Fish population and spawning surveys in eight New Forest streams, September – December 2016

Higher Level Stewardship Agreement

The Verderers of the New Forest AG00300016

March 2017

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PROJECT MANAGER:	Adrian C. Pinder
REPORT AUTHOR(s):	Dr Andy Harrison, Adrian Pinder

BU Global Environmental Solutions (BUG)
Bournemouth University
Department of Life and Environmental Sciences
Faculty of Science and Technology
Christchurch House, Fern Barrow
Poole, Dorset, BH12 5BB
www.bournemouth.ac.uk/bug

Client:
Forestry Commission
South England Forest District
The Queens House
Lyndhurst
Hampshire
SO43 7NH

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EXECUTIVE SUMMARY

The starting point of any restoration project should be an understanding of what the objectives of the restoration activity are. This is particularly true for river restoration, which may have one or many different objectives. For example, is the objective mainly to restore hydrology with a view to controlling water levels and flood plain connectivity, or is ecological recovery the key objective?

Importantly, the above two objectives are not mutually exclusive – decisions made with a view to controlling water levels will, of course, have an influence on river ecology. It is important, therefore, to understand at the outset how both the existing ecological community is functioning and what ecological outcomes we hope to achieve.

This data report presents the findings of fish surveys at eight New Forest streams during September 2016 and highlights any fish species of conservation importance recorded at each location. The report does not attempt to provide ecological interpretation based on this single year of data collection; rather, it comprises a record of fish survey data only, with a view to informing longer-term fish population datasets aimed at tracking post-restoration ecological recovery.

KEY FINDINGS

The following summarises the fish species recorded at each location:

- **Drivers Nursery**: Minnow, bullhead, stoneloach, river/brook lamprey, pike, 3-spined stickleback, brown trout, eel.
- **Harvestslade:** Minnow, bullhead, brown trout, river/brook lamprey, eel.
- **Linford Brook:** Minnow, chub, stoneloach, brown trout.
- **Longwater:** Minnow, 3-spined stoneloach, roach, bullhead, river/brook lamprey, eel.
- **Millersford Brook:** Brown trout.
- **Pondhead:** Bullhead, minnow, stoneloach, brown trout, roach, river/brook lamprey, 3-spined stickleback, eel.
- **Soldiers Bog:** Minnow, stoneloach, brown trout, bullhead, river/brook lamprey.
- **South Oakley:** Minnow, stoneloach, dace.

RECOMMENDATIONS

The current programme of pre- and post-restoration ecological surveys exhibits best practice on the part of the Forestry Commission, with regard to its approach to the wetland restoration programme in the New Forest. As work progresses it is essential to continue collecting robust ecological data to both highlight changes post-restoration and to inform future management decisions on the most appropriate restoration options to implement.

In addition to the continued collection of fish survey data, a full appraisal of barriers downstream of restoration sites to assess connectivity for migratory salmonids would help to inform the fish population data.

1. INTRODUCTION

Geo- and hydromorphological restoration of flowing water bodies are widely regarded as being of positive environmental benefit; however, this can be difficult to justify to local land owners, interest groups and other organisations without sound supporting evidence. This project has been designed to focus specifically on freshwater fish communities as an indicator of ecological quality and to detect whether any temporal changes in community structure (positive or negative) can be attributed to the physical re-engineering of stream profiles.

The Forestry Commission (FC) has either completed restoration works, or has been advised by Natural England that restoration work may be necessary, at stream locations throughout the New Forest. This document reports the findings of electric fishing surveys and redd count surveys at eight of these restoration works locations.

Pre-work surveys included Millersford Brook, Linford Brook, South Oakley and Pondhead. A post-recent work survey was conducted at Harvestslade. Post-older work surveys were undertaken at Longwater, Drivers Nursery and Soldiers Bog.

1.1 Aims and objectives

The specific aims and objectives of this project are as follows:

- Provide pre- or post-restoration fish survey data for the selected New Forest streams to highlight any rare species afforded conservation protection under the following designations:
    - Schedule 5 Wildlife and Countryside Act (1981) Species
    - Red Data Book Species
    - UK BAP Priority Species
    - Nationally and Regionally Scarce Species
- Provide pre- or post-restoration indications of ecological quality, based on fish populations, in line with Water Framework Directive (WFD) best practice methodology.

Note: This work is delivered under Call-Off Contract 1 under Framework 304/NF/16/1326 Specialist Ecological Surveys.

2. METHODOLOGY

2.1 Site selection

In advance of the surveys being undertaken, the Forestry Commission provided BUG with National Grid Reference coordinates for the upstream and downstream extent of the proposed (or completed) works area at each location (Table 2.1).

The extent of the works area for each location was mapped in ArcGIS, to provide an overview of the location of each works area in relation to the wider catchment (Figure 2.1). In addition, potential downstream barriers to fish migration (e.g. weirs, sluices) were also mapped, taken from the 2013 Environment Agency Obstruction Database.

Table 2.1. Upstream and downstream limits of works area at each location.

Location	Upstream extent of works area	Downstream extent of works area	Length of works area (km)	Number of fish survey sites
Drivers Nursery	SU2869005020	SU2876004550	0.7	1
Harvestslade	SU2078005760	SU2064005400	0.4	2
Linford Brook	SU1953008320	SU1824007350	1.8	2
Longwater	SU3192009030	SU3306008590	1.5	2
Millersford Brook	SU1979016710	SU1820016080	2.2	3
Pondhead	SU3137006820	SU3242006920	1.2	2
Soldiers Bog	SU2299007400	SU2306006990	0.5	1
South Oakley	SU2214005910	SU2345005290	1.5	3

Given the pressing timeframes for completion of the electric fishing surveys, it was not possible to conduct prior site visits to assess the habitat types present within each works area. Accordingly, the number and location of electric fishing survey sites required to obtain a representative sample of the fish populations present was difficult to define in advance. However, in the absence of this information, it was decided to conduct one electric fishing survey per kilometre of river or part thereof (see final column in Table 2.1 above).

Interrogation of GIS maps and Google Maps aerial imagery, along with details of planned or completed restoration works (where available), were used to identify appropriate fish survey sites in advance of the field surveys.

Further details on the extent of the works area and the location of fish survey sites are provided in Sections 2.1.1 to 2.1.8 below. A more detailed description of site characteristics is provided within the introduction to each site in the results Section 3.

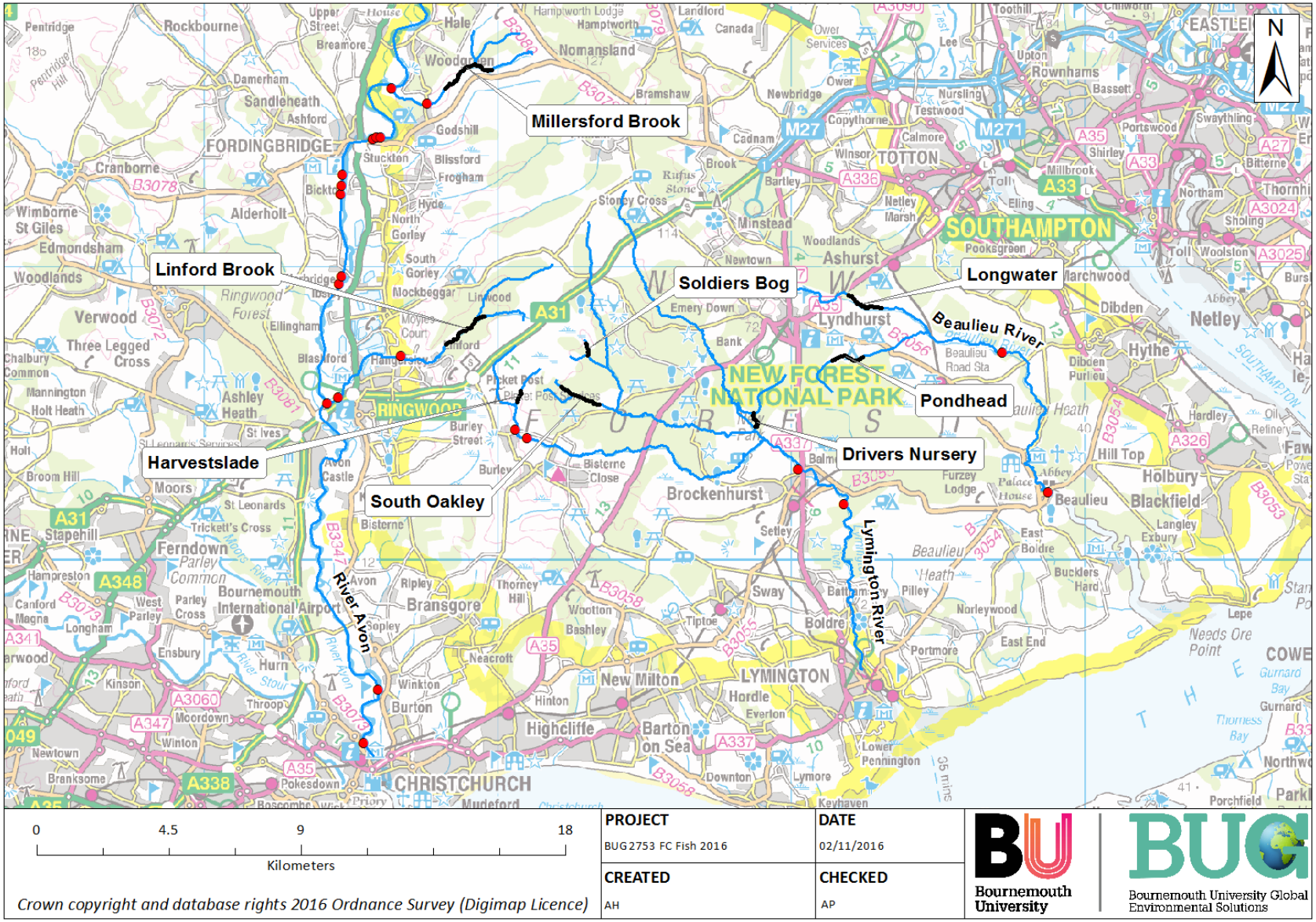

Figure 2.1. Extent of works area at each location. Obstacles listed in the EA barrier database are shown as red dots.

2.1.1 Drivers Nursery

Drivers Nursery is located on the Highland Water, a small tributary of the Lymington River (Figure 2.1). There are two obstacles listed in the EA barrier database located downstream of the works area; however, the passability of these obstacles to fish is unknown.

The works area, shown in Figure 2.2, has a total length of 0.7 km. One site was surveyed at this location, in the middle of the works area. The upstream and downstream extents of the 100 m electric fishing site are shown in Figure 2.2 and Table 2.2. A full description of the survey site is provided within the results Section 3.1.

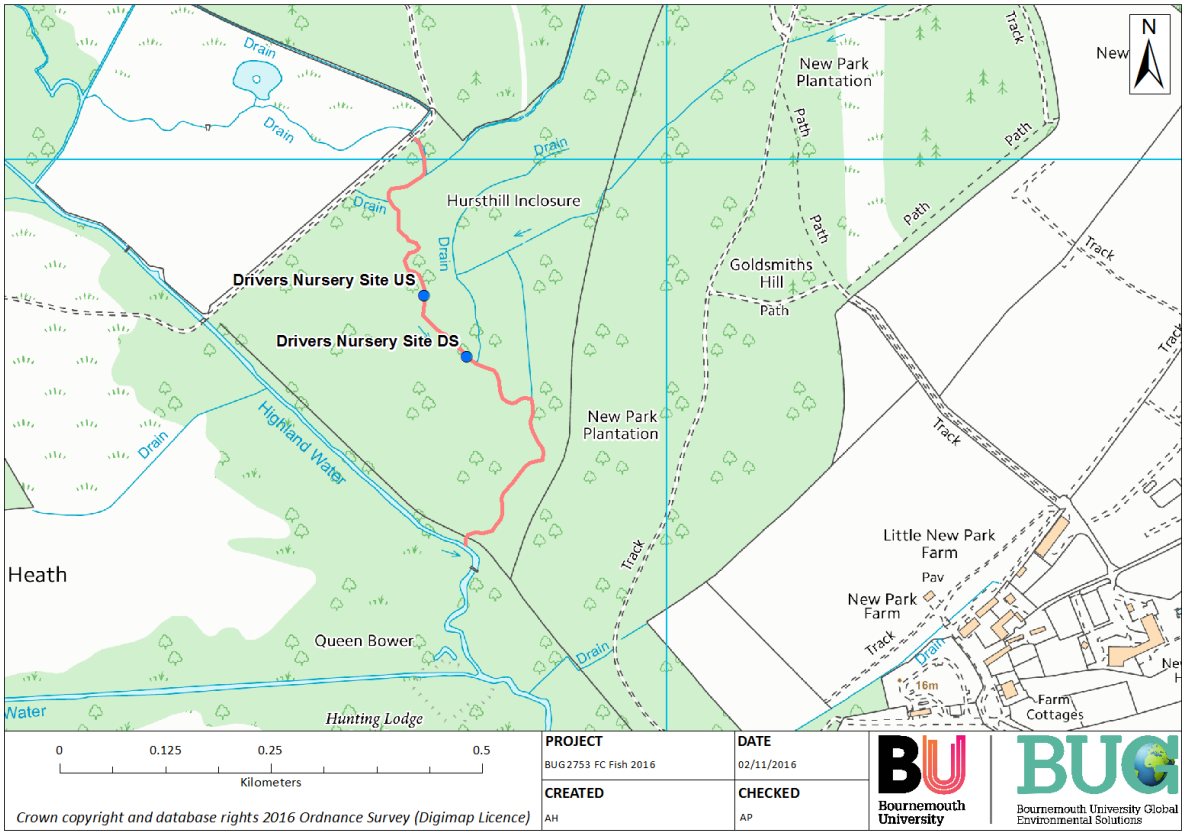

Figure 2.2. Upstream and downstream extent of survey area at Drivers Nursery. Extent of works area is shown in pink shading.

Table 2.2. Upstream and downstream limits of fish survey site at Drivers Nursery.

Site	Upstream extent of survey area	Downstream extent of survey area	Length of survey area (m)	Date of survey
Drivers Nursery Site	SU2871304840	SU2876404768	100	15/09/2016

2.1.2 Harvestslade

Harvestslade is located on a small tributary of Mill Lawn Brook, which flows into the Lymington River (Figure 2.1). There are a total of four obstacles listed in the EA barrier database located downstream of the works area; however, the passability of these obstacles to fish is unknown.

The works area, shown in Figure 2.3, has a total length of 0.4 km. One site was surveyed within the works area at this location (Harvestslade Site 1); however, an additional site was surveyed downstream of the works area as a control site for in-stream habitat alteration (Harvestslade Site 2). The upstream and downstream extents of both 100 m electric fishing sites are shown in Figure 2.3 and Table 2.3. Note: Harvestslade Site 1 is located within a new (un-mapped) channel, which was formed as part of the restoration works. Full descriptions of the survey sites are provided within the results Sections 3.2 and 3.3.

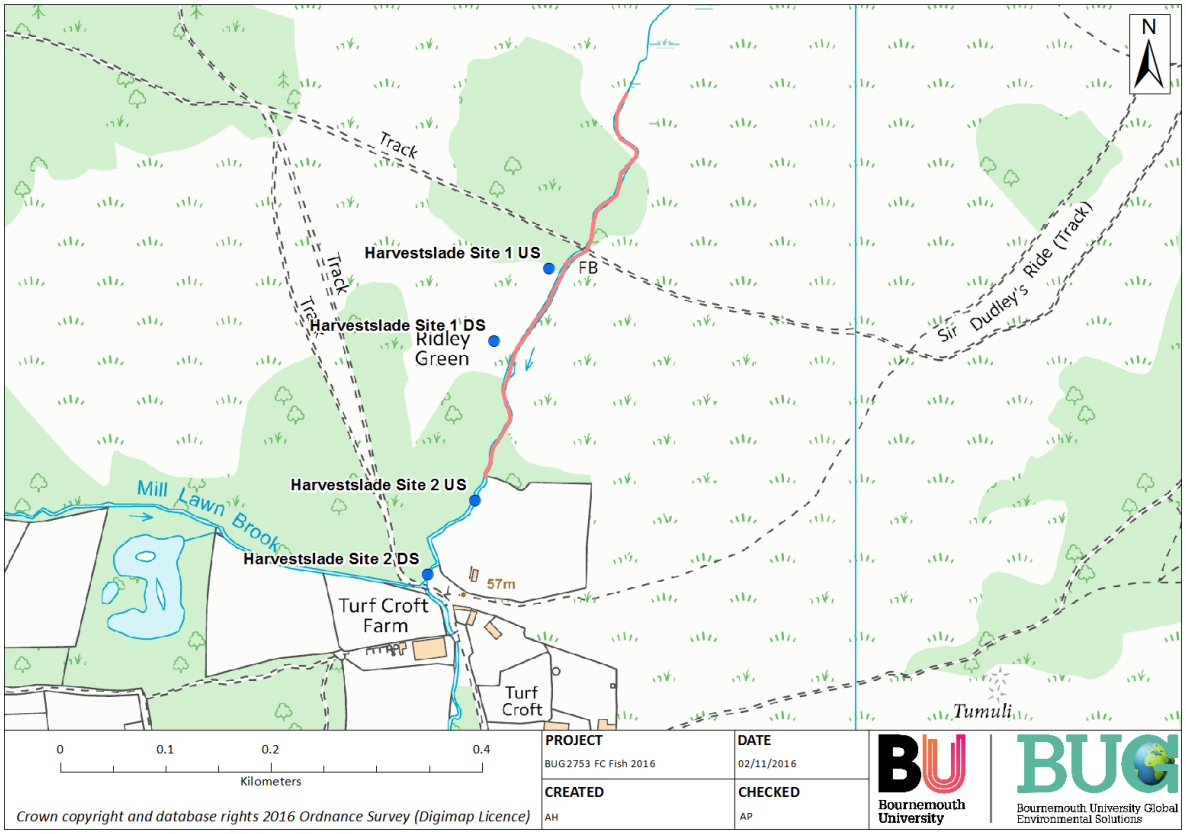

Figure 2.3. Upstream and downstream extent of survey areas at Harvestslade. Extent of works area is shown in pink shading. NOTE: Harvestslade Site 1 is located in a new (un-mapped) channel.

Table 2.3. Upstream and downstream limits of fish survey sites at Harvestslade.

Site	Upstream extent of survey area	Downstream extent of survey area	Length of survey area (m)	Date of survey
Harvestslade Site 1	SU2070905601	SU2065705532	100	22/09/2016
Harvestslade Site 2	SU2063905381	SU2059405311	100	29/09/2016

2.1.3 Linford Brook

Linford Brook is a tributary of the River Avon (Figure 2.1). There are a total of five obstacles listed in the EA barrier database located downstream of the works area; however, the passability of these obstacles to fish is unknown.

The works area, shown in Figure 2.4, has a total length of 1.8 km. Two sites were surveyed at this location; one near the downstream extent of the works area (Linford Brook Site 1) and one toward the upstream extent (Linford Brook Site 2). The upstream and downstream extents of both 100 m electric fishing sites are shown in Figure 2.4 and Table 2.4. Full descriptions of the survey sites are provided within the results Sections 3.4 and 3.5.

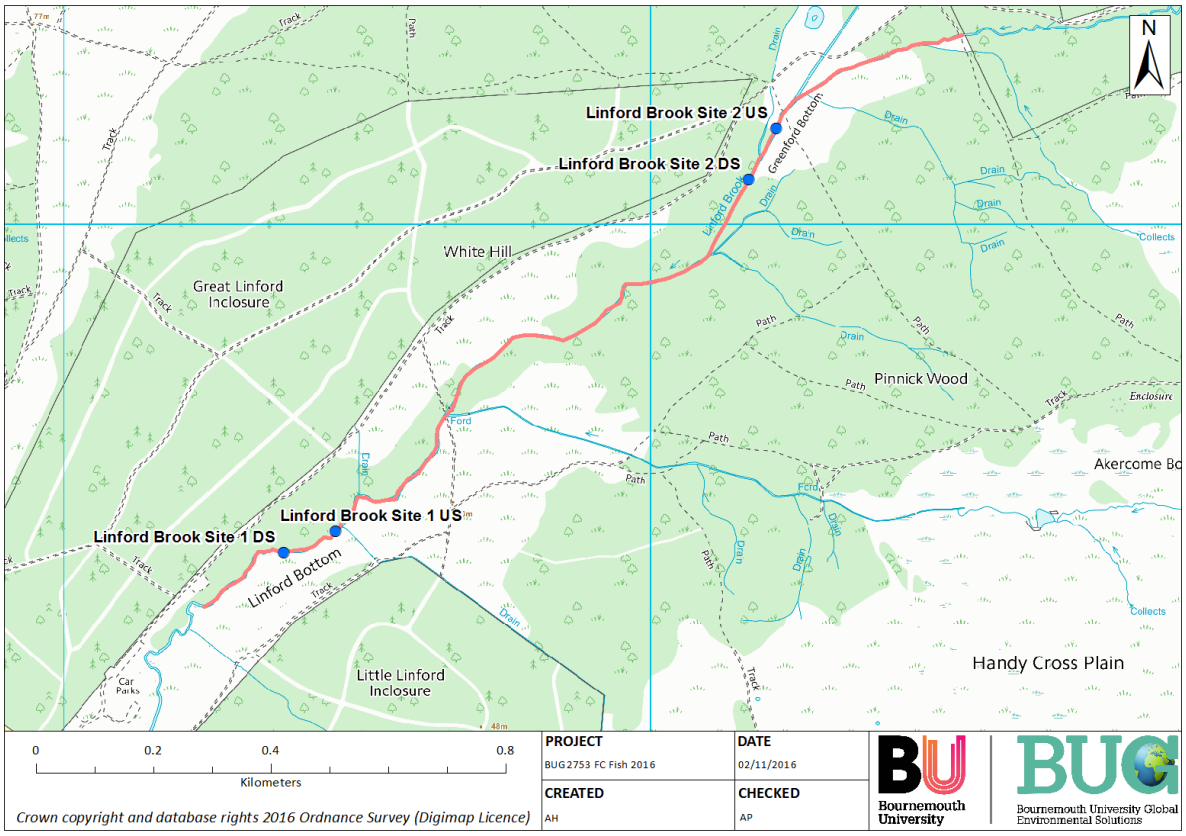

Figure 2.4. Upstream and downstream extent of survey areas at Linford Brook. Extent of works area is shown in pink shading.

Table 2.4. Upstream and downstream limits of fish survey sites at Linford Brook.

Site	Upstream extent of survey area	Downstream extent of survey area	Length of survey area (m)	Date of survey
Linford Brook Site 1	SU1846407477	SU1837507441	100	20/09/2016
Linford Brook Site 2	SU1921408163	SU1916808076	100	20/09/2016

2.1.4 Longwater

Longwater is located on the Beaulieu River (Figure 2.1). There are two obstacles listed in the EA barrier database located downstream of the works area; however, the passability of these obstacles to fish is unknown.

The works area, shown in Figure 2.5, has a total length of 1.5 km. Two sites were surveyed at this location; one near the upstream extent of the works area (Longwater Site 1) and one toward the downstream extent (Longwater Site 2). The upstream and downstream extents of both 100 m electric fishing sites are shown in Figure 2.5 and Table 2.5. Note: Longwater Site 1 is located within a new (un-mapped) channel, which was formed as part of the restoration works. Full descriptions of the survey sites are provided within the results Sections 3.6 and 3.7.

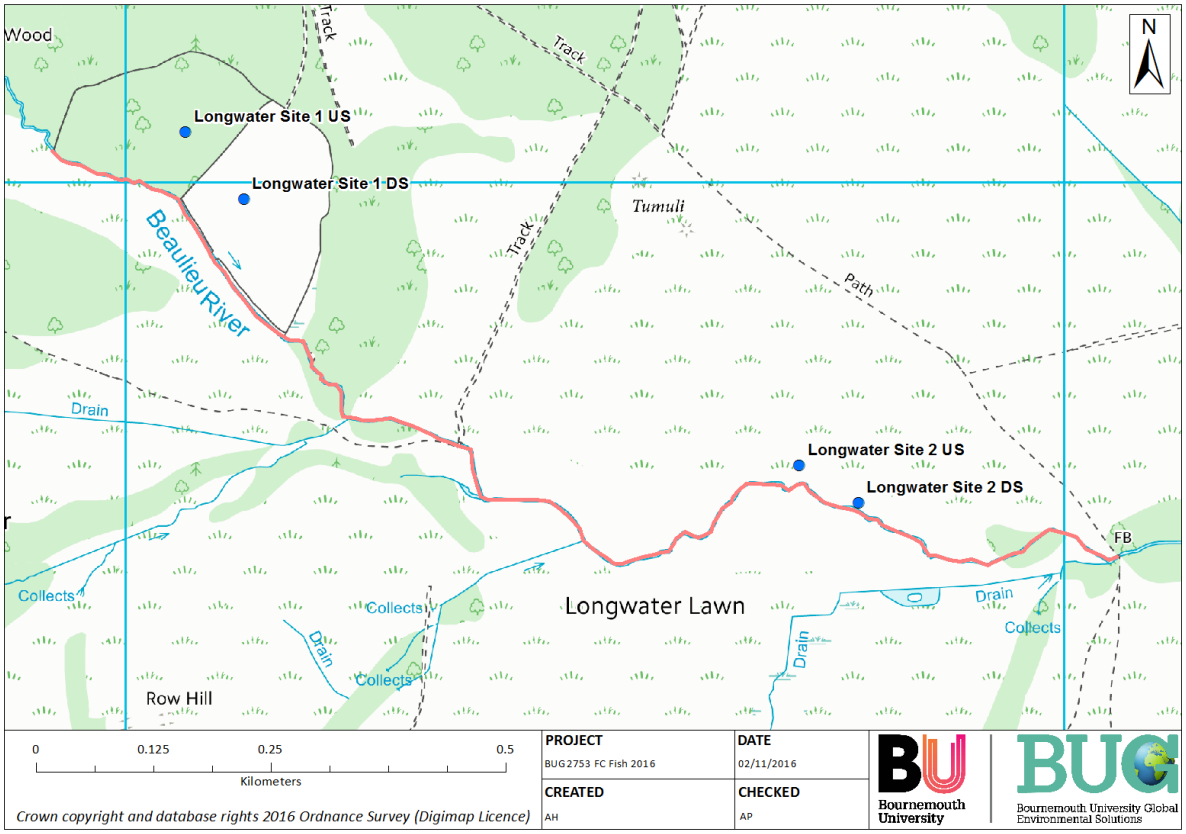

Figure 2.5. Upstream and downstream extent of survey areas at Longwater. Extent of works area is shown in pink shading. NOTE: Longwater Site 1 is located in a new (un-mapped) channel.

Table 2.5. Upstream and downstream limits of fish survey sites at Longwater.

Site	Upstream extent of survey area	Downstream extent of survey area	Length of survey area (m)	Date of survey
Longwater Site 1	SU3206409054	SU3212608983	100	13/09/2016
Longwater Site 2	SU3271808699	SU3278108659	100	13/09/2016

2.1.5 Millersford Brook

Milersford Brook is a tributary of the River Avon (Figure 2.1). There are a total of 12 obstacles listed in the EA barrier database located downstream of the works area; however, the passability of these obstacles to fish is unknown.

The works area, shown in Figure 2.6, has a total length of 2.2 km. Three sites were surveyed at this location; one near the upstream extent of the works area (Millersford Brook Site 1), one toward the downstream extent (Millersford Brook Site 2) and one near the mid-point of the works area (Millersford Brook Site 3). The upstream and downstream extents of the three 100 m electric fishing sites are shown in Figure 2.6 and Table 2.6. Full descriptions of the survey sites are provided within the results Sections 3.8, 3.9 and 3.10.

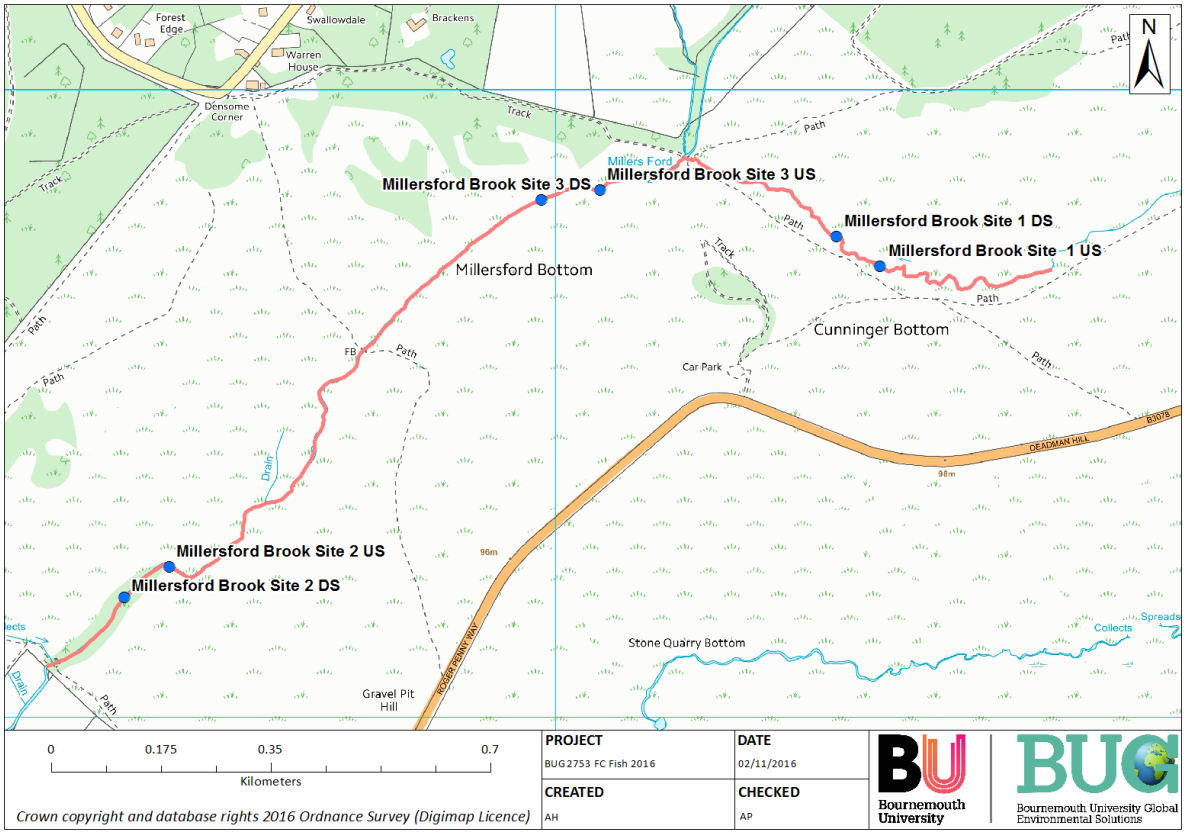

Figure 2.6. Upstream and downstream extent of survey areas at Millersford. Extent of works area is shown in pink shading.

Table 2.6. Upstream and downstream limits of fish survey sites at Millersford Brook.

Site	Upstream extent of survey area	Downstream extent of survey area	Length of survey area (m)	Date of survey
Millersford Brook Site 1	SU1951816719	SU1944816766	100	21/09/2016
Millersford Brook Site 2	SU1838416240	SU1831216191	100	21/09/2016
Millersford Brook Site 3	SU1907116841	SU1897816825	100	22/09/2016

2.1.6 Pondhead

Pondhead is located on a small tributary of the Beaulieu River (Figure 2.1). There are two obstacles listed in the EA barrier database located downstream of the works area; however, the passability of these obstacles to fish is unknown.

The works area, shown in Figure 2.7, has a total length of 1.2 km. One site was surveyed within the works area at this location (Pondhead Site 2); however, an additional site was surveyed downstream of the works area as a control site (Pondhead Site 1). The upstream and downstream extents of both 100 m electric fishing sites are shown in Figure 2.7 and Table 2.7. Full descriptions of the survey sites are provided within the results Sections 3.11 and 3.12.

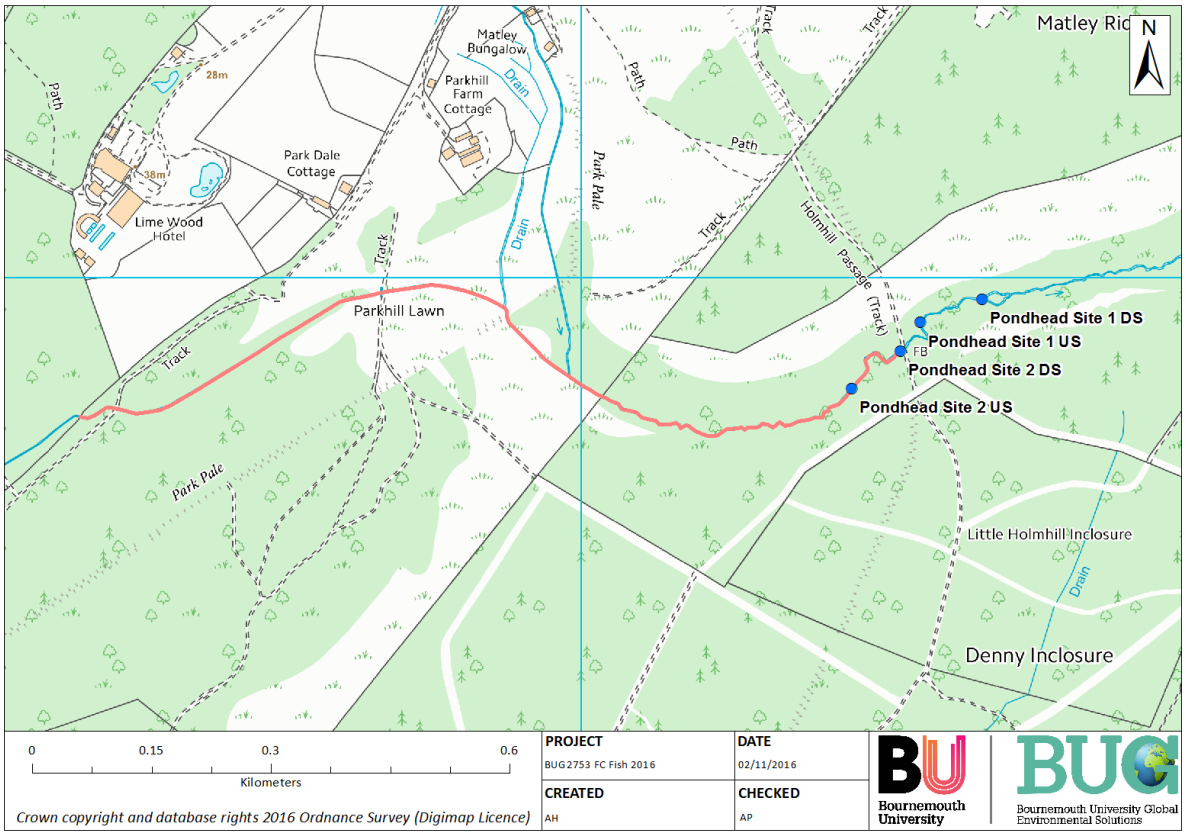

Figure 2.7. Upstream and downstream extent of survey areas at Pondhead. Extent of works area is shown in pink shading.

Table 2.7. Upstream and downstream limits of fish survey sites at Pondhead.

Site	Upstream extent of survey area	Downstream extent of survey area	Length of survey area (m)	Date of survey
Pondhead Site 1	SU3242706944	SU3250406973	100	27/09/2016
Pondhead Site 2	SU3234006861	SU3240206908	100	27/09/2016

2.1.7 Soldiers Bog

Soldiers Bog is located on Blackensfod Brook, a small tributary of the Blackwater which flows into the Lymington River (Figure 2.1). There are two obstacles listed in the EA barrier database located downstream of the works area; however, the passability of these obstacles to fish is unknown.

The works area, shown in Figure 2.8, has a total length of 0.5 km. One site was surveyed at this location, situated toward the downstream extent of the works area. The upstream and downstream extents of the 100 m electric fishing site are shown in Figure 2.8 and Table 2.8. A full description of the survey site is provided within the results Section 3.13.

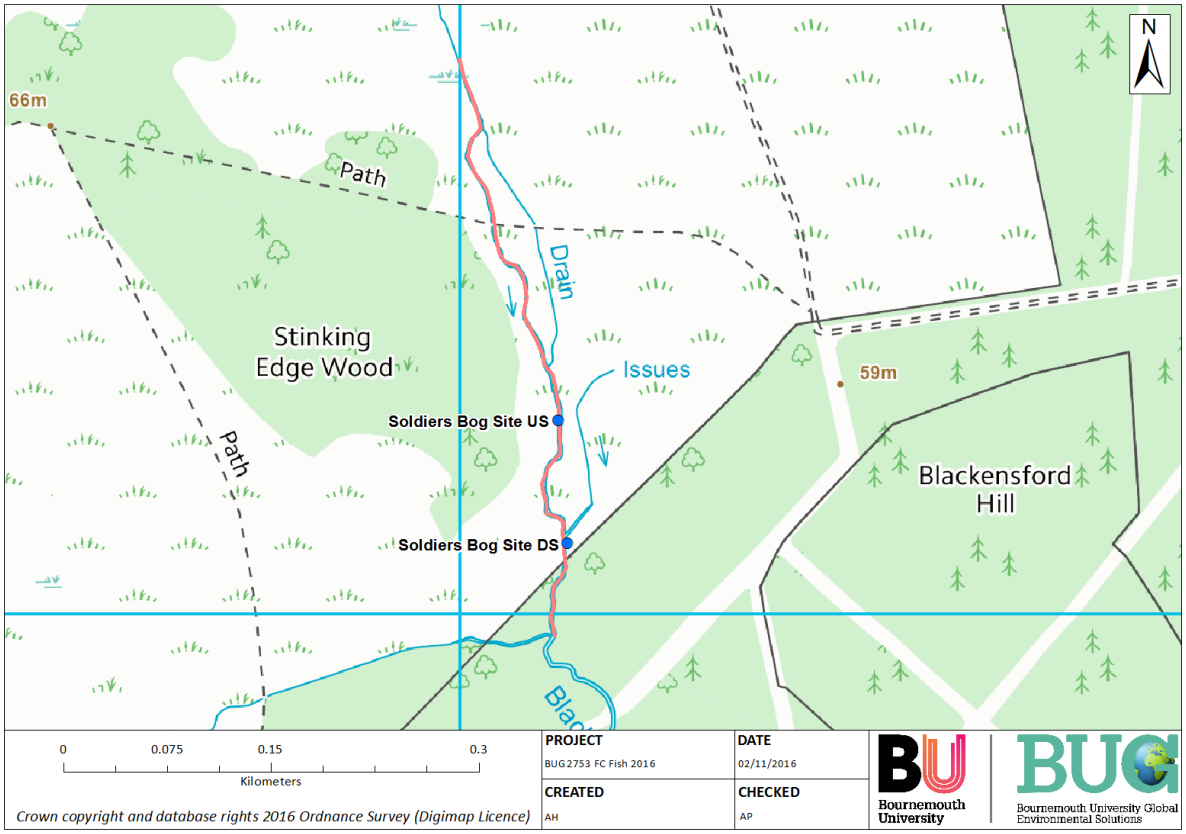

Figure 2.8. Upstream and downstream extent of survey area at Soldiers Bog. Extent of works area is shown in pink shading.

Table 2.8. Upstream and downstream limits of fish survey site at Soldiers Bog.

Site	Upstream extent of survey area	Downstream extent of survey area	Length of survey area (m)	Date of survey
Soldiers Bog Site	SU2307107140	SU2307807051	100	15/09/2016

2.1.8 South Oakley

South Oakley is located on the Blackwater, a small tributary of the Lymington River (Figure 2.1). There are two obstacles listed in the EA barrier database located downstream of the works area; however, the passability of these obstacles to fish is unknown.

The works area, shown in Figure 2.9, has a total length of 1.5 km. Two sites were surveyed at this location; one near the upstream extent of the works area (South Oakley Site 2) and one toward the mid-point of the works area (South Oakley Site 3). In addition, a further site (South Oakley Site 3) was investigated as a control/comparison with South Oakley Site 2. The upstream and downstream extents of both 100 m electric fishing sites, along with the location of South Oakley Site 1, are shown in Figure 2.9 and Table 2.9. A full description of the survey sites are provided within the results Sections 3.14, 3.15 and 3.16.

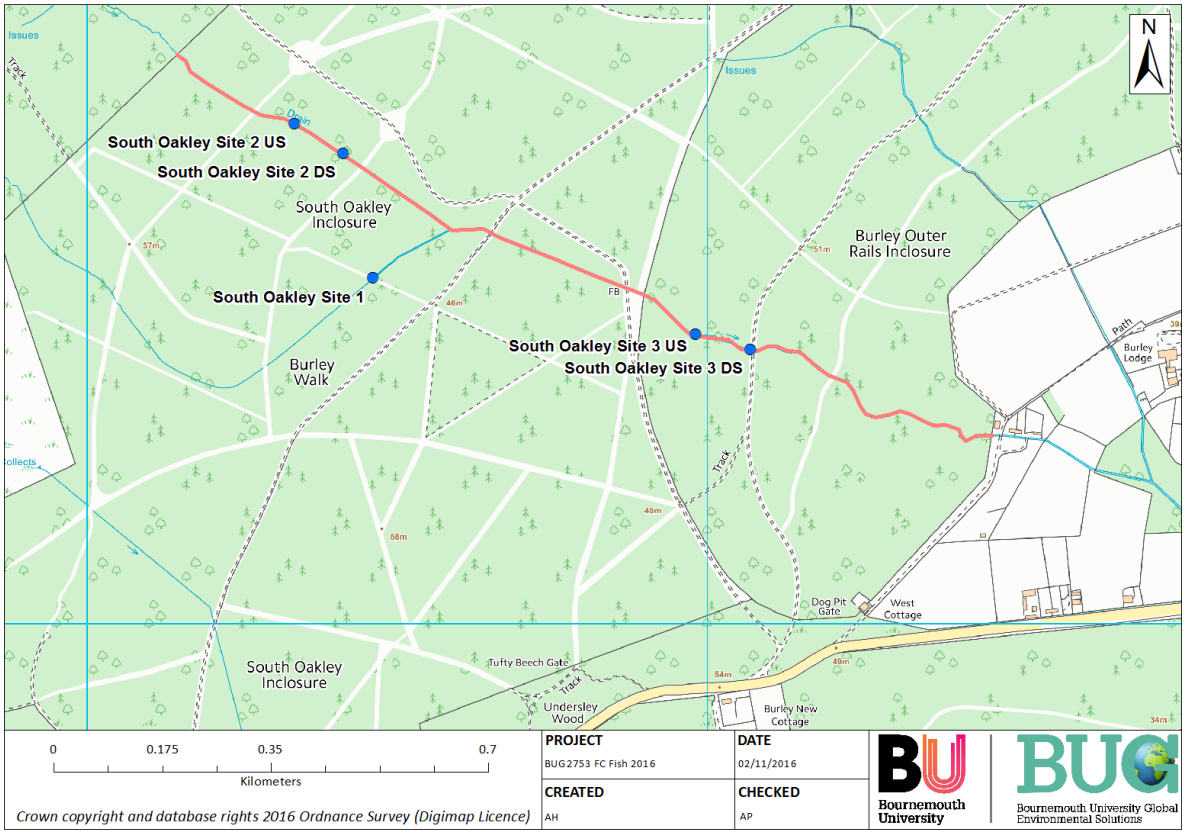

Figure 2.9. Upstream and downstream extent of survey areas at South Oakley. Extent of works area is shown in pink shading.

Table 2.9. Upstream and downstream limits of fish survey sites at Millersford Brook.

Site	Upstream extent of survey area	Downstream extent of survey area	Length of survey area (m)	Date of survey
South Oakley Site 1	SU2246105558		Point sample	14/09/2016
South Oakley Site 2	SU2233405807	SU2241305759	100	14/09/2016
South Oakley Site 3	SU2298105468	SU2307005443	100	14/09/2016

2.2 Electric fishing

At each site (other than South Oakley Site 1), 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 100 m 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), shown in Table 2.10 below.

Table 2.10. National Fisheries Classification Scheme for brown 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

2.3 Redd counts

Redd count surveys were undertaken at all eight locations over two days; Tuesday 13th December (Longwater, Pondhead, Drivers Nursery, Harvestslade and Linford Brook) and Wednesday 14th December (Millersford Brook, Soldiers Bog and South Oakley).

The full extent of the works area at each location was walked by two experienced fisheries scientists and all evidence of sea trout (and brown trout) spawning was recorded. This included established

redds, ‘scrapes’ and adult fish observations. Other salient features, such as debris dams and barriers to upstream migration were also recorded.

A handheld GPS was used to record the location of points of interest, and field notes (redd size, fish size, behaviour, habitat, etc.) were recorded in a waterproof notepad. All data were transcribed and mapped in GIS and are presented in Section 4.

3. RESULTS – ELECTRIC FISHING SURVEYS

3.1 Drivers Nursery

3.1.1 Site description

The Drivers Nursery site is located within an area of broadleaf / mixed woodland; however, the majority of trees are dead and, thus, there is limited canopy cover along the river stretch (see Section 2.1.1). Table 3.1 below summarises the key physical characteristics of the 100 m survey site, and Appendix 1 provides a photographic record of habitat variability. The mean wetted width was 2.95 m, with an overall surveyed area of 294.5 m^2.

The river reach was dominated by dense in-stream macrophyte coverage. Substrate was mainly silt; however, some gravel and pebble substrate was present in areas where the macrophyte-constricted channel width increased flow velocity. Fish habitat appeared typical of a coarse fish dominated system, and this was largely reflected in the fish survey data (Section 3.1.2).

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.2.

Table 3.1. Habitat data recorded during the electric fishing survey at Drivers Nursery.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	5	10	20	30	20	15		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent	10	60	10	10	10			
Instream vegetation: **80 %**		Silted? **Yes**		Substrate: **Stable** & **Partly compacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	10	30	30			30		
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	10	10	80					
Right bank %	10	10	80					
Total LB fish cover: **20 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **20 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / Simple / **Complex**				RB Bankface vegetation: Bare / Uniform / Simple / **Complex**				
LB Banktop vegetation: Bare / Uniform / **Simple** / Complex				RB Banktop vegetation: Bare / Uniform / **Simple** / Complex				
LB Overhanging Boughs (%): **0**			RB Overhanging Boughs (%): **0**			Canopy Cover (%): **0**		

Table 3.2. Physico-chemical parameters recorded during fish survey at Drivers Nursery.

Parameter	Value
Temperature (°C)	15.9
Dissolved Oxygen (%)	86.1
Dissolved Oxygen (mgl^{-1})	8.5
pH	Probe failure
Conductivity (μScm^{-1})	177

3.1.2 Electric fishing survey results

A total of 257 fish were captured at Drivers Nursery, comprising eight species. Minnow was the most abundant species captured, followed by bullhead, stoneloach and river/brook lamprey (Figure 3.1).

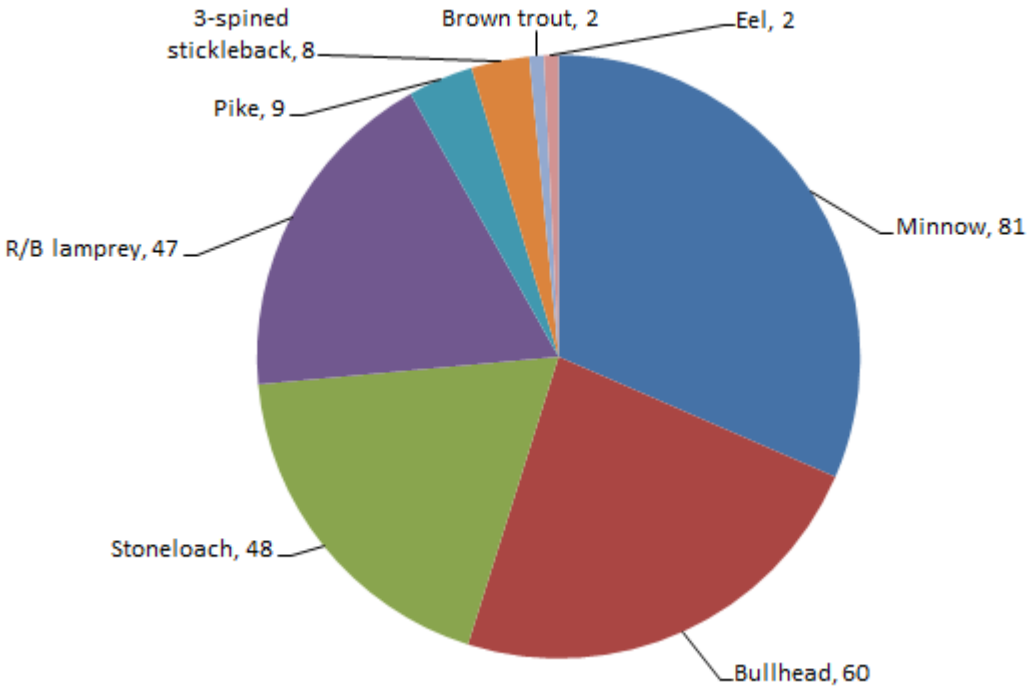

Figure 3.1. Species composition (total number captured) at Drivers Nursery.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.3. The National Fisheries Classification Scheme (NFCS) classifications for 0+ and 1++ brown trout are also shown.

Table 3.3. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Drivers Nursery. National Fisheries Classification Scheme (NFCS) grades are also provided for brown trout.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)	NFCS Classification
Minnow	81 (2.0 – 5.8)	83	0.69	79	87	28	N/A
Bullhead	60 (2.5 – 7.0)	100	0.26	32	168	34	N/A
Stoneloach	48 (3.0 – 10.6)	105	0.18	-33	243	36	N/A
R/B lamprey	47 (10.0 – 14.5)	116	0.16	-73	305	39	N/A
Pike	9 (17.2 – 22.4)	10	0.45	4	16	3	N/A
3-spined stickleback	8 (3.0 – 3.6)	8	0.62	6	10	3	N/A
Brown trout (0+)	0 (-)	N/A	N/A	N/A	N/A	N/A	F (Fishless)
Brown trout (1++)	2 (18.5 – 18.7)	2	0.50	0	4	1	E (Poor)
Eel	2 (30.0 – 49.0)	2	0.50	0	4	1	N/A
TOTAL	**257**						

Length frequency charts for the most abundant fish species recorded are provided in Figure 3.2 to Figure 3.5 below. Where relevant, age cohorts (0+ and 1++) have been displayed on the charts; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

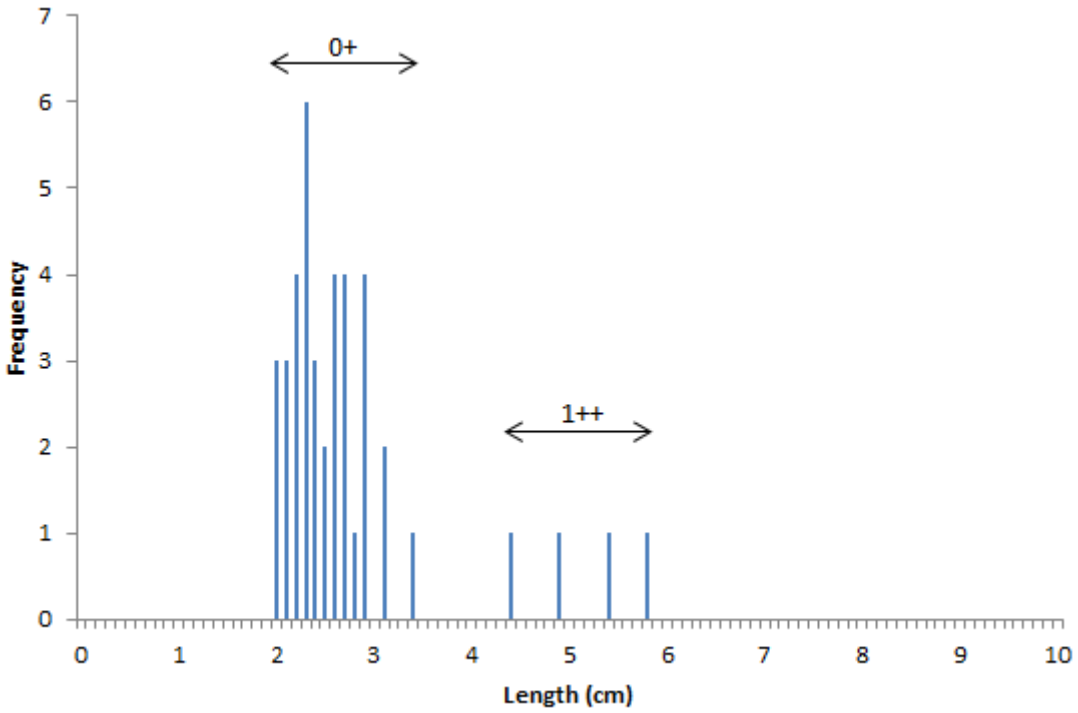

Figure 3.2. Length frequency of minnow captured at Drivers Nursery (n=41). In the absence of growth analysis, highlighted age cohorts are indicative only.

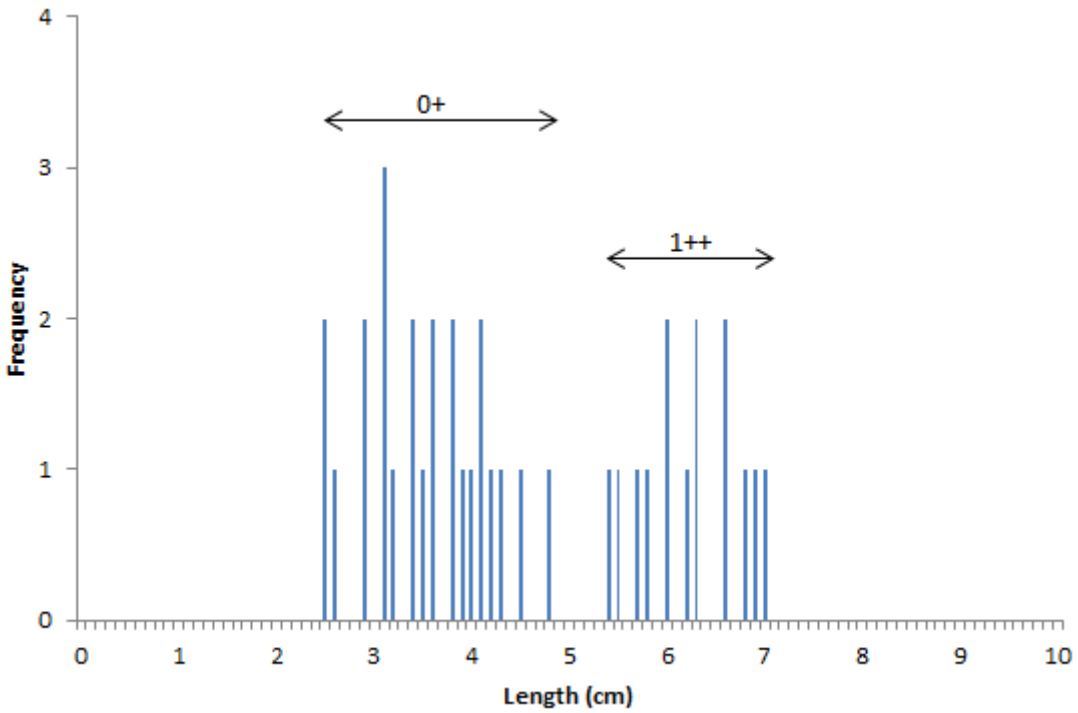

Figure 3.3. Length frequency of bullhead captured at Drivers Nursery (n=38). In the absence of growth analysis, highlighted age cohorts are indicative only.

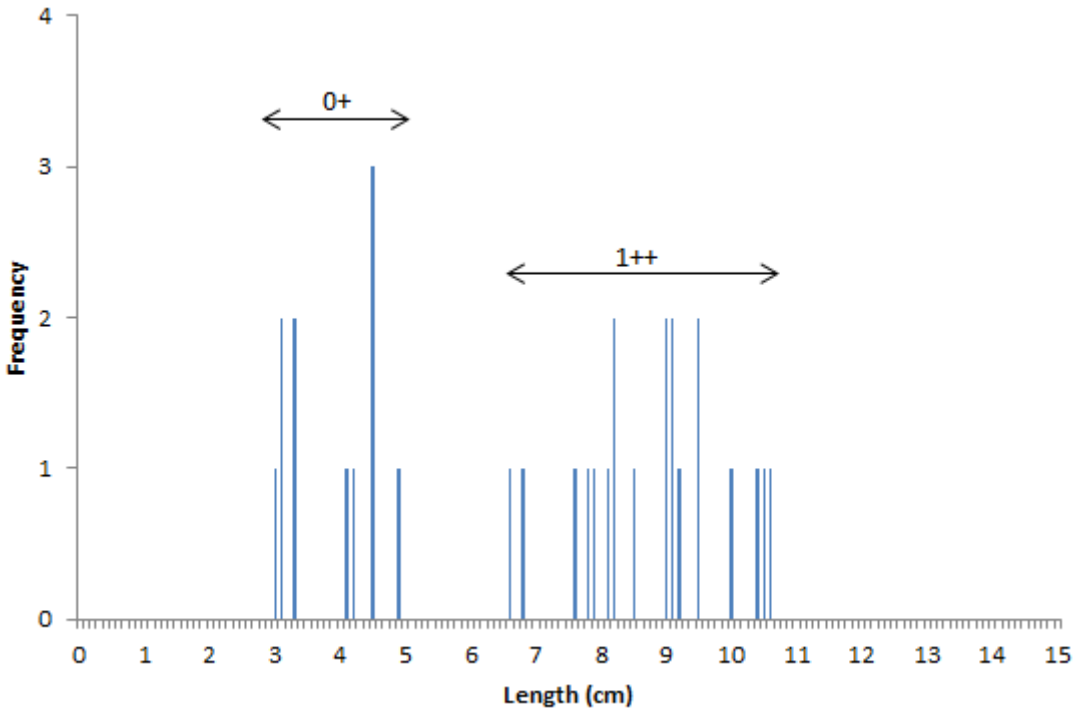

Figure 3.4. Length frequency of stoneloach captured at Drivers Nursery (n=31). In the absence of growth analysis, highlighted age cohorts are indicative only.

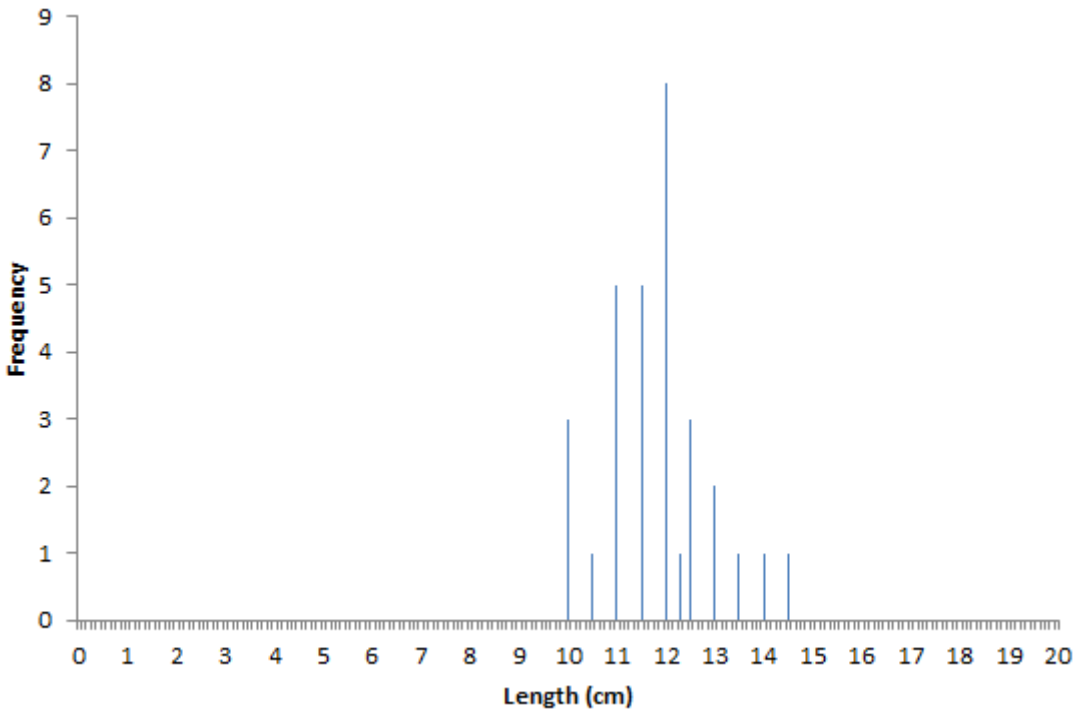

Figure 3.5. Length frequency of lamprey captured at Drivers Nursery (n=31).

3.2 Harvestslade Site 1

3.2.1 Site description

Harvestslade Site 1 is located within an area of moorland / heath, with limited canopy cover along the river stretch (see Section 2.1.2). Table 3.4 below summarises the key physical characteristics of the 100 m survey site, and Appendix 2 provides a photographic record of habitat variability. The mean wetted width was 2.07 m, with an overall surveyed area of 207.3 m^2.

The survey site was located in a new channel which has been created as part of the restoration works at this location. The old incised channel has been filled in and the new channel excavated to reinstate historic meanders with an elevated bed profile. Substrate was largely comprised of imported gravel, pebble and cobbles; however, a layer of fine silt was evident throughout.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.5.

Table 3.4. Habitat data recorded during the electric fishing survey at Harvestslade Site 1.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	20	20	20	20	10	10		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent		20		30	30	20		
Instream vegetation: **10 %**		Silted? **No**		Substrate: **Stable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	20	20	20	10		20	10	
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	5		95					
Right bank %	5		95					
Total LB fish cover: **5 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **5 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / **Simple** / Complex				RB Bankface vegetation: Bare / Uniform / **Simple** / Complex				
LB Banktop vegetation: Bare / Uniform / **Simple** / Complex				RB Banktop vegetation: Bare / Uniform / **Simple** / Complex				
LB Overhanging Boughs (%): **0**			RB Overhanging Boughs (%): **0**			Canopy Cover (%): **0**		

Table 3.5. Physico-chemical parameters recorded during fish survey at Harvestslade Site 1.

Parameter	Value
Temperature (°C)	14.7
Dissolved Oxygen (%)	92.6
Dissolved Oxygen (mgl^{-1})	9.39
pH	Probe failure
Conductivity (μScm^{-1})	74

3.2.2 Electric fishing survey results

A total of 324 fish were captured at Harvestslade Site 1, comprising five species. Minnow was the most abundant species captured, followed by bullhead and brown trout (Figure 3.6).

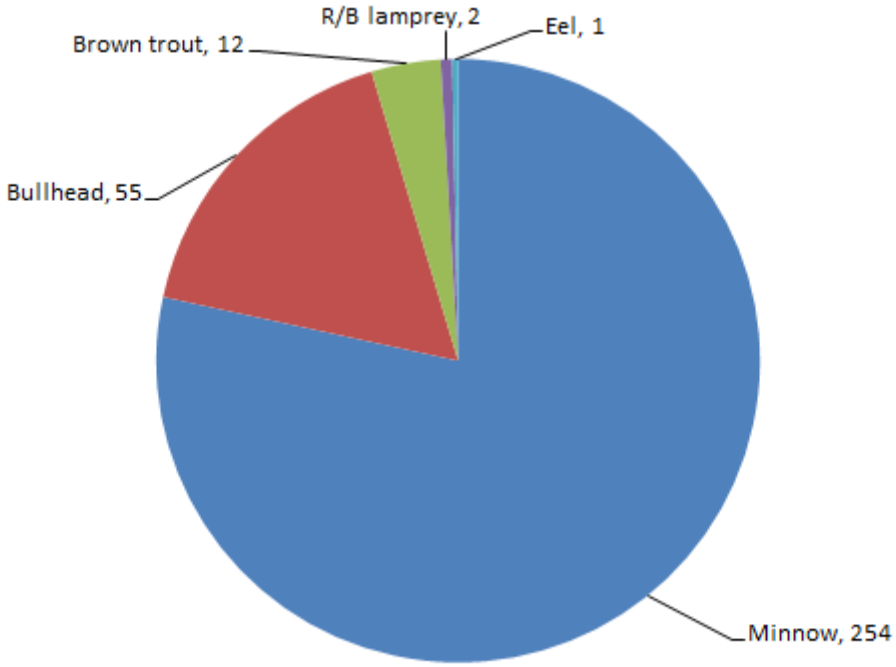

Figure 3.6. Species composition (total number captured) at Harvestslade Site 1.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.6. The National Fisheries Classification Scheme (NFCS) classifications for 0+ and 1++ brown trout are also shown.

Table 3.6. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Harvestslade Site 1. National Fisheries Classification Scheme (NFCS) grades are also provided for brown trout.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)	NFCS Classification
Minnow	254 (2.1 – 7.2)	307	0.44	271	343	148	N/A
Bullhead	55 (2.6 – 6.7)	69	0.40	48	90	33	N/A
Brown trout (0+)	12 (5.1 – 7.6)	12	0.75	11	13	6	D (Fair/Poor)
Brown trout (1++)	0 (-)	N/A	N/A	N/A	N/A	N/A	F (Fishless)
R/B lamprey	2 (12.0 – 12.8)	2	0.67	1	3	1	N/A
Eel	1 (19.0)	1	1.00	1	1	<1	N/A
TOTAL	**324**						

Length frequency charts for the most abundant fish species recorded are provided in Figure 3.7 to Figure 3.9 below. Where relevant, age cohorts (0+ and 1++) have been displayed on the charts; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

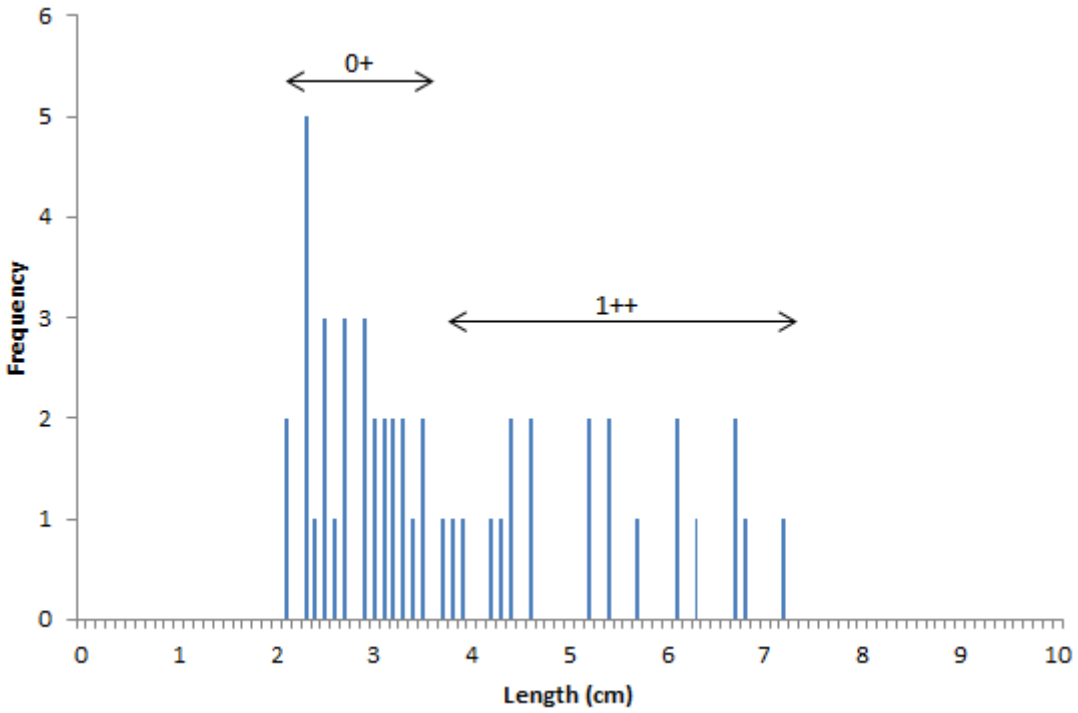

Figure 3.7. Length frequency of minnow captured at Harvestslade Site 1 (n=50). In the absence of growth analysis, highlighted age cohorts are indicative only.

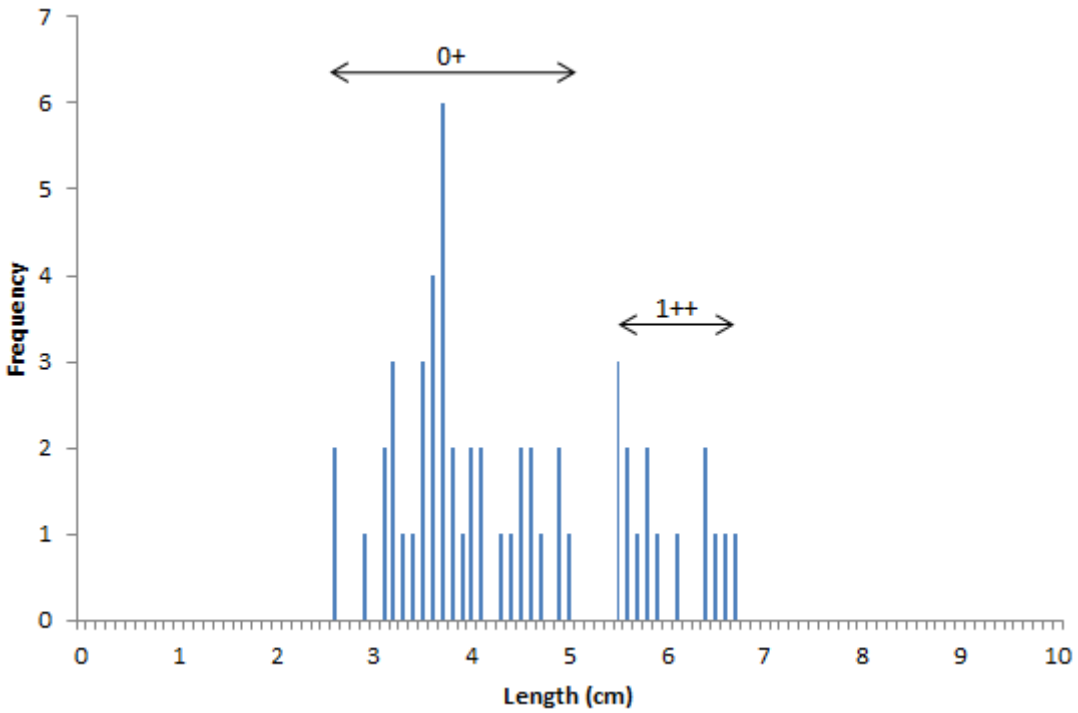

Figure 3.8. Length frequency of bullhead captured at Harvestslade Site 1 (n=55). In the absence of growth analysis, highlighted age cohorts are indicative only.

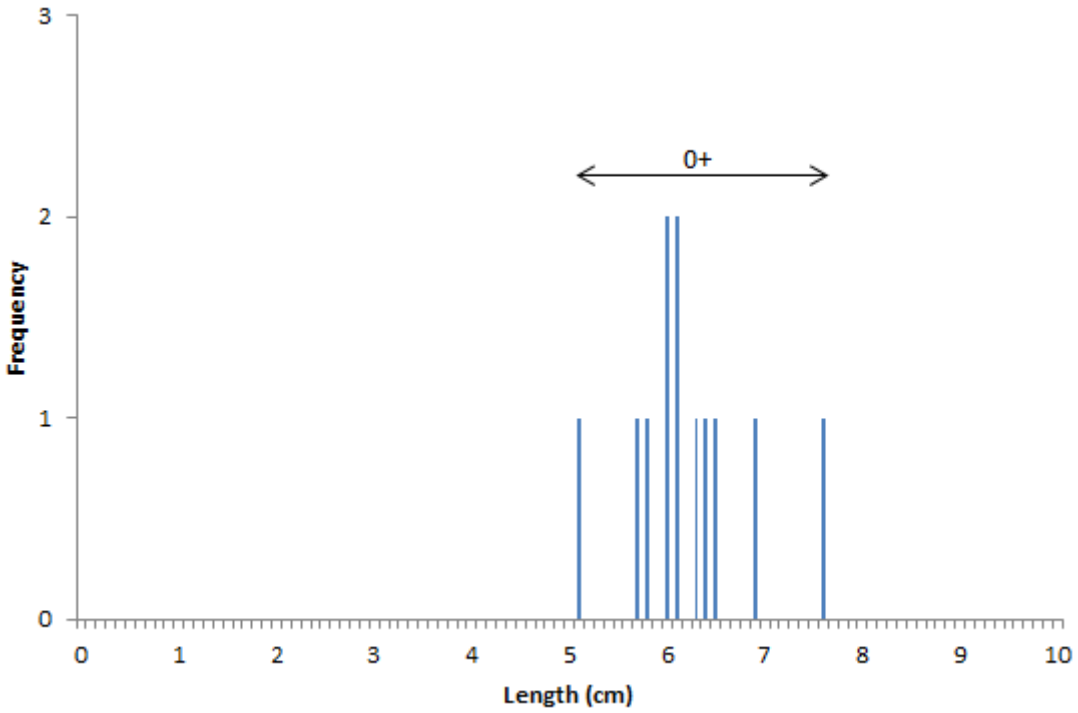

Figure 3.9. Length frequency of brown trout captured at Harvestslade Site 1 (n=12). In the absence of growth analysis, highlighted age cohorts are indicative only.

3.3 Harvestslade Site 2

3.3.1 Site description

Harvestslade Site 2 is located within an area of broadleaf / mixed woodland, with approximately 90 % canopy cover along the river stretch (see Section 2.1.2). Table 3.7 below summarises the key physical characteristics of the 100 m survey site, and Appendix 3 provides a photographic record of habitat variability. The mean wetted width was 2.10 m, with an overall surveyed area of 210.0 m^2.

Being long-established; the river reach comprised a diversity of habitat types. Substrate was largely comprised of gravel, pebble and cobbles; however, a layer of fine silt was evident throughout and dominated the substrate in slower flowing stretches.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.8.

Table 3.7. Habitat data recorded during the electric fishing survey at Harvestslade Site 2.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	10	20	20	10	20	20		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent		40		20	20	20		
Instream vegetation: **5 %**		Silted? **Yes**		Substrate: **Stable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent								
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	30	10	50		10			
Right bank %	30	10	50		10			
Total LB fish cover: **50 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **50 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / Simple / **Complex**				RB Bankface vegetation: Bare / Uniform / Simple / **Complex**				
LB Banktop vegetation: Bare / Uniform / Simple / **Complex**				RB Banktop vegetation: Bare / Uniform / Simple / **Complex**				
LB Overhanging Boughs (%): **20**			RB Overhanging Boughs (%): **20**			Canopy Cover (%): **90**		

Table 3.8. Physico-chemical parameters recorded during fish survey at Harvestslade Site 2.

Parameter	Value
Temperature (°C)	15.6
Dissolved Oxygen (%)	92.2
Dissolved Oxygen (mgl^{-1})	9.18
pH	Probe failure
Conductivity (μScm^{-1})	73

3.3.2 Electric fishing survey results

A total of 331 fish were captured at Harvestslade Site 2, comprising five species. Minnow was the most abundant species captured, followed by river/brook lamprey and bullhead (Figure 3.10).

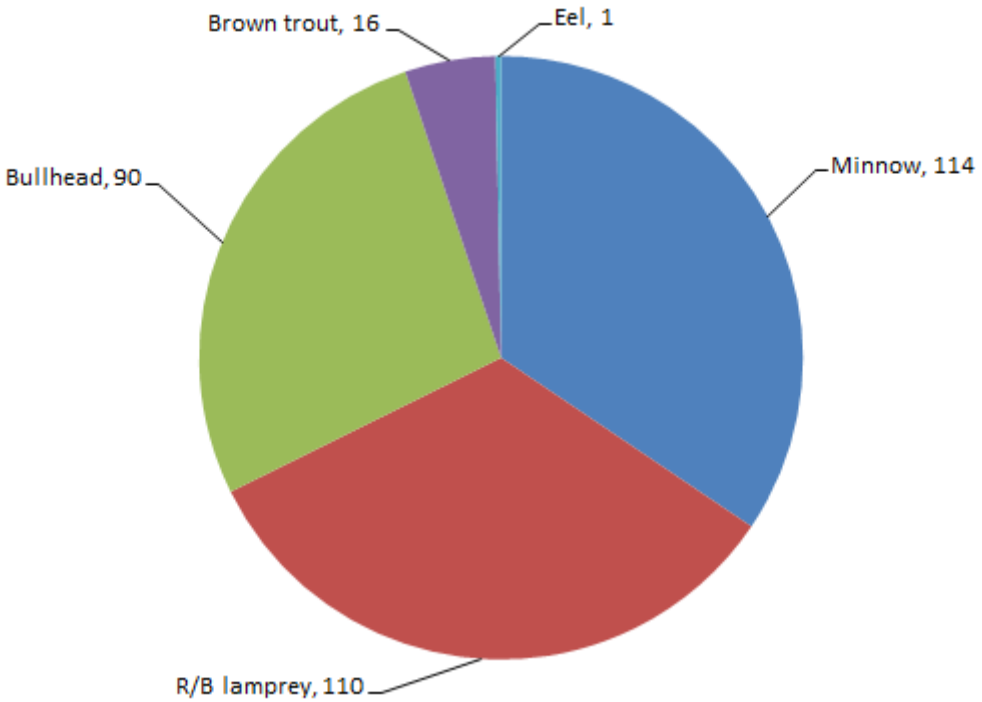

Figure 3.10. Species composition (total number captured) at Harvestslade Site 2.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.9. The National Fisheries Classification Scheme (NFCS) classifications for 0+ and 1++ brown trout are also shown.

Table 3.9. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Harvestslade Site 2. National Fisheries Classification Scheme (NFCS) grades are also provided for brown trout.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)	NFCS Classification
Minnow	114 (2.2 – 8.6)	195	0.25	95	295	93	N/A
R/B lamprey	110 (4.5 – 13.0)	N/A	N/A	N/A	N/A	N/A	N/A
Bullhead	90 (2.7 – 6.1)	110	0.43	87	133	52	N/A
Brown trout (0+)	5 (5.7 – 7.5)	5	0.83	5	5	2	E (Poor)
Brown trout (1++)	11 (11.6 – 25.0)	11	0.73	10	12	5	C (Fair)
Eel	1 (52.0)	1	0.98	0	2	<1	N/A
TOTAL	**331**						

Length frequency charts for the most abundant fish species recorded are provided in Figure 3.11 to Figure 3.14 below. Where relevant, age cohorts (0+ and 1++) have been displayed on the charts; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

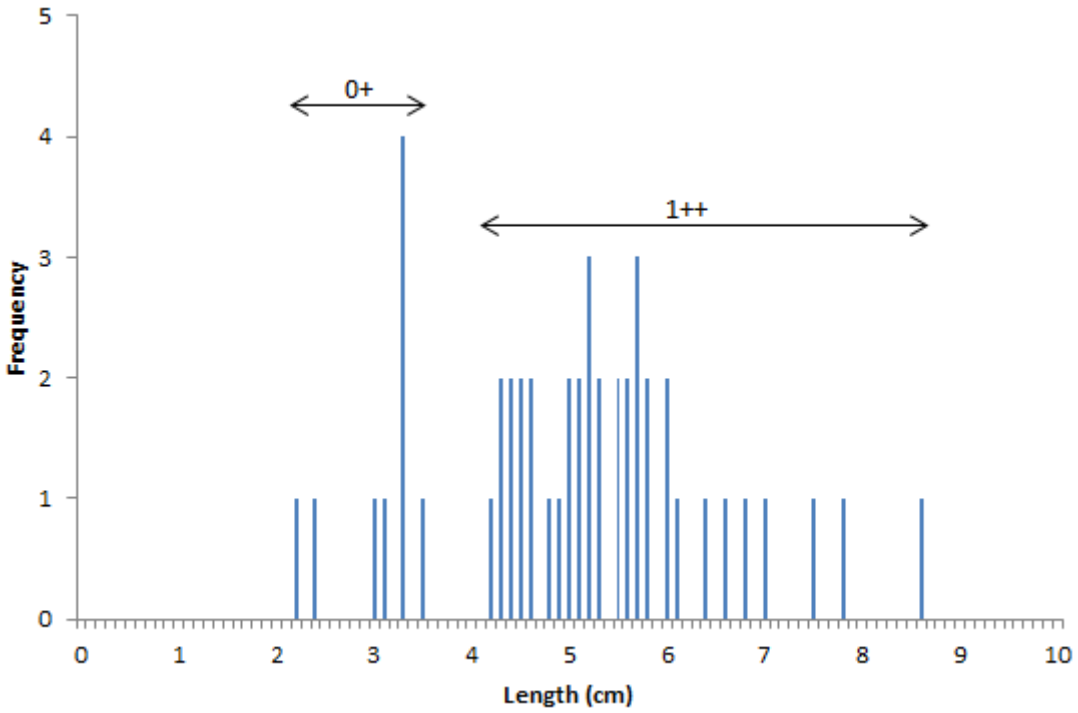

Figure 3.11. Length frequency of minnow captured at Harvestslade Site 2 (n=48). In the absence of growth analysis, highlighted age cohorts are indicative only.

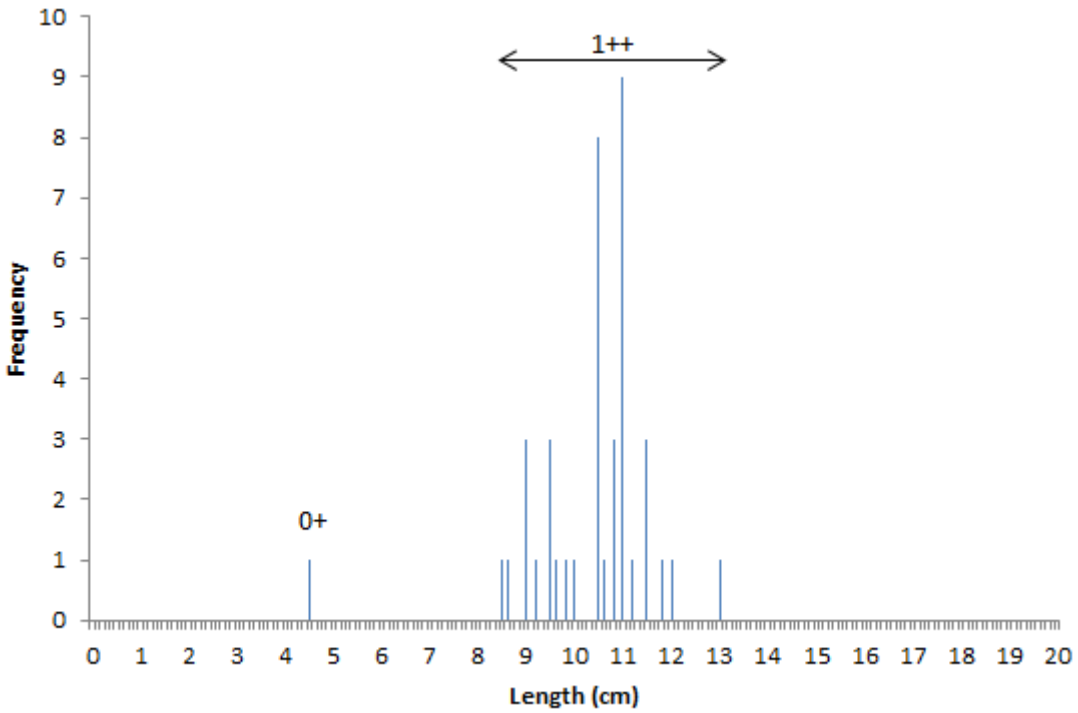

Figure 3.12. Length frequency of R/B lamprey captured at Harvestslade Site 2 (n=41). In the absence of growth analysis, highlighted age cohorts are indicative only.

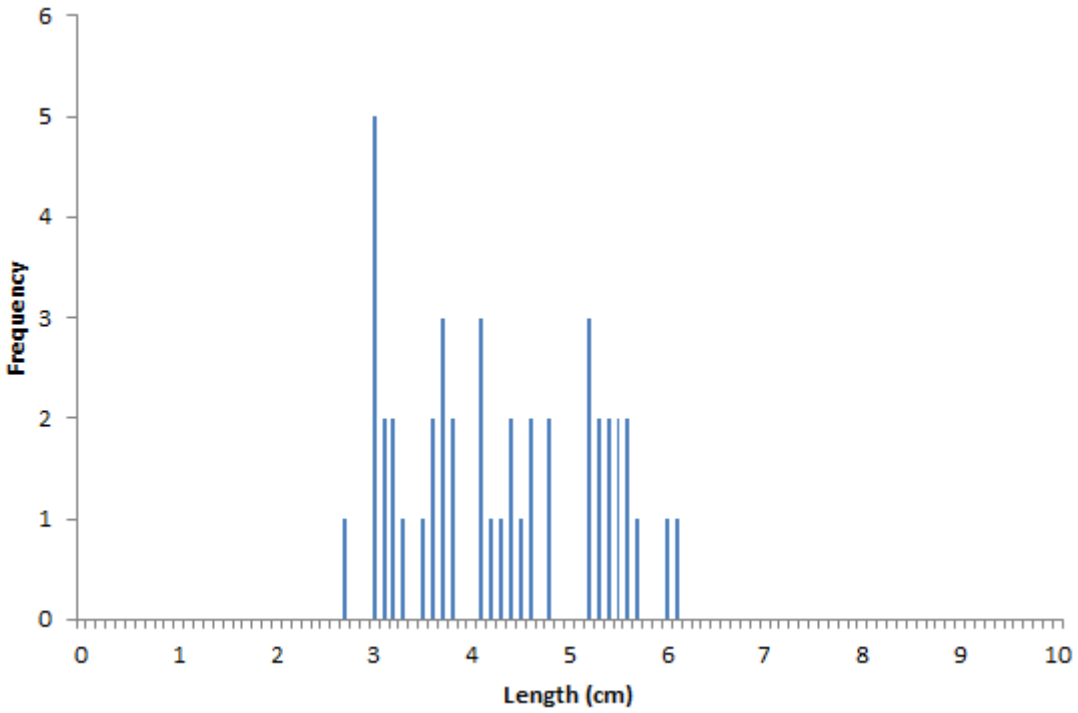

Figure 3.13. Length frequency of bullhead captured at Harvestslade Site 2 (n=45).

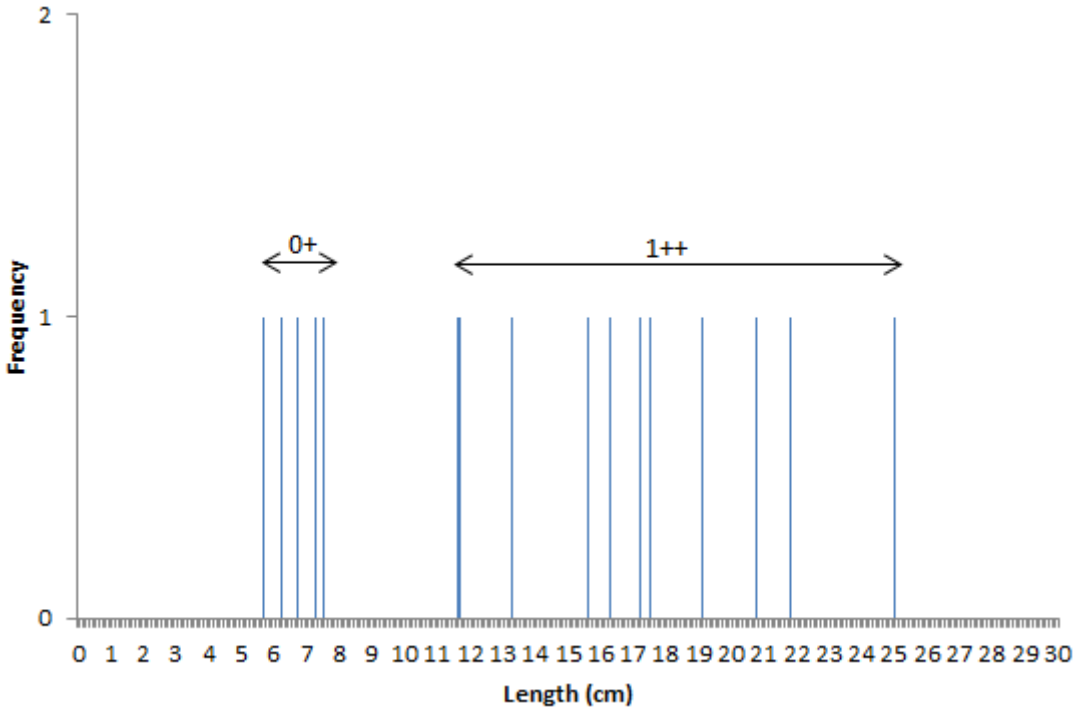

Figure 3.14. Length frequency of brown trout captured at Harvestslade Site 2 (n=16). In the absence of growth analysis, highlighted age cohorts are indicative only.

3.4 Linford Brook Site 1

3.4.1 Site description

Linford Brook Site 1 is located within an area of broadleaf / mixed woodland, with approximately 80 % canopy cover along the river stretch (see Section 2.1.3). Table 3.10 below summarises the key physical characteristics of the 100 m survey site, and Appendix 4 provides a photographic record of habitat variability. The mean wetted width was 3.08 m, with an overall surveyed area of 308.2 m^2.

The river reach comprised a diversity of habitat types. Substrate was largely comprised of clean gravel, pebble and cobbles. In-river characteristics appeared to be typical of salmonid habitat, with a diversity of flow types, gravel/pebble/cobble substrate, holding pools and bankside/riparian cover.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.11.

Table 3.10. Habitat data recorded during the electric fishing survey at Linford Brook Site 1.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	20		10	10	10	50		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent				30	40	30		
Instream vegetation: **0 %**		Silted? **No**		Substrate: **Stable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent								
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	20	10	70					
Right bank %	20	10	70					
Total LB fish cover: **30 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **30 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / Simple / **Complex**				RB Bankface vegetation: Bare / Uniform / Simple / **Complex**				
LB Banktop vegetation: Bare / Uniform / Simple / **Complex**				RB Banktop vegetation: Bare / Uniform / Simple / **Complex**				
LB Overhanging Boughs (%): **20**			RB Overhanging Boughs (%): **20**			Canopy Cover (%): **80**		

Table 3.11. Physico-chemical parameters recorded during fish survey at Linford Brook Site 1.

Parameter	Value
Temperature (°C)	14.9
Dissolved Oxygen (%)	102.3
Dissolved Oxygen (mgl^{-1})	10.32
pH	Probe failure
Conductivity (μScm^{-1})	148

3.4.2 Electric fishing survey results

A total of 75 fish were captured at Linford Brook Site 1, comprising four species. Minnow was the most abundant species captured, followed by chub (Figure 3.15).

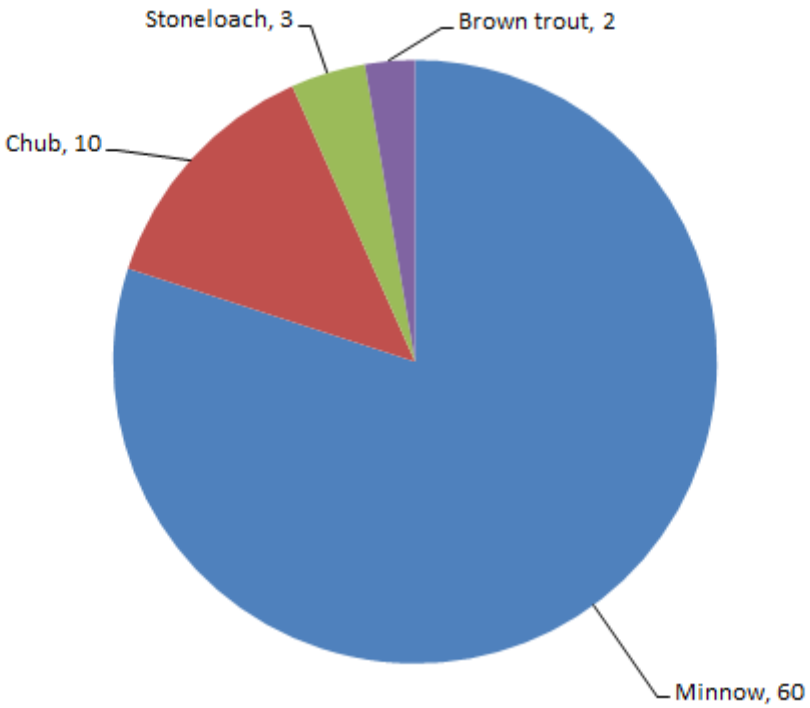

Figure 3.15. Species composition (total number captured) at Linford Brook Site 1.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.12. The National Fisheries Classification Scheme (NFCS) classifications for 0+ and 1++ brown trout are also shown.

Table 3.12. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Linford Brook Site 1. National Fisheries Classification Scheme (NFCS) grades are also provided for brown trout.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)	NFCS Classification
Minnow	60 (1.4 – 8.4)	128	0.19	-15	271	42	N/A
Chub	10 (3.5 – 22.4)	10	0.59	7	13	3	N/A
Stoneloach	3 (7.2 – 9.4)	3	0.60	2	4	1	N/A
Brown trout (0+)	1 (6.6)	1	1.00	1	1	<1	E (Poor)
Brown trout (1++)	1 (16.5)	1	1.00	1	1	<1	E (Poor)
TOTAL	**75**						

Length frequency charts for the most abundant fish species recorded are provided in Figure 3.16 and Figure 3.17 below. Where relevant, age cohorts (0+ and 1++) have been displayed on the charts; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

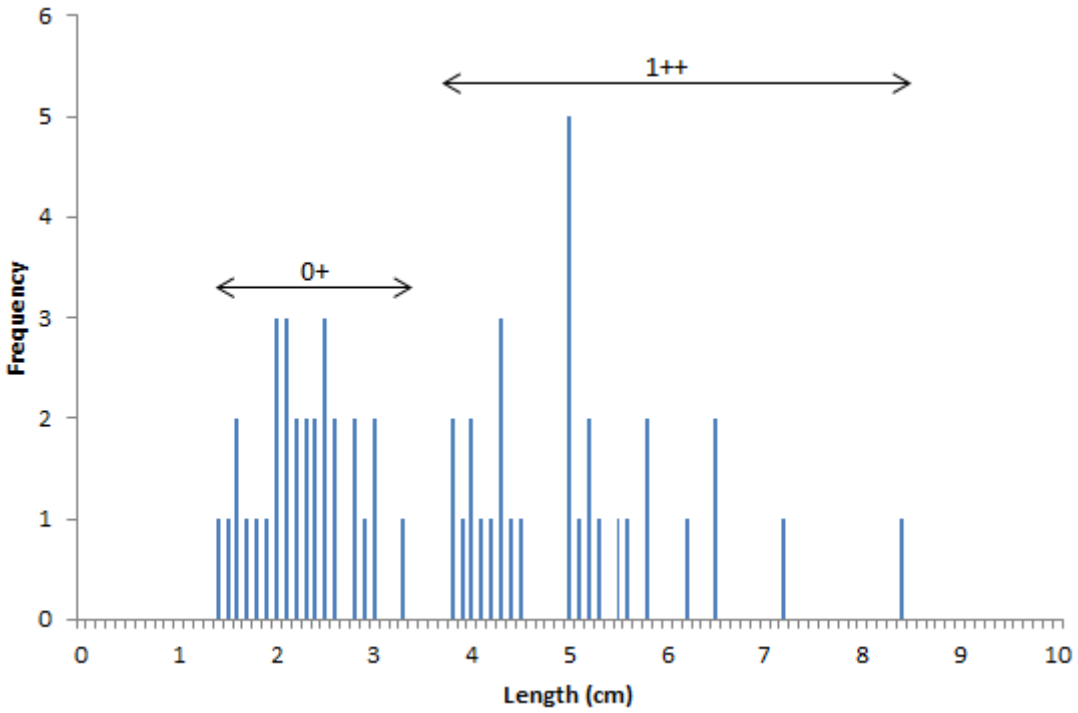

Figure 3.16. Length frequency of minnow captured at Linford Brook Site 1 (n=60). In the absence of growth analysis, highlighted age cohorts are indicative only.

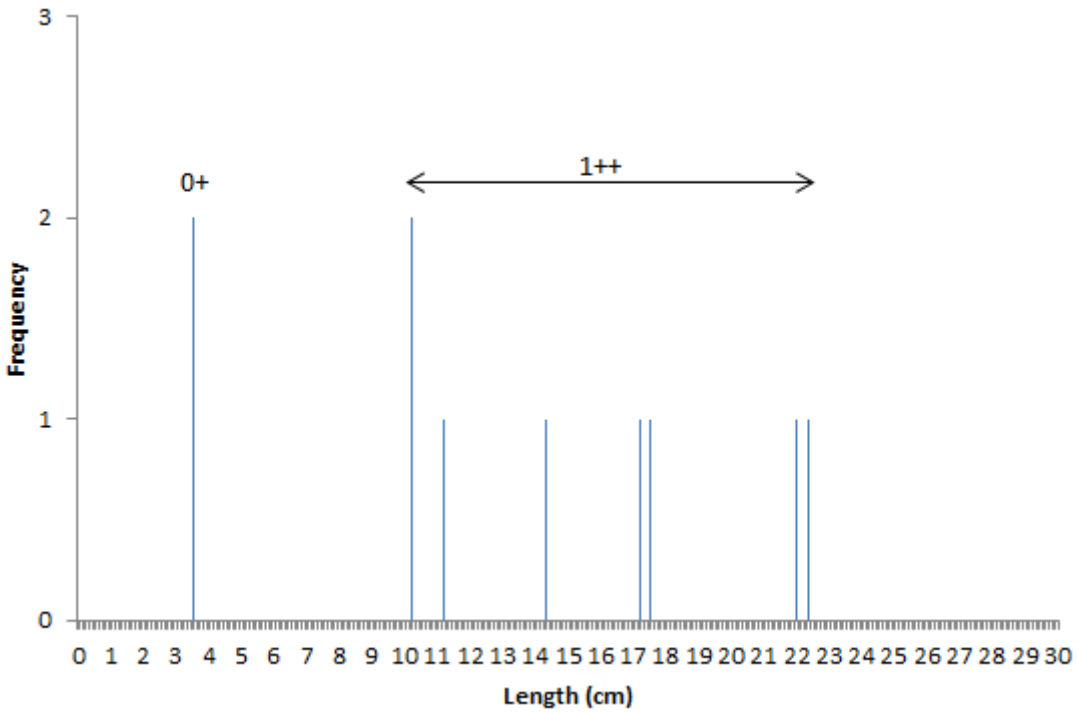

Figure 3.17. Length frequency of chub captured at Linford Brook Site 1 (n=10). In the absence of growth analysis, highlighted age cohorts are indicative only.

3.5 Linford Brook Site 2

3.5.1 Site description

Linford Brook Site 2 is located within an area of broadleaf / mixed woodland and moorland / heath, with canopy cover along approximately 20 % of the surveyed river stretch (see Section 2.1.3). Table 3.13 below summarises the key physical characteristics of the 100 m survey site, and Appendix 5 provides a photographic record of habitat variability. The mean wetted width was 3.16 m, with an overall surveyed area of 316.4 m^2.

The river reach comprised a diversity of habitat types. Substrate was largely comprised of clean gravel, pebble and cobbles. In-river characteristics appeared to be typical of salmonid habitat, with a diversity of flow types, gravel/pebble/cobble substrate, holding pools and bankside/riparian cover.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.14.

Table 3.13. Habitat data recorded during the electric fishing survey at Linford Brook Site 2.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	30	10	20	10	20	10		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent				50	30	20		
Instream vegetation: **0 %**		Silted? **No**		Substrate: **Stable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	20	20			20	20	20	
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	20		80					
Right bank %	20		80					
Total LB fish cover: **20 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **20 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / **Simple** / Complex				RB Bankface vegetation: Bare / Uniform / **Simple** / Complex				
LB Banktop vegetation: Bare / Uniform / **Simple** / Complex				RB Banktop vegetation: Bare / Uniform / **Simple** / Complex				
LB Overhanging Boughs (%): **5**			RB Overhanging Boughs (%): **5**			Canopy Cover (%): **20**		

Table 3.14. Physico-chemical parameters recorded during fish survey at Linford Brook Site 2.

Parameter	Value
Temperature (°C)	15.2
Dissolved Oxygen (%)	101.2
Dissolved Oxygen (mgl^{-1})	10.16
pH	Probe failure
Conductivity (μScm^{-1})	154

3.5.2 Electric fishing survey results

A total of 221 fish were captured at Linford Brook Site 2, comprising four species. Minnow was the most abundant species captured, followed by stoneloach and brown trout (Figure 3.18).

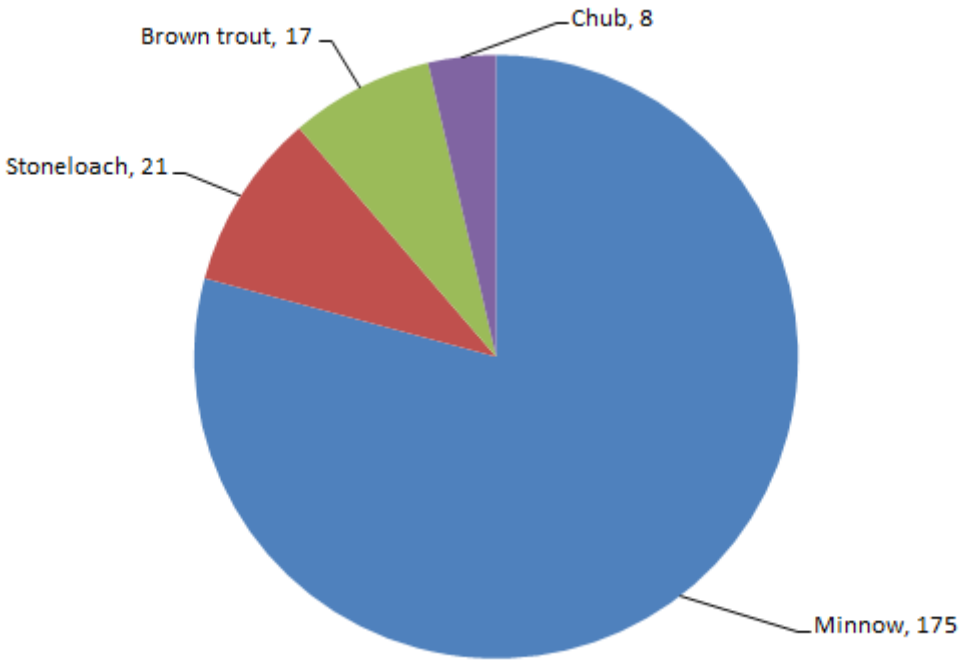

Figure 3.18. Species composition (total number captured) at Linford Brook Site 2.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.15. The National Fisheries Classification Scheme (NFCS) classifications for 0+ and 1++ brown trout are also shown.

Table 3.15. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Linford Brook Site 2. National Fisheries Classification Scheme (NFCS) grades are also provided for brown trout.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)	NFCS Classification
Minnow	175 (1.6 – 9.7)	191	0.56	177	205	60	N/A
Stoneloach	21 (7.9 – 12.1)	36	0.24	-11	83	11	N/A
Brown trout (0+)	10 (4.8 – 7.7)	10	0.59	7	13	3	D (Fair/Poor)
Brown trout (1++)	7 (13.0 – 16.0)	7	1.00	7	7	2	D (Fair/Poor)
Chub	8 (12.3 – 19.6)	8	0.89	8	8	3	N/A
TOTAL	**221**						

Length frequency charts for the most abundant fish species recorded are provided in Figure 3.19 to Figure 3.22 below. Where relevant, age cohorts (0+ and 1++) have been displayed on the charts; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

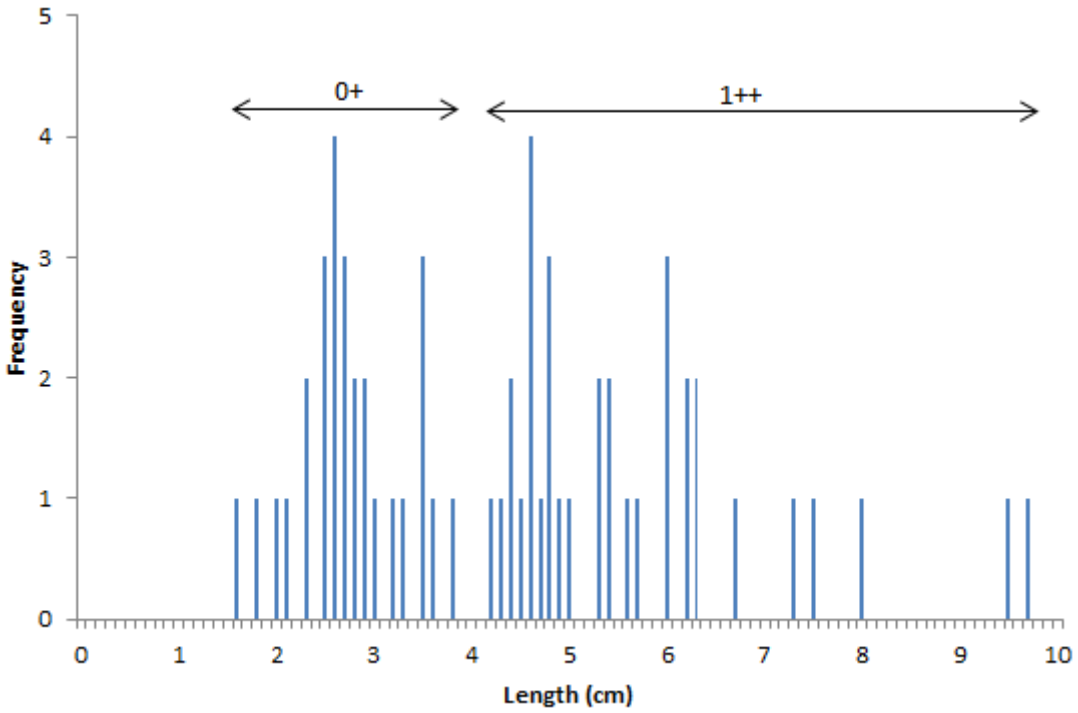

Figure 3.19. Length frequency of minnow captured at Linford Brook Site 2 (n=62). In the absence of growth analysis, highlighted age cohorts are indicative only.

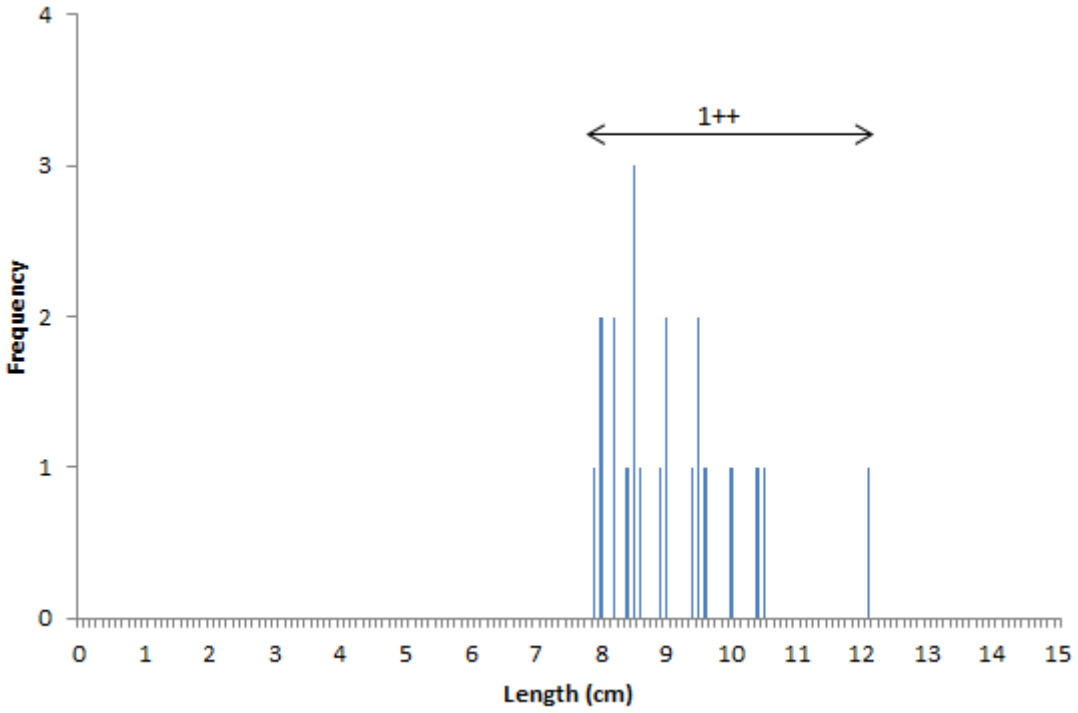

Figure 3.20. Length frequency of stoneloach captured at Linford Brook Site 2 (n=21). In the absence of growth analysis, highlighted age cohorts are indicative only.

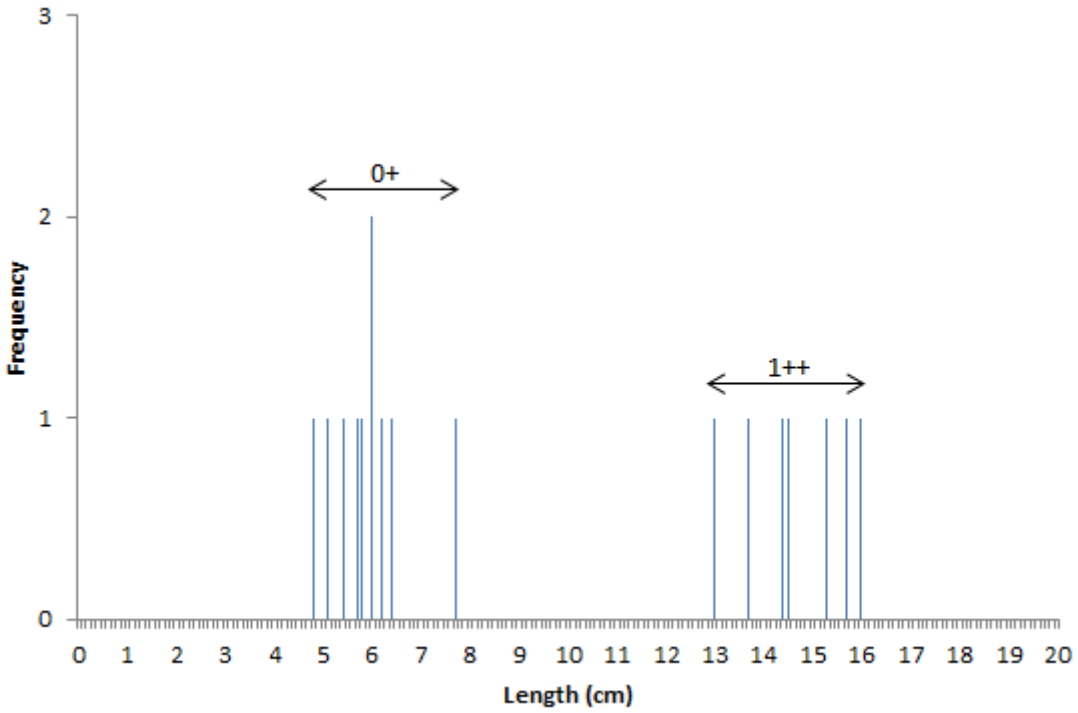

Figure 3.21. Length frequency of brown trout captured at Linford Brook Site 2 (n=17). In the absence of growth analysis, highlighted age cohorts are indicative only.

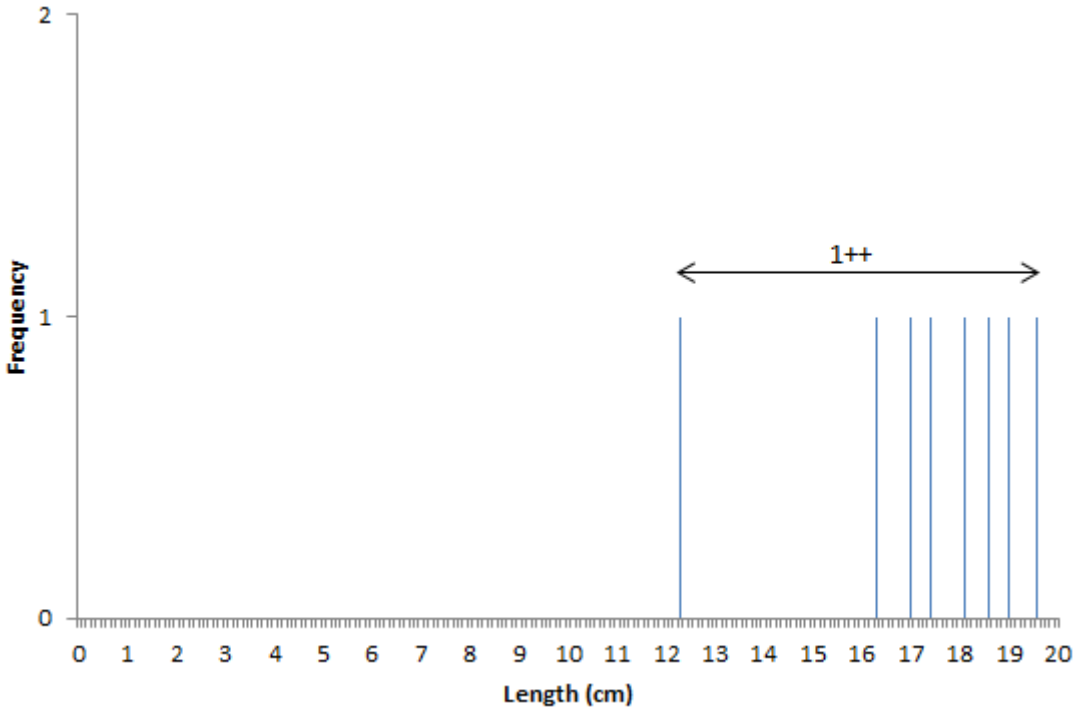

Figure 3.22. Length frequency of chub captured at Linford Brook Site 2 (n=8).

3.6 Longwater Site 1

3.6.1 Site description

Longwater Site 1 is located within an area of broadleaf / mixed woodland and improved / semi-improved grassland, with canopy cover along approximately 50 % of the surveyed river stretch (see Section 2.1.4). Table 3.16 below summarises the key physical characteristics of the 100 m survey site, and Appendix 6 provides a photographic record of habitat variability. The mean wetted width was 1.39 m, with an overall surveyed area of 139.1 m^2.

The surveyed stretch comprised a new channel, based on paleo meanders, that had been created as part of the restoration works; this included infilling the old channel that flowed along the field edge tree line, and replacing it with a new meandering channel excavated in the middle of an open field.

The new channel exhibited evidence of excessive poaching by livestock, bank erosion, shallow vegetation-choked channel and silted substrate.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.17.

Table 3.16. Habitat data recorded during the electric fishing survey at Longwater Site 1.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	40	40	20					
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent		40	20	40				
Instream vegetation: **10 %**		Silted? **Yes**		Substrate: **Unstable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	30	35	30				5	
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	10	10	80					
Right bank %	10	10	80					
Total LB fish cover: **20 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **20 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / **Simple** / Complex				RB Bankface vegetation: Bare / Uniform / **Simple** / Complex				
LB Banktop vegetation: Bare / Uniform / **Simple** / Complex				RB Banktop vegetation: Bare / Uniform / **Simple** / Complex				
LB Overhanging Boughs (%): **10**			RB Overhanging Boughs (%): **10**			Canopy Cover (%): **50**		

Table 3.17. Physico-chemical parameters recorded during fish survey at Longwater Site 1.

Parameter	Value
Temperature (°C)	17.3
Dissolved Oxygen (%)	104.3
Dissolved Oxygen (mgl^{-1})	10.0
pH	Probe failure
Conductivity (μScm^{-1})	240

3.6.2 Electric fishing survey results

A total of 711 fish were captured at Longwater Site 1, comprising six species. Minnow was the most abundant species captured, followed by 3-spined stickleback and stoneloach (Figure 3.23).

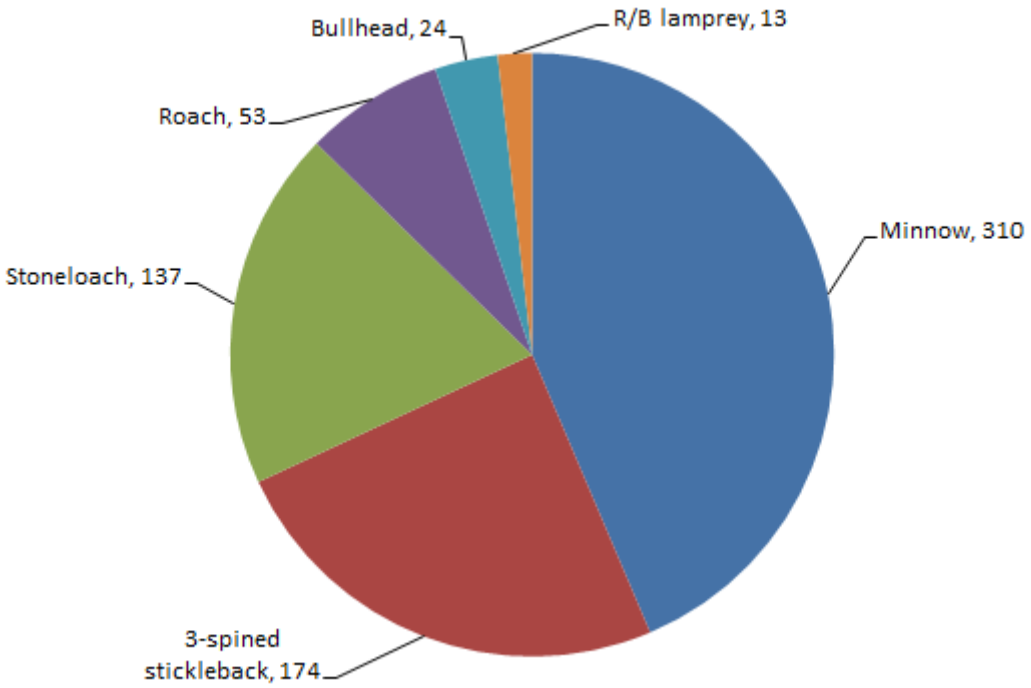

Figure 3.23. Species composition (total number captured) at Longwater Site 1.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.18.

Table 3.18. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Longwater Site 1.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)
Minnow	310 (1.2 – 8.6)	467	0.30	362	572	336
3-spined stickleback	174 (1.9 – 3.7)	362	0.20	140	584	260
Stoneloach	137 (2.2 – 9.1)	184	0.36	139	229	132
Roach	53 (5.5 – 6.6)	179	0.11	-259	617	129
Bullhead	24 (2.8 – 9.0)	25	0.62	21	29	18
R/B lamprey	13 (6.3 – 16.0)	39	0.12	-140	218	28
TOTAL	**711**					

Length frequency charts for the most abundant fish species recorded are provided in Figure 3.24 to Figure 3.29 below. Where relevant, age cohorts (0+ and 1++) have been displayed on the charts; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

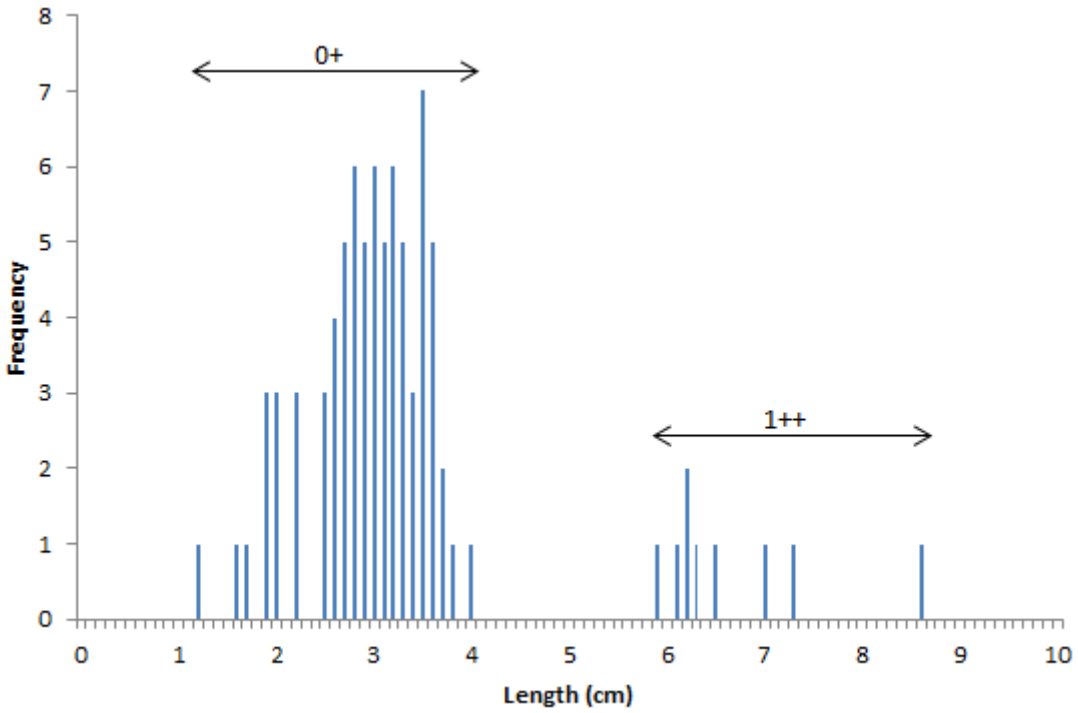

Figure 3.24. Length frequency of minnow captured at Longwater Site 1 (n=85). In the absence of growth analysis, highlighted age cohorts are indicative only.

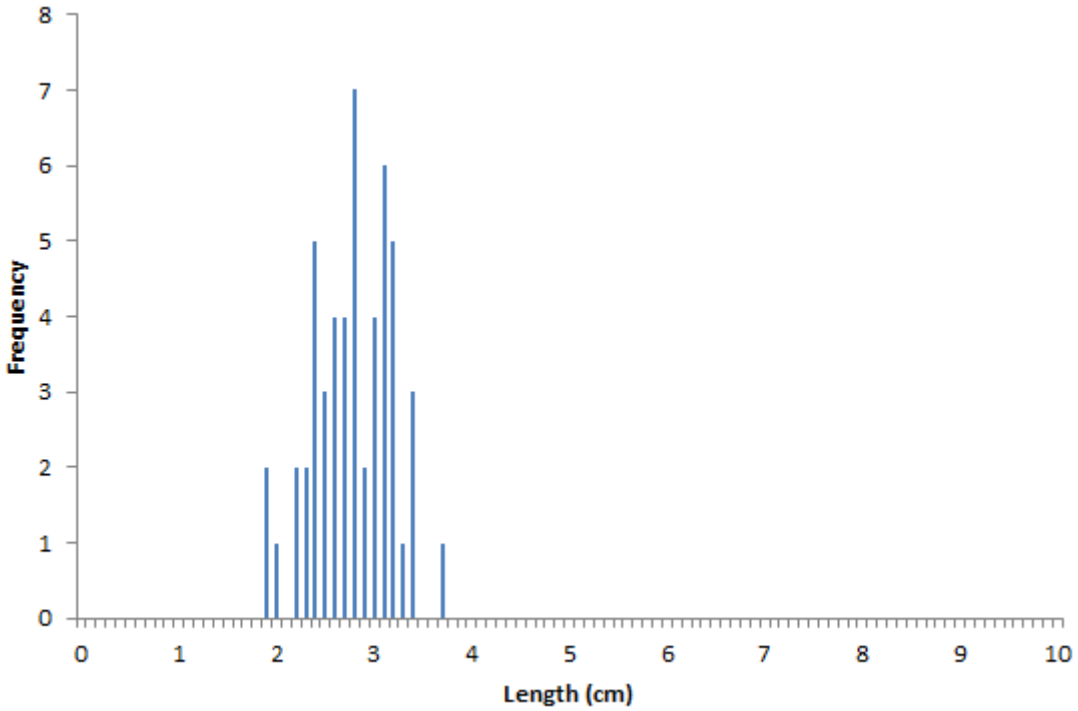

Figure 3.25. Length frequency of 3-spined stickleback captured at Longwater Site 1 (n=52).

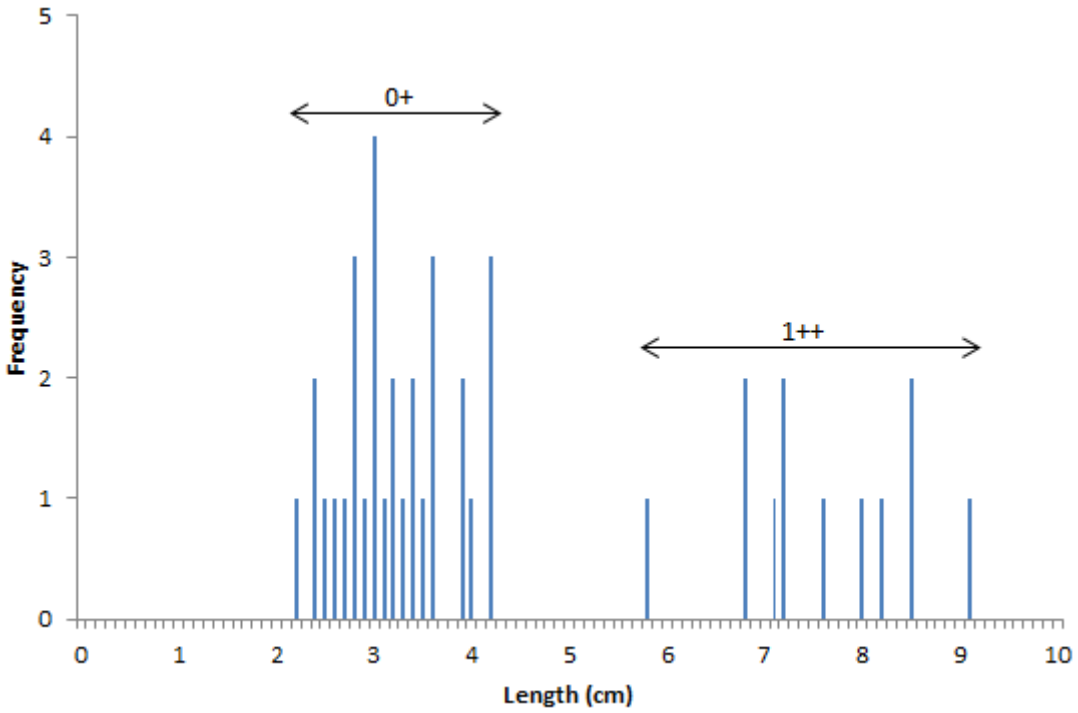

Figure 3.26. Length frequency of stoneloach captured at Longwater Site 1 (n=42). In the absence of growth analysis, highlighted age cohorts are indicative only.

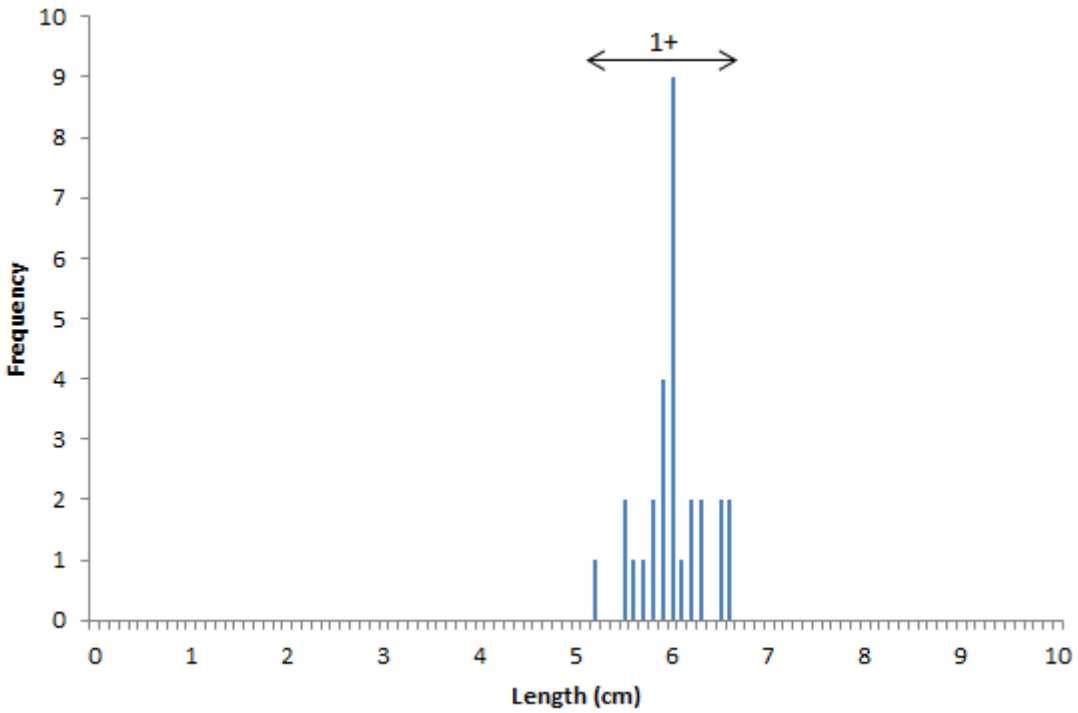

Figure 3.27. Length frequency of roach captured at Longwater Site 1 (n=29). In the absence of growth analysis, highlighted age cohorts are indicative only.

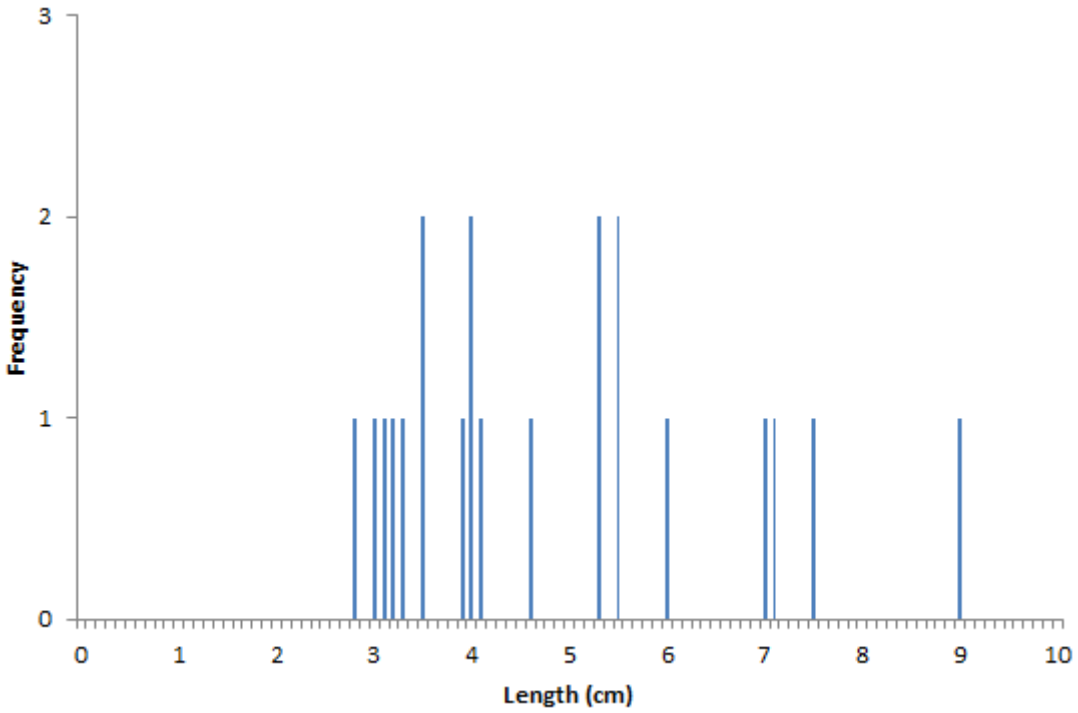

Figure 3.28. Length frequency of bullhead captured at Longwater Site 1 (n=21).

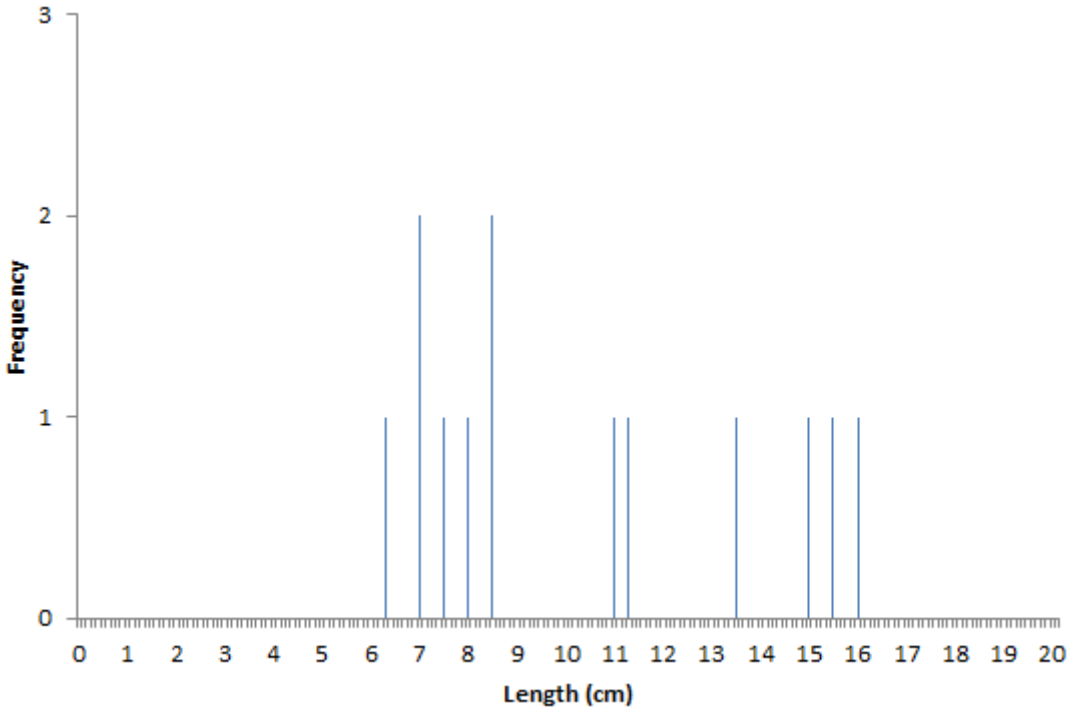

Figure 3.29. Length frequency of R/B lamprey captured at Longwater Site 1 (n=13).

3.7 Longwater Site 2

3.7.1 Site description

Longwater Site 2 is located within an area of improved / semi-improved grassland and moorland / heath, with a lack of any significant canopy cover along the surveyed river stretch (see Section 2.1.4). Table 3.19 below summarises the key physical characteristics of the 100 m survey site, and Appendix 7 provides a photographic record of habitat variability. The mean wetted width was 1.52 m, with an overall surveyed area of 151.8 m^2.

Longwater Site 2 appeared to be subject to similar pressures to Longwater Site 1, with evidence of livestock poaching and bank erosion. Where exposed substrate was present, this comprised mainly of relatively clean gravel.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.20.

Table 3.19. Habitat data recorded during the electric fishing survey at Longwater Site 2.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	10	20	30	30	10			
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent		20	20	60				
Instream vegetation: **80 %**		Silted? **No**		Substrate: **Stable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	20	30	40	10				
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	5		95					
Right bank %	5		95					
Total LB fish cover: **5 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **5 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / **Simple** / Complex				RB Bankface vegetation: Bare / Uniform / **Simple** / Complex				
LB Banktop vegetation: Bare / Uniform / **Simple** / Complex				RB Banktop vegetation: Bare / Uniform / **Simple** / Complex				
LB Overhanging Boughs (%): **1**			RB Overhanging Boughs (%): **1**			Canopy Cover (%): **1**		

Table 3.20. Physico-chemical parameters recorded during fish survey at Longwater Site 2.

Parameter	Value
Temperature (°C)	20.0
Dissolved Oxygen (%)	118.2
Dissolved Oxygen (mgl^{-1})	10.74
pH	Probe failure
Conductivity (μScm^{-1})	242

3.7.2 Electric fishing survey results

A total of 953 fish were captured at Longwater Site 2, comprising seven species. Three-spined stickleback was the most abundant species captured, followed by minnow and stoneloach (Figure 3.30).

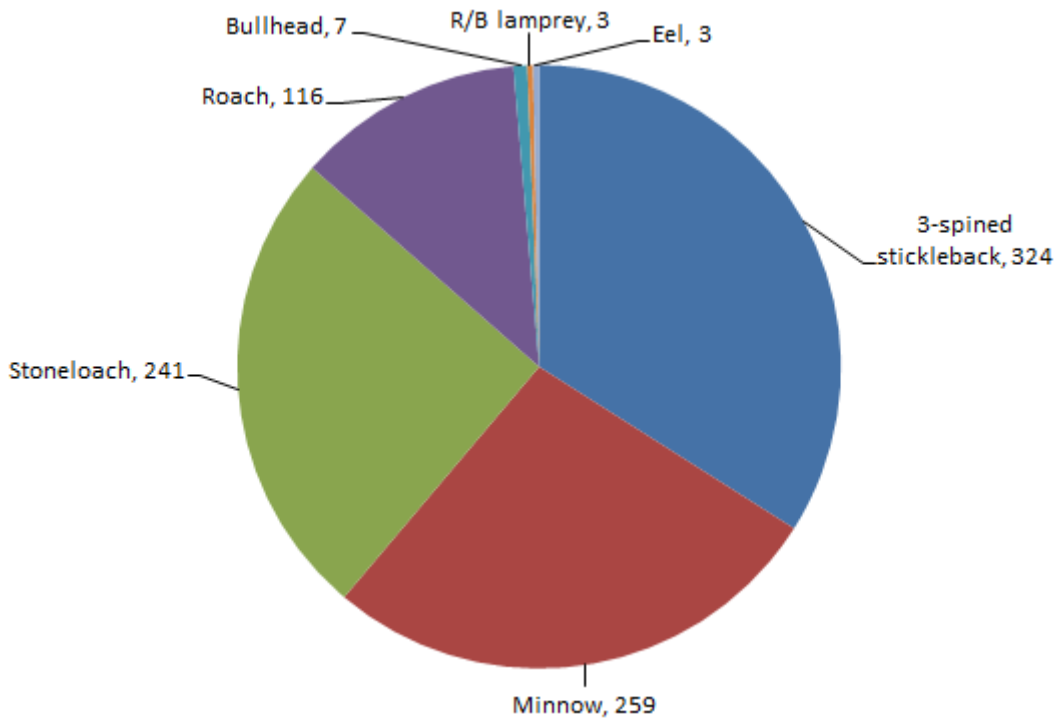

Figure 3.30. Species composition (total number captured) at Longwater Site 2.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.21.

Table 3.21. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Longwater Site 2.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)
3-spined stickleback	324 (1.8 – 3.4)	586	0.23	387	785	386
Minnow	259 (2.5 – 7.3)	335	0.39	284	386	221
Stoneloach	241 (2.1 – 8.8)	352	0.32	269	435	232
Roach	116 (6.0 – 8.0)	146	0.41	116	176	96
Bullhead	7 (3.0 – 8.0)	9	0.33	-3	21	6
R/B lamprey	3 (10.0 – 13.2)	3	0.50	1	5	2
Eel	3 (16.3 – 60.0)	3	1.00	3	3	2
TOTAL	**953**					

Length frequency charts for the most abundant fish species recorded are provided in Figure 3.31 to Figure 3.35 below. Where relevant, age cohorts (0+ and 1++) have been displayed on the charts; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

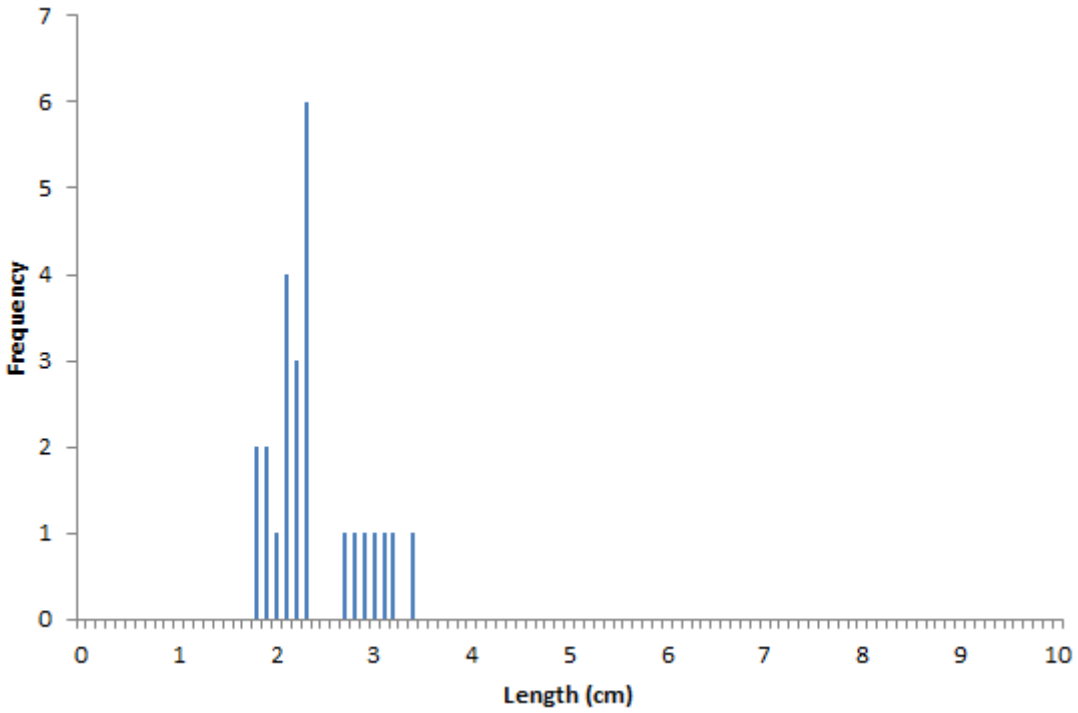

Figure 3.31. Length frequency of 3-spined stickleback captured at Longwater Site 2 (n=25).

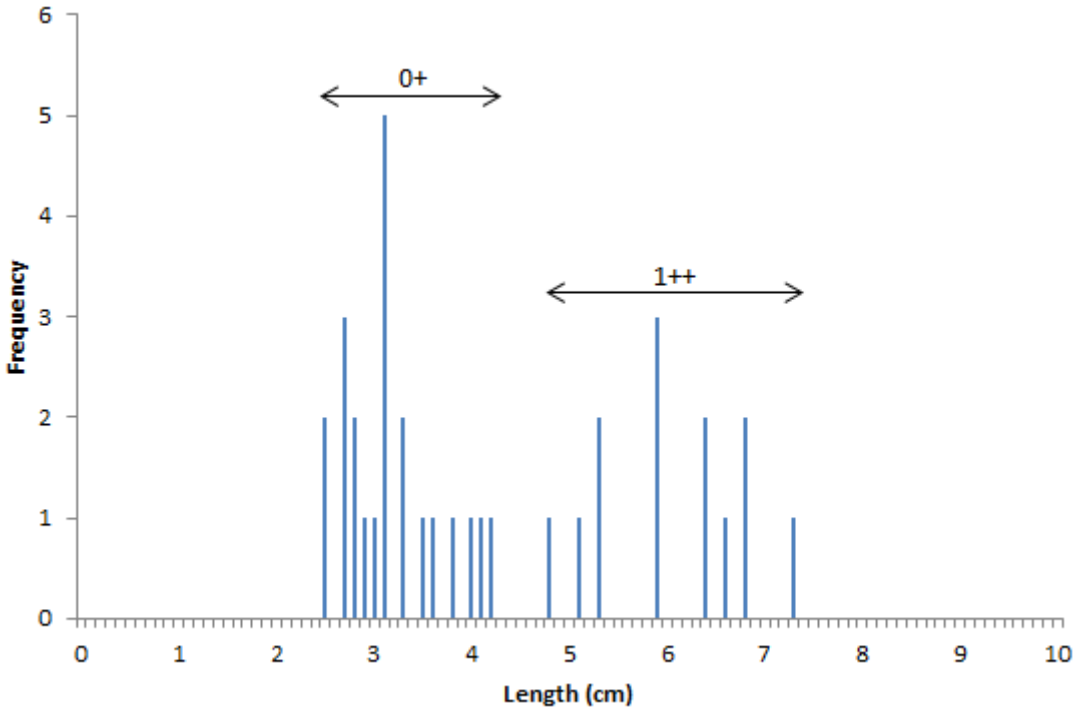

Figure 3.32. Length frequency of minnow captured at Longwater Site 2 (n=35). In the absence of growth analysis, highlighted age cohorts are indicative only.

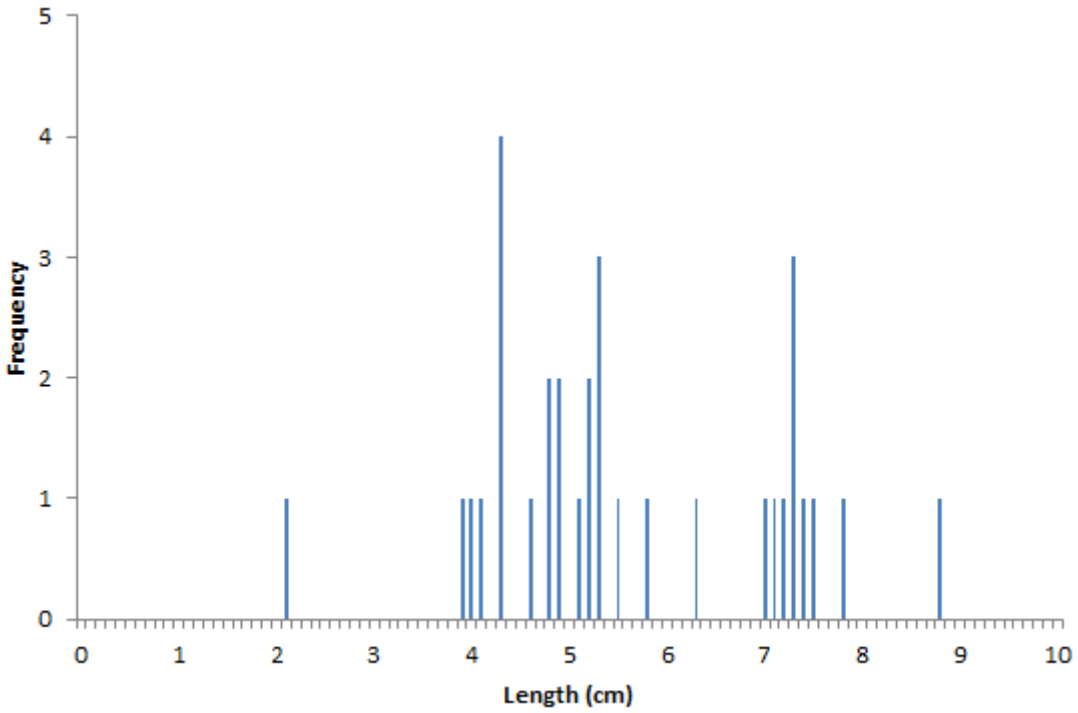

Figure 3.33. Length frequency of stoneloach captured at Longwater Site 2 (n=32).

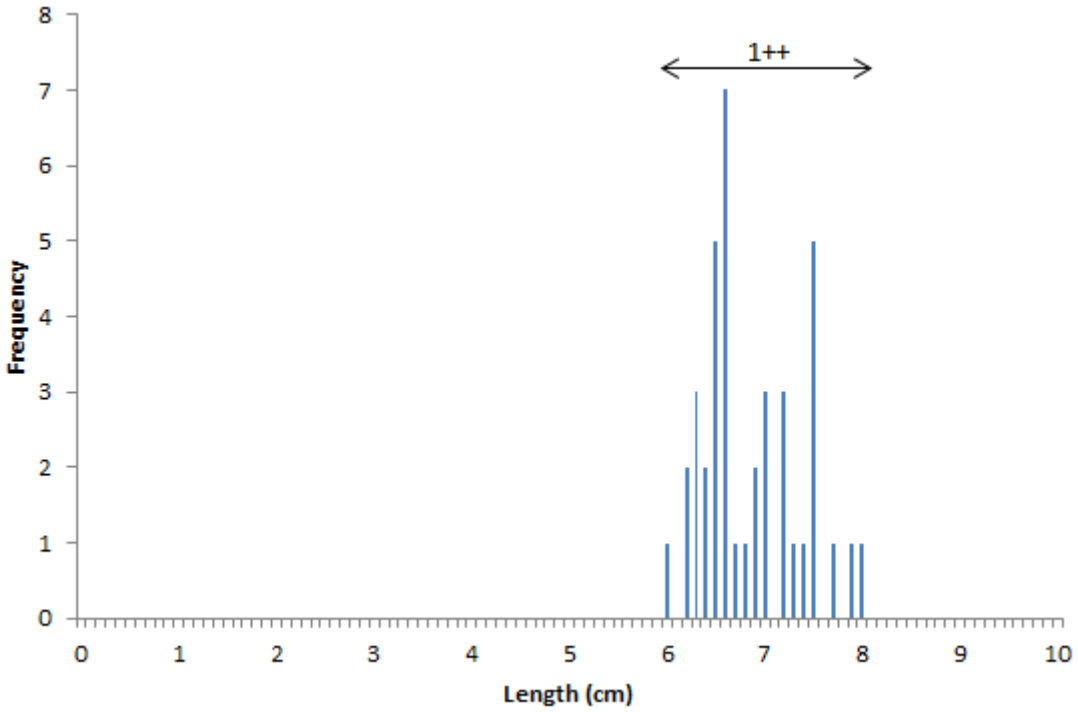

Figure 3.34. Length frequency of roach captured at Longwater Site 2 (n=40). In the absence of growth analysis, highlighted age cohorts are indicative only.

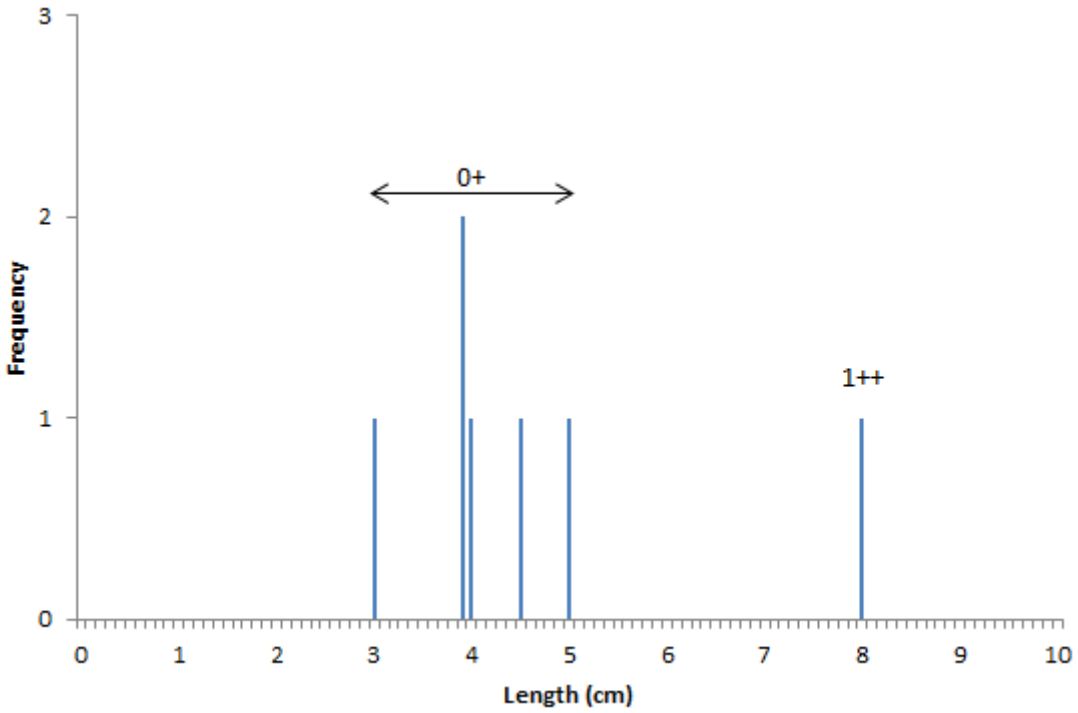

Figure 3.35. Length frequency of bullhead captured at Longwater Site 2 (n=7). In the absence of growth analysis, highlighted age cohorts are indicative only.

3.8 Millersford Brook Site 1

3.8.1 Site description

Millersford Brook Site 1 is located within an area of moorland / heath, with no significant canopy cover along the surveyed river stretch (see Section 2.1.5). Table 3.22 below summarises the key physical characteristics of the 100 m survey site, and Appendix 8 provides a photographic record of habitat variability. The mean wetted width was 1.00 m, with an overall surveyed area of 100.0 m^2.

Although relatively small and narrow, the river reach comprised a diversity of habitat types. In-river characteristics appeared to be typical of upland fish habitat type, with a diversity of flow types, gravel/pebble/cobble substrate, holding pools and bankside/riparian cover.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.23.

Table 3.22. Habitat data recorded during the electric fishing survey at Millersford Brook Site 1.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	30	20	10	20	10	10		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent		20	20	30	20	10		
Instream vegetation: **20 %**		Silted? **No**		Substrate: **Stable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	20	30	20	10		10	10	
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	30	30		10				
Right bank %	30	30		10				
Total LB fish cover: **80 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **80 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / Simple / **Complex**				RB Bankface vegetation: Bare / Uniform / Simple / **Complex**				
LB Banktop vegetation: Bare / Uniform / Simple / **Complex**				RB Banktop vegetation: Bare / Uniform / Simple / **Complex**				
LB Overhanging Boughs (%): **1**			RB Overhanging Boughs (%):**1**			Canopy Cover (%):**1**		

Table 3.23. Physico-chemical parameters recorded during fish survey at Millersford Brook Site 1.

Parameter	Value
Temperature (°C)	15.5
Dissolved Oxygen (%)	91.5
Dissolved Oxygen (mgl^{-1})	9.13
pH	Probe failure
Conductivity (μScm^{-1})	52

3.8.2 Electric fishing survey results

No fish captured

3.9 Millersford Brook Site 2

3.9.1 Site description

Millersford Brook Site 2 is located within an area of broadleaf / mixed woodland and improved / semi-improved grassland, with canopy cover along approximately 80 % of the surveyed river stretch (see Section 2.1.5). Table 3.24 below summarises the key physical characteristics of the 100 m survey site, and Appendix 9 provides a photographic record of habitat variability. The mean wetted width was 2.25 m, with an overall surveyed area of 224.5 m^2.

The river reach comprised a diversity of habitat types. Substrate was largely comprised of gravel, pebble and cobbles. In-river characteristics appeared to be typical of salmonid habitat, with a diversity of flow types, gravel/pebble/cobble substrate, holding pools and bankside/riparian cover.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.25.

Table 3.24. Habitat data recorded during the electric fishing survey at Millersford Brook Site 2.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	30		10	10		50		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent				30	30	30	10	
Instream vegetation: **0 %**		Silted? **No**		Substrate: **Stable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	20	30	20	20		5	5	
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	30	10	55			5		
Right bank %	30	10	55			5		
Total LB fish cover: **45 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **45 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / Simple / **Complex**				RB Bankface vegetation: Bare / Uniform / Simple / **Complex**				
LB Banktop vegetation: Bare / Uniform / Simple / **Complex**				RB Banktop vegetation: Bare / Uniform / Simple / **Complex**				
LB Overhanging Boughs (%): **20**			RB Overhanging Boughs (%): **20**			Canopy Cover (%): **80**		

Table 3.25. Physico-chemical parameters recorded during fish survey at Millersford Brook Site 2.

Parameter	Value
Temperature (°C)	14.9
Dissolved Oxygen (%)	99.4
Dissolved Oxygen (mgl^{-1})	10.01
pH	Probe failure
Conductivity (μScm^{-1})	128

3.9.2 Electric fishing survey results

A total of 42 fish were captured at Millersford Brook Site 2, comprising a single species; brown trout. The total number captured, length range (cm) and catch depletion density estimate for each life stage are shown in Table 3.26. The National Fisheries Classification Scheme (NFCS) classifications for 0+ and 1++ brown trout are also shown.

Table 3.26. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Millersford Brook Site 2. National Fisheries Classification Scheme (NFCS) grades are also provided for brown trout.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density ($No./100m^2$)	NFCS Classification
Brown trout (0+)	12 (6.4 – 8.4)	14	4.18	6	22	6	D (Fair/Poor)
Brown trout (1++)	30 (9.8 – 21.8)	31	1.81	27	35	14	B (Good)
TOTAL	**42**						

A length frequency chart is provided in Figure 3.36 below. Age cohorts (0+ and 1++) have been displayed on the chart; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

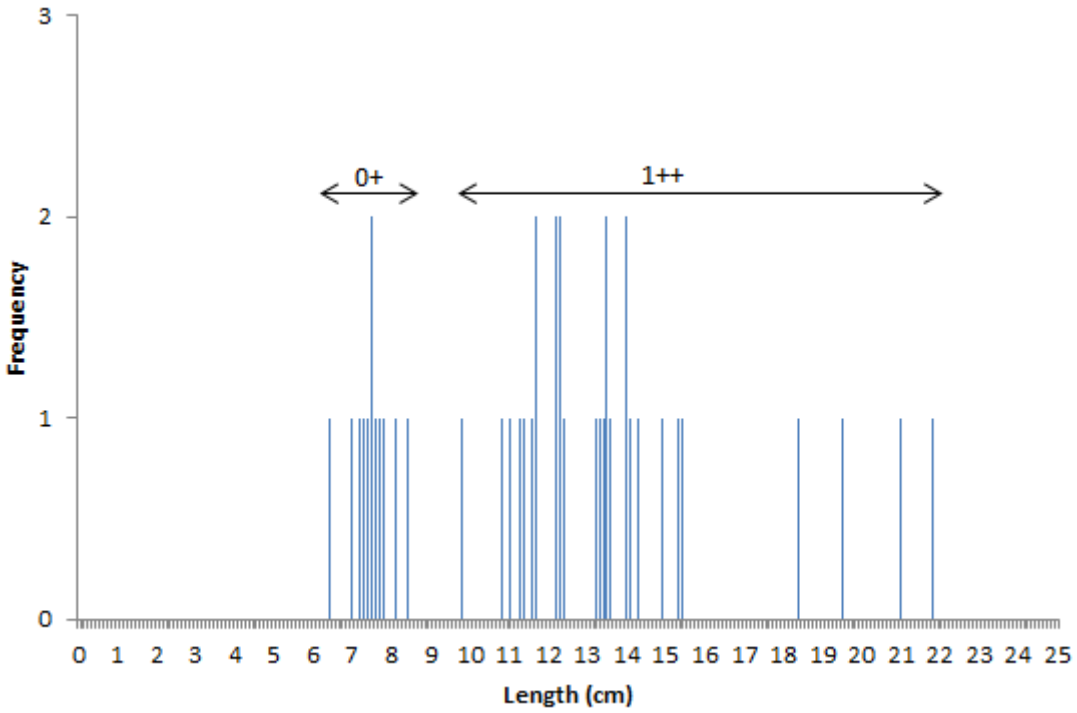

Figure 3.36. Length frequency of brown trout captured at Millersford Brook Site 2 (n=42). In the absence of growth analysis, highlighted age cohorts are indicative only.

3.10 Millersford Brook Site 3

3.10.1 Site description

Millersford Brook Site 3 is located within an area of broadleaf / mixed woodland and moorland / heath, with canopy cover along approximately 90 % of the surveyed river stretch (see Section 2.1.5). Table 3.27 below summarises the key physical characteristics of the 100 m survey site, and Appendix 10 provides a photographic record of habitat variability. The mean wetted width was 1.75 m, with an overall surveyed area of 157.5 m^2.

The river reach comprised a diversity of habitat types. Substrate was largely comprised of gravel, pebble and cobbles. In-river characteristics appeared to be typical of salmonid habitat, with a diversity of flow types, gravel/pebble/cobble substrate, holding pools and bankside/riparian cover.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.28.

Table 3.27. Habitat data recorded during the electric fishing survey at Millersford Brook Site 3.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	20	10	10	10	10	40		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent				30	40	30		
Instream vegetation: **5 %**		Silted? **No**		Substrate: **Stable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	10	40	20			10	20	
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	30	10	60					
Right bank %	30	10	60					
Total LB fish cover: **40 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **40 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / Simple / **Complex**				RB Bankface vegetation: Bare / Uniform / Simple / **Complex**				
LB Banktop vegetation: Bare / Uniform / Simple / **Complex**				RB Banktop vegetation: Bare / Uniform / Simple / **Complex**				
LB Overhanging Boughs (%): **25**			RB Overhanging Boughs (%):**25**			Canopy Cover (%): **90**		

Table 3.28. Physico-chemical parameters recorded at Millersford Brook Site 3 during the fish survey.

Parameter	Value
Temperature (°C)	15.8
Dissolved Oxygen (%)	96.7
Dissolved Oxygen (mgl^{-1})	9.57
pH	Probe failure
Conductivity (μScm^{-1})	206

3.10.2 Electric fishing survey results

A total of 26 fish were captured at Millersford Brook Site 3, comprising a single species; brown trout. The total number captured, length range (cm) and catch depletion density estimate for each life stage are shown in Table 3.29. The National Fisheries Classification Scheme (NFCS) classifications for 0+ and 1++ brown trout are also shown.

Table 3.29. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Millersford Brook Site 3. National Fisheries Classification Scheme (NFCS) grades are also provided for brown trout.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density ($No./100m^2$)	NFCS Classification
Brown trout (0+)	7 (7.1 – 9.5)	7	0.78	6	8	4	D (Fair/Poor)
Brown trout (1++)	19 (11.0 – 19.5)	19	0.73	17	21	12	B (Good)
TOTAL	**26**						

A length frequency chart is provided in Figure 3.37 below. Age cohorts (0+ and 1++) have been displayed on the chart; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

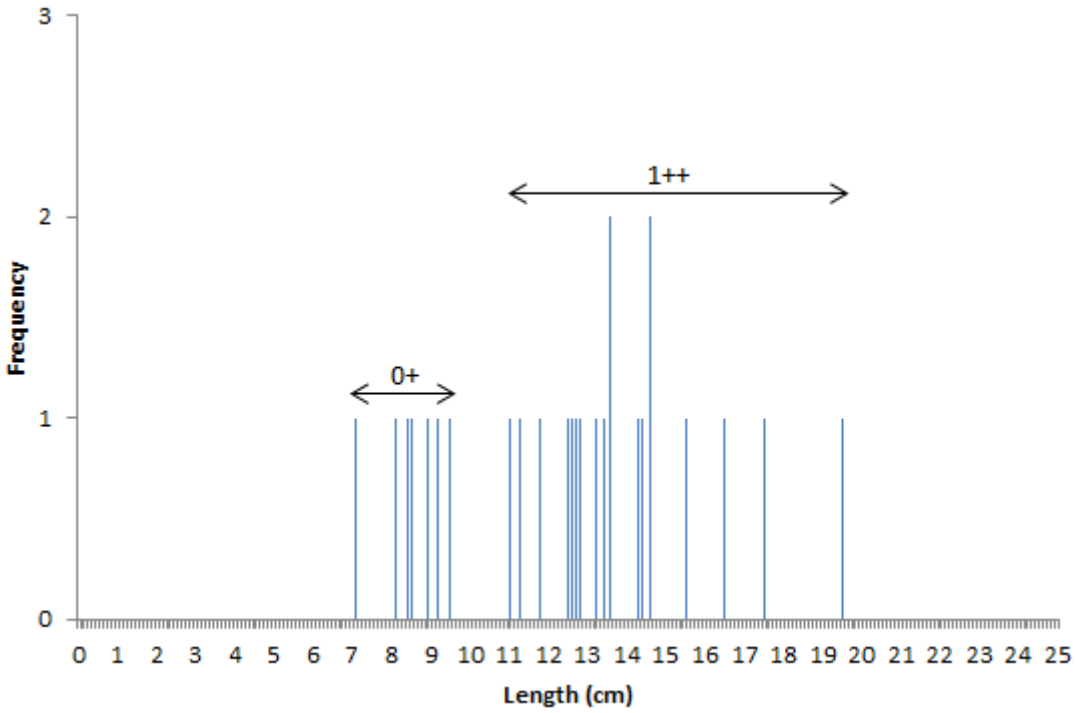

Figure 3.37. Length frequency of brown trout captured at Millersford Brook Site 3 (n=26). In the absence of growth analysis, highlighted age cohorts are indicative only.

3.11 Pondhead Site 1

3.11.1 Site description

Pondhead Site 1 is located within an area of broadleaf / mixed woodland, with canopy cover along approximately 90 % of the surveyed river stretch. Although not within the proposed works area; this site was chosen as a control for Pondhead Site 2, which is located immediately upstream and at the lower extent of the works area (see Section 2.1.6). Table 3.30 below summarises the key physical characteristics of the 100 m survey site, and Appendix 11 provides a photographic record of habitat variability. The mean wetted width was 2.31 m, with an overall surveyed area of 230.9 m^2.

The river reach comprised a diversity of habitat types. Substrate was largely comprised of gravel, pebble and cobbles. In-river characteristics appeared to be typical of salmonid habitat, with a diversity of flow types, gravel/pebble/cobble substrate, holding pools and bankside/riparian cover.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.31.

Table 3.30. Habitat data recorded during the electric fishing survey at Pondhead Site 1.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	20	10	10	10	30	20		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent		10		30	30	30		
Instream vegetation: **0 %**		Silted? **No**		Substrate: **Stable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	10	30	10	10	10	10	20	
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	20	10	70					
Right bank %	20	10	70					
Total LB fish cover: **30 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **30 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / **Simple** / Complex				RB Bankface vegetation: Bare / Uniform / **Simple** / Complex				
LB Banktop vegetation: Bare / Uniform / **Simple** / Complex				RB Banktop vegetation: Bare / Uniform / **Simple** / Complex				
LB Overhanging Boughs (%): **5**			RB Overhanging Boughs (%): **5**			Canopy Cover (%): **90**		

Table 3.31. Physico-chemical parameters recorded at Pondhead Site 1 during the fish survey.

Parameter	Value
Temperature (°C)	13.8
Dissolved Oxygen (%)	68.0
Dissolved Oxygen (mgl^{-1})	7.03
pH	Probe failure
Conductivity (μScm^{-1})	222

3.11.2 Electric fishing survey results

A total of 289 fish were captured at Pondhead Site 1, comprising eight species. Bullhead was the most abundant species captured, followed by minnow, stoneloach and brown trout (Figure 3.38).

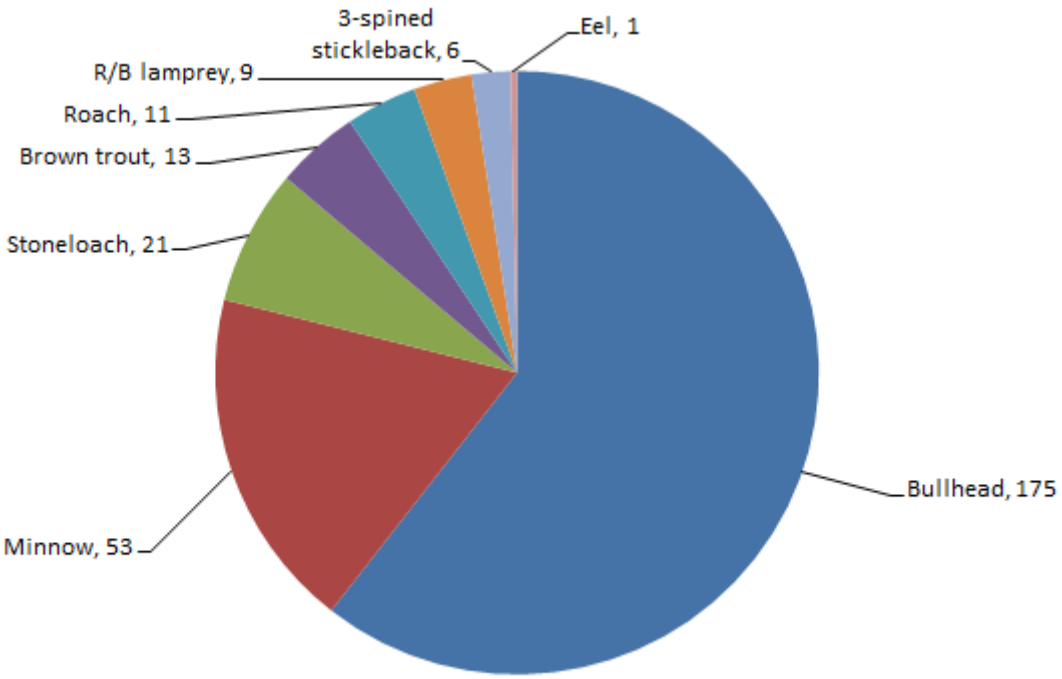

Figure 3.38. Species composition (total number captured) at Pondhead Site 1.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.32. The National Fisheries Classification Scheme (NFCS) classifications for 0+ and 1++ brown trout are also shown.

Table 3.32. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Pondhead Site 1. National Fisheries Classification Scheme (NFCS) grades are also provided for brown trout.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)	NFCS Classification
Bullhead	175 (1.9 – 7.9)	271	0.29	183	359	117	N/A
Minnow	53 (1.2 – 9.3)	70	0.37	43	97	30	N/A
Stoneloach	21 (3.6 – 11.1)	24	0.47	15	33	10	N/A
Brown trout (0+)	3 (6.9 – 8.1)	3	0.43	-1	7	1	E (Poor)
Brown trout (1++)	10 (13.2 – 22.7)	10	0.77	9	11	4	D (Fair/Poor)
Roach	11 (5.7 – 6.5)	13	0.42	5	21	6	N/A
R/B lamprey	9 (6.5 – 14.5)	16	0.21	-23	55	7	N/A
3-spined stickleback	6 (2.4 – 4.5)	6	0.55	3	9	3	N/A
Eel	1 (55.0)	1	1.00	1	1	<1	N/A
TOTAL	**289**						

Length frequency charts for the most abundant fish species recorded are provided in Figure 3.39 to Figure 3.43 below. Where relevant, age cohorts (0+ and 1++) have been displayed on the charts; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

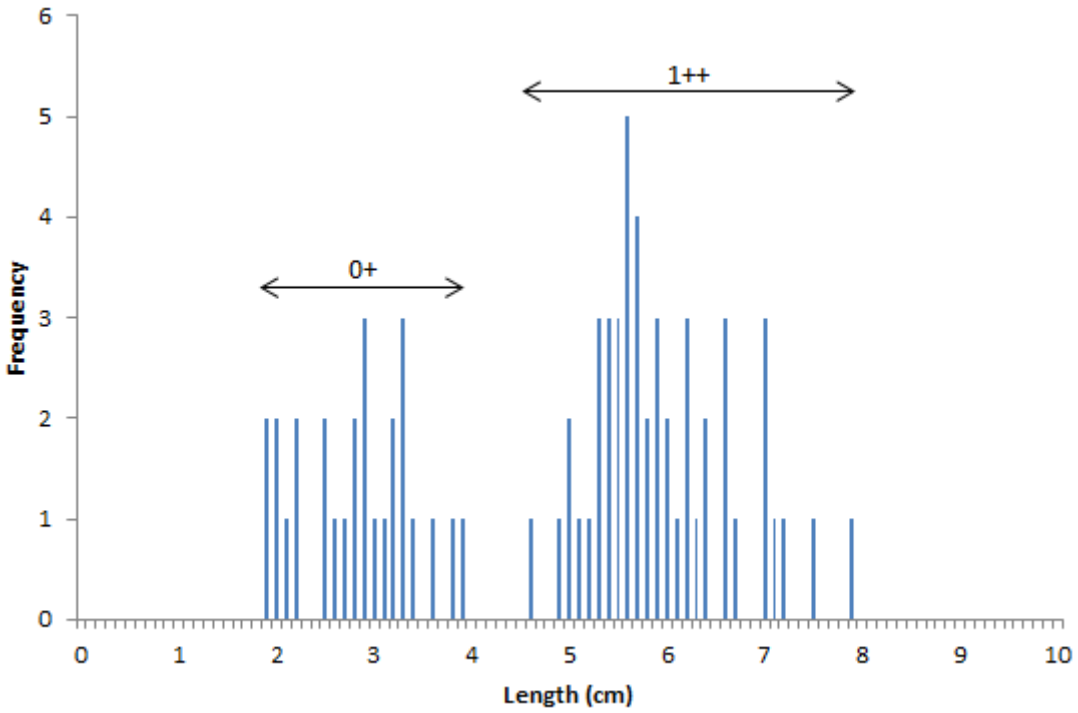

Figure 3.39. Length frequency of bullhead captured at Pondhead Site 1 (n=76). In the absence of growth analysis, highlighted age cohorts are indicative only.

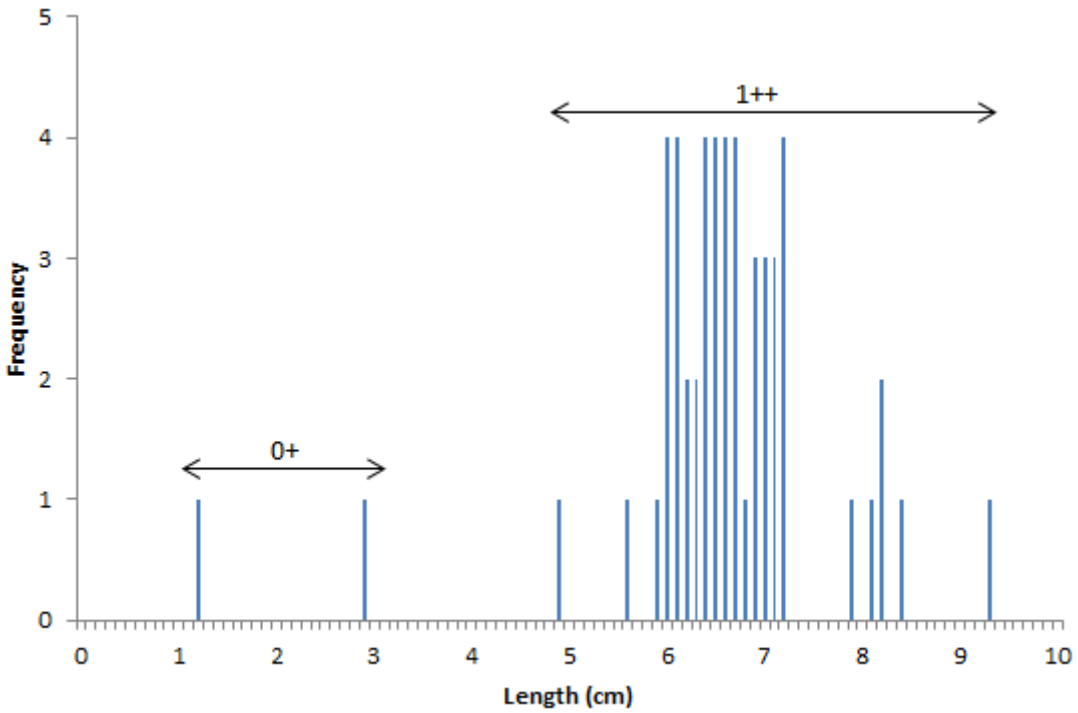

Figure 3.40. Length frequency of minnow captured at Pondhead Site 1 (n=53). In the absence of growth analysis, highlighted age cohorts are indicative only.

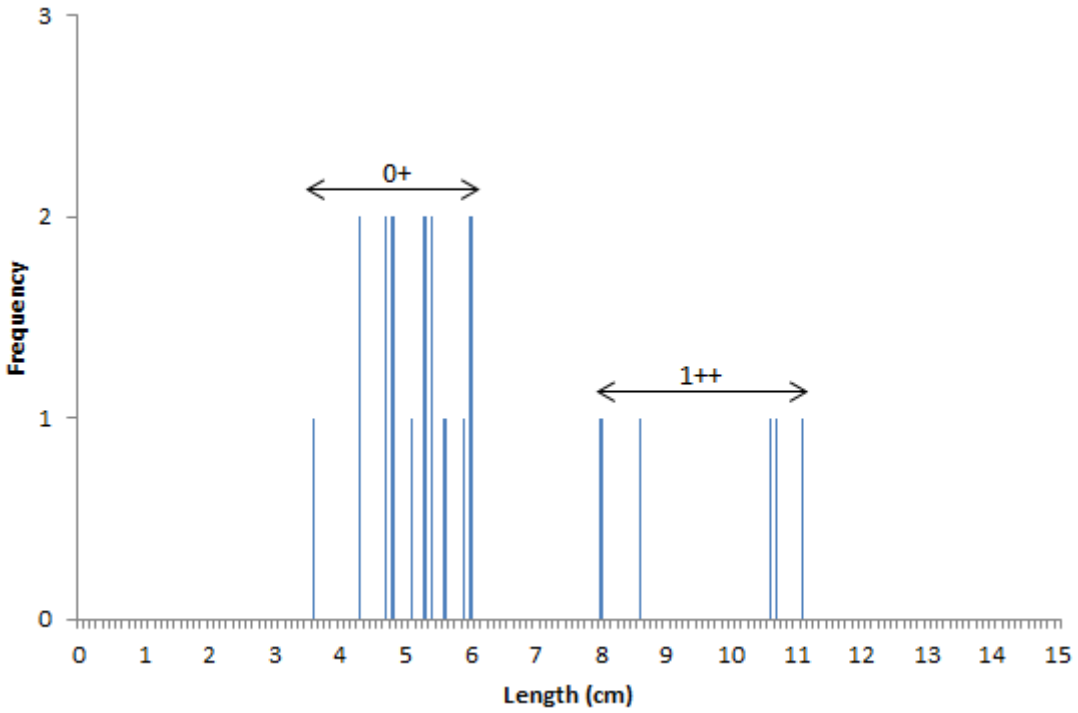

Figure 3.41. Length frequency of stoneloach captured at Pondhead Site 1 (n=21). In the absence of growth analysis, highlighted age cohorts are indicative only.

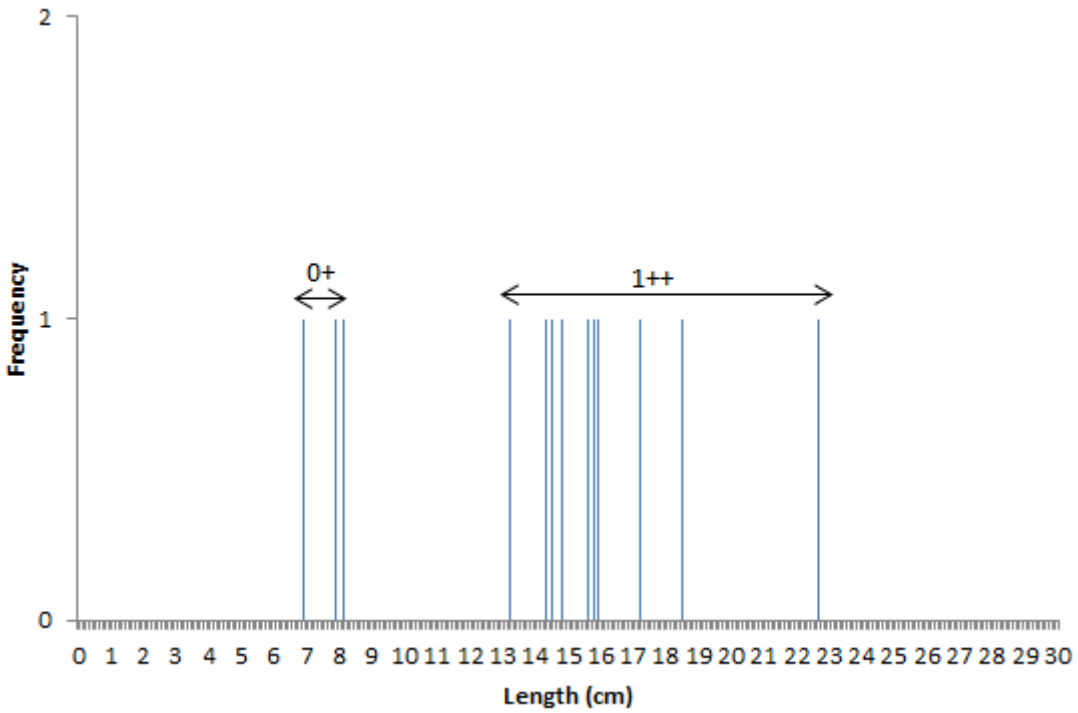

Figure 3.42. Length frequency of brown trout captured at Pondhead Site 1 (n=13). In the absence of growth analysis, highlighted age cohorts are indicative only.

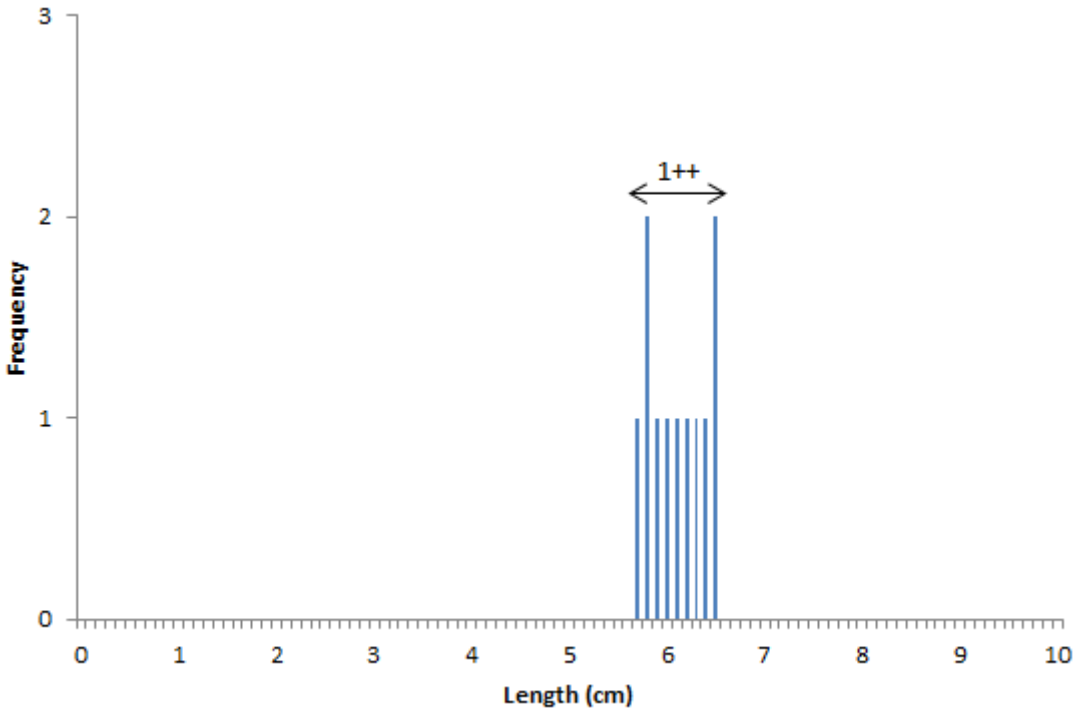

Figure 3.43. Length frequency of roach captured at Pondhead Site 1 (n=11). In the absence of growth analysis, highlighted age cohorts are indicative only.

3.12 Pondhead Site 2

3.12.1 Site description

Pondhead Site 2 is located within an area of broadleaf / mixed woodland, with canopy cover along approximately 90 % of the surveyed river stretch. This site is located at the downstream extent of the proposed works area and is immediately upstream of Pondhead Site 1 (see Section 2.1.6). Table 3.33 below summarises the key physical characteristics of the 100 m survey site, and Appendix 12 provides a photographic record of habitat variability. The mean wetted width was 2.10 m, with an overall surveyed area of 210.0 m^2.

The river reach comprised a diversity of habitat types. Substrate was largely comprised of gravel, pebble and cobbles. Although parts of the reach were canalised; in general, in-river characteristics appeared to be typical of salmonid habitat, with a diversity of flow types, gravel/pebble/cobble substrate, holding pools and bankside/riparian cover.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.34.

Table 3.33. Habitat data recorded during the electric fishing survey at Pondhead Site 2.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	20	10	20	20	20	10		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent		20		50	20	10		
Instream vegetation: **20 %**		Silted? **Yes**		Substrate: **Stable** & **Partly compacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	20	10	50			10	10	
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	10		90					
Right bank %	10		90					
Total LB fish cover: **10 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **10 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / Simple / **Complex**				RB Bankface vegetation: Bare / Uniform / Simple / **Complex**				
LB Banktop vegetation: Bare / Uniform / Simple / **Complex**				RB Banktop vegetation: Bare / Uniform / Simple / **Complex**				
LB Overhanging Boughs (%): **0**			RB Overhanging Boughs (%): **0**			Canopy Cover (%): **90**		

Table 3.34. Physico-chemical parameters recorded at Pondhead Site 2 during the fish survey.

Parameter	Value
Temperature (°C)	13.8
Dissolved Oxygen (%)	68.0
Dissolved Oxygen (mgl^{-1})	7.03
pH	Probe failure
Conductivity (μScm^{-1})	222

3.12.2 Electric fishing survey results

A total of 275 fish were captured at Pondhead Site 2, comprising seven species. Bullhead was the most abundant species captured, followed by minnow, stoneloach and brown trout (Figure 3.44).

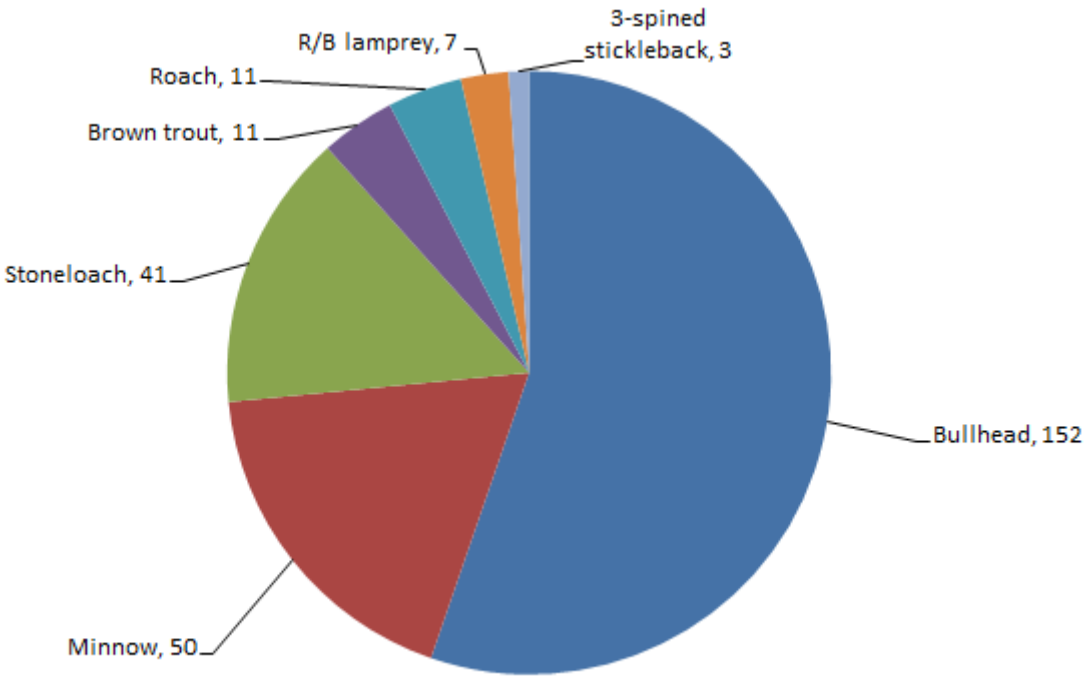

Figure 3.44. Species composition (total number captured) at Pondhead Site 2.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.35. The National Fisheries Classification Scheme (NFCS) classifications for 0+ and 1++ brown trout are also shown.

Table 3.35. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Pondhead Site 2. National Fisheries Classification Scheme (NFCS) grades are also provided for brown trout.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)	NFCS Classification
Bullhead	152 (1.8 – 6.8)	552	0.10	-311	1415	265	N/A
Minnow	50 (2.2 – 7.6)	54	0.57	47	61	26	N/A
Stoneloach	41 (3.3 – 11.8)	46	0.51	37	55	22	N/A
Brown trout (0+)	2 (7.6 – 8.3)	2	0.67	1	3	1	E (Poor)
Brown trout (1++)	9 (12.3 – 21.3)	9	0.75	8	10	4	D (Fair/Poor)
Roach	11 (5.6 – 7.6)	12	0.21	7	17	6	N/A
R/B lamprey	7 (11.0 – 13.6)	12	0.39	-21	45	6	N/A
3-spined stickleback	3 (2.4 – 2.9)	4	0.58	-8	16	2	N/A
TOTAL	**275**						

Length frequency charts for the most abundant fish species recorded are provided in Figure 3.45 to Figure 3.49 below. Where relevant, age cohorts (0+ and 1++) have been displayed on the charts; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

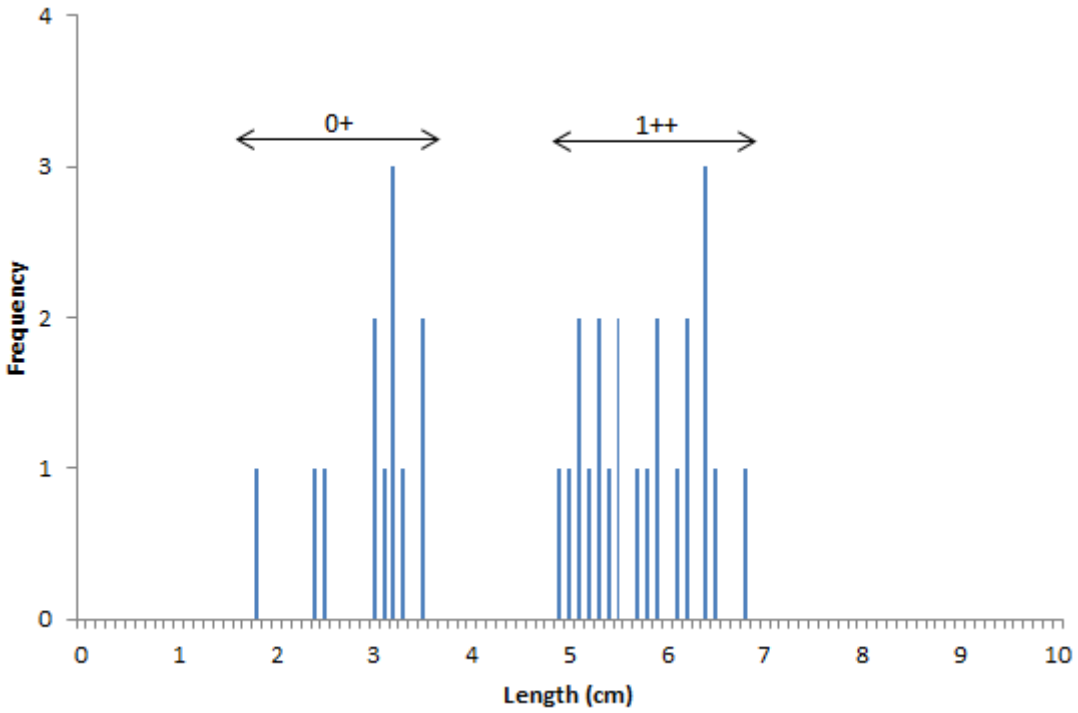

Figure 3.45. Length frequency of bullhead captured at Pondhead Site 2 (n=34). In the absence of growth analysis, highlighted age cohorts are indicative only.

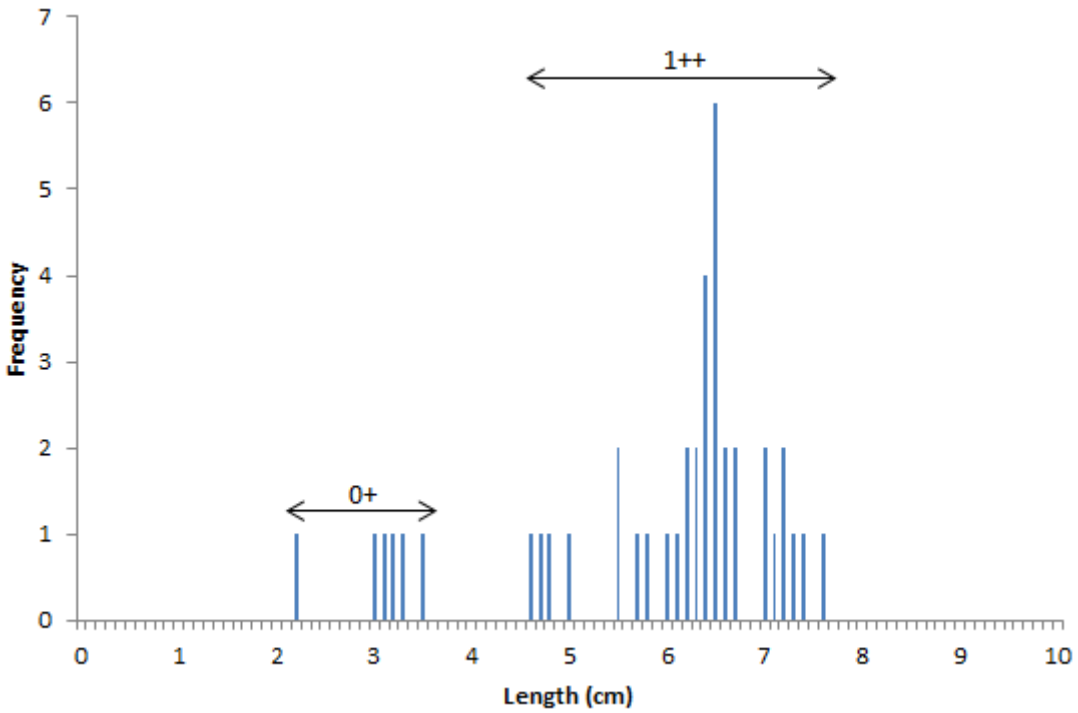

Figure 3.46. Length frequency of minnow captured at Pondhead Site 2 (n=42). In the absence of growth analysis, highlighted age cohorts are indicative only.

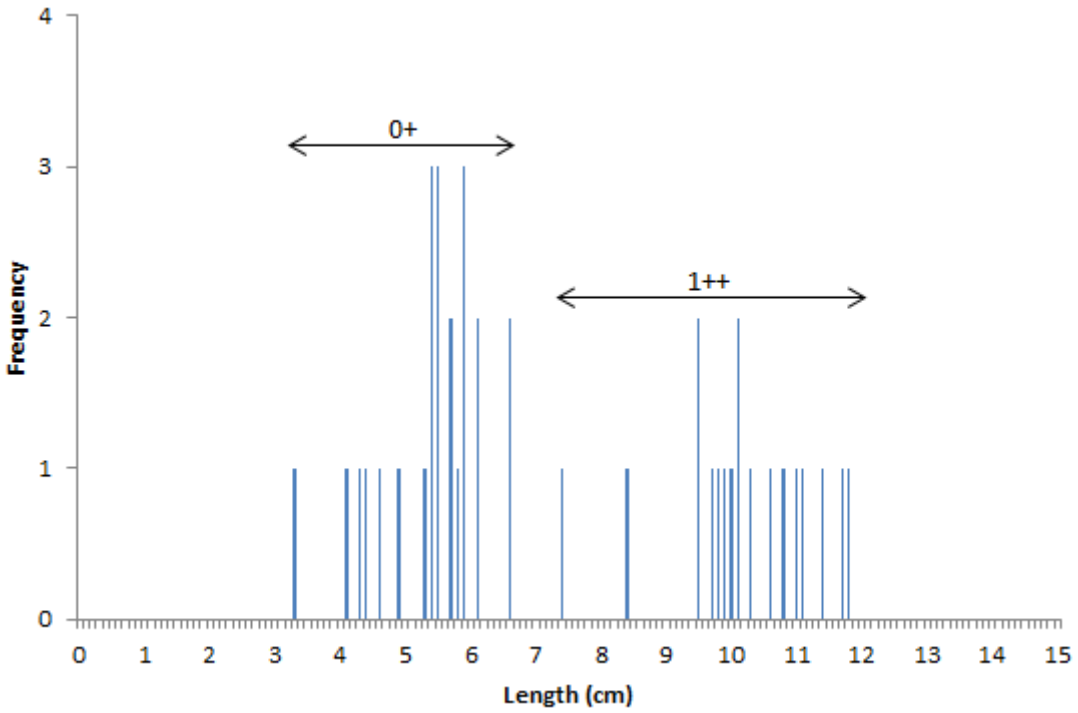

Figure 3.47. Length frequency of stoneloach captured at Pondhead Site 2 (n=41). In the absence of growth analysis, highlighted age cohorts are indicative only.

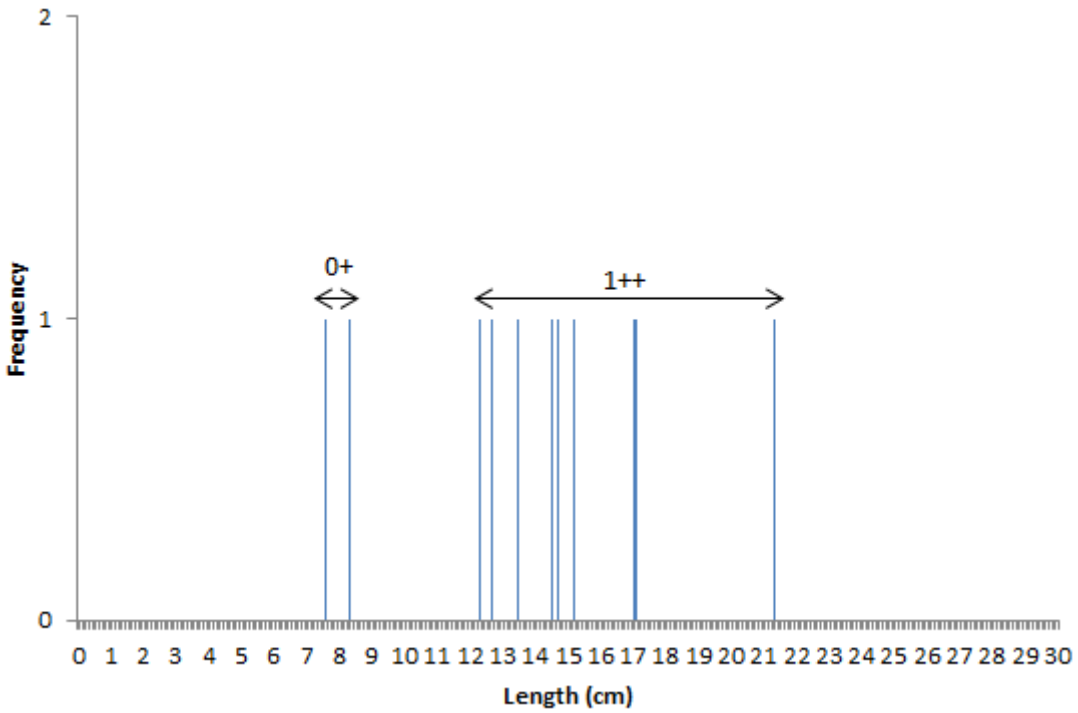

Figure 3.48. Length frequency of brown trout captured at Pondhead Site 2 (n=11). In the absence of growth analysis, highlighted age cohorts are indicative only.

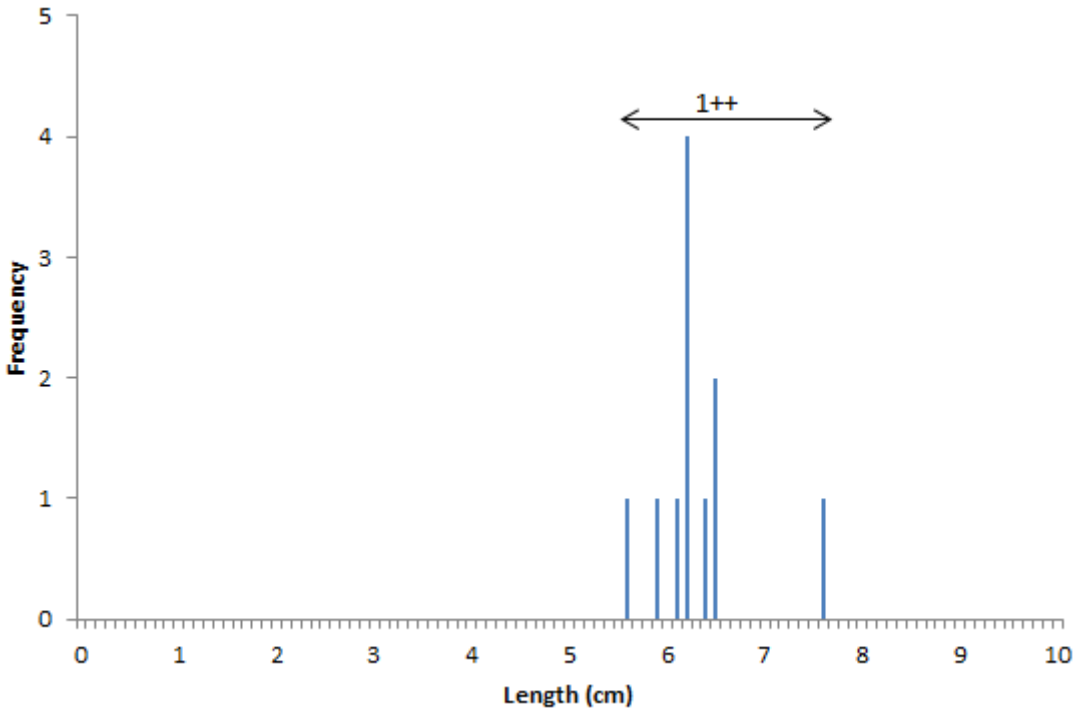

Figure 3.49. Length frequency of roach captured at Pondhead Site 2 (n=11). In the absence of growth analysis, highlighted age cohorts are indicative only.

3.13 Soldiers Bog

3.13.1 Site description

Soldiers Bog is located within an area of broadleaf / mixed woodland and moorland / heath; however, canopy cover was absent along the surveyed river stretch. The site is located toward the downstream extent of the works area (see Section 2.1.7). Table 3.36 below summarises the key physical characteristics of the 100 m survey site, and Appendix 13 provides a photographic record of habitat variability. The mean wetted width was 1.96 m, with an overall surveyed area of 196.4 m^2.

The river reach of this post-restoration site comprised a diversity of habitat types, resulting from in-channel modifications and raised bed levels. Substrate was largely comprised of gravel, and pebble. In general, in-river characteristics appeared to be typical of salmonid habitat, with a diversity of flow types, gravel/pebble/cobble substrate, holding pools and bankside/riparian cover.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.37.

Table 3.36. Habitat data recorded during the electric fishing survey at Soldiers Bog.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	20	65	10	5				
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent		30		60	10			
Instream vegetation: **10 %**		Silted? **Yes**		Substrate: **Stable** & **Partly compacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	20				60		20	
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	20	10						
Right bank %	20	10						
Total LB fish cover: **30 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **30 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / **Simple** / Complex				RB Bankface vegetation: Bare / Uniform / **Simple** / Complex				
LB Banktop vegetation: Bare / Uniform / **Simple** / Complex				RB Banktop vegetation: Bare / Uniform / **Simple** / Complex				
LB Overhanging Boughs (%): **0**			RB Overhanging Boughs (%): **0**			Canopy Cover (%): **0**		

Table 3.37. Physico-chemical parameters recorded at Soldiers Bog during the fish survey.

Parameter	Value
Temperature (°C)	20.9
Dissolved Oxygen (%)	92.8
Dissolved Oxygen (mgl^{-1})	8.28
pH	Probe failure
Conductivity (μScm^{-1})	142

3.13.2 Electric fishing survey results

A total of 115 fish were captured at Soldiers Bog, comprising five species. Minnow was the most abundant species captured, followed by stoneloach and brown trout (Figure 3.50).

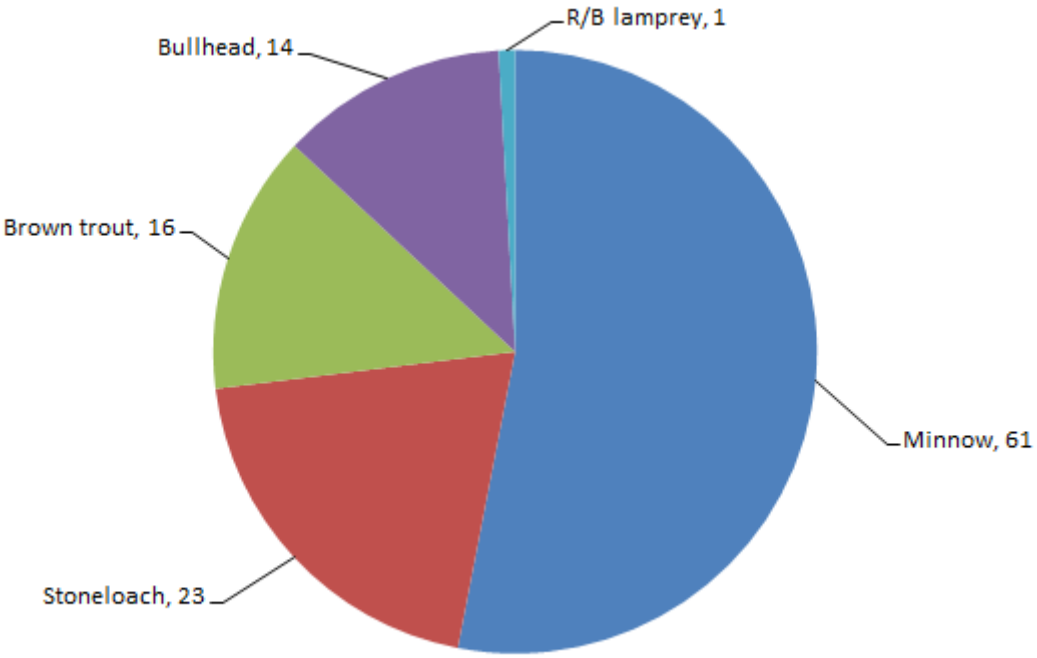

Figure 3.50. Species composition (total number captured) at Soldiers Bog.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.38. The National Fisheries Classification Scheme (NFCS) classifications for 0+ and 1++ brown trout are also shown.

Table 3.38. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at Soldiers Bog. National Fisheries Classification Scheme (NFCS) grades are also provided for brown trout.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)	NFCS Classification
Minnow	61 (1.5 – 7.4)	86	0.33	49	123	44	N/A
Stoneloach	23 (3.2 – 9.0)	30	0.37	12	48	15	N/A
Brown trout (0+)	10 (5.0 – 6.3)	10	0.63	9	12	5	C (Fair)
Brown trout (1++)	6 (9.6 – 16.2)	6	0.86	6	6	3	D (Fair/Poor)
Bullhead	14 (2.7 – 6.0)	14	0.67	12	16	7	N/A
R/B lamprey	1 (11.5)	1	0.33	-3	5	1	N/A
TOTAL	**115**						

Length frequency charts for the most abundant fish species recorded are provided in Figure 3.51 to Figure 3.54 below. Where relevant, age cohorts (0+ and 1++) have been displayed on the charts; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

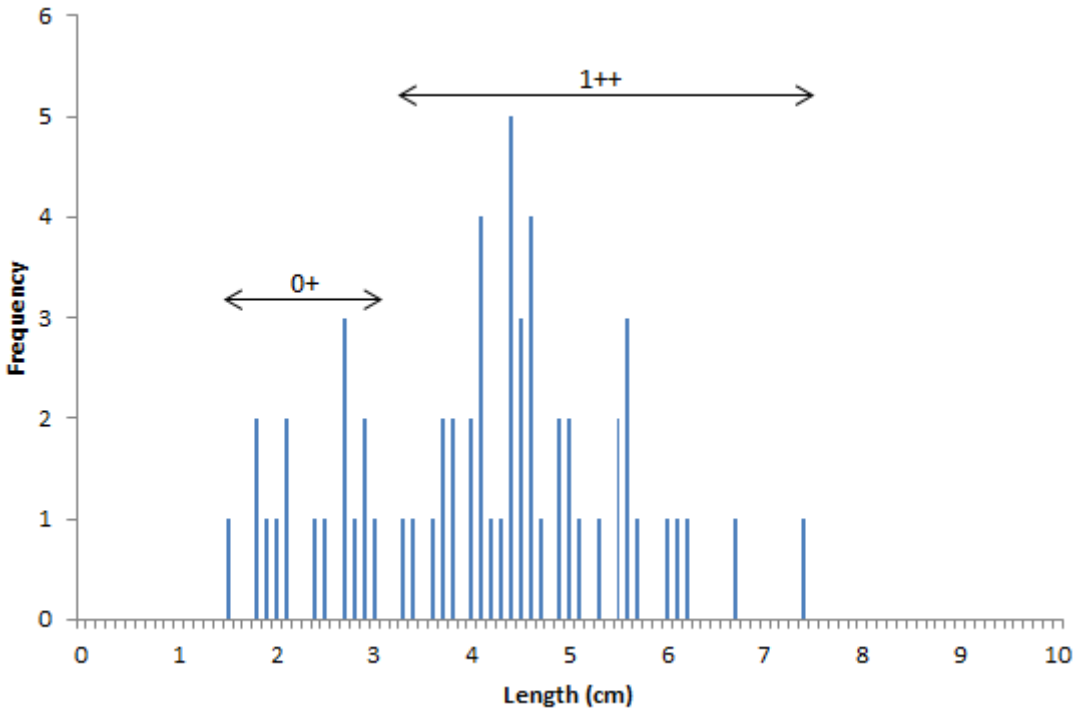

Figure 3.51. Length frequency of minnow captured at Soldiers Bog (n=61). In the absence of growth analysis, highlighted age cohorts are indicative only.

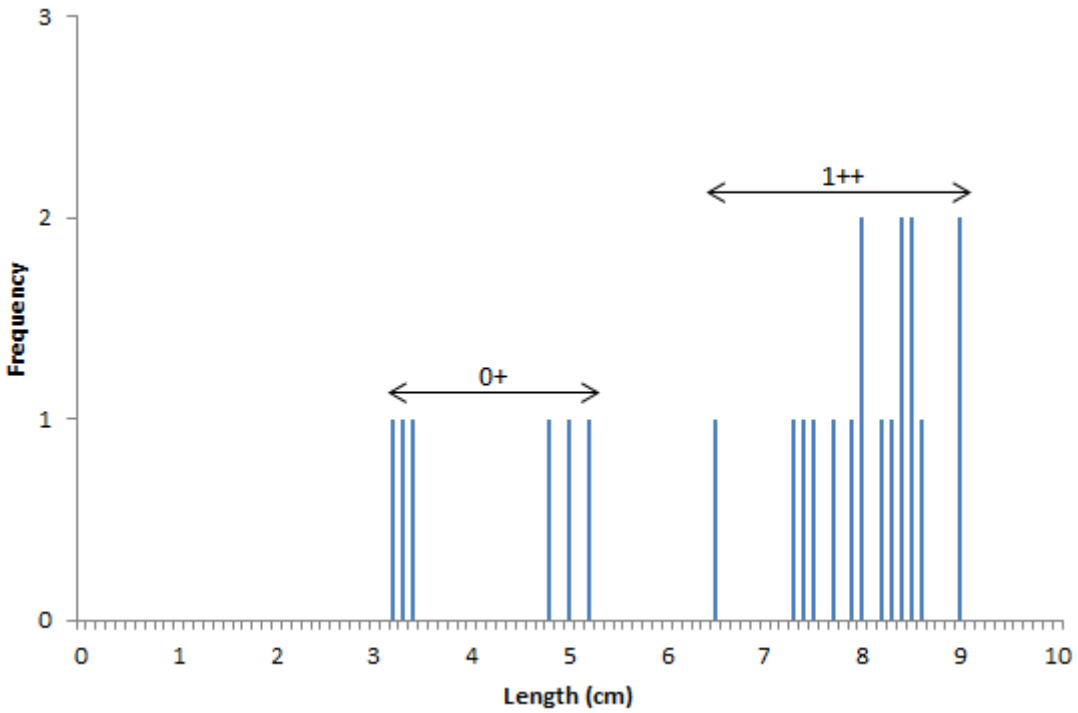

Figure 3.52. Length frequency of stoneloach captured at Soldiers Bog (n=23). In the absence of growth analysis, highlighted age cohorts are indicative only.

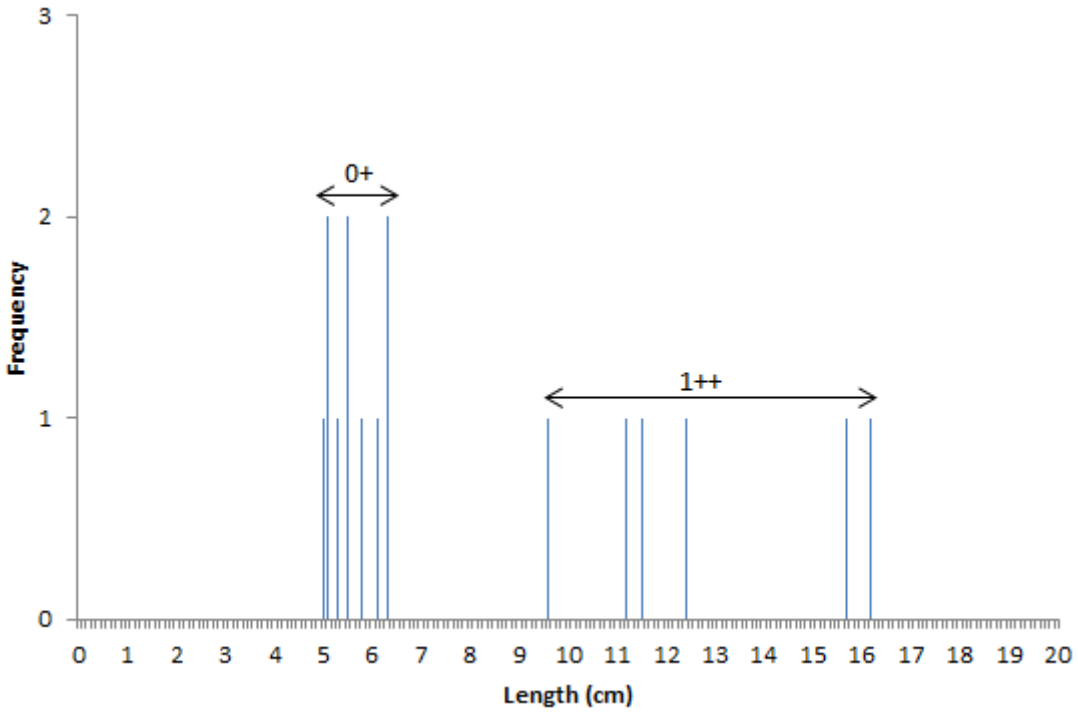

Figure 3.53. Length frequency of brown trout captured at Soldiers Bog (n=16). In the absence of growth analysis, highlighted age cohorts are indicative only.

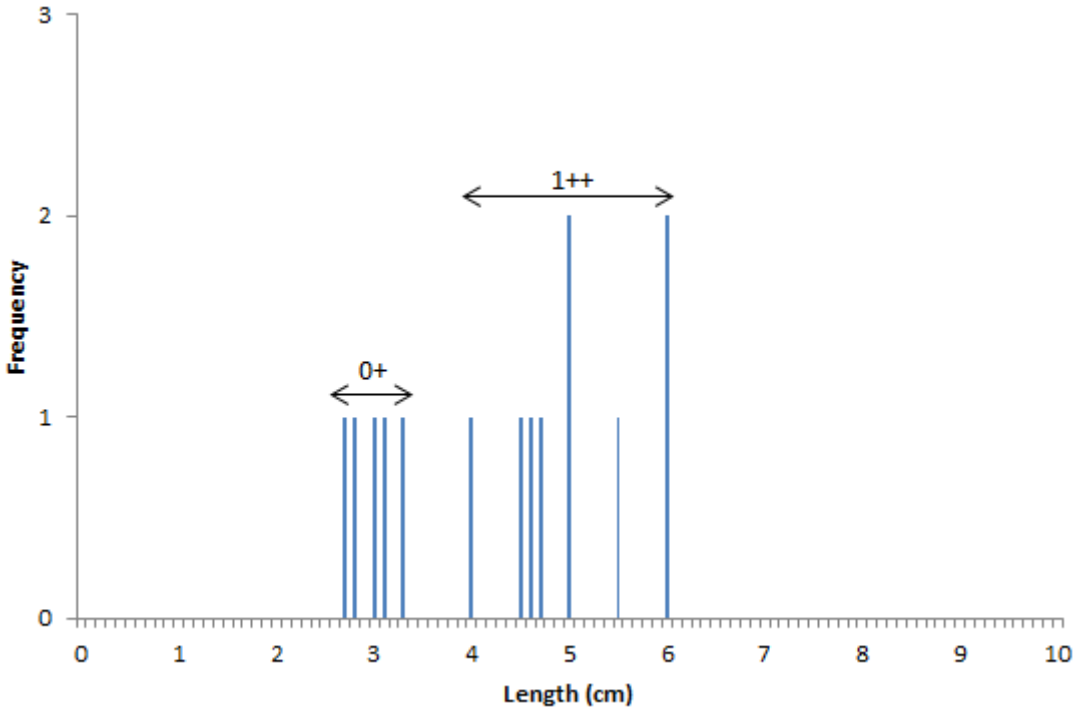

Figure 3.54. Length frequency of bullhead captured at Soldiers Bog (n=14). In the absence of growth analysis, highlighted age cohorts are indicative only.

3.14 South Oakley Site 1

In response to capturing no fish at South Oakley Site 2 (see Section 3.15), a quick 'investigative' survey was conducted at South Oakley Site 1. This site was similar in location and habitat characteristics to South Oakley Site 2, with a perched culvert located under a forest track (Appendix 14). Therefore, to conduct an initial assessment as to the impact that the culverts at both sites may be having on fish populations upstream, the pool immediately below the culvert at South Oakley Site 1 was electric fished to see if any fish were present.

Two brown trout (1++) were captured within the pool and a third brown trout was observed swimming upstream in shallow water toward the pool. Although only an initial assessment, this provides some evidence that the perched culverts at South Oakley Sites 1 and 2 may be impacting the ability of brown trout (and other fish species) to reach the upstream habitat.

3.15 South Oakley Site 2

3.15.1 Site description

South Oakley Site 2 is located within an area of broadleaf / mixed woodland, with canopy cover along approximately 95 % of the surveyed river stretch. This site is located toward the upstream extent of the proposed works area and is immediately upstream of a perched culvert (see Section 2.1.8). Table 3.39 below summarises the key physical characteristics of the 100 m survey site, and Appendix 15 provides a photographic record of habitat variability. The mean wetted width was 1.00 m, with an overall surveyed area of 100.0 m^2.

The river reach comprised a diversity of habitat types; however, the channel was deeply incised and shaded by dense marginal vegetation during the time of the survey. In addition, flows were very low in this small tributary stream. The perched culvert immediately downstream appeared to present an impassable barrier for all fish species. Substrate included areas of gravel, interspersed with areas of sand, silt and organic matter. Although flows were low during the survey; in-river characteristics appeared capable of supporting salmonids (and other fish species), with a diversity of flow types, gravel/pebble/cobble substrate, holding pools and bankside/riparian cover.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.40.

Table 3.39. Habitat data recorded during the electric fishing survey at South Oakley Site 2.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	50		20	10	10	10		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent	10	30	20	50				
Instream vegetation: **0 %**		Silted? **Yes**		Substrate: **Stable** & **Uncompacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent								
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	30	30	20		20			
Right bank %	30	30	20		20			
Total LB fish cover: **80 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **80 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / Simple / **Complex**				RB Bankface vegetation: Bare / Uniform / Simple / **Complex**				
LB Banktop vegetation: Bare / Uniform / Simple / **Complex**				RB Banktop vegetation: Bare / Uniform / Simple / **Complex**				
LB Overhanging Boughs (%): **40**			RB Overhanging Boughs (%):**40**			Canopy Cover (%):**95**		

Table 3.40. Physico-chemical parameters recorded at South Oakley Site 2 during the fish survey.

Parameter	Value
Temperature (°C)	15.9
Dissolved Oxygen (%)	68.2
Dissolved Oxygen (mgl^{-1})	6.74
pH	Probe failure
Conductivity (μScm^{-1})	126

3.15.2 Electric fishing survey results

No fish captured

3.16 South Oakley Site 3

3.16.1 Site description

South Oakley Site 3 is located within an area of broadleaf / mixed woodland, with canopy cover along approximately 90 % of the surveyed river stretch. This site is located toward the mid-point of the proposed works area (see Section 2.1.8). Table 3.41 below summarises the key physical characteristics of the 100 m survey site, and Appendix 16 provides a photographic record of habitat variability. The mean wetted width was 1.35 m, with an overall surveyed area of 135.5 m^2.

The river reach comprised a diversity of habitat types; however, flows were very low during the time of the survey. Substrate included areas of gravel, interspersed with areas of sand, silt and organic matter. Although flows were low during the survey; in-river characteristics appeared capable of supporting salmonids (and other fish species), with a diversity of flow types, gravel substrate, holding pools and bankside/riparian cover.

Physico-chemical parameters recorded during the time of the survey are provided in Table 3.42.

Table 3.41. Habitat data recorded during the electric fishing survey at South Oakley Site 3.

Depths (cm)	**< 10**	**11 - 20**	**21 - 30**	**31 - 40**	**41 - 50**	**> 50**		
Percent	30		30	20	10	10		
Substrate	**Organic**	**Silt**	**Sand**	**Gravel**	**Pebble**	**Cobble**	**Boulder**	**Bedrock**
Percent	10	20	20	50				
Instream vegetation: **5 %**		Silted? **No**		Substrate: **Stable** & **Partly compacted**				
Flow	**SM**	**DP**	**SP**	**DG**	**SG**	**RU**	**RI**	**TO**
Percent	30	30	40					
Speed / Level: **Low**	FLOW DEFINITIONS: SM <10cm still/eddy, smooth, silent; DP ≥30cm slow/eddy, smooth, silent; SP <30cm slow/eddy, smooth, silent; DG ≥30cm mod/fast, smooth, silent; SG <30cm mod/fast, smooth, silent; RU fast, unbroken waves, silent; RI fast, broken waves, audible; TO white water, noisy, substrate invisible							
Bankside cover	**UC**	**DR**	**BA**	**MA**	**RT**	**RK**	**OTH**	
Left bank %	20	20	50		10			
Right bank %	20	20	50		10			
Total LB fish cover: **50 %**	DEFINITIONS: UC undercut banks; DR vegetation rooted in riparian zone, branches/leaves touch or almost touch surface; BA no cover or fish can't get to cover due to lack of water; MA veg rooted in stream, excl fully aquatic veg; RT cover provided by exposed roots; RK cover from rocks within bank structure; OTH other bankside cover							
Total RB fish cover: **50 %**								
Bankside land use								
LB Bankface vegetation: Bare / Uniform / Simple / **Complex**				RB Bankface vegetation: Bare / Uniform / Simple / **Complex**				
LB Banktop vegetation: Bare / Uniform / Simple / **Complex**				RB Banktop vegetation: Bare / Uniform / Simple / **Complex**				
LB Overhanging Boughs (%): **5**			RB Overhanging Boughs (%): **5**			Canopy Cover (%): **90**		

Table 3.42. Physico-chemical parameters recorded at South Oakley Site 3 during the fish survey.

Parameter	Value
Temperature (°C)	16.0
Dissolved Oxygen (%)	80.4
Dissolved Oxygen (mgl^{-1})	7.94
pH	Probe failure
Conductivity (μScm^{-1})	138

3.16.2 Electric fishing survey results

A total of 82 fish were captured at South Oakley Site 3, comprising three species. Minnow was the most abundant species captured, followed by stoneloach (Figure 3.55).

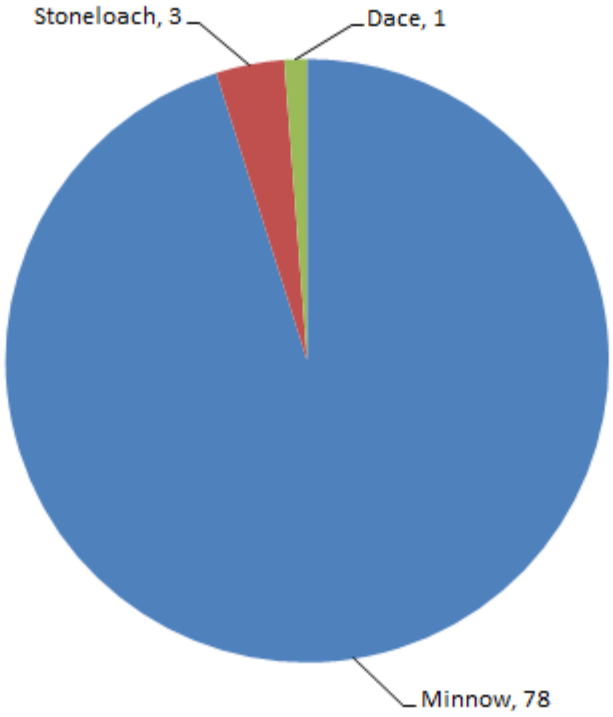

Figure 3.55. Species composition (total number captured) at South Oakley Site 3.

The total number captured, length range (cm) and catch depletion density estimate for each fish species are shown in Table 3.43.

Table 3.43. Number captured and catch depletion estimates (Carle & Strub), including Upper and Lower 95 % Confidence Intervals, for all species recorded at South Oakley Site 3.

Species	No. captured (length range, cm)	Catch depletion population estimate	Catch depletion probability of capture	Catch depletion 95% LCI	Catch depletion 95% UCI	Catch depletion density (No./100m^2)
Minnow	78 (2.1 – 6.9)	88	0.51	75	101	65
Stoneloach	3 (8.0 – 12.5)	3	0.60	2	4	2
Dace	1 (11.5)	1	1.00	1	1	1
TOTAL	**82**					

The length frequency chart for minnow is provided in Figure 3.56 below. Age cohorts (0+ and 1++) have been displayed on the chart; however, in the absence of age and growth analysis, it is emphasised that these are indicative only.

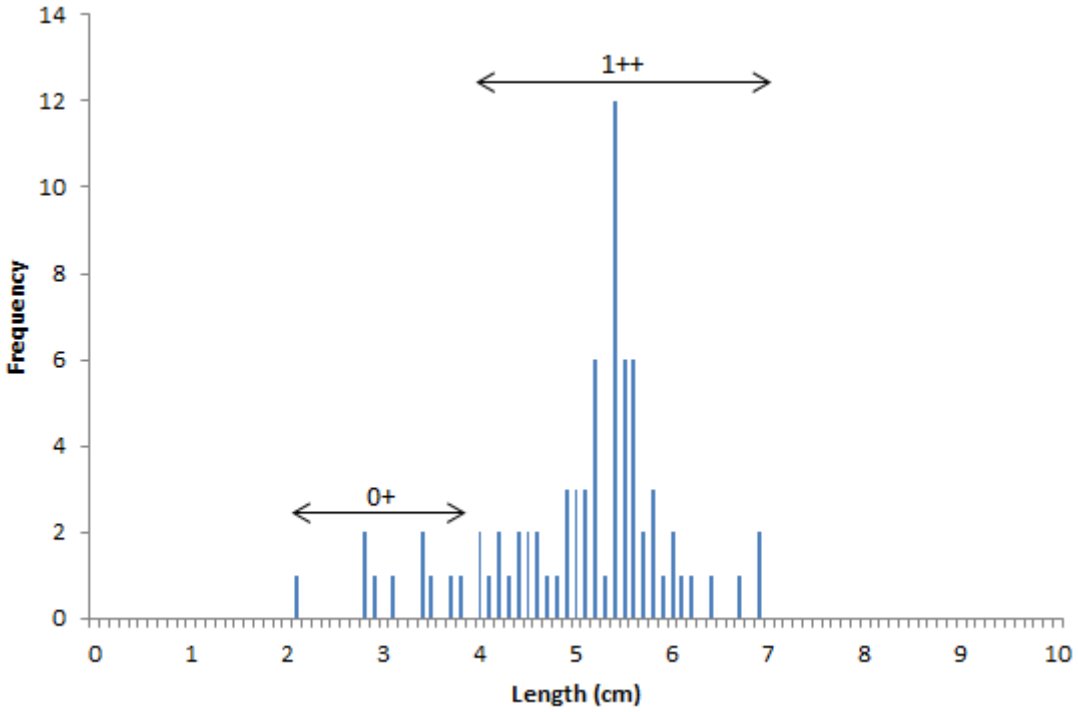

Figure 3.56. Length frequency of minnow captured at South Oakley Site 3 (n=78). In the absence of growth analysis, highlighted age cohorts are indicative only.

4. RESULTS – REDD COUNTS

4.1 Drivers Nursery

No redds or evidence of sea trout spawning were observed within the works area at Drivers Nursery. River level was relatively high; however, habitat throughout the reach was not considered suitable salmonid spawning habitat, with few areas of high energy and/or gravel substrate present.

4.2 Harvestslade

No redds or evidence of sea trout spawning were observed within the works area at Harvestslade. However; the river level was relatively low, which may have restricted sea trout access to the upper reaches of the river system.

4.3 Linford Brook

No redds or evidence of sea trout spawning were observed within the works area at Linford Brook. However; the river level was relatively low, which may have restricted sea trout access to the upper reaches of the river system. A substantial debris dam was recorded in the middle of the works area (Figure 4.1), which constituted a total barrier to fish movement upstream under the flow conditions at the time of the survey.

Figure 4.1. Debris dam recorded during the redd count survey at Linford Brook.

4.4 Longwater

A single sea trout redd (80 cm x 50 cm x 20 cm) was recorded within the works area at Longwater (Figure 4.2 and Figure 4.3). Two large (~ 45 cm) sea trout were observed spawning on this redd. In addition, a large (~ 45 cm) female sea trout (pre-spawning) was observed in a shallow bay nearby. A smaller resident brown trout redd (40 cm x 40 cm x 10 cm) was also observed just downstream.

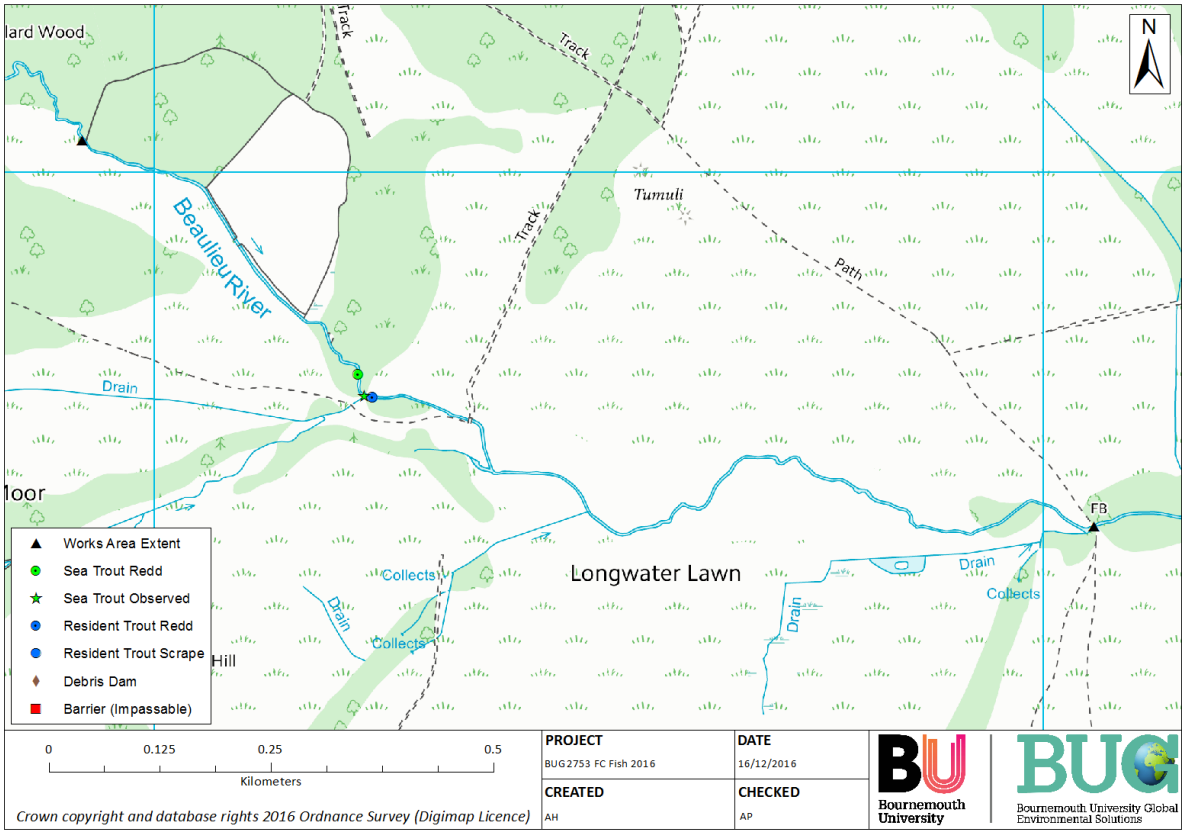

Figure 4.2. Observations recorded during the redd count survey at Longwater.

Figure 4.3. Sea trout redd observed during the survey at Longwater. Two large sea trout were observed spawning on this redd.

4.5 Millersford Brook

No redds or evidence of sea trout spawning were observed within the works area at Millersford Brook. However; the river level was relatively low, which may have restricted sea trout access to the upper reaches of the river system. In particular, the shallow nature of the channel at the downstream extent of the works area would likely have constituted an impassable barrier under the flows observed during the survey.

4.6 Pondhead

No redds or evidence of sea trout spawning were observed within the works area at Pondhead. However; the river level was relatively low, which may have restricted sea trout access to the upper reaches of the river system. Furthermore, upstream of the bifurcation within the works area, the habitat comprised mainly a narrow, shallow ditch with extensive poaching; considered unsuitable for salmonid spawning (Figure 4.4).

Figure 4.4. Typical ditch habitat upstream of the bifurcation at Pondhead, considered unsuitable for salmonid spawning.

4.7 Soldiers Bog

No redds or evidence of sea trout spawning were observed within the works area at Soldiers Bog. However; the river level was relatively low, which may have restricted sea trout access to the upper reaches of the river system. A single resident brown trout redd (40 cm x 30 cm x 10 cm) and a small resident brown trout scrape (40 cm x 20 cm x 10 cm) were observed toward the lower extent of the works area (Figure 4.5 and Figure 4.6).

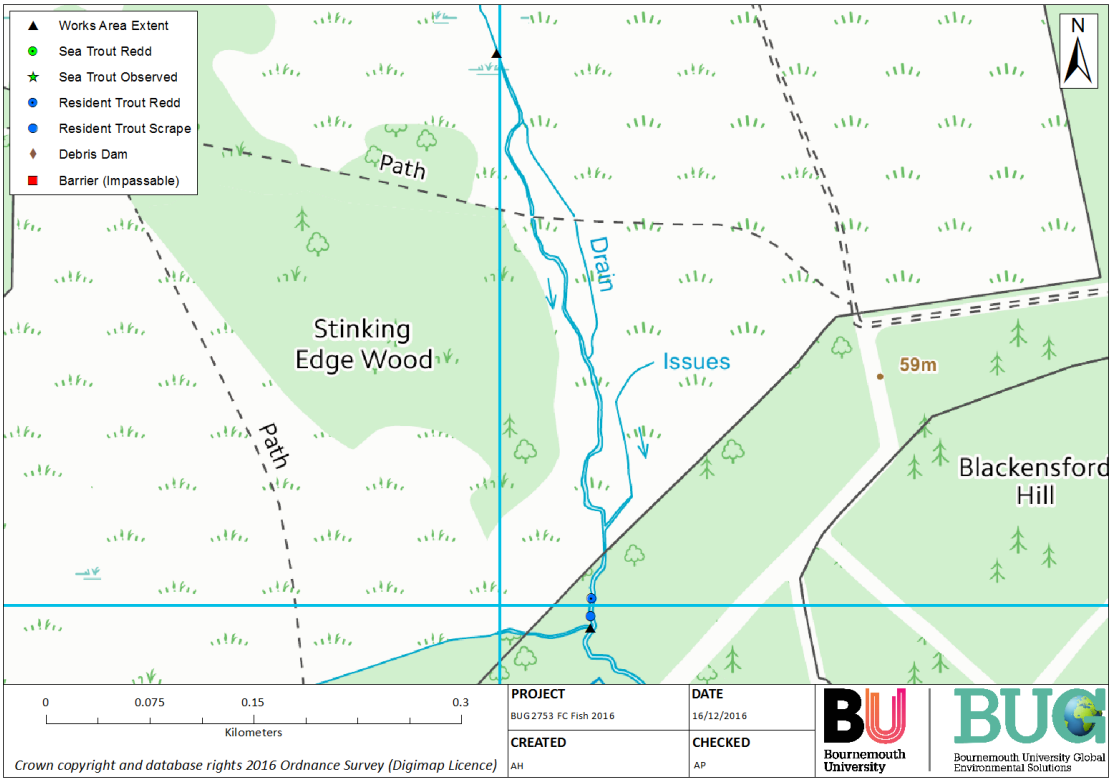

Figure 4.5. Observations recorded during the redd count survey at Soldiers Bog.

Figure 4.6. Small resident brown trout redd observed during the survey at Soldiers Bog.

4.8 South Oakley

A single sea trout redd (100 cm x 35 cm x 10 cm) was recorded within the works area at South Oakley (Figure 4.7, Figure 4.8 and Figure 4.9), immediately downstream of a debris dam (Figure 4.10) considered impassable under the flows observed during the survey. A large (~ 45 cm) sea trout was observed on this redd, with three smaller (resident) brown trout also present. In addition, two large (~ 45 cm and 35 cm) sea trout were observed in a pool immediately downstream of a debris dam (Figure 4.11). A smaller resident brown trout redd (50 cm x 40 cm x 10 cm) was also observed toward the downstream extent of the survey area (Figure 4.12).

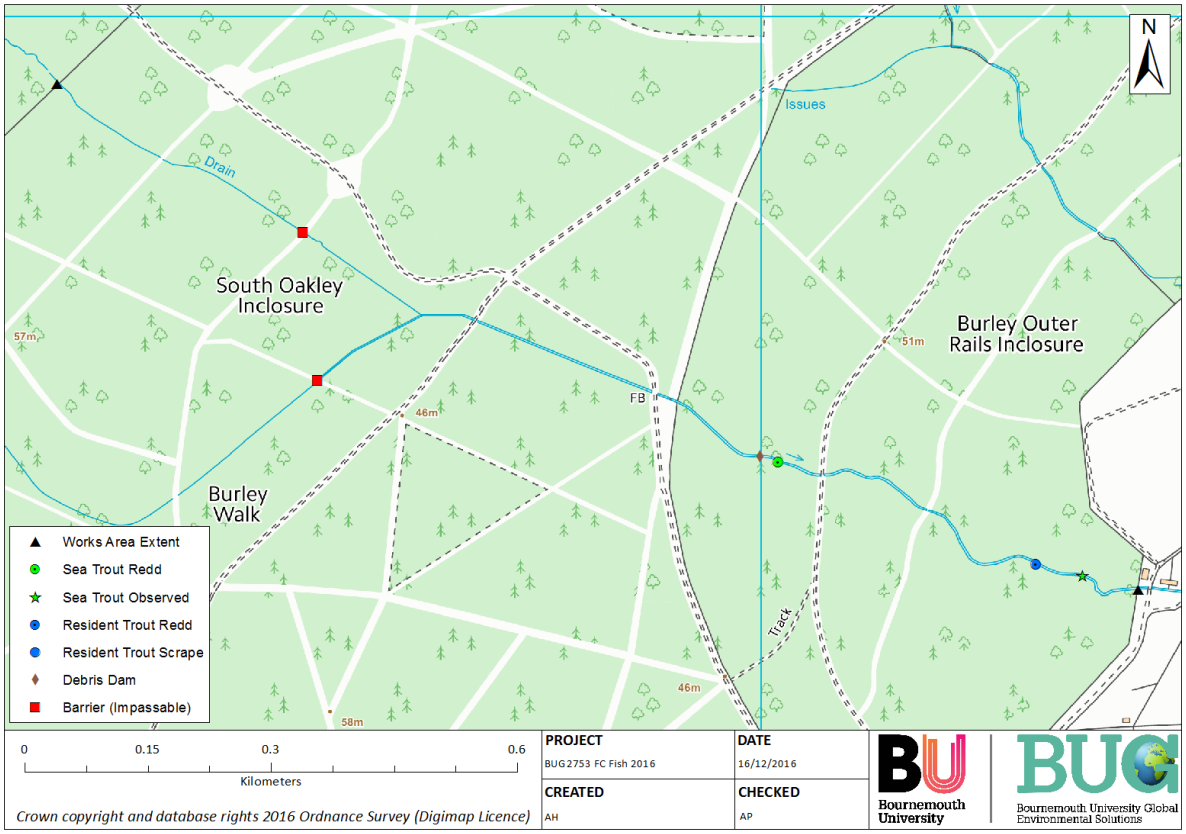

Figure 4.7. Observations recorded during the redd count survey at South Oakley.

Figure 4.8. Sea trout redd with large female sea trout just visible (white arrow) observed during the survey at South Oakley.

Figure 4.9. The same sea trout redd as above observed during the survey at South Oakley.

Figure 4.10. Debris dam located immediately upstream of the sea trout redd observed during the survey at South Oakley.

Figure 4.11. Pool immediately downstream of debris dam where two large sea trout were observed during the survey at South Oakley.

Figure 4.12. Small resident brown trout redd observed during the survey at South Oakley.

5. SPECIES OF CONSERVATION IMPORTANCE

This section provides information on the fish species of conservation importance that were recorded at each location.

5.1 Drivers Nursery

Table 5.1 highlights the species of conservation importance that were recorded at Drivers Nursery during the electric fishing survey. All species that would be expected to be present were recorded.

Table 5.1. Species of conservation importance that could potentially be present and species that were recorded during the fish survey at Drivers Nursery.

Species	Conservation designation	Potential to be present?	Present?
Brown trout / Sea trout	UK BAP (Priority Species)	Y	Y
Bullhead	Habitats Directive (Annex II)	Y	Y
Eel	EC Eel Regulation (Eels [England and Wales] Regulations, IUCN Red List (Critically Endangered), UK BAP (Priority Species)	Y	Y
Lamprey (Brook)	Habitats Directive (Annex II)	Y	Y
Lamprey (River)	Habitats Directive (Annex II)	Y[1]	N
Lamprey (Sea)	Habitats Directive (Annex II)	Y[1]	N
Salmon	UK BAP (Priority Species), Habitats Directive (Annex II)	Y[2]	N

[1] River and sea lamprey are anadromous species found around the coast of the UK and, therefore, both species could potentially colonise the New Forest streams. However, it is generally accepted that brook lamprey is the only species to inhabit the Lymington River catchment. Notwithstanding this, Environment Agency records indicate the presence of sea lamprey in electric fishing survey data; however, the reliability of these data is unknown. All lamprey recorded are, therefore, assumed to be brook lamprey.

[2] As an anadromous species, salmon have the ability to colonise any rivers with access to/from the sea. However, it is generally accepted that sea trout is the only migratory salmonid species present within the Lymington River.

5.2 Harvestslade

Table **5.2** highlights the species of conservation importance that were recorded at Harvestslade during the electric fishing surveys. All species that would be expected (or that have potential) to be present were recorded.

Table 5.2. Species of conservation importance that could potentially be present and species that were recorded during the fish surveys at Harvestslade.

Species	Conservation designation	Potential to be present?	Present?
Brown trout / Sea trout	UK BAP (Priority Species)	Y	Y

Species	Conservation designation	Potential to be present?	Present?
Bullhead	Habitats Directive (Annex II)	Y	Y
Eel	EC Eel Regulation (Eels [England and Wales] Regulations, IUCN Red List (Critically Endangered), UK BAP (Priority Species)	Y	Y
Lamprey (Brook)	Habitats Directive (Annex II)	Y	Y
Lamprey (River)	Habitats Directive (Annex II)	Y[1]	N
Lamprey (Sea)	Habitats Directive (Annex II)	Y[1]	N
Salmon	UK BAP (Priority Species), Habitats Directive (Annex II)	Y[2]	N

[1] River and sea lamprey are anadromous species found around the coast of the UK and, therefore, both species could potentially colonise the New Forest streams. However, it is generally accepted that brook lamprey is the only species to inhabit the Lymington River catchment. Notwithstanding this, Environment Agency records indicate the presence of sea lamprey in electric fishing survey data; however, the reliability of these data is unknown. All lamprey recorded are, therefore, assumed to be brook lamprey.

[2] As an anadromous species, salmon have the ability to colonise any rivers with access to/from the sea. However, it is generally accepted that sea trout is the only migratory salmonid species present within the Lymington River.

5.3 Linford Brook

Table 5.3 highlights the species of conservation importance that were recorded at Linford Brook during the electric fishing surveys. Of the species expected (or that have potential) to be present, only trout was recorded.

Table 5.3. Species of conservation importance that could potentially be present and species that were recorded during the fish surveys at Linford Brook.

Species	Conservation designation	Potential to be present?	Recorded?
Brown trout / Sea trout	UK BAP (Priority Species)	Y	Y
Bullhead	Habitats Directive (Annex II)	Y	N
Eel	EC Eel Regulation (Eels [England and Wales] Regulations, IUCN Red List (Critically Endangered), UK BAP (Priority Species)	Y	N
Lamprey (Brook)	Habitats Directive (Annex II)	Y	N
Lamprey (River)	Habitats Directive (Annex II)	Y[1]	N
Lamprey (Sea)	Habitats Directive (Annex II)	Y	N
Salmon	UK BAP (Priority Species), Habitats Directive (Annex II)	Y[2]	N

[1] River lamprey is an anadromous species found around the coast of the UK and, therefore, could potentially colonise the New Forest streams. Both sea lamprey and brook lamprey are known to inhabit the River Avon catchment; however, it is generally accepted that river lamprey are absent.

[2] Salmon are known to be present in the Avon Catchment; although, no records are available from Linford Brook.

5.4 Longwater

Table 5.4 highlights the species of conservation importance that were recorded at Longwater during the electric fishing surveys. Of the species expected (or that have potential) to be present, bullhead, eel and brook lamprey were recorded.

Table 5.4. Species of conservation importance that could potentially be present and species that were recorded during the fish surveys at Longwater.

Species	Conservation designation	Potential to be present?	Recorded?
Brown trout / Sea trout	UK BAP (Priority Species)	Y	N
Bullhead	Habitats Directive (Annex II)	Y	Y
Eel	EC Eel Regulation (Eels [England and Wales] Regulations, IUCN Red List (Critically Endangered), UK BAP (Priority Species)	Y	Y
Lamprey (Brook)	Habitats Directive (Annex II)	Y	Y
Lamprey (River)	Habitats Directive (Annex II)	Y[1]	N
Lamprey (Sea)	Habitats Directive (Annex II)	Y[1]	N
Salmon	UK BAP (Priority Species), Habitats Directive (Annex II)	Y[2]	N

[1] River and sea lamprey are anadromous species found around the coast of the UK and, therefore, both species could potentially colonise the New Forest streams. However, it is generally accepted that brook lamprey is the only species to inhabit the Beaulieu River. Notwithstanding this, Environment Agency records indicate the presence of both sea lamprey and river lamprey in electric fishing survey data; however, the reliability of these data is unknown. All lamprey recorded are, therefore, assumed to be brook lamprey.

[2] As an anadromous species, salmon have the ability to colonise any rivers with access to/from the sea. However, it is generally accepted that sea trout is the only migratory salmonid species present within the Beaulieu River.

5.5 Millersford Brook

Table 5.5 highlights the species of conservation importance that were recorded at Millersford Brook during the electric fishing surveys. Of the species expected (or that have potential) to be present, only trout was recorded.

Table 5.5. Species of conservation importance that could potentially be present and species that were recorded during the fish surveys at Millersford Brook.

Species	Conservation designation	Potential to be present?	Recorded?
Brown trout / Sea trout	UK BAP (Priority Species)	Y	Y
Bullhead	Habitats Directive (Annex II)	Y	N
Eel	EC Eel Regulation (Eels [England and Wales] Regulations, IUCN Red List (Critically Endangered), UK BAP (Priority Species)	Y	N
Lamprey (Brook)	Habitats Directive (Annex II)	Y	N

Species	Conservation designation	Potential to be present?	Recorded?
Lamprey (River)	Habitats Directive (Annex II)	Y[1]	N
Lamprey (Sea)	Habitats Directive (Annex II)	Y	N
Salmon	UK BAP (Priority Species), Habitats Directive (Annex II)	Y[2]	N

[1] River lamprey is an anadromous species found around the coast of the UK and, therefore, could potentially colonise the New Forest streams. Both sea lamprey and brook lamprey are known to inhabit the River Avon catchment; however, it is generally accepted that river lamprey are absent.

[2] Salmon are known to be present in the Avon Catchment; although, no records are available from Millersford Brook.

5.6 Pondhead

Table 5.6 highlights the species of conservation importance that were recorded at Pondhead during the electric fishing surveys. All species that would be expected to be present were recorded.

Table 5.6. Species of conservation importance that could potentially be present and species that were recorded during the fish surveys at Pondhead.

Species	Conservation designation	Potential to be present?	Recorded?
Brown trout / Sea trout	UK BAP (Priority Species)	Y	Y
Bullhead	Habitats Directive (Annex II)	Y	Y
Eel	EC Eel Regulation (Eels [England and Wales] Regulations, IUCN Red List (Critically Endangered), UK BAP (Priority Species)	Y	Y
Lamprey (Brook)	Habitats Directive (Annex II)	Y	Y
Lamprey (River)	Habitats Directive (Annex II)	Y[1]	N
Lamprey (Sea)	Habitats Directive (Annex II)	Y[1]	N
Salmon	UK BAP (Priority Species), Habitats Directive (Annex II)	Y[2]	N

[1] River and sea lamprey are anadromous species found around the coast of the UK and, therefore, both species could potentially colonise the New Forest streams. However, it is generally accepted that brook lamprey is the only species to inhabit the Beaulieu River. Notwithstanding this, Environment Agency records indicate the presence of both sea lamprey and river lamprey in electric fishing survey data; however, the reliability of these data is unknown. All lamprey recorded are, therefore, assumed to be brook lamprey.

[2] As an anadromous species, salmon have the ability to colonise any rivers with access to/from the sea. However, it is generally accepted that sea trout is the only migratory salmonid species present within the Beaulieu River.

5.7 Soldiers Bog

Table 5.7 highlights the species of conservation importance that were recorded at Soldiers Bog during the electric fishing surveys. Of the species expected (or that have potential) to be present, trout, bullhead and brook lamprey were recorded.

Table 5.7. Species of conservation importance that could potentially be present and species that were recorded during the fish surveys at Soldiers Bog.

Species	Conservation designation	Potential to be present?	Recorded?
Brown trout / Sea trout	UK BAP (Priority Species)	Y	Y
Bullhead	Habitats Directive (Annex II)	Y	Y
Eel	EC Eel Regulation (Eels [England and Wales] Regulations, IUCN Red List (Critically Endangered), UK BAP (Priority Species)	Y	N
Lamprey (Brook)	Habitats Directive (Annex II)	Y	Y
Lamprey (River)	Habitats Directive (Annex II)	Y[1]	N
Lamprey (Sea)	Habitats Directive (Annex II)	Y[1]	N
Salmon	UK BAP (Priority Species), Habitats Directive (Annex II)	Y[2]	N

[1] River and sea lamprey are anadromous species found around the coast of the UK and, therefore, both species could potentially colonise the New Forest streams. However, it is generally accepted that brook lamprey is the only species to inhabit the Lymington River. Notwithstanding this, Environment Agency records indicate the presence of sea lamprey in electric fishing survey data; however, the reliability of these data is unknown. All lamprey recorded are, therefore, assumed to be brook lamprey.

[2] As an anadromous species, salmon have the ability to colonise any rivers with access to/from the sea. However, it is generally accepted that sea trout is the only migratory salmonid species present within the Lymington River.

5.8 South Oakley

Table 5.8 highlights the species of conservation importance that were recorded at South Oakley during the electric fishing surveys. Of the species expected (or that have potential) to be present, none were recorded. Note: Both sea trout and brown trout were observed during the subsequent redd count survey.

Table 5.8. Species of conservation importance that could potentially be present and species that were recorded during the fish surveys at South Oakley.

Species	Conservation designation	Potential to be present?	Recorded?
Brown trout / Sea trout	UK BAP (Priority Species)	Y	N
Bullhead	Habitats Directive (Annex II)	Y	N
Eel	EC Eel Regulation (Eels [England and Wales] Regulations, IUCN Red List (Critically Endangered), UK BAP (Priority Species)	Y	N
Lamprey (Brook)	Habitats Directive (Annex II)	Y	N
Lamprey (River)	Habitats Directive (Annex II)	Y[1]	N
Lamprey (Sea)	Habitats Directive (Annex II)	Y[1]	N
Salmon	UK BAP (Priority Species), Habitats Directive (Annex II)	Y[2]	N

[1] River and sea lamprey are anadromous species found around the coast of the UK and, therefore, both species could potentially colonise the New Forest streams. However, it is generally accepted that brook lamprey is the only species to inhabit the Lymington River. Notwithstanding this, Environment Agency records indicate the presence of sea lamprey in

electric fishing survey data; however, the reliability of these data is unknown. All lamprey recorded are, therefore, assumed to be brook lamprey.

[2] As an anadromous species, salmon have the ability to colonise any rivers with access to/from the sea. However, it is generally accepted that sea trout is the only migratory salmonid species present within the Lymington River.

Figure A1.1. Upstream stop net and typical habitat at Drivers Nursery.

Figure A1.2. Typical habitat at Drivers Nursery .

Figure A1.3. Typical habitat at Drivers Nursery.

Figure A1.4. Typical habitat at Drivers Nursery.

Figure A1.5. Downstream stop net and typical habitat at Drivers Nursery.

Figure A1.6. Brown trout captured at Drivers Nursery.

Figure A1.7. Pike captured at Drivers Nursery.

Figure A2.1. Upstream stop net and typical habitat at Harvestslade Site 1.

Figure A2.2. Typical habitat at Harvestslade Site 1.

Figure A2.3. Typical habitat at Harvestslade Site 1.

Figure A2.4. Typical habitat at Harvestslade Site 1.

Figure A2.5. Typical habitat at Harvestslade Site 1.

Figure A2.6. Downstream stop net and typical habitat at Harvestslade Site 1.

Figure A2.7. Brown trout captured at Harvestslade Site 1.

Figure A3.1. Upstream stop net and typical habitat at Harvestslade Site 2.

Figure A3.2. Typical habitat at Harvestslade Site 2.

Figure A3.3. Typical habitat at Harvestslade Site 2.

Figure A3.4. Typical habitat at Harvestslade Site 2.

Figure A3.5. Typical habitat at Harvestslade Site 2.

Figure A3.6. Downstream stop net and typical habitat at Harvestslade Site 2.

Figure A3.7. Brown trout captured at Harvestslade Site 2.

Figure A4.1. Upstream stop net and typical habitat at Linford Brook Site 1.

Figure A4.2. Typical habitat at Linford Brook Site 1.

Figure A4.3. Typical habitat at Linford Brook Site 1.

Figure A4.4. Typical habitat at Linford Brook Site 1.

Figure A4.5. Typical habitat at Linford Brook Site 1.

Figure A4.6. Typical habitat at Linford Brook Site 1.

Figure A4.7. Downstream stop net and typical habitat at Linford Brook Site 1.

Figure A4.8. Brown trout captured at Linford Brook Site 1.

Figure A5.1. Upstream stop net and typical habitat at Linford Brook Site 2.

Figure A5.2. Typical habitat at Linford Brook Site 2.

Figure A5.3. Typical habitat at Linford Brook Site 2.

Figure A5.4. Downstream stop net and typical habitat at Linford Brook Site 2.

Figure A5.5. Chub captured at Linford Brook Site 2.

Figure A5.6. Brown trout captured at Linford Brook Site 2.

Figure A6.1. Upstream stop net and typical habitat at Longwater Site 1 (upstream section).

Figure A6.2. Typical habitat at Longwater Site 1 (upstream section).

Figure A6.3. Typical habitat at Longwater Site 1 (upstream section).

Figure A6.4. Typical habitat at Longwater Site 1 (downstream section).

Figure A6.5. Severely poached banks at Longwater Site 1 (downstream section).

Figure A6.6. Typical habitat at Longwater Site 1 (downstream section).

Figure A6.7. Typical habitat at Longwater Site 1 (downstream section).

Figure A6.8. Roach captured at Longwater Site 1.

Figure A7.1. Upstream stop net and typical habitat at Longwater Site 2.

Figure A7.2. Typical habitat at Longwater Site 2.

Figure A7.3. Typical habitat at Longwater Site 2.

Figure A7.4. Typical habitat at Longwater Site 2.

Figure A7.5. Typical habitat at Longwater Site 2.

Figure A7.6. Downstream stop net and typical habitat at Longwater Site 2.

Figure A7.7. Silver eel captured at Longwater Site 2.

Figure A8.1. Upstream stop net and typical habitat at Millersford Brook Site 1.

Figure A8.2. Typical habitat at Millersford Brook Site 1.

Figure A8.3. Typical habitat at Millersford Brook Site 1.

Figure A8.4. Typical habitat at Millersford Brook Site 1.

Figure A8.5. Typical habitat at Millersford Brook Site 1.

Figure A9.1. Upstream stop net and typical habitat at Millersford Brook Site 2.

Figure A9.2. Left hand bank riparian land use at Millersford Brook Site 2.

Figure A9.3. Typical habitat at Millersford Brook Site 2.

Figure A9.4. Typical habitat at Millersford Brook Site 2.

Figure A9.5. Typical habitat at Millersford Brook Site 2.

Figure A9.6. Typical habitat at Millersford Brook Site 2.

Figure A9.7. Downstream stop net and typical habitat at Millersford Brook Site 2.

Figure A9.8. Brown trout captured at Millersford Brook Site 2.

Figure A9.9. Brown trout captured at Millersford Brook Site 2.

Figure A9.10. Brown trout captured at Millersford Brook Site 2.

Figure A10.1. Upstream stop net and typical habitat at Millersford Brook Site 3.

Figure A10.2. Typical habitat at Millersford Brook Site 3.

Figure A10.3. Typical habitat at Millersford Brook Site 3.

Figure A10.4. Typical habitat at Millersford Brook Site 3.

Figure A10.5. Typical habitat at Millersford Brook Site 3.

Figure A10.6. Typical habitat at Millersford Brook Site 3.

Figure A10.7. Downstream stop net and typical habitat at Millersford Brook Site 3.

Figure A10.8. Brown trout captured at Millersford Brook Site 3.

Figure A11.1. Upstream stop net and typical habitat at Pondhead Site 1.

Figure A11.2. Typical habitat at Pondhead Site 1.

Figure A11.3. Typical habitat at Pondhead Site 1.

Figure A11.4. Typical habitat at Pondhead Site 1.

Figure A11.5. Downstream stop net and typical habitat at Pondhead Site 1.

Figure A11.6. Brown trout captured at Pondhead Site 1.

Figure A11.7. Brown trout captured at Pondhead Site 1.

Figure A12.1. Upstream stop net and typical habitat at Pondhead Site 2.

Figure A12.2. Typical habitat at Pondhead Site 2.

Figure A12.3. Typical habitat at Pondhead Site 2.

Figure A12.4. Typical habitat at Pondhead Site 2.

Figure A12.5. Typical habitat at Pondhead Site 2. Note U/S excavation for meander restoration.

Figure A12.6. Typical habitat at Pondhead Site 2. Note D/S excavation for meander restoration.

Figure A13.1. Upstream stop net and typical habitat at Soldiers Bog.

Figure A13.2. Typical habitat at Soldiers Bog.

Figure A13.3. Typical habitat at Soldiers Bog.

Figure A13.4. Typical habitat at Soldiers Bog.

Figure A13.5. Downstream stop net and typical habitat at Soldiers Bog.

Figure A13.6. Brown trout captured at Soldiers Bog.

Figure A13.7. Brown trout captured at Soldiers Bog.

Figure A14.1. Downstream end of culvert at South Oakley 1.

Figure A14.2. Downstream end of culvert at South Oakley 1.

Figure A14.3. Habitat immediately downstream of culvert at South Oakley 1.

Figure A14.4. Typical habitat at South Oakley 1.

Figure A14.5. Typical habitat at South Oakley 1.

Figure A14.6. Typical habitat at South Oakley 1.

Figure A14.7. Brown trout captured in the pool below culvert at South Oakley 1.

Figure A15.1. Typical habitat at South Oakley 2.

Figure A15.2. Typical habitat at South Oakley 2.

Figure A15.3. Typical habitat at South Oakley 2.

Figure A15.4. Typical habitat at South Oakley 2.

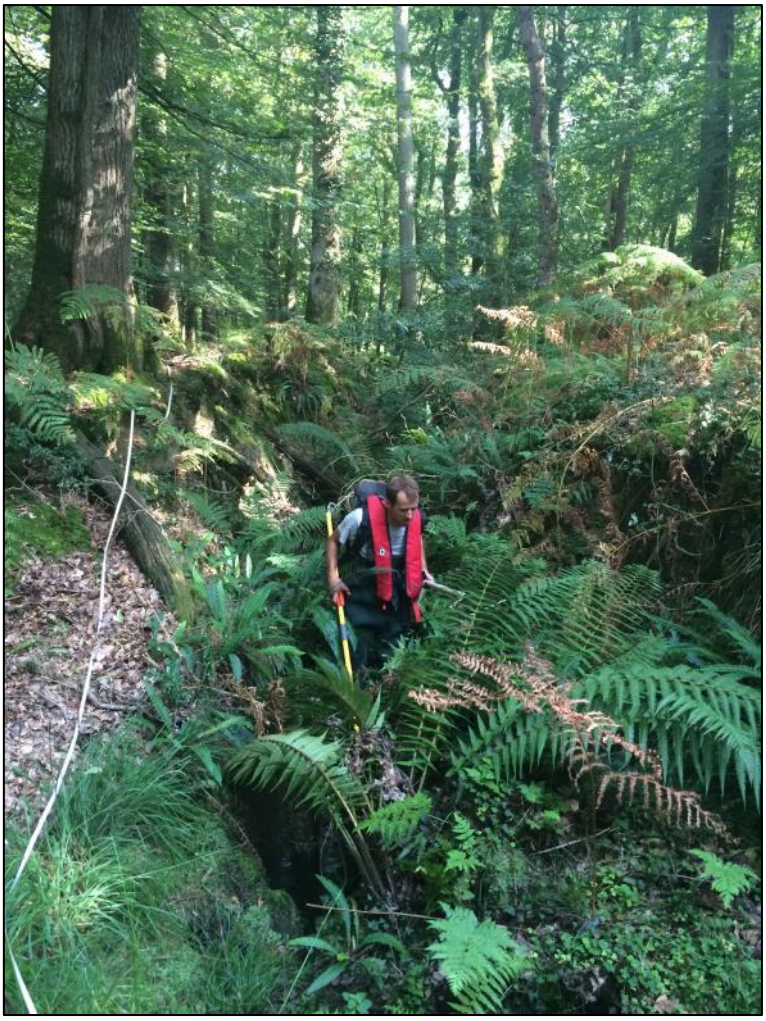

Figure A15.5. Typical habitat at South Oakley 2.

Figure A16.1. Upstream stop net and typical habitat at South Oakley 3.

Figure A16.2. Typical habitat at South Oakley 3.

Figure A16.3. Typical habitat at South Oakley 3.

Figure A16.4. Typical habitat at South Oakley 3.

Figure A16.5. Upstream stop net and typical habitat at South Oakley 3.

Figure A16.6. Typical habitat at South Oakley 3.

Figure A16.7. Typical habitat at South Oakley 3.

Figure A16.8. Typical habitat at South Oakley 3.

Figure A16.9. Downstream stop net and typical habitat at South Oakley 3.