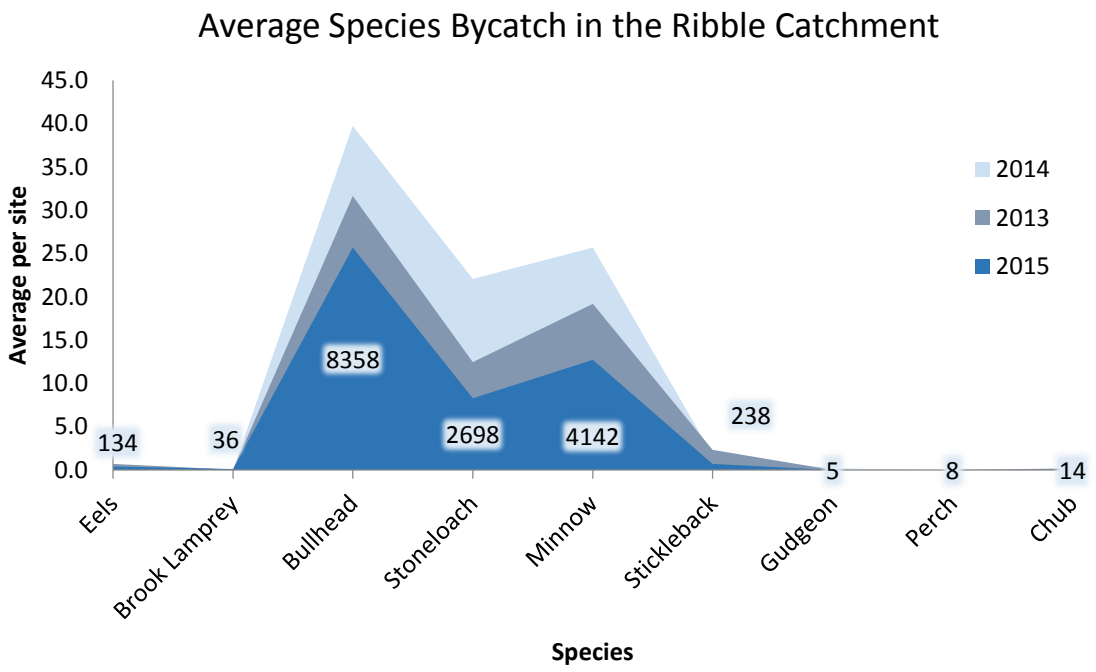

Figure 18 The chart above displays the average number of each species captured as bycatch. The highlighted values show the total number caught in 2015

Eel

The continued sightings of 'endangered' (IUCN Red list) European eel (*Anguilla anguilla*) has prompted us to question their population distribution within the Ribble catchment.

The map (Figure 19) shows the distribution of eels that are encountered during RRT surveys from 2014 – 2015. There are distinct clusters around Dunsop Bridge and further along the River Hodder. The area of year on year eel encounters runs from Waddington down to the lower tributaries of the Ribble. An analysis of the lengths of eels captured did not produce any significant results; due in part to the difficulty in capturing eels, their predominantly nocturnal activity, and the response of the eels to the electric-fishing equipment (set with a bias towards salmonid capture). The presence of a large proportion of eels within the lower reaches of the Ribble compared to the rest of the catchment provides interesting opportunities for future research. Greater efforts to quantify the eel population of the Ribble are required and a bid to address this is under development.

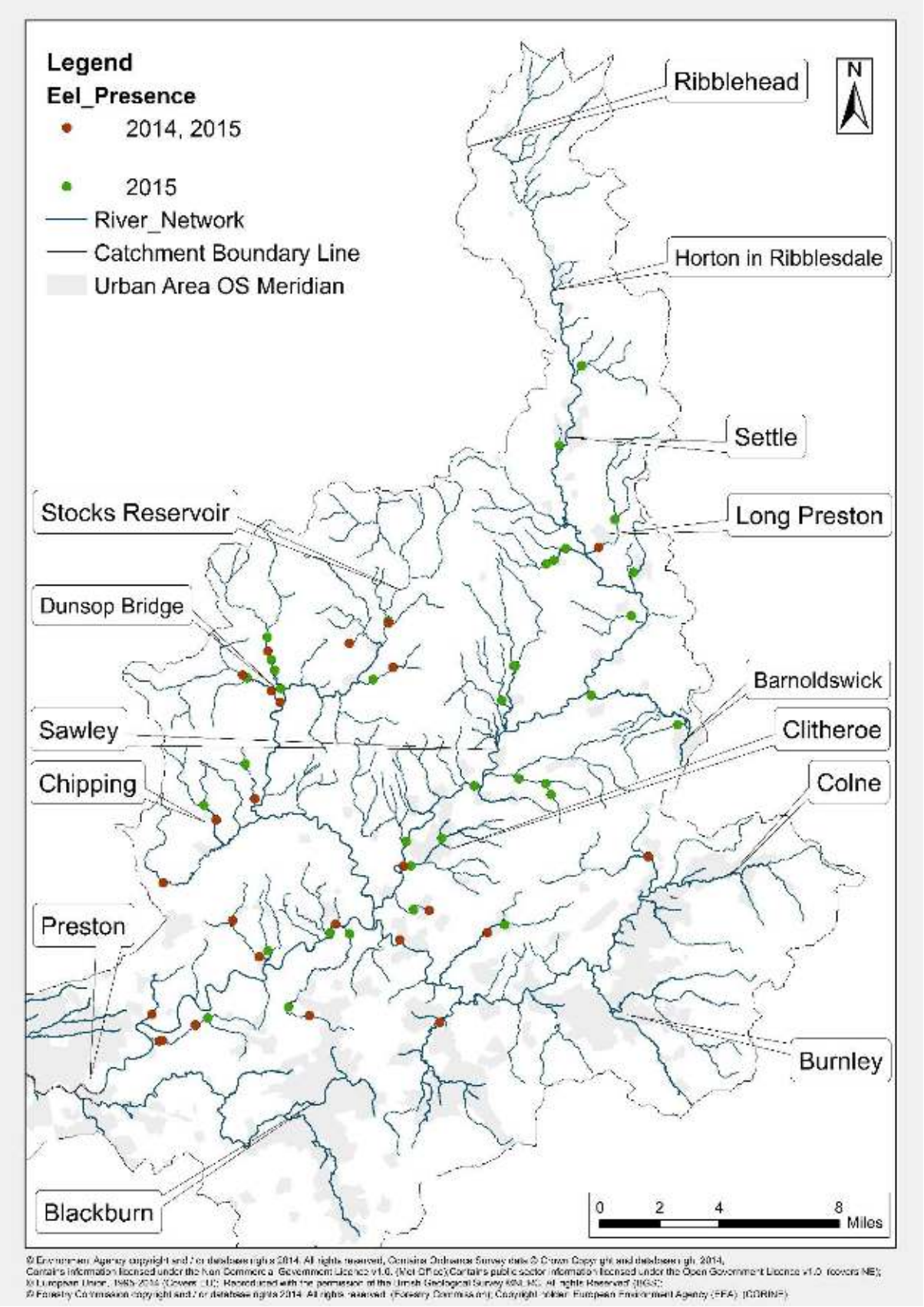

Figure 19 *Map showing the presence of eel within the Ribble catchment over the past two years. Data collected during RRT fisheries surveys.*

Crayfish

There has been a steady increase in the number of observed White clawed crayfish and their populations within Gayle beck (in the headwaters of the Ribble). This suggests that their distribution may be widening and the presence of a range of cohorts within separate brooks indicates the presence of a successfully breeding population. The surprise find of a large adult (estimated at 8-12yrs of age) within Waddington brook provided one of the highlights of this year's programme. This is the furthest south in the catchment that a sighting has been made throughout of eight years of RRT surveying. The find indicates the need for a formal crayfish survey to confirm the presence (or absence) of a healthy breeding population there.

Figure 20 *Photo of a WC crayfish captured on Waddington brook*

The sighting of an invasive American signal crayfish (*Pacifastacus leniusculus*) in Trawden brook, Cliviger at the top of the Calder system is a worrying development. A local commented that 'signals were placed into Trawden four years ago for eating purposes and these are being collected".

Figure 21 *Berried (with eggs) female American signal crayfish (left) and view of the survey site (right)*

Another known ASC location is Bookil Gill beck, above Long Preston. These signals were known to have populated the waters of Bookil Gill beck and a short way upstream of the confluence with Long Preston beck. This year our survey identified a substantial population about 50m downstream of the confluence. How far the signals have invaded downstream of this point is unknown – although invasion predominantly occurs in a downstream direction. The high densities of salmonids and the rich species diversity of Long Preston beck, and the surrounding SSSI of Long Preston deeps strengthen the case for a comprehensive survey of the beck to assess the location and spread of this invasive species. It is hoped that the monitoring phase of this campaign will begin next summer provided the relevant funding can be acquired. The RRT is seeking partners with whom to devise and deliver a monitoring strategy for both native and invasive species.

Conclusions

This year has represented a poor year again for trout recruitment. This follows on from a disappointing return in 2014. However, healthy populations persist in the upper Calder and Hodder systems.

Concerns have arisen over the low salmon fry recruitment, with some tributaries in the Hodder showing some of the worse fry returns in recent memory. This decline continues a trend from 2014 and indications of a longer term trend back to 2008). The high densities of salmon within the main stem of the Ribble and new finds within the Calder catchment, coupled with the upstream movements of parr within main Ribble tributaries provide zones for protecting our diminishing salmon population.

Recommendations

The recommendations from this year's findings are as follows -

- Direct Project Officers towards targeted habitat improvement works, in addition to revisits to existing schemes in need of maintenance.

- Continue inter-annual electrofishing monitoring of CRF area sites for cost/benefit monitoring purposes of riparian habitat schemes. As a minimum, this ought to sustain the RRT record of fisheries data by repeating the survey for the 75 sites for which a continuous 8-year record is held.

- Continue to monitor the main stem Ribble, with the possibility of increasing the number of main stem sites. Evaluate the efficiency of single anode backpack electric fishing along main rivers.

- Monitor the movement of smolts/kelts, and eels (within the outlined hot-spots) and use the barrier prioritisation model to assess the downstream passage efficiency of existing barriers or fish passes.

- Continue to monitor sites above fish easements/passes to assess their success in allowing multiple fish-species migration. This is specifically targeted towards sites in the Calder system.

- Targeted mailings of the 'Water Friendly Homes' guides under cover letter to addresses in close proximity to evidence of garden waste dumping into local watercourses within Chipping, Clayton, Rising Bridge, Sabden, West Bradford and Waddington.

- Study the population distribution of invasive American signal crayfish in Trawden brook and Long Preston through targeted fish surveys and kick sampling. Apply for permission to trap in confirmed sighting locations (such as Colne Water and Trawden) heading down river to establish their frontiers

- Study the population of white-clawed crayfish in Waddington brook to assess their health and lead on to generate maps of rare species (e.g. eels, lamprey and white-clawed crayfish) for re-distribution amongst Project Officers for consideration of pending RRT works or planning applications.

- Consider future research into the proposed topics: -

1. Systematic monitoring of water courses connecting stocked fisheries to ascertain the change in community structure and proximity to salmonid rearing areas. The knowledge obtained would inform fisheries management decisions over the contribution of these facilities to the local wild population. Barrow Brook, Dean Clough (Calder) and the upper main stem of the Hodder would provide preliminary study sites.
2. Examination of Bullhead and Stone Loach: Salmonid fry ratios using a high resolution data set. Could the initiation of disturbance events boost salmonid spawning and rearing success by increasing resource (or would primary colonisation by non-salmonids occur)?
3. Classification of low NFCS grade Ribble tributaries for the apportionment of suitable habitat works.
4. Re-population of in-river construction areas by tagged Brown Trout further to fish rescues.
5. Establish and quantify the movement of elvers over hydrometry stations fitted with pumped elver passes particularly throughout of the lower Ribble catchment area

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Appendices

Appendix 1

Fry and parr cut off lengths (mm)

Sub-catchment	Trout	Salmon
Hodder	86	80
Calder	86	80
Ribble	105	105

*The mortality rate of captured salmonids during 2015 was less than 1% of the total number of captures.