6. Fish Monitoring

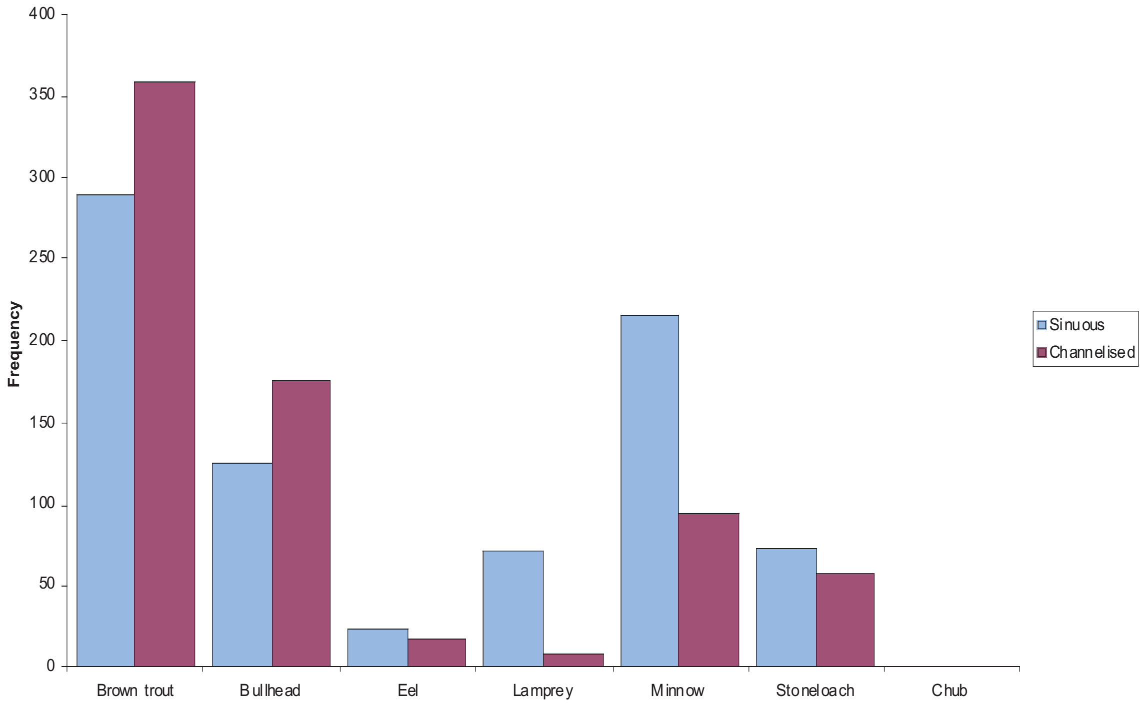
6.1 Background

New Forest streams support diverse fish populations and are recognised for their stocks of sea trout and brown trout. Certain stretches of the Lymington, Beaulieu and Hampshire Avon Tributaries are designated as Salmonid Fisheries under the EEC Freshwater Fisheries Directive. Sea trout are also found in the Avon Water and Bartley Water. The sea trout populations are unique to each river and possibly even to individual tributaries. A number of coarse fish species are also present throughout the catchments. Environment Agency fish surveys of New Forest streams, over the years, have recorded at least 15 different fish species:

- Sea trout
- Brown trout
- Bullhead
- Eel
- Minnow
- Brook Lamprey
- Stoneloach
- Pike
- 3-spined stickleback
- Chub
- Roach
- Perch
- Dace
- Gudgeon
- Flounder

Early monitoring work carried out by the Environment Agency (2005) under the Life 3 project looking at the impact on fish populations anticipated that some changes in the density or distribution of fish numbers might be expected due to changes in the habitat as a result of river restoration works. Initial trends are shown in Figure 6.1. River restoration is considered to provide a number of benefit to the fish community. Notably, the re-instatement of sinuous reaches provides a mosaic of differing habitats able to support a more diverse fish population in terms of age and size range. Deep pools provide refuges for larger trout and provide thermal refugia during hotter periods, organic deposition creates habitat for lamprey juveniles, backwaters act as shelters from spate conditions and riffle areas become more stable and therefore provide better for spawning and salmonid survival.

Figure 6.1: Life 3 Fish Community Monitoring Results



Source: Environment Agency

6.2 Restoration Objectives

- To restore sites that can maintain and develop a rich and diverse fish community

6.3 HLS Monitoring Sites

As part of HLS Monitoring, fish surveys have been carried out by:

- The Environment Agency as part of fish rescues to clear river reaches of fish prior to restoration. This provided data from electro-fishing records

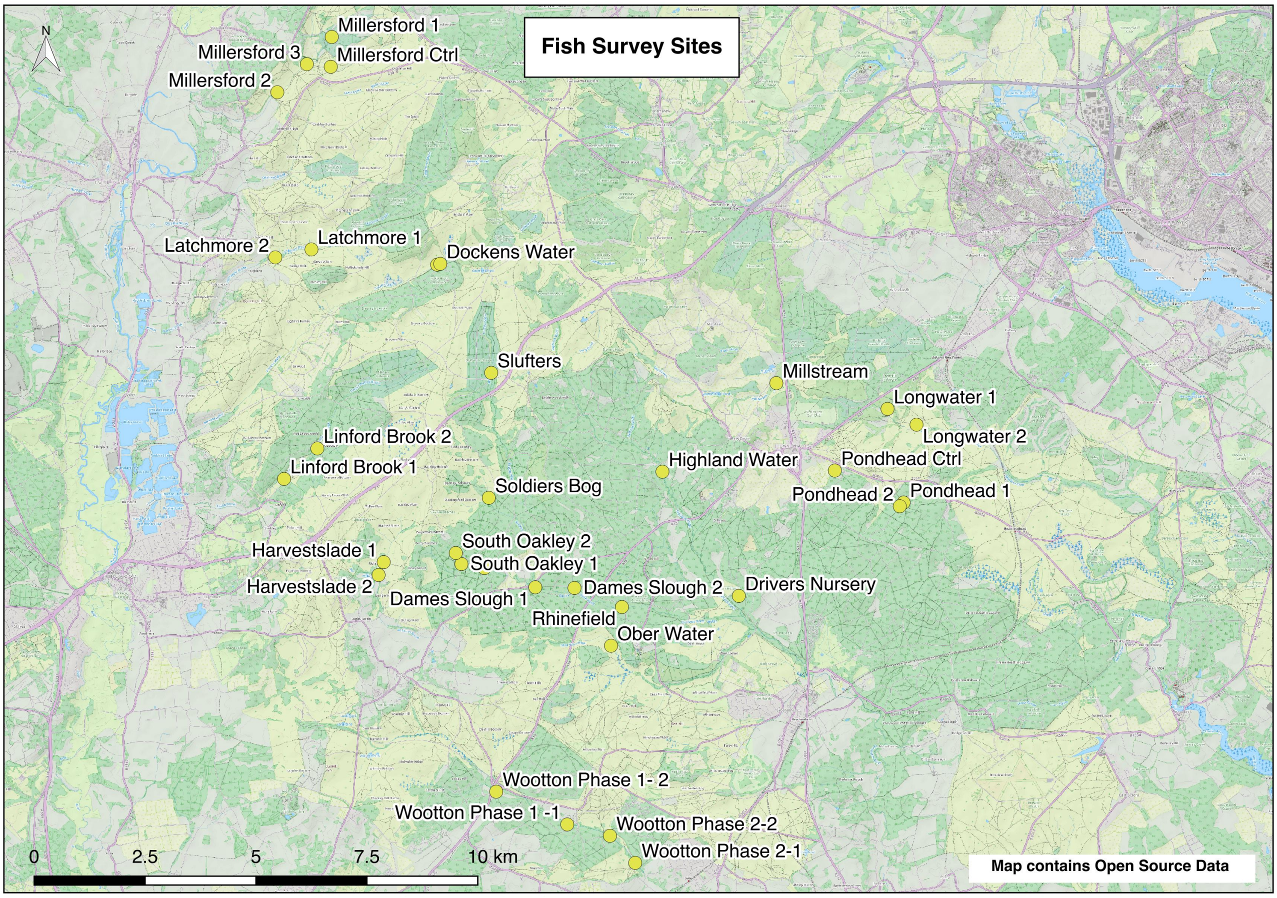
- Formal Fish surveys by APEM (2014) and Bournemouth University Global Solutions (BUG) from 2015 to 2019. Formal fish surveys have been conducted at 18 locations, pre and post restoration. The locations of formal fish surveys are shown in Table 6-1 and Figure 6.2.

The analysis of HLS fish monitoring data for the purposes of the HLS wetland monitoring review will primarily draw upon the results of the formal surveys carried out by APEM and BUG due to the consistency of data and repeat surveys.

Table 6-1: HLS Fish Survey Monitoring Sites

Site	Pre-Restoration Surveys	Post Restoration Surveys	Restoration Status
Dames Slough	No data	2017	Restored
Dockens Water	2019	N/A	Unrestored
Drivers Nursery	No data	2016	Restored
Harvestlade	2014	2016,2018	Restored
Highland Water	2019	N/A	Unrestored
Latchmore	2017,2018,2019	N/A	Unrestored
Linford	2016	N/A	Unrestored
Longwater	No data	2016	Restored
Millersford	2016,2017,2018,2019	N/A	Unrestored
Mill Lawn Brook	2018	N/A	Unrestored
Mill Stream	2019	N/A	Unrestored
Ober Water	2019	N/A	Unrestored
Pondhead	2014,2016	No data	Restored
Rhinefield	No data	2017	Restored
Slufters	No data	2017	Restored
Soldiers Bog	No data	2016,2018	Restored
South Oakley	2016	N/A	Restored
Wootton	2014	2017,2018,2019	Restored

Figure 6.2 – Fish Monitoring Locations



6.4 Fish Monitoring & Methodology

At each site, a fully-quantitative (triple run) electric fishing survey was conducted using backpack electric fishing kit. Stop-nets were positioned at both the upstream and downstream extent of the survey site to isolate a 100m stretch. In combination with measurement of river habitat characteristics at 10 m intervals (e.g. width, depth and substrate), the total survey area was calculated for each site.

All fish captured were identified to species, a representative sub-sample of each species was measured, and all fish allowed to recover in aerated holding tanks prior to their release. Fish from each electric fishing run were processed separately to facilitate calculation of population densities using catch depletion models.

Fish capture, processing, data recording and analyses was completed in accordance with best practice guidance (e.g. Joint Nature Conservation Committee Common Standards Monitoring). Where relevant, 0+ and 1++ brown trout densities were classified according to the National Fisheries Classification Scheme (NFCS) (refer to Table 6-2).

Table 6-2: National Fisheries Classification Scheme (NFCS) for Trout

Classification	Density (No./100m^2)	
	Trout fry (0+)	Trout parr (1++)
A (Excellent)	>= 38	>= 21
B (Good)	17 – 37.9	12 – 20.9
C (Fair)	8 – 16.9	5 – 11.9
D (Fair / Poor)	3 – 7.9	2 – 4.9
E (Poor)	< 3	< 2
F (Fishless)	Absent	Absent

Source: BUG 2016

6.5 Analysis & Discussion of Results

6.5.1 Fish Species

The HLS fish monitoring surveys recorded a total 14 species:

- Sea trout
- Brown trout
- Bullhead
- Eel
- Minnow
- Brook Lamprey
- Stoneloach
- Pike
- 3-spined stickleback
- Chub

- Roach
- Perch
- Dace
- Gudgeon

Sea trout were noted from redd counts. Only one species, Flounder, was not recorded. This species is more typically found in brackish waters and has only been recorded in the lower reaches of the catchments during past Environmental Agency fish surveys so would not be expected to feature at any of the sample sites.

Of the fish species recorded Brown trout, Sea trout, Bullhead, Eel and Brook Lamprey are of conservation importance as shown in Table 6-3.

Table 6-3: Conservation Status of Fish Species

Species	Conservation Status
Brown trout	UK BAP (Priority Species)
Sea trout	Habitats Directive (Annex II)
Eel	EC Eel Regulation (Eels (England and Wales) Regulations, IUCN Red List (Critically Endangered), UK BAP (Priority Species)
Brook Lamprey	Habitats Directive (Annex II)

6.5.2 Population Response

Comparison of monitoring results from all sample sites shows that the average fish population has tended to increase in restored sites compared to unrestored sites (Figure 6.3).

Figure 6.3 and Appendix A shows how individual fish species have reacted across all monitoring sites. Restoration appears to particularly favour the 3-Spined stickleback, Bullhead, Minnow, R/B lamprey and Stoneloach. Overall numbers of fish species of conservation importance have also increased slightly due to increases in populations of Bullhead and Lamprey.

The river/brook lamprey is an eel-like fish belonging to one of the most ancient groups of jawless fish. They spawn in March/April laying eggs in shallow depressions in suitable gravels (average size of less than 0.5cm), created by lifting away small stones with their suckers. After hatching the ammocoetes swim or drift downstream to areas of still water where they burrow in the silt. They can remain in their nursery habitat for up to seven years before metamorphosis and emergence as adults. The adults do not migrate far and spawning grounds tend to be in close proximity to nursery grounds. Nor do adult brook lamprey feed and they die approximately one month after spawning. Lamprey tend to prefer silty sediments, which can be found in the slower flowing areas of sinuous sections where meanders have been restored.

Bullhead is the only freshwater cottid found in the UK. It is a small fish which rarely reaches 18cm in length. It is a unique and distinctive fish due to a combination of male parental care and nest building, production of sounds, potential for mate choice, high degree of territoriality and a body and eyes adapted to a flowing environment. Bullhead generally prefer gravel substrates and faster flows often characteristic of unrestored channelised stretches but although numbers have fallen as some sites such as Pondhead and Soldiers Bog, overall numbers do not seem to have been significantly affected. Bullhead populations have significantly increased at Wootton. The substrate sizes used as part of river restoration is probably attractive to bullhead.

Although it would appear from Figure 6.4 that numbers of coarse fish, for example chub, perch and dace have reduced these species occurred in samples taken from sites that have not yet been restored such as Latchmore Brook and Linford Brook. No significant populations of coarse fish were identified from other monitoring sites and no suitable data sets were available to analyse the impact of restoration on coarse fish species pre and post restoration.

Sea trout populations are unique to each river with adults returning to spawn in the river in which they originated. Adult sea trout enter the rivers from April/June and migrate up-stream to spawn in headwater gravel beds between October and January. Smolts move downstream for the marine migrations from March to June. The time for this migration is largely water temperature dependant. Redd counts, as discussed in section   , indicate that restored sections are still to spawning trout.

Figure 6.3: Response in fish population between restored and unrestored sites

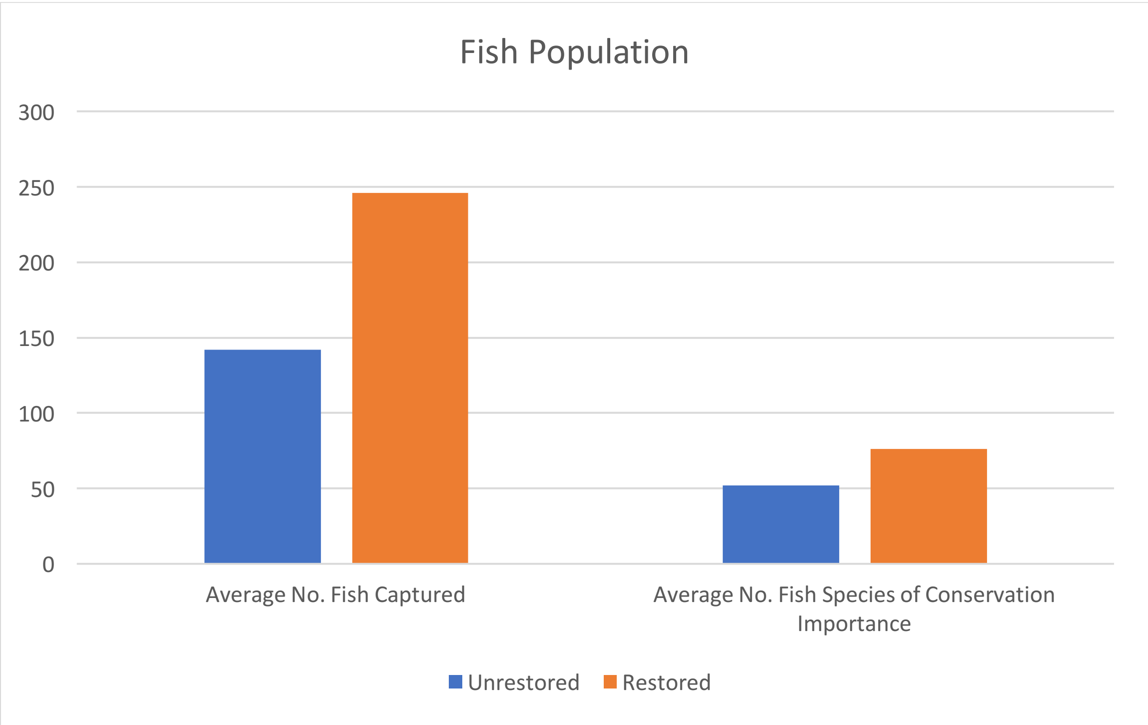
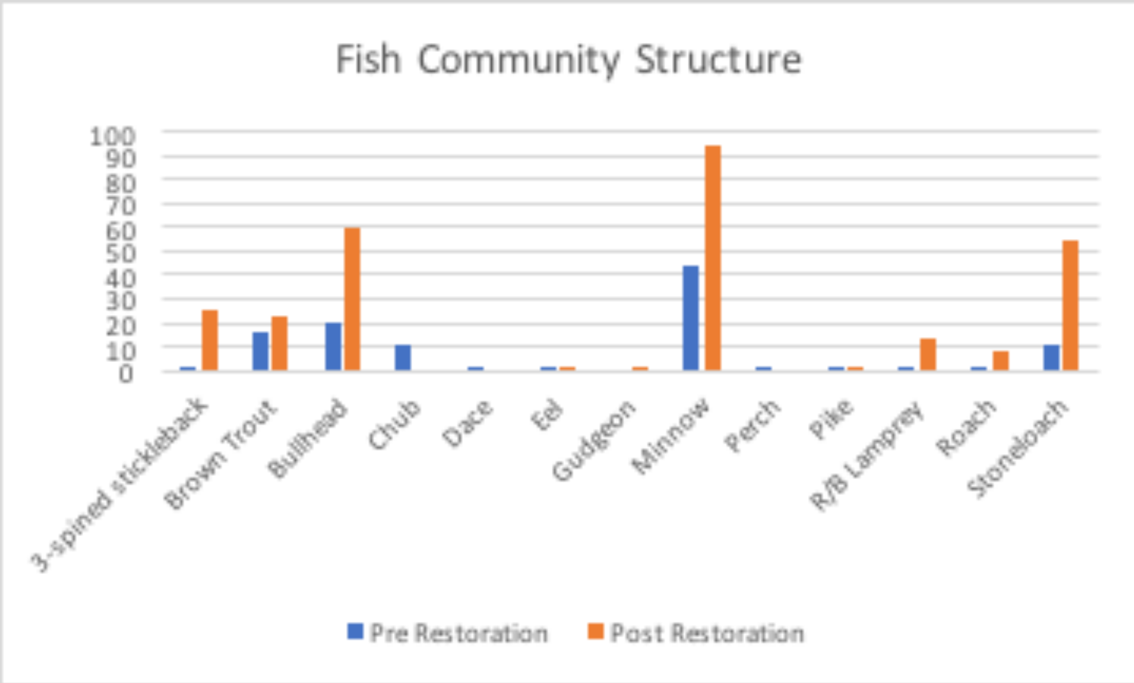


Figure 6.4.: Response in Fish Community between restored and unrestored sites



Two sites, Wootton and Harvestlade have sets of monitoring data, pre and post restoration, which give an early indication of how fish communities are responding at individual sites (Refer to Figures 6.5 to 6.7).

At Wootton Phase 1 (Figure 6.5), in the first year post restoration (2017) fish numbers had significantly declined but had recovered well by the second year (2018) before slightly declining again in 2019. Work was taking place further downstream in Wootton Phase 2 so it is possible that this was affecting fish movement through the system.

At Wootton Phase 2, (Figure 6.6) shows the results of fish sampling shortly after restoration in 2018 and repeated in 2019. Interestingly, populations of fish were significantly higher in 2018 immediately post restoration especially for Bullhead, Brown trout, Lamprey and Stoneloach. Bullhead populations did seem to boom generally in 2018 throughout the Wootton Phase 1 & 2 reaches.

At Harvestlade (Figure 6.7), fish populations two years post restoration appear to have recovered well, following a similar trend to Wootton. Four years on from restoration (2018) populations of Lamprey, Bullhead and Brown Trout seem to have suddenly declined but this may be due to the extremely hot conditions and summer drought that occurred in 2018. Unfortunately, there is no monitoring data post 2018 to see if populations have recovered again. It was notable from data from other sites in 2018 that fish may be moving down through the system in response to environmental conditions. For example, at Millersford 2 (unrestored) which appears to have a fairly stable resident trout population, it is noticeable that trout numbers suddenly declined in 2018 but increased proportionally at Millersford 3 further downstream before returning to normal in 2019 which suggests that a proportion of the trout population temporarily moved downstream where conditions were more favourable. Fish movement as a result of the extreme conditions may partly account for the boom in the Wootton Bullhead population in 2018 or may be due to natural recruitment patterns.

Figure 6.5: Wootton Phase 1 – Fish Community Recovery

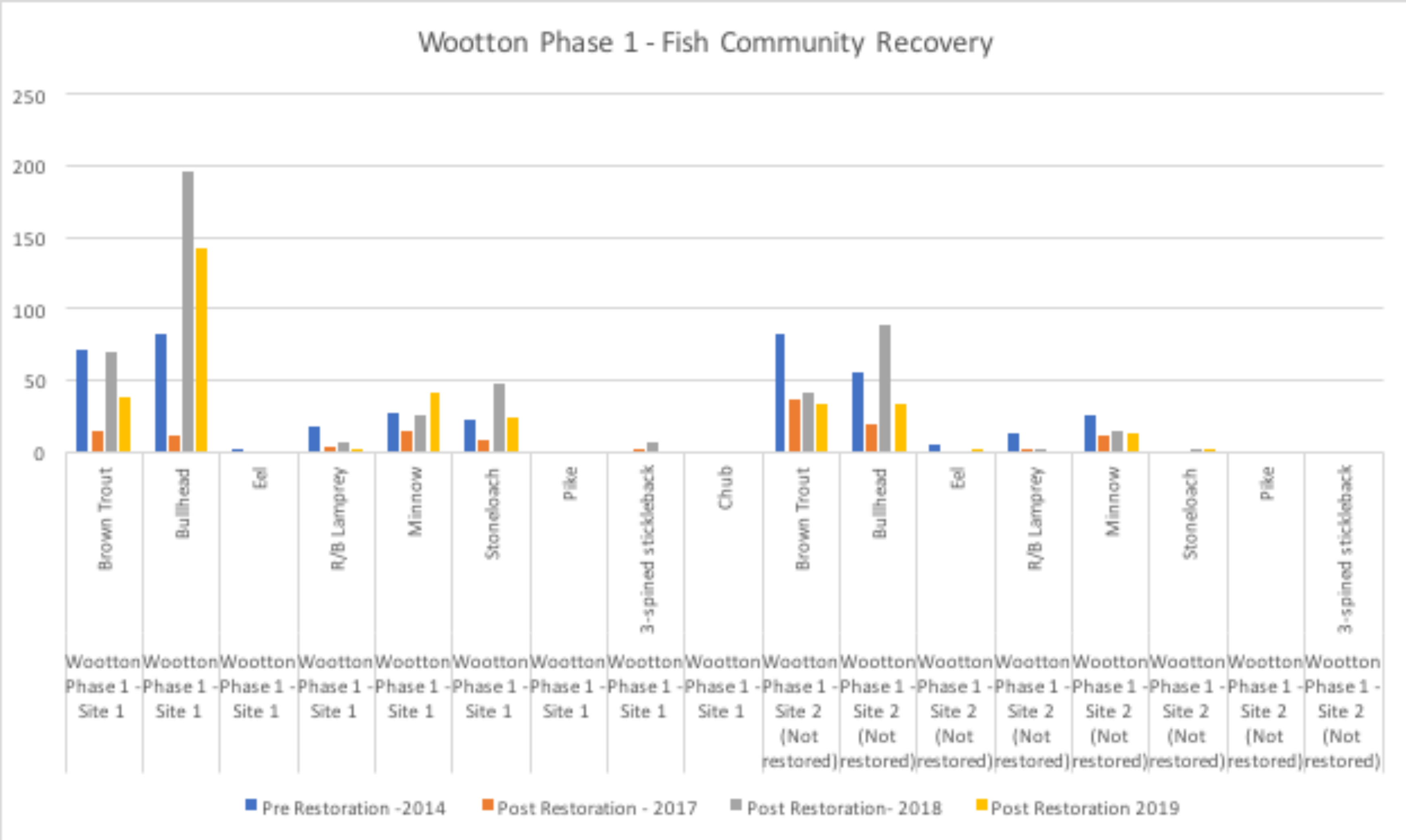


Figure 6.6: Wootton Phase 2 – Fish Community Recovery

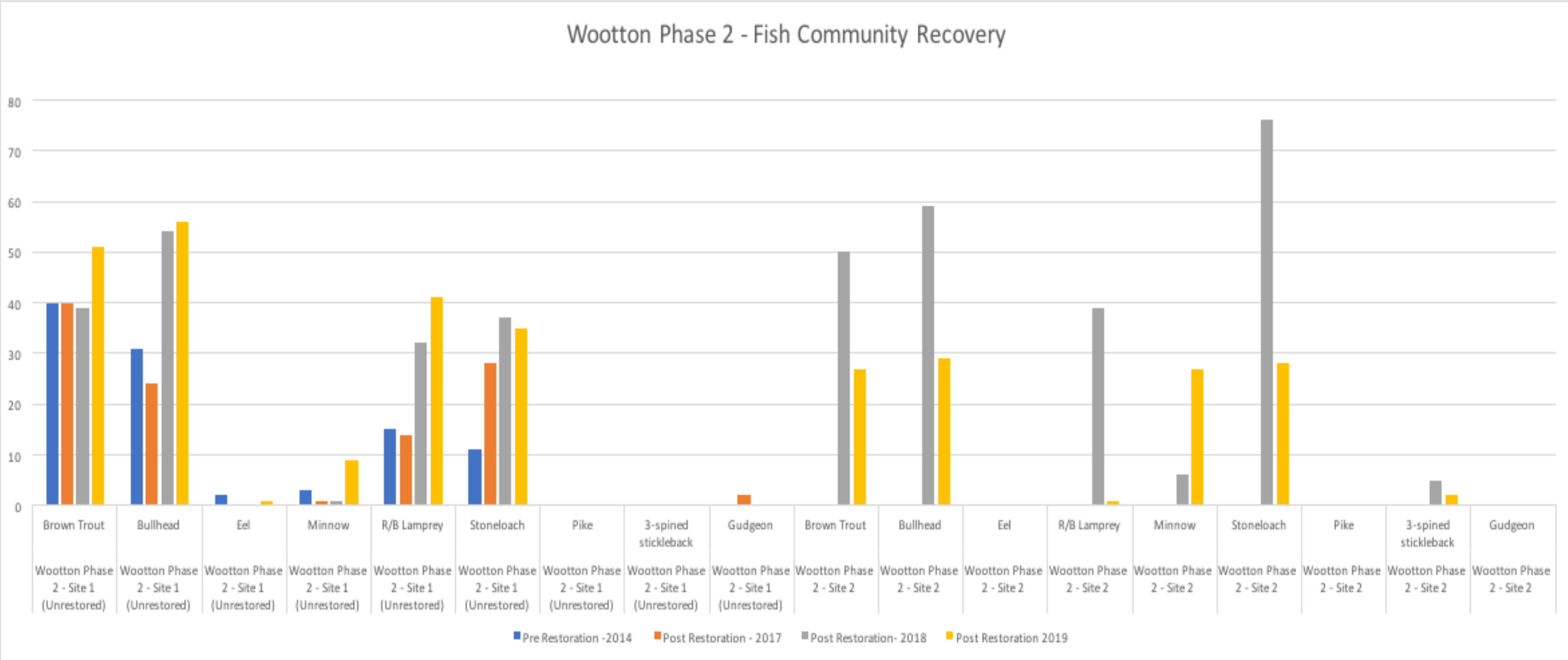
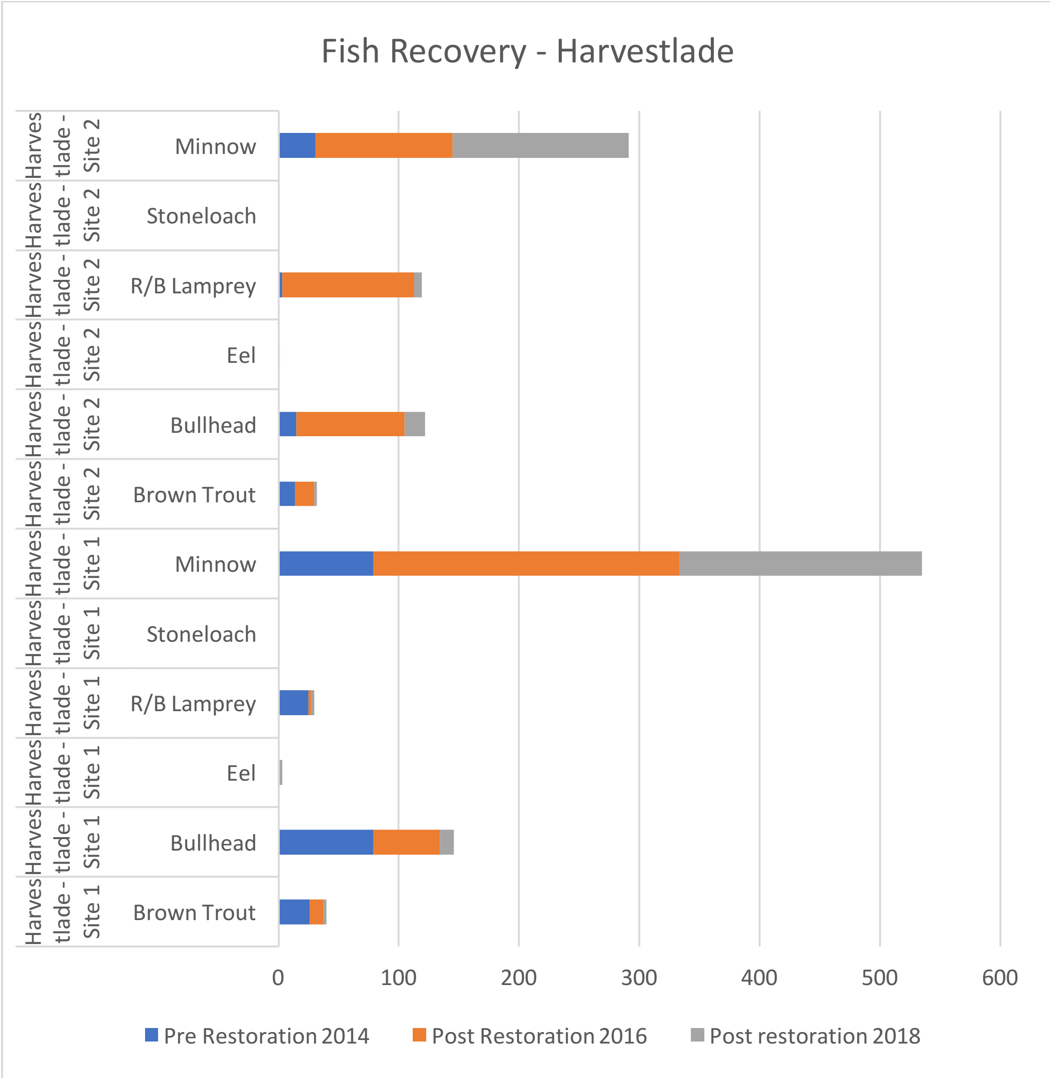


Figure 6.7: Harvestlade - Fish Community Recovery



6.5.3 Trout Classification

The BUG Surveys from 2016 to 2019 have assigned a trout classification based on the density of trout fry and trout parr to sites where trout were present (refer to Table 6-4). In order to get an understanding and visual representation of the results a series of pie charts have been generated (refer to Figure 6.8) to show the percentage of restored and unrestored sites that fall into the various trout classifications. Some caution is required in interpreting the results as there were more sample sites from unrestored sites than restored sites and classifications vary from year to year but these initial results are potentially useful in identifying early trends.

The unrestored sites seem to fair better with regard to trout fry with a slightly higher percentage of sites falling into a good or fair classification and a lower number falling into fair/poor or poor but 20% of restored sites were fishless whereas none of the unrestored sites fell into this category. When looking at Table 6-4, it can be seen that two sites had fishless results – Drivers Nursery in 2016 and Harvestlade1 in 2018. The Harvestlade result may well be due to the drought conditions and high temperatures that featured in the summer of 2018 which trout are sensitive to.

With regard to trout parr, restored sites do not seem to compare as well with un-restored sites. Although the percentage of good sites is almost comparable results decline for the remaining trout classifications from C(fair) through to F (Fishless). Harvestlade 1 in 2018 accounts for the fishless percentage so again this could be a result of the drought conditions.

When trying to looking at the trends for individual for sites pre and post restoration there are not many samples to compare so it not possible to make any meaningful comment on individual sites.

6.5.4 Redd Counts

It is interesting to look at results for redd counts to see whether the redds counts recorded relative to the trout classification for individual sites give any indication of survival rates. Table 6-5 shows the results of surveys undertaken by BUG to record resident trout and sea trout redds.

No redds were recorded at Drivers, Harvestlade or Linford which probably explains the fishless/poor status classifications for trout fry and parr. However, redds were recorded at Latchmore, Rhinefield and Slufters. Indeed, the highest total number of redds was recorded at Rhinefield which is regarded as E(Poor) for both trout fry and parr.

When looking at the fish species community composition at these sites it is apparent that predation could be a factor in explaining the disparity between redd counts and trout classification status. Pike are known to be voracious feeders of trout fry and parr. Pike were only recorded at Dameslough (3), Latchmore (2), Drivers Nursery (9) and Rhinefield (3). Other than Harvestlade and Linford these sites all have the lowest trout classifications for trout fry & parr. But other than at Drivers Nursery (which also recorded low adult trout numbers as well as no redds but the highest pike numbers), redds were recorded at Dameslough, Latchmore and Rhinefield so ordinarily would be expected to show better results for parr and fry.

No redds were recorded at Linford or Harvestlade and this could well be due to low flow conditions in both these streams which create very hostile conditions for migratory trout and for the survival of trout of fry and parr during the summer months.

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Table 6-4: Trout Classification Status

Site	Survey Year	Restoration Status	Classification	
			Trout Fry (0+)	Trout Parr (1++)
Dockens Water	2019	Unrestored	D (Fair/Poor)	F (Fishless)
Highland Water	2019	Unrestored	E (Poor)	E (Poor)
Latchmore 1	2018	Unrestored	E (Poor)	F (Fishless)
Latchmore 2	2017	Unrestored	E (Poor)	D (Fair/Poor)
Latchmore 2	2018	Unrestored	E (Poor)	D (Fair/Poor)
Latchmore 2	2019	Unrestored	D (Fair/Poor)	D (Fair/Poor)
Linford 1	2016	Unrestored	E (Poor)	E (Poor)
Linford 2	2016	Unrestored	D (Fair/Poor)	D (Fair/Poor)
Mill Lawn Brook	2018	Unrestored	E (Poor)	C (Fair)
Mill Stream	2019	Unrestored	C (Fair)	D (Fair/Poor)
Millerford 3	2019	Unrestored	C (Fair)	C (Fair)
Millersford 2	2016	Unrestored	D (Fair/Poor)	B (Good)
Millersford 2	2017	Unrestored	B (Good)	D (Fair/Poor)
Millersford 2	2018	Unrestored	E (Poor)	C (Fair)
Millersford 2	2019	Unrestored	C (Fair)	B (Good)
Millersford 3	2016	Unrestored	D (Fair/Poor)	B (Good)
Millersford 3	2017	Unrestored	C (Fair)	C (Fair)
Millersford 3	2018	Unrestored	B (Good)	C (Fair)
Pondhead 1	2016	Unrestored	E (Poor)	D (Fair/Poor)
Pondhead 1	2019	Unrestored	D (Fair/Poor)	D (Fair/Poor)
Pondhead 2	2016	Unrestored	E (Poor)	D (Fair/Poor)
Wootton P2	2017	Unrestored	D (Fair/Poor)	C (Fair)
Wootton P2	2018	Unrestored	D (Fair/Poor)	C (Fair)
Wootton P2	2019	Unrestored	D (Fair/Poor)	C (Fair)
Wootton P1 - 2	2017	Unrestored	C (Fair)	B (Good)
Wootton P1 - 2	2019	Unrestored	C (Fair)	B (Good)
Wootton P1 - 2	2018	Unrestored	C (Fair)	B (Good)
Dames Slough 1	2017	Restored	E (Poor)	E (Poor)
Drivers Nursery	2016	Restored	F (Fishless)	E (Poor)
Harvestlade 1	2018	Restored	F (Fishless)	E (Poor)
Harvestlade 1	2016	Restored	D (Fair/Poor)	F (Fishless)
Harvestlade 2	2018	Restored	F (Fishless)	E (Poor)
Harvestlade 2	2016	Restored	E (Poor)	C (Fair)
Pondhead 2	2019	Restored	D (Fair/Poor)	E (Poor)
Rhinefield	2017	Restored	E (Poor)	E (Poor)
Slufters	2017	Restored	E (Poor)	E (Poor)
Soldiers Bog	2016	Restored	C (Fair)	D (Fair/Poor)
Wootton P1 - 1	2017	Restored	D (Fair/Poor)	D (Fair/Poor)
Wootton P1 - 1	2019	Restored	C (Fair)	C (Fair)
Wootton P1 - 1	2018	Restored	B (Good)	D (Fair/Poor)
Wootton P2 - 2	2019	Restored	D (Fair/Poor)	D (Fair/Poor)
Wootton P2 - 2	2018	Restored	B (Good)	C (Fair)

Figure 6.8: Trout Classification at Restored and Unrestored Sites

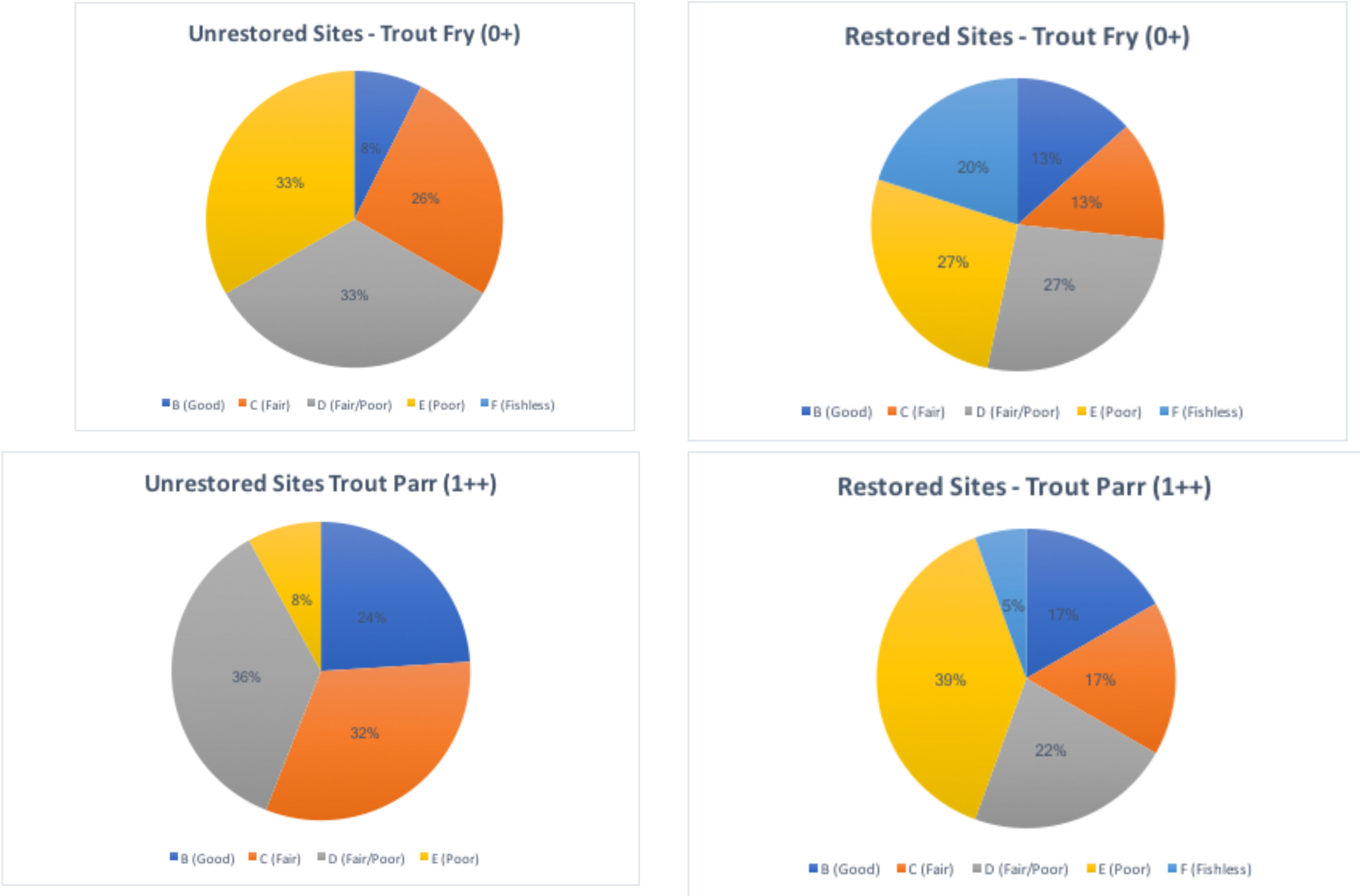


Table 6-5: Results of Redd Counts

Site	Year	Restoration Status	Trout Redd	Sea Trout Redd	Comments
Drivers Nursery	2016	Restored	0	0	
Harvestlade	2016	Restored	0	0	River level relatively low which may have restricted sea trout access to upper reaches of the river system
Harvestlade	2018	Restored	0	0	
Linford Brook	2016	Unrestored	0	0	River level relatively low which may have restricted sea trout access to upper reaches of the river system. Debris dam also restricting access
Longwater	2016	Restored	1	1	In addition to pair of sea trout spawning on the redd, a large (~ 45 cm) female sea trout (pre-spawning) was observed in a shallow bay nearby
Dameslough	2017	Restored	2	5	
Latchmore Brook	2017	Unrestored	3	1	
Latchmore Brook	2018	Unrestored	1	1	
Linford Brook	2017	Unrestored	1	1	
Millersford Brook 1	2017	Unrestored	0	0	
Millersford Brook	2018	Unrestored	0	0	Multiple trout spawning 'scrapes' were recorded just downstream of the area of interest on a large riffle area below the footbridge at SU1818616070.
Mill Lawn Brook	2018	Unrestored	0	2	
Rhinefield	2017	Restored	3	10	
Slufters	2017	Restored	1	0	
Soldiers Bog	2018	Restored	1	0	
South Oakley	2017	Unrestored	0	2	
Wootton Phase 1	2017	Restored	5	6	
Wootton Phase 1	2018	Restored	0	5	
Wootton Phase 2	2017	Unrestored	0	5	
Wootton Phase 2	2018	Restored	2	0	

Source: BUG Reports 2016 to 2019

6.5.5 Fish Population – age/size distribution

Early analysis of survey data from Life 3 projects carried out by the Environment Agency suggested that the re-instatement of sinuous reaches provided a mosaic of differing habitats able to support a more diverse fish population in terms of age and size range (Wright, 2003)

In order to evaluate whether the HLS restoration sites were showing a similar the trend length/frequency data and graphs produced by APEM and BUG respectively for Wootton Phase 1-1 were compared to look for any noticeable differences from pre-restoration in 2014 through post restoration and site recovery from samples surveyed in 2017 and 2019. Wootton 1-1 was selected for evaluation as it is the site with the longest run of data with both pre and post restoration data. Length/Frequency data is available for bullhead, brown trout and minnow as shown in Figure 6.9.

The graphs do show discernible patterns among all three fish species. In relation to bullhead (Figures 6.9 a,b,c), the 2014 data shows that an entire age range population was present with individuals ranging in size from 2.4 to 6.7 cm. In 2017, one year after restoration the Bullhead population is confined to a narrow size cohort between 4.6 and 5.7 cm. Through 2018 the bullhead population suddenly boomed and two years later, by 2019, the population age range has expanded in line with the pre-restoration range with length frequencies ranging from 2 to 6.3cm with a significantly denser population than was present pre-restoration. However, there is a notable gap in the length distribution between 3.5cm and

4.5cm, probably reflecting the population/recruitment gap from the period immediately post restoration.

In the UK, minnows reach sexual maturity around 5cm and have an average lifespan of approximately 3 years (Sandlund, 2008). Graphs of length frequency for minnow at Wootton Site 1-1 are shown in Figure 6.9 d,e,f. Pre-restoration in 2014, the length frequency of the minnow population at Wootton Site 1-1 ranged from 2 to 6.4cm encompassing juvenile to mature adults. In 2017, one year post restoration a reduced minnow population was entirely dominated by adults of breeding or approaching breeding size in a narrow size range band of 4.4 and 8.1cm. By 2019 the age range distribution is back in line with the pre-restoration population ranging in sizes from 2.3 to 7.5cm with a denser population than pre-restoration.

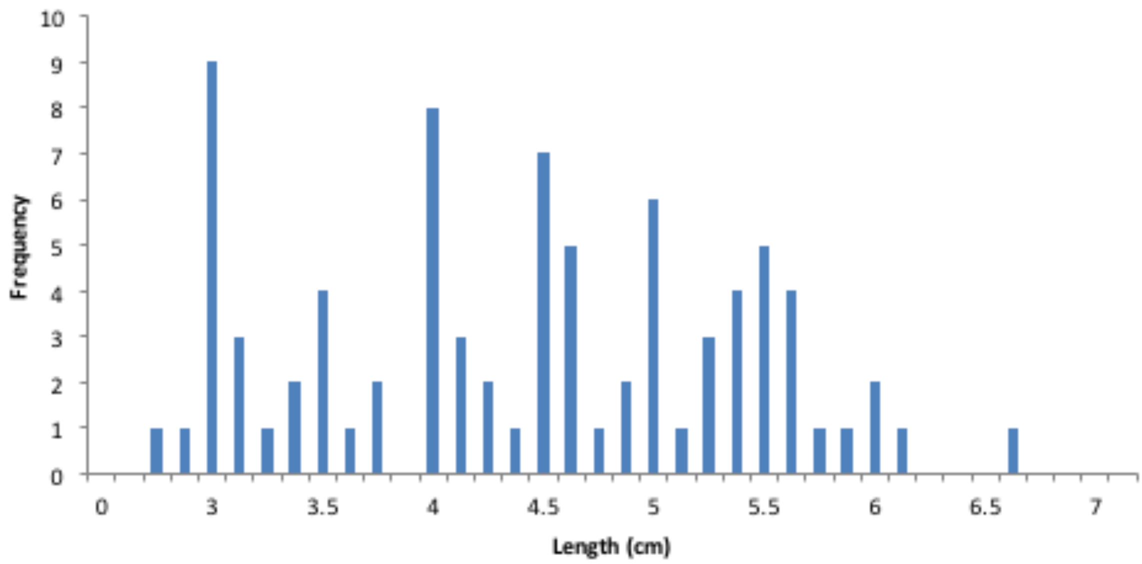
Trends for the trout population length frequency are shown in Figures 6.9 g,h,i. Trout lengths ranged from 4.4cm to 29.2cm in 2014, 6 to 25.5cm in 2017 and 5.1 to 24.5cm in 2019 so there has not been a significant variation in age range. The main difference has been a reduction in population density across all age ranges, although numbers did recover significantly in 2018 back up to pre-restoration levels but then declined quite significantly in 2019. There was also a decline in Site 1-2 (control site) but to a lesser degree and trout numbers are rising and falling in downstream samples so there is no immediately obvious reason why this decline occurred until one looks more closely at the population length frequency and density in 2018 (Fig 6.9 j).

In 2018 the trout population at Wootton Site 1-1 boomed and recruitment was primarily in the juvenile age range (Figure 6.9 j) which largely accounted for the rise in population size. Brown trout are highly territorial and aggressively defend territories from the fry stage onwards. Numerous studies have looked at the territorial behaviour of trout. One study (RG Tittus, 1990) specifically looked at territorial behaviour and its role in population regulation and found that aggression rates among newly-emerged fry increase with progressively higher initial population densities as does selection pressure for individuals with greater growth potential (GGP dominants). Beyond the optimum initial density where maximum parr recruitment is attained, GGP dominants continue to progressively increase their territory size by increasing attack distance toward territorial intruders and exclude subordinates from even suboptimal feeding positions and driving them downstream out of the territory where they often die from malnutrition. Consequently, parr recruitment gradually decreases and becomes negatively density-dependent. At the same time the number of adult brown trout increased between 2018 and 2019 and adult trout are known to predate on young trout parr so equally predation as well as territorial defence pressure among parr could be a factor in explaining the sudden decline in total trout density.

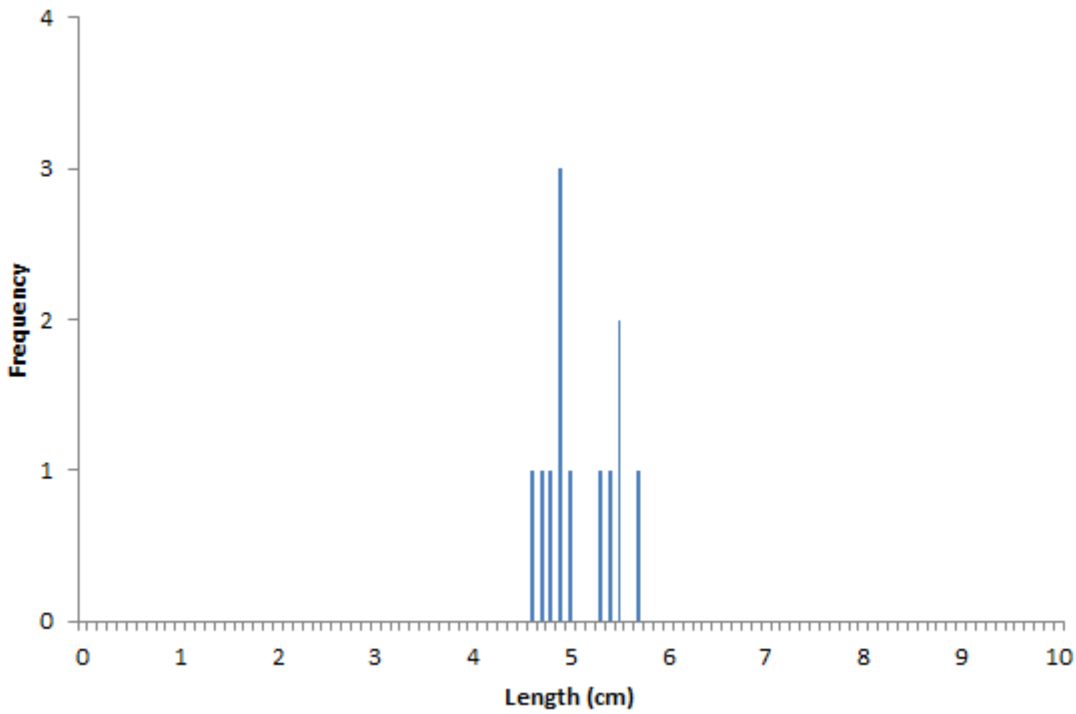
Further monitoring over future years may reveal or confirm reasons behind fish population fluctuations which can be influenced by a number of factors relating to habitat structure, food availability, predation, water levels and obstructions to migratory movements.
Length frequency data is not available for all fish species but it would appear from initial analysis of the data available for bullhead, minnow and brown trout that the fish population structure, certainly at Wootton Phase 1 is recovering post restoration.

Figure 6.9: Wootton Phase 1-1 - Species length frequencies

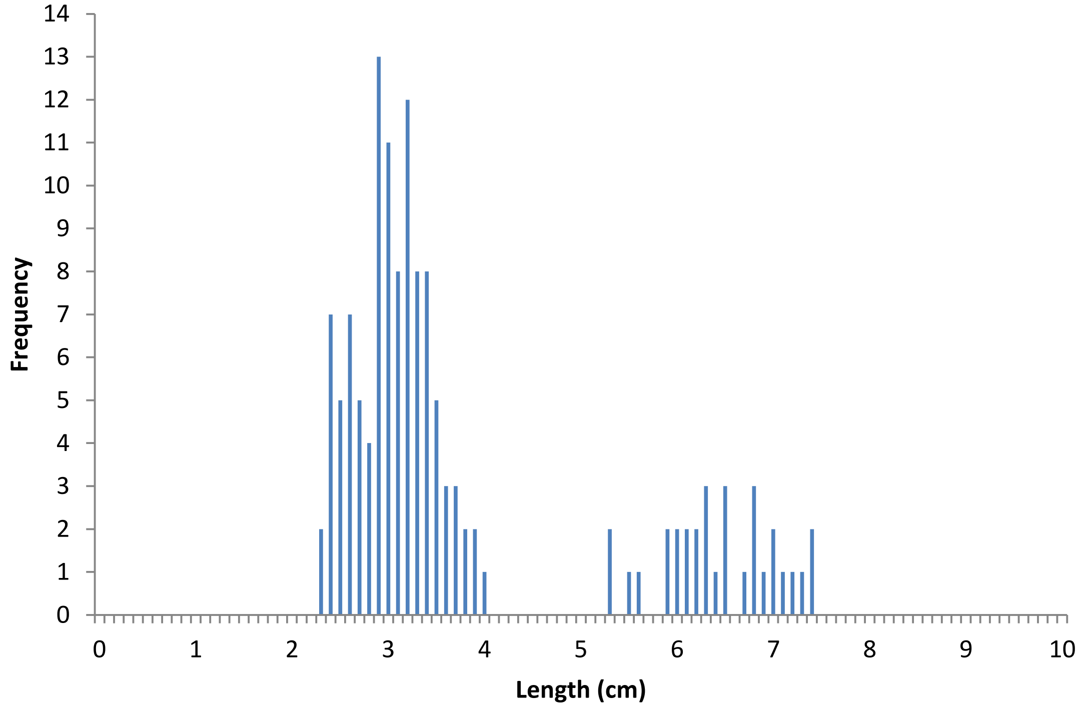
a) 2014 - Length frequency of bullhead captured at Wootton Phase 1 Site 1 (n=82).



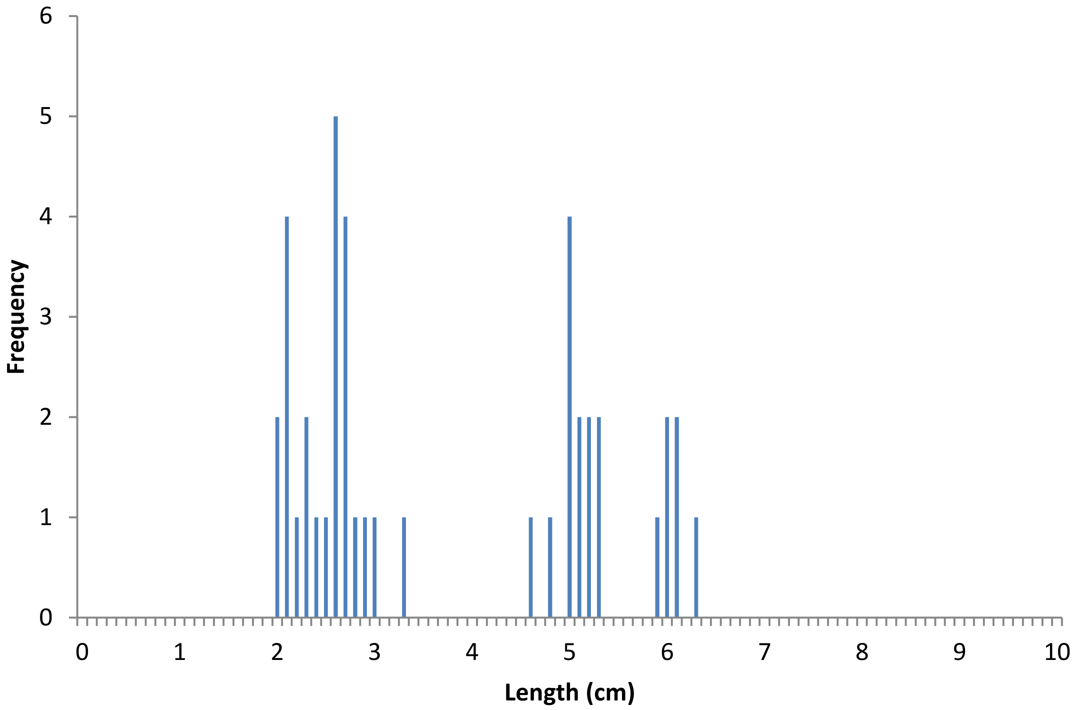
b) 2017 - Length frequency of bullhead captured at Wootton Phase 1 Site 1 (n=12).



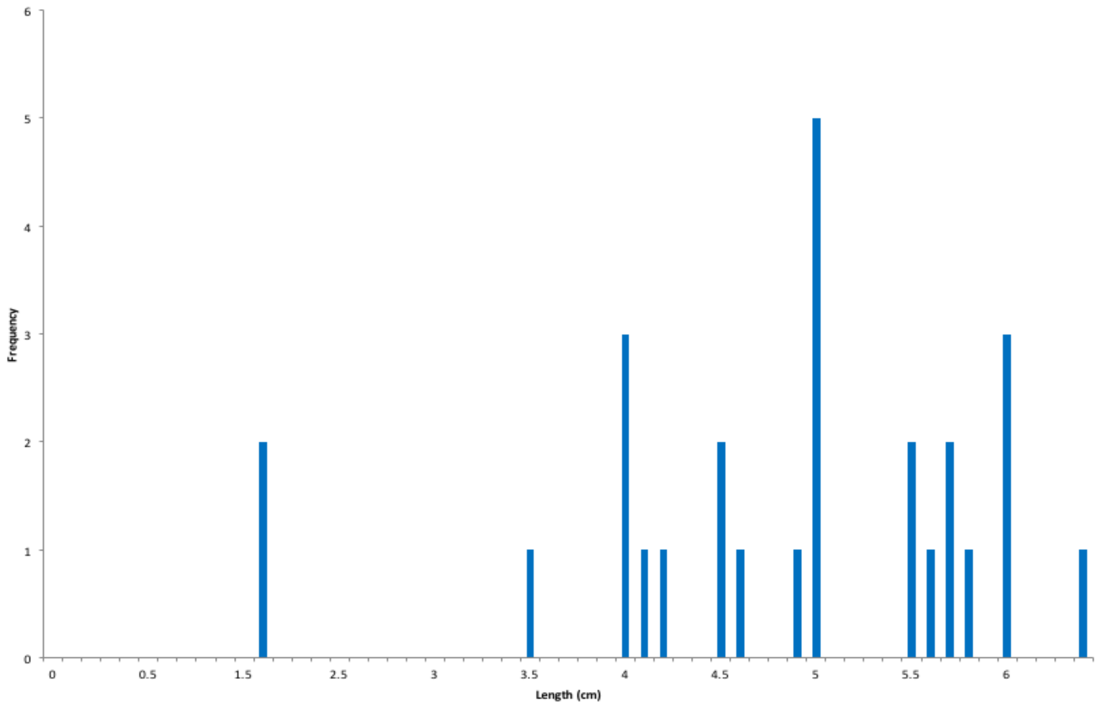
c) 2018 - Length frequency of bullhead captured at Wootton Phase 1 Site 1 (n=137).



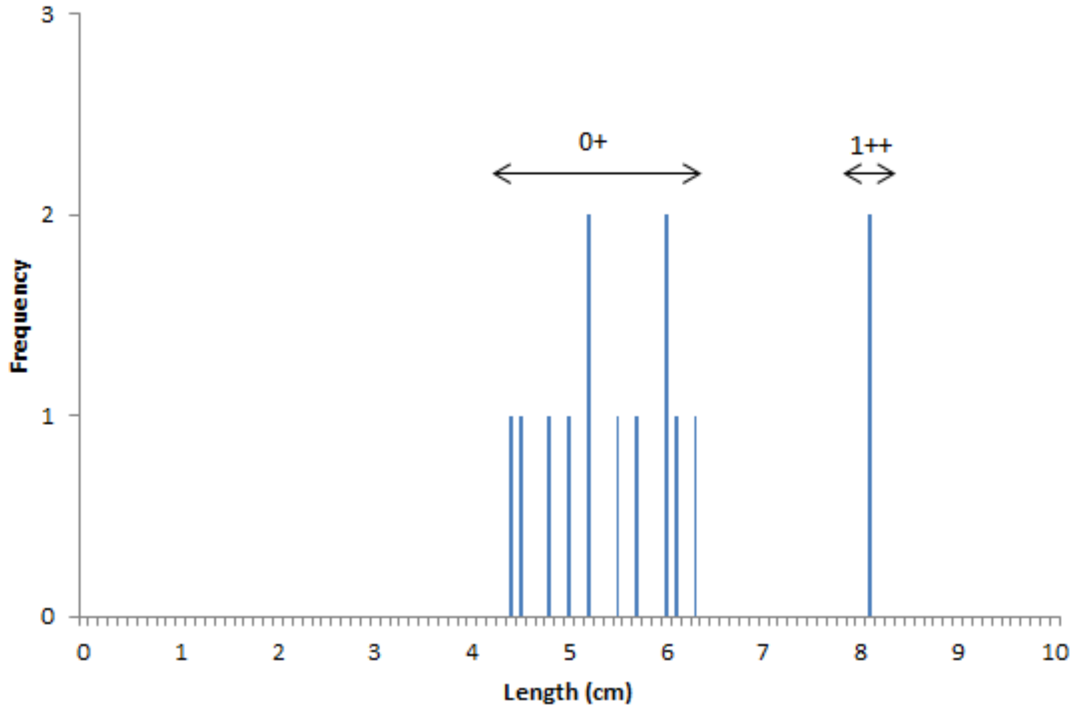
d) 2019 - Length frequency of bullhead capture at Wootton Phase 1-1 (n=142)



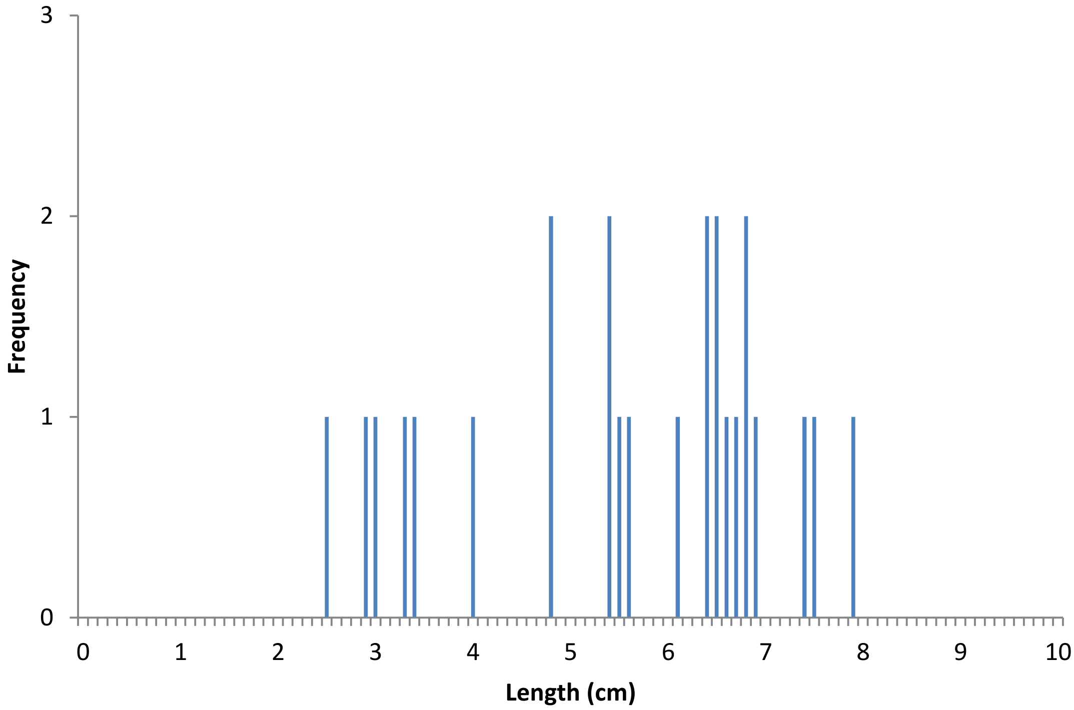
e) 2014 - Length frequency of minnow captured at Wootton Phase 1 Site 1 (n=27).



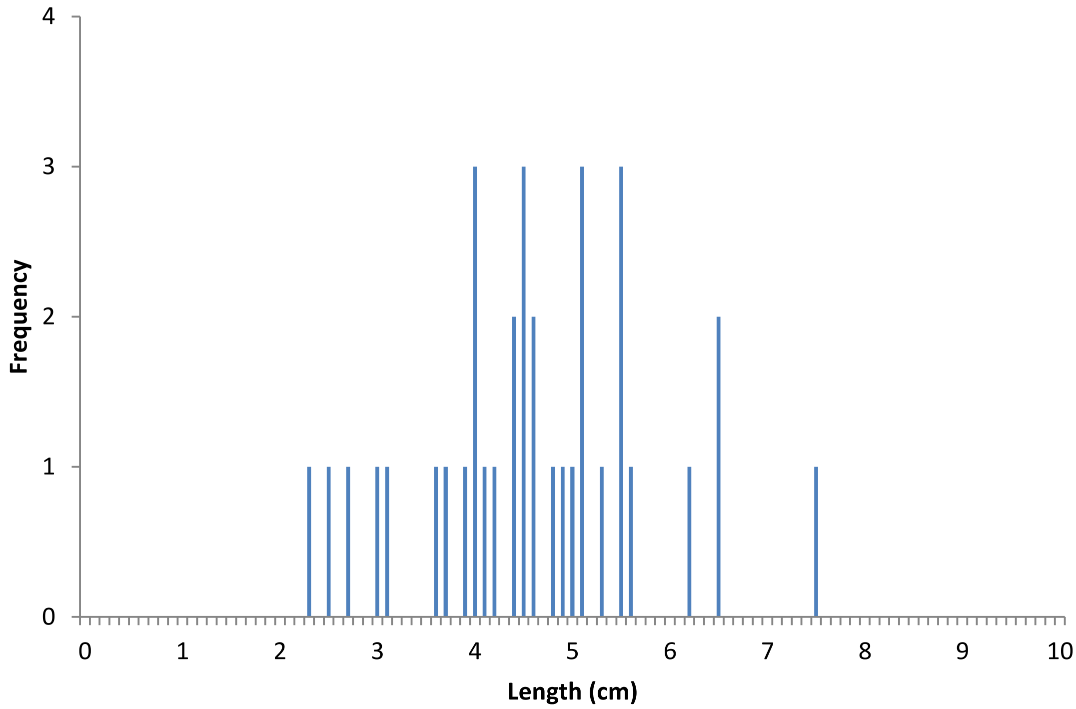
f) 2017 - Length frequency of minnow captured at Wootton Phase 1 Site 1 (n=14). In the absence of growth analysis, highlighted age cohorts are indicative only.



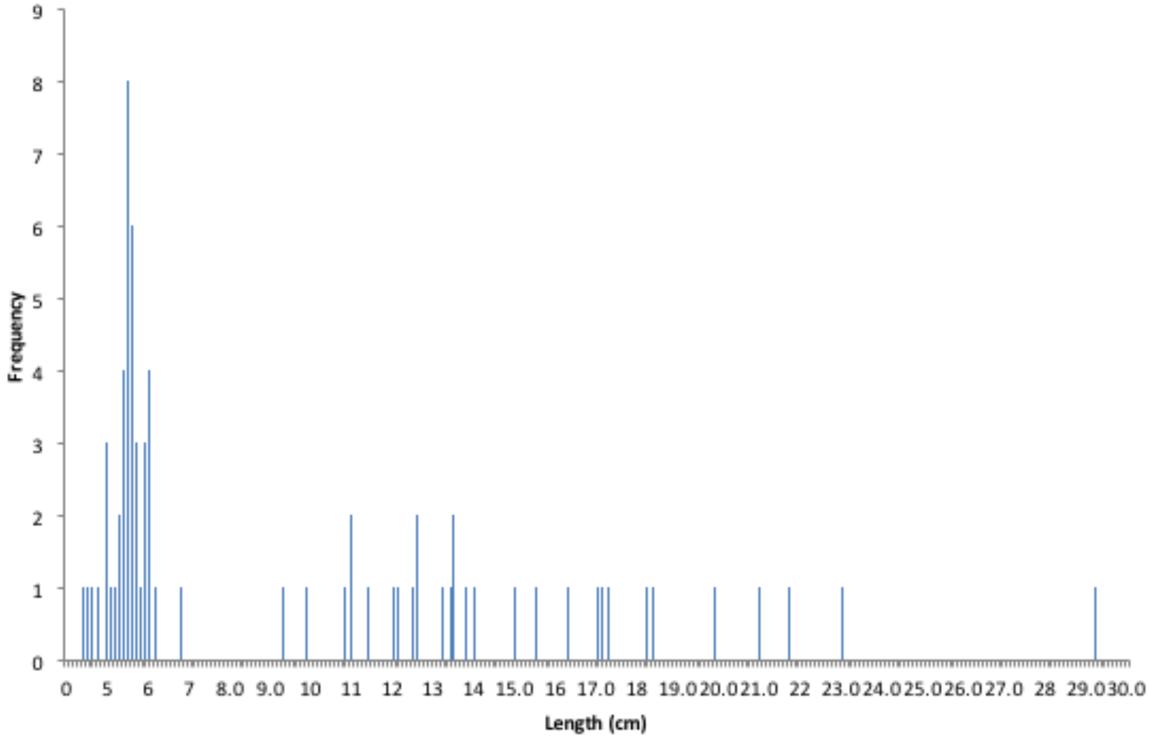
g) 2018 - Length frequency of minnow captured at Wootton Phase 1 Site 1 (n=25)



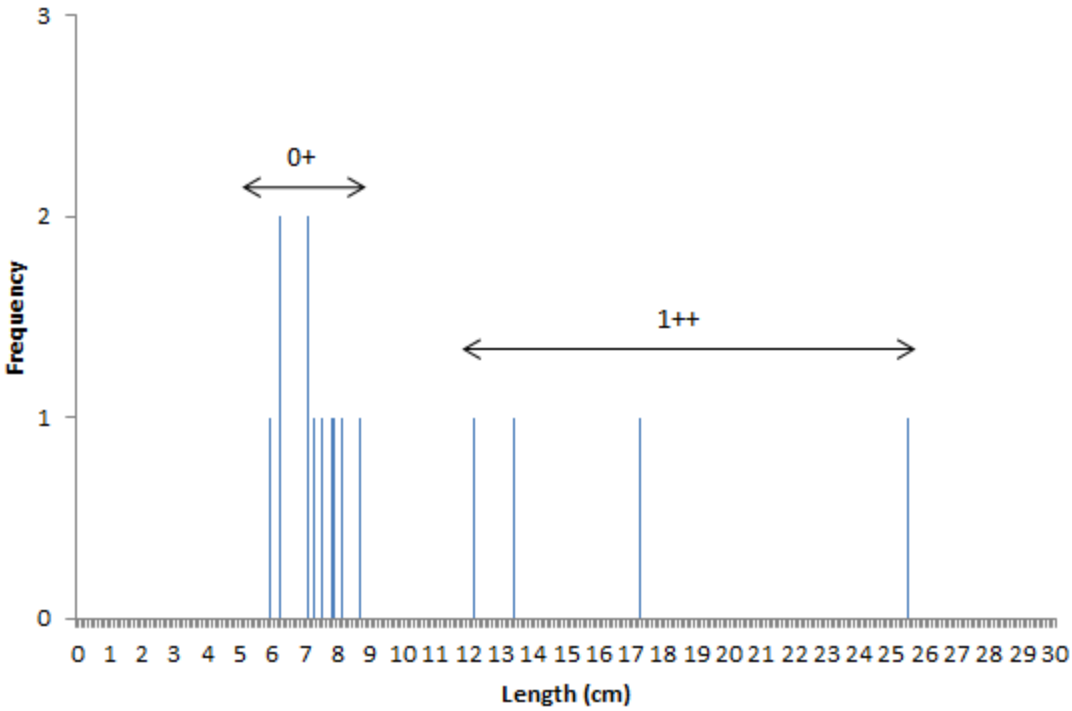
h) 2019 - Length frequency of minnow captured at Wootton Phase 1 Site 1 (n=35).



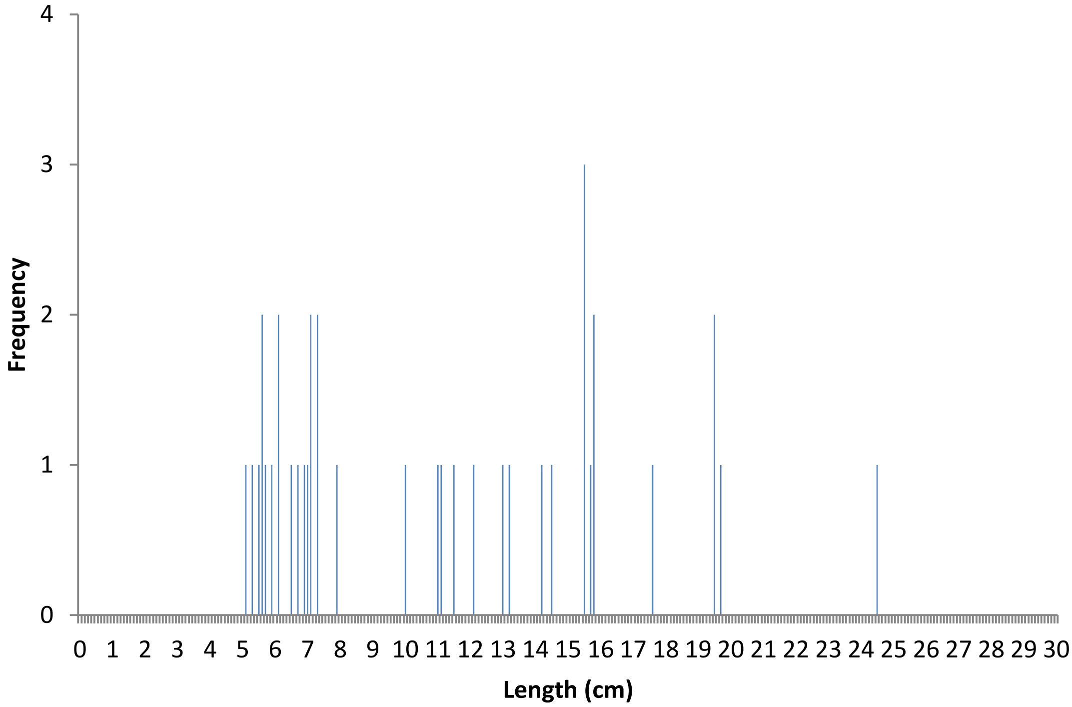
i) Figure 2014 - Length frequency of brown trout captured at Wootton Phase 1 - Site 1 (n=72).



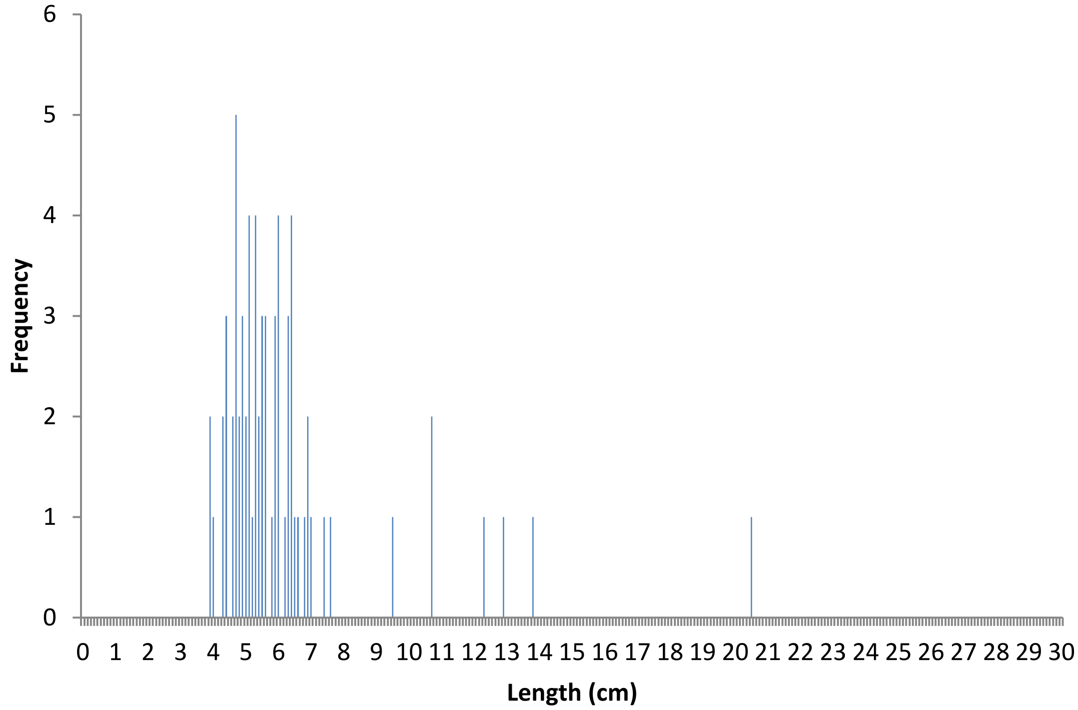
j) Figure Length frequency of brown trout captured at Wootton Phase 1 2017 - Site 1 (n=15). In the absence of growth analysis, highlighted age cohorts are indicative only.



k) 2019 - Length frequency of brown trout captured at Wootton Phase 1 Site 1 (n=38).



l) Length frequency of brown trout captured at Wootton Phase 1 Site 1 (n=70).



6.6 Conclusions

HLS fish monitoring data from 18 sites has provided useful data to help evaluate the impact of wetland restoration on fish species and population dynamics. Monitoring for some sites is at an early stage therefore data sets are not yet consistent enough over a long enough period pre and post restoration to allow detailed statistical analysis over a wide range of sites but it is possible to observe emerging trends based on data evaluated from APEM and BUG fish surveys.

Data shows that:

- All 14 fish species that frequent the mid and upper reaches of New Forest streams and rivers have been recorded during surveys.
- Individual fish species populations naturally fluctuate from year to year, on both unrestored and restored sites, potentially due to a combination of factors including habitat structure, food availability, predation, water levels and obstructions to migratory movements.
- Most species seem to benefit from restoration with 3-Spined stickleback, minnow, bullhead, stoneloach and B/R Lamprey responding well with populations of these species enhanced at restored sites. Overall the average fish population, including species of conservation concern is higher in restored sites than unrestored sites.
- Trends do show that fish numbers and population structure appear to be negatively impacted in the year following restoration but start to recover rapidly thereafter with good recovery within the first three years.
- Trout are present at all sites where they were recorded pre-restoration but numbers are generally slower to recover than for other species. Evidence from redd surveys and informal field observation suggests that Brown trout and Sea trout readily use gravels in restored sections to spawn. However, trout parr densities at restored sites do not seem to compare as well with un-restored sites. Although the percentage of good sites is comparable, results decline for the remaining trout classifications from C(fair) through to F (Fishless). However there seems to be close correlation in the success of trout recruitment with the presence of pike. Sites where redds had been observed but trout classifications for fry and parr populations were particularly low tended to feature pike in the community structure. These sites had no pre-restoration data so it is not possible to determine whether river restoration has made the habitat more favourable for pike or whether pike were present prior to restoration.
- Analysis of data from Wootton Phase 1-1 which provides the longest data set suggests that community structure does appear to be affected in the first few years post restoration often with an initial decline in juveniles. As breeding adults re-populate the site the population balance starts to redress and is close to pre-restoration structure within 3 years.
- Overall, initial results suggest river restoration is benefiting fish populations and meeting the restoration objectives of maintaining and developing a rich and diverse fish community

In terms of future monitoring:

- Building consistent data sets from the same sample locations, using a replicated methodology will help improve the robustness of future trend analysis.

- If resources are limited it would be worth focusing on sites which already have a good series of data. Currently Wootton Phase 1 provides the best data set as it follows through from pre to post restoration. Further monitoring at Harvestlade could also be useful as it appears to be vulnerable to low water levels. Further monitoring would also be interesting at Rhinefield and Drivers Nursery to monitor the impact of pike on the trout population as the presence of pike could well be limiting the recovery of trout populations at certain restored sites.

It can be concluded that the HLS Restoration Objective Traffic Light Status is **Green** with monitoring results suggesting that river restoration does appear to meeting its aims and objectives in terms of:

- maintaining and developing a rich and diverse fish community