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INVESTIGATION INTO SPRAINTING SITE PREFERENCE OF EUROPEAN OTTER LUTRA LUTRA

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1.Introduction

1.1 Aim

To analyse patterns of otter (*lutra lutra*) sprainting in relationship to the ecology of the environment by investigating and comparing two sites, one known to be used by otters, the other absent of otter signs.

1.2 Study sites

<u>The River Brue at Bruton</u>

Bruton is a small historic town situated within the River Brue upper catchment (see picture XX). Bruton, at an altitude of 70 metres, is 3.5km downstream from the river source at Kingswood Warren (130 metre altitude). From its source the river travels south and is added to by several small tributary. The catchment is small; however, the river has been historically prone to flooding. Bruton Dam provides protection to the town of Bruton. The river from source to Bruton flows through a landscape of grassland with notably wooded hills and areas of good riparian habitat. This is somewhat marred by Bruton Dam and slipway. Directly upstream from Bruton is a small industrial area.

The river flows through the centre of Bruton and is bordered by walkways and park land.

Picture 1: The Brue at Church Bridge, Bruton. Picture: Jo Pearse 2010

Picture 2: Map of the river through Bruton   Picture: http://digimaps.edina.co.uk

River Alham at Eastern Trowbridge, Alhampton

The Alham is made up by springs rising near Higher Alham at an altitude of 150 metres. The Eastern Trowbridge is approximately 10km from source and at an altitude of 40 metres. As it travels towards Alhampton it is joined by several small tributaries. The area is characterised by flat fields of mostly dairy farms. 16km from source it joins the River Brue near Alford (picture 26).

Picture 3: The Alham at Eastern Trowbridge, Alhampton
Picture: Jo Pearse 2011

Picture 4: Map of the river through countryside near Alhampton.
Picture: http://digimap.edina.ac.uk

The research examines differences in water quality, habitat and prey availability and considers other possible factors in the prefence for sprainting or presence of otters. The hypothesis were developed to test a range of theories.

Hypothesis

1. Otter use (as indicated by spraints) of a site is correlated to water quality.
2. Otter use of a site is correlated to habitat quality.
3. Otter use of a site is correlated to prey availability.

2 Literary Review

Standard methodology for otter surveys was developed by Macdonald (1983) and is used across Europe. It uses presence/absence data from spraint surveys on a 600 metre stretch of river. The inherent problem with this method is that the absence of a spraint does not prove that an otter has not visited the site; merely that it did not spraint. Even on sites that are usually regularly sprainted, otters may still visit and not spraint. In one study this was found to be the case. In 50% of the nights that an otter visits a site they left no spraint (Guter, A., Dolev, A., Saltz, D.and Kromfeld-schor 2003).

The distinction is important because the presence/absence data may give more of an understanding of preference of sprainting sites rather than otter populations. However, the density of spraints over time can be used to give a broad estimate of population and can show general trends and significantly any declines.

There is a correlation between otter sprainting behaviour and feeding (Kruuk 1992). It has been suggested that otters spraint for the purpose of informing other otters that an area has been fished and depleted of stock (Kruuk 1992). This is reinforced by a seasonal correlation between fish availability and spraints. This prevents over fishing and avoids aggressive encounters (Gosling 1982). Otter's prefer to spraint close to their holts (with the exception of natal holts), couches (resting up sites) and notable landmarks such as under bridges and at confluence of rivers.

Distribution of otter spraints have been found to positively correlate to tree species, but again conclusions should be tentative. Macdonald and Mason 1983 showed that *fraxinus excelsior* (ash) and *acer pseudoplatnus* (sycamore) had overall 46% of spraints over a 5km stretch of river and that mature *quercus petraea* (sessile oak) made up 14% of holt sites.

Habitat is thought to be important to otter presence (Green *et al* 1984) in regards to resting up sites. Meliquist and Hornocker (1983) also found that cover was so important that impoverished sites would not be used even if food supply was plentiful. Macdonald and Mason (1989) highlighted the importance of rolling sites and the preference of otters to spraint there.

However, more recent research has indicated that habitat is not so essential (Chanin 2003) and that otters will tolerate a wide range of habitats. The twenty years difference in the research is significant, as otter numbers have rose and they have moved into less attractive sites, availability of prey being the more essential factor.

Otters are largely piscivorous but will diversify if fish numbers are low, eating frogs (Mason and Macdonald 1989), invertebrates and small mammals. Ongoing research at Cardiff University Otter Project have examined stomach and gastro-intestinal contents from otter post mortems and have shown eel, salmonid, stickleback, marine species, mallard, coot, pied wagtail, crow, brown rat, bank vole and rabbit (details from http://www.otterproject.cf.ac.uk). De La Hay (2008) also found wildfowl to be significant, arguing that otters are a generalist and opportunist feeder. His studies on Shapwick Heath, indicates cultural preferences in otter's diets.

De La Hay (2008) questions if the high level of predation on water fowl could be due to the low pH of the water affecting invertebrate and fish population. The opportunist otter would then predate on the high level of water fowl available.

Water quality potentially affects otters in different ways:

a) By affecting the level of prey available.
b) By bioaccumulation of toxins
c) By direct poisoning

The decline and almost extinction of otters in the 1950 - 70's due to endocrine disrupting chemicals such as polychlorinated biphenyls (PCB) and organochlorine pesticides (OC) has been well researched (Chanin 2003). The otter's position at the top of the food chain made it susceptible to the bio-accumulating effect of OC's and PCB's (Mason and Madsen 1993, Chanin and Jefferies 1978, Gutleb and Kranz 1998).

Legislation phased out the manufacture of these chemicals (The Environmental Protection (Disposal of Polychlorinated Biphenyls and Other Dangerous Substances (England and Wales) Regulations 2000). The reduction of the OC's and PCB's (along with targeted releases) has assisted the gradual return of the otter.

Studies have found these chemical to still be present in low numbers. They do not degrade easily and can be present in river sediment where they are able to bio-accumulate in the fat of fish. Mason and MacDonald (1993) found low land rivers to be more contaminated than upland where over 50% of samples from lowland stretches had OC levels above maximum allowable levels compared with mostly 'no effects level' from upland. It was proposed that this may impede colonisation of lowland areas. OC and PCB's have a half life of up to 25 years and otter autopsies now show that these have significantly declined from the environment (Simpson 1998).

So, our rivers are a lot cleaner today than when the otter declined, however they are still subject to pesticide pollution incidents. In February 2010 a pollution incident at River Brue in Glastonbury caused a fish kill of several thousand over a 3km stretch (Frampton 2010). It was unknown the effect this had on otters.

Deterioration of river quality can also occur due to farm effluents. Farm effluents can reduce oxygen levels in rivers affecting invertebrates and fish numbers. Williams (2010) describes a deliberate emptying of silage sweepings that caused a major fish kill. Currently it has not been shown how this can affect carrying capacity of otters as following an incident of pollution the otter may switch to small mammals or wildfowl. But repeated incidents over time or a build up of nutrients from agricultural run-off will cause depletion of otters major prey source.

In July 2009 there was a large fish kill on the River Cary at Somerton. The deaths were due to oxygen starvation caused by an algae bloom brought on by low water levels (Central Somerset News 2009).

Haslam and Wolseley (1981) argue that as an overall pollution assessment the following should be examined using a 'damage rating': Substantial shading, visitor trampling or swimming, cattle disturbance, boats, dredging, cutting, herbicide use, road works, concrete or rock bed, undue turbulence caused by bridge piers, unduly steep banks, unduly wide or shallow. However, how these 'pollution' factors affect otter pollution is rather indirect and hard to quantify. The important factor would be how these elements affect otter prey.

Prenda and GranadaloLorencio (1996) examined the relationship between riparian habitat and fish availability with sprainting activity and found that sprainting behaviour was more consistent with fish availability, particularly larger size fish. They also noted that higher human activity reduced sprainting behaviour. Madsen and Prang (2001) also found that where features would be considered less than ideal (pH<7.0 and stream depth <1metre and few bankside trees) it could still represent productive waters. However, Mason and

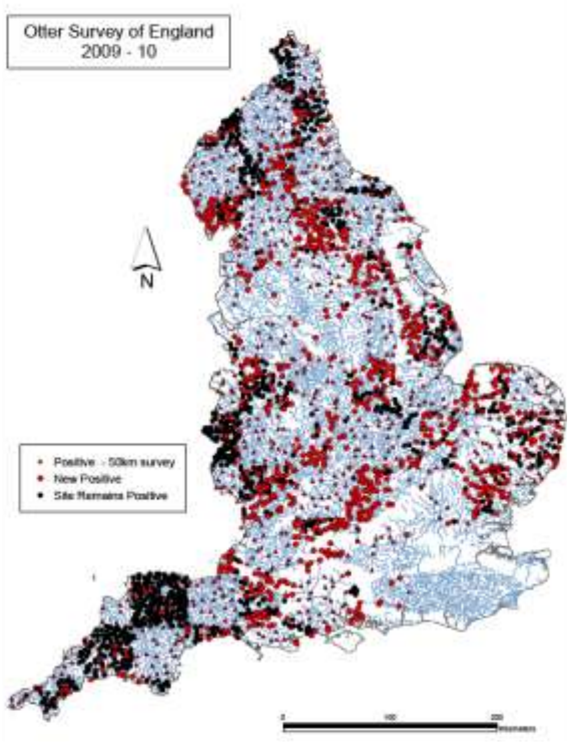
Macdonald (1989) found highly significant correlations between otter marking and significantly lower pH so as to be detrimental to fish populations.

Bedford (2009) found rivers unpopulated with otters in Devon were of significantly lower biological quality and of poorer riparian quality than Devon rivers populated with otters.

River water quality tests are completed by examining an invertebrate sample and scoring according to their sensitivity to low oxygen levels. Oxygen levels are important as the ecosystem is built on them, ensuring sufficient prey in the food chain.

Although there are natural fluctuations in oxygen levels, pollution reduces the amount of oxygen water can hold. Oxygen is used during the anaerobic processes of converting ammonia to nitrates, microbial respiration and decomposition. The cause for depletion is the respiration of extreme activity of microorganisms feeding on biodegradable substances that for example, excessive nutrients may have caused.

Overall, European otters have made a firm comeback in the UK. They appear to have a wide band of living perimeters, perhaps preferring areas of good cover and plentiful fish, but can adapt to lesser habitats. However, they are still vulnerable. The re-population of the southeast (see map below) is still in its infancy and they are considered locally extinct in large parts of the Netherlands, Switzerland and Japan.



Picture 5: Fifth Otter Survey of England 2009-2010

During the national two day national survey no signs were found in Kent and most of Sussex.

The region has good (or fair) quality rivers, good riparian habitat and a good availability of both salmonid and cyprinid fish.

http://www.environment-agency.gov.uk/static/documents/Leisure/otter_survey_oct10_full_report(1).pdf

In 2006, otters sent for post mortem went up by 50% (Williams 2010), 44 deaths compared with 26 in 2005 and 29 in 2007. It is unclear why there was this difference.

Recent post mortems (Simpson et al 2005) show that the Somerset Levels are hosting a parasitic fluke *Pseudamphisomum truncatum*. Whilst the fluke does not appear to kill an otter outright, it weakens the otter and makes it vulnerable. In a Somerset study Gentner (2007) found 13% of spraints collected were infected. They were found in all three main catchment of the Levels (Tone, Brue-Axe and Parrett).

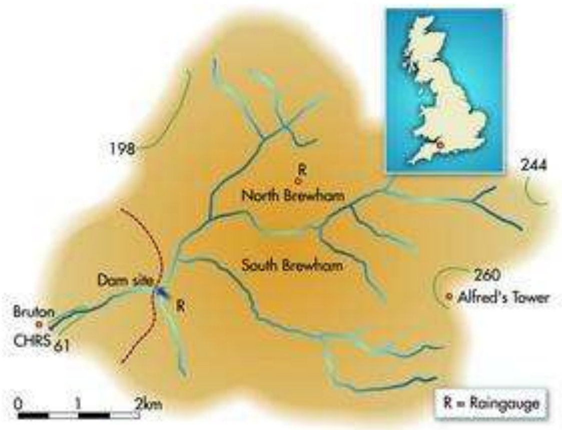
The parasites second intermediate host is found on species such as roach, a common fish of otter prey in Somerset. So whilst things are improving for the otter, this shows that care has to be taken not to make assumptions about its success. An otter needs a large territory to provide enough prey and is vulnerable to a number of potential problems – loss of prey, bile fluke, habitat loss and motor car mortality.

The study on the Upper Brue and River Alham looks at factors that could determine why one area shows fewer spraints than the other.

3 Methodology

3.1The landscapes

Early investigations established the two areas that were different. However, on both sites the results were rather low and unstable.

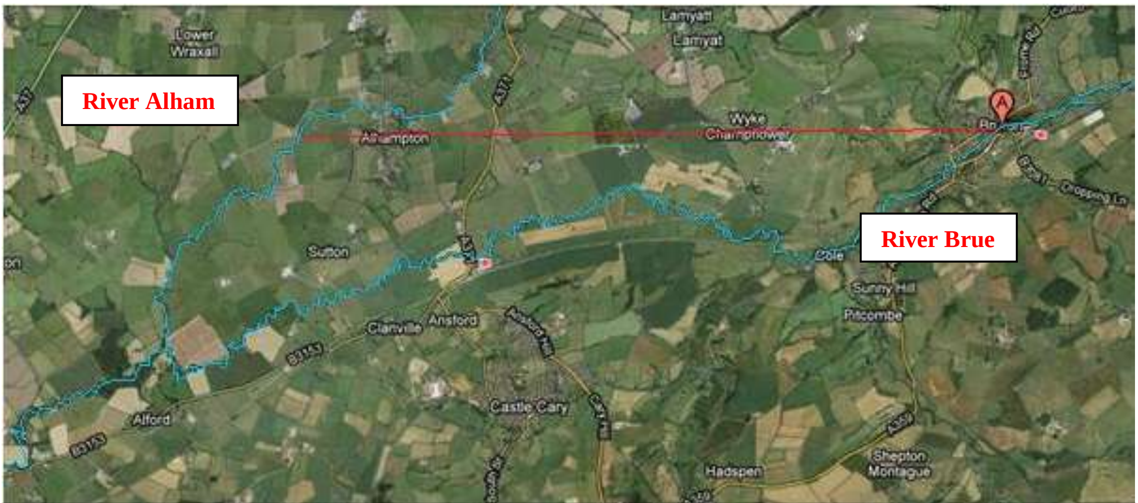


Picture 6: Upper Brue catchment area

The surrounding land is moderate to steep. Land use is agricultural grassland and 10% woodland. The circular shaped catchment historically caused synchronous arrival of runoff and a rapid rise of the river (and fall), initiating the construction of Bruton Dam after severe flooding in Bruton.

http://www.waterpowermagazine.com/graphic.asp?sc=2025430&seq=3

The two rivers were similar in that they are of comparable landscape use and geology. They are also affected by the same climatic conditions being less than 6km apart. However, Bruton is much closer to its source (3.5km) than Alhampton (10km) and therefore more subject to water shortages.



Picture 7: Rural east Somerset, showing an agricultural landscape of primarily dairy farms. The rivers are highlighted in blue. Picture source: http://maps.google.co.uk/maps?hl=en&ie=UTF-8&tab=wl

Picture 8 & 9 Underlying geology

The Brue (coloured pale green) has a bedrock of Sandstone -Dyrham, with alluvium, clay, silt, sand and gravel superficial deposits. At the centre of Bruton (coloured orange), the bedrock is ooidal limestone (inferior oolite group) with a surrounding geology of mudstone, brown colour, and mudstone (yellow green colour).

The River Alham around Alhampton is of mudstone, with superficial river terrace deposits (sand coloured). The surrounding area (camel colour) is also mudstone.

Picture source: http://www.bgs.ac.uk/OpenGeoscience/?Accordion1=3#data

3.2 Otter signs

Typical sprainting sites include banksides, boulders, waterfalls, gravel bars, weirs, tree stumps, overhanging branches, saddles of trees, holt sites, under bridges and confluences (Chanin 2003). The aim was to complete weekly surveys, with the understanding that there would be days where a survey would not be possible due to weather, river depth and other factors. In addition the wider area would be surveyed monthly to gather data relating to otter use of the area. Fresh, recent and old spraints would be recorded. Any other indications would be noted but not recorded as a positive, such as padding or runs as it is not possible to ascertain when they occurred.

Signs of otter presence

Picture 10: Fresh run from a fishing lake to the river, Spargrove 2009. This fresh run went up the bank, under a fence and into a fishing lake

Picture 11: Padding in the soft mud under Westhay Bridge. Padding can sometimes be hard to decipher, as only part of the padding can be seen. This one show the five toes on the back foot and leads into the river. The positioning of the front feet together and the back feet together indicates the undulating gate of the otter.

Picture 12: Sprainted run into the lake at Ham Wall Nature Reserve. This run may be used by other animals; however, the presence of sprain ts confirms it as used by otters.

Picture source: J. Pearse 2010 & 2011

Otter spraints

Picture 13: Large spraint on a boulder, under a bridge

Picture 14: Spraint side of boulder at Westcombe.

Picture 15: Anal jelly on rock under bridge. The stone was placed under bridge by the surveyor to encourage sprainting. Legg Bridge, Bruton.

There is great variation in otter spraints, but they are usually to be found on a prominent stone.

Despite the array of otter spraint shapes, sizes and colours, they are distinctive and easy to identify. Being usually black, brown or green, tarry and consisting of undigested fish bones and other matter (scales, shells etc). Spraints have a characteristic odour, this is not unpleasant, but faintly musky and sweet. The otter also produces a substance known as anal jelly and again this can be a range of colours from black to green and be of variable size. The otter will often spraint in the same place and usually in a prominent position. Bridge ledges, stream confluences and tree stumps are all checked as part of the survey.

Pictures: Jo Pearse 2010 & 2011

Whilst building a tentative picture of otter use of the areas, the sites were examined for factors that could that could influence otter usage. Water quality was examined for biological, chemical and nutrient levels and standards and compared with Environment Agency data water quality tests.

Information regarding fish stock was also obtained from the Environment Agency to consider prey availability.

3.3 Table of methodology

METHOD	**TABLE 1** **DESCRIPTION**	**STATISTICAL ANALYSIS OR OTHER ANALYSIS**
Spraint Surveys	An adapted form of standard methodology was used to take account of limited time. Initially surveys were undertaken over a large area t build up a picture of possible population. Weekly surveys of two main sites on different rivers were then conducted for 9 months. The survey involved checking under bridges and investigating both bank sides for approximately 25 metres upstream and 25 metres downstream. If the water was too deep, the water was left and rejoined past the pool. Binoculars were also used for assessing opposite bank sides where there were pools. Once a month wider surveys of the waterway were completed. Records were made of spraints according to the categories fresh, recent and old. Data from previous year's surveys was examined for larger patterns and overall otter utilisation of the rivers. Also recorded were weather conditions, water depth and anything else of interest such as signs or sightings of mink.	Ratio, percentages, graphs on seasonal differences.
pH readings	Using a digital metre, comparative pH readings were taken. Three samples were taken in each site and the average recorded, to reduce error.	Graphs and average.

Dissolved oxygen levels	Oxygen levels were taken on site using a Palintest waterproof portable metre with probe. The metre measures percentage of oxygen saturation and the temperature (°C) digitally. Three samples were taken in each site and the average recorded, to reduce error. The probe was calibrated in air after rinsing in deionised water to achieve 100% saturation (air contains 21% oxygen). In total three different days were sampled over a three week period.	Percentages
Nutrient and chemical testing	A sample of water was taken from each site by filling an airtight container, ensuring that no air was left in the bottle. These were analysed in the Cannington laboratory the following day, using a Palintest Photometre. The samples were tested for nitrogen, ammonia, ammonium and phosphate.	Comparative graphs
Biological testing - Invertebrate kick sampling	A standard three minute kick sample was used (Sutherland 1996). A standard 1mm net conforming to Environment Agency specifications was used. Whilst the net is held firmly against the substrate, the surveyor kicks at the surface just upstream so all debris and sediment is captured by the net. The three minutes is divided proportionally to the different habitats within the stream (riffles, slow water, pool, sand, vegetation). The contents of the net are then emptied into a tray. A smaller container was used to identify family species, which are recorded on site. The invertebrates are returned to the river afterwards. For BMWP (using revised scoring system) a biological score is allocated to families relating to their sensitivity to pollution stress. ASPT score were also calculated to provide an overall rating of the sight relating to water quality.	BMWP & ASPT Graphs and averages.
River corridor survey	An adapted version of the river corridor survey was undertaken. A 500 metre stretch of river was surveys, with 50 metres on either side of the river (approximate). A sketch of the site was produced using digimaps as a base map.	

Environment Agency Data	The EA provides chemical, biological and nutrient information over long stretches of river (from 3 to 9km). The information was downloaded from the EA website. Additional information and raw data was obtained by request regarding these areas and also fish data from specific sites on the study rivers. Other information was also obtained from their website regarding pollution events in the study area.	
Other	Other sources were used such as local newspapers Data was also used from the Somerset Otter Group records and newsletters.	

4.Results

4.1 Habitat

4.1.1 Standard symbols for use in River Corridor Surveys

4.1.2 7km stretch of the Brue centred on Bruton

4.1.3 River Corridor Map 1 and Notes

4.1.4 River Corridor Map 2 and Notes

4.1.5 River Corridor Map 3 and Notes

4.1.6 River Corridor Map 4 and Notes

4.1.7 4km stretch of the Alham at Alhampton

4.1.8 River Corridor Map 5 and Notes

4.1.9 River Corridor Map 6 and Notes

4.1.10 River Corridor Map 7 and Notes

4.1.11 River Corridor Map 8 and Notes

4.2 Otter surveys

4.2.1 Background surveys

Initial otter surveys began in July 2009 in the area of the upper Brue catchment. The ancient Fosseway Road marks a rough boundary of the area – west of the Fosseway are the Somerset Levels and to the south east the relatively higher ground. The principle rivers of the area are the Brue, Alham, Pitt and Cary. It appeared that signs of otters were rather low. In July 2010 the decision was made to focus on two sites, one on the Brue and one on the Alham.

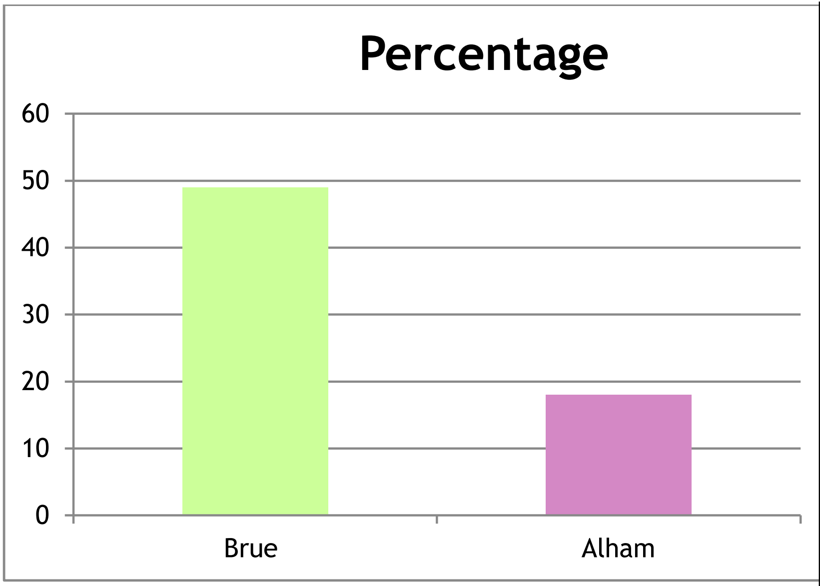


Table 2: Percentage of visits that showed otter signs.

Of all the sites surveyed from July 2009 to April 2011, 49% of the Brue and 18% on the Alham showed signs of otter presence.

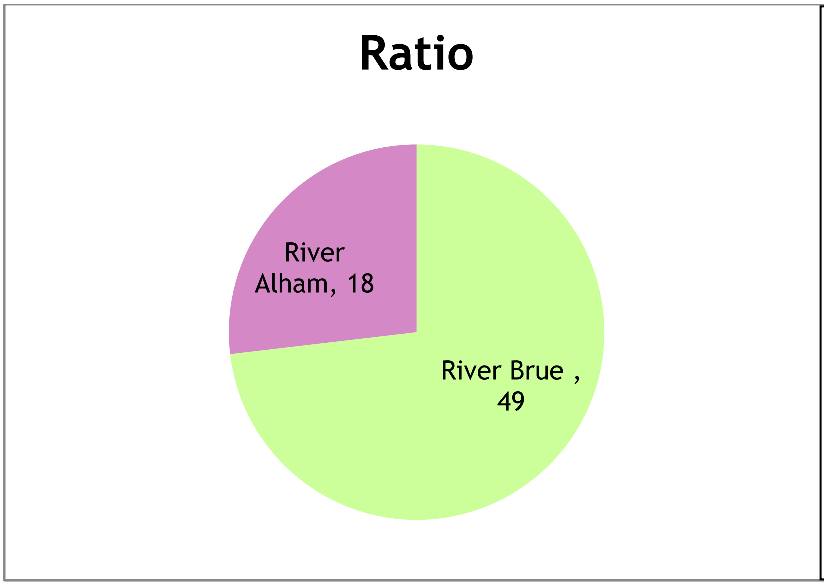


Table 3: Ratio's of percentages of sites visited that showed otter signs.

This gave a ratio of 49:18 or 2.7:1

This can be compared with the results from the Somerset 2010 2 day otter survey

Area	Percentage of sites showing positive signs
Somerset	73%
Devon	90%
Greater Exmoor	79%
Total of survey	**76%**

Table 4: Somerset Otter Group 2 day survey

The survey data does not compare favourable to the findings of the Devon and Somerset survey where the total is 76%

Information adapted from Newslotter 31 Somerset Otter Group

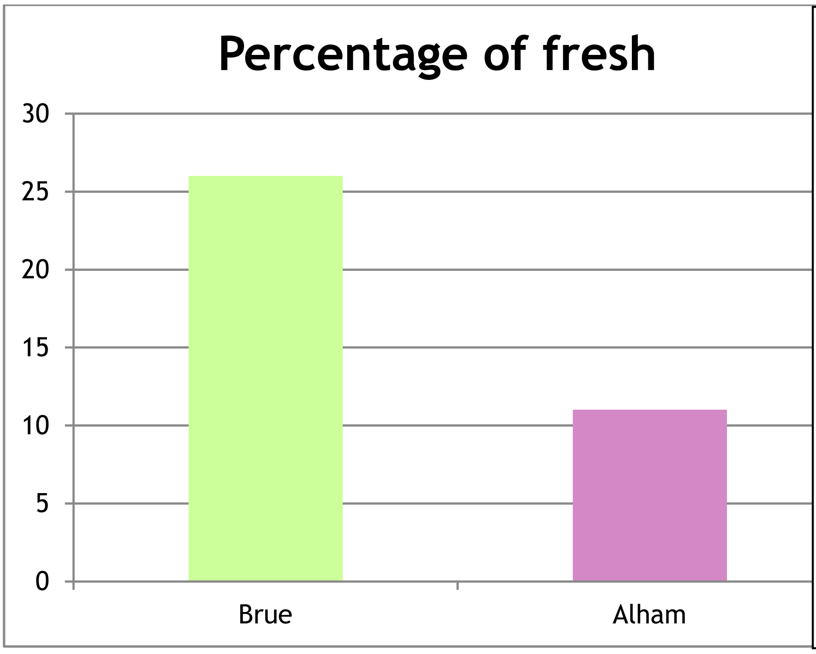


Table 5: Percentage of fresh spraint found.

Recording fresh spraint is useful as it shows that the spraint is the result of activity from the previous night and it ensures that the spraint has not been counted during a previous visit.

If the number of fresh spraints only are looked at the percentages drop to 26% and 11%.

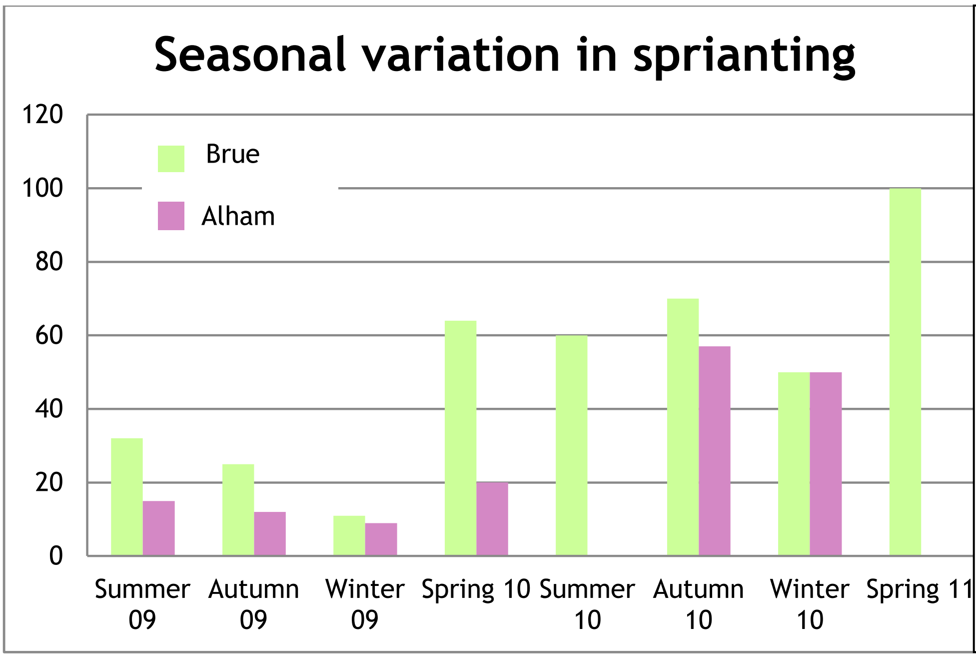


Table 6: Seasonal variation in sprainting habits.

The results show some variation between 2009 and 2010, with 2009 showing less positive sites. Spring 2011 figures are not representative as the surveys stopped half way through the month.

4.2.2 Main site surveys

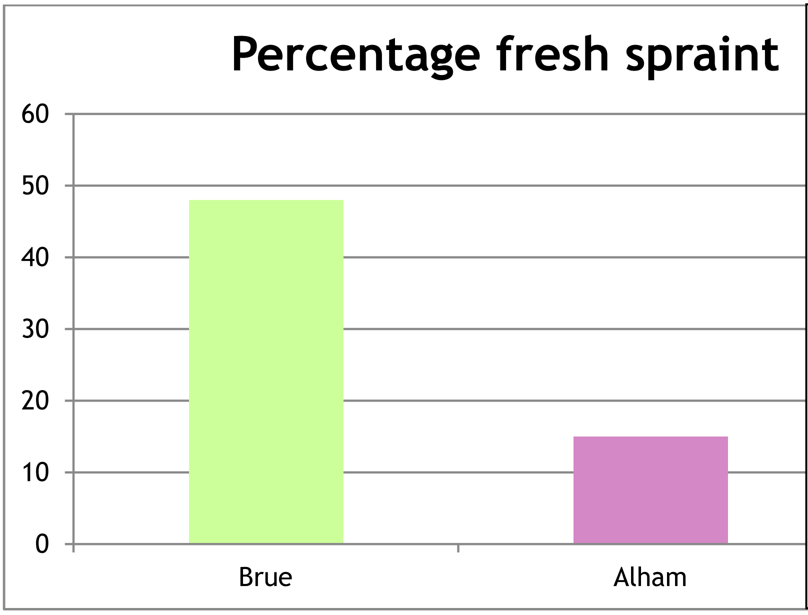


Table 7: Spraint surveys from July 2010 to April 2011

Fresh signs indicating site usage from the previous night

These were focused on the two main study areas. It was known that otters visited the Brue at Bruton from the previous year's data, so this could be considered to be favourable in some way.

The Alham's totals were low at 15%, appearing that this was a less favourable area.

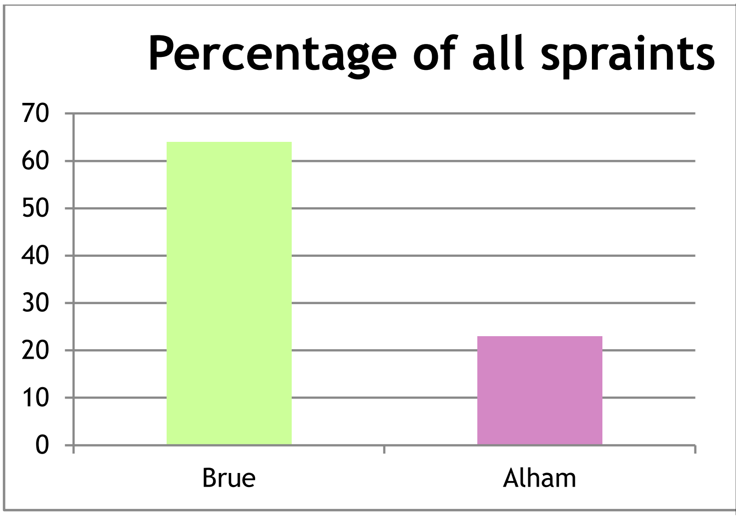


Table 8: Totals of all spraints

When fresh, recent and old are amalgamated, the Brue's totals rise to 64% and the Alham's remain low at 23%.

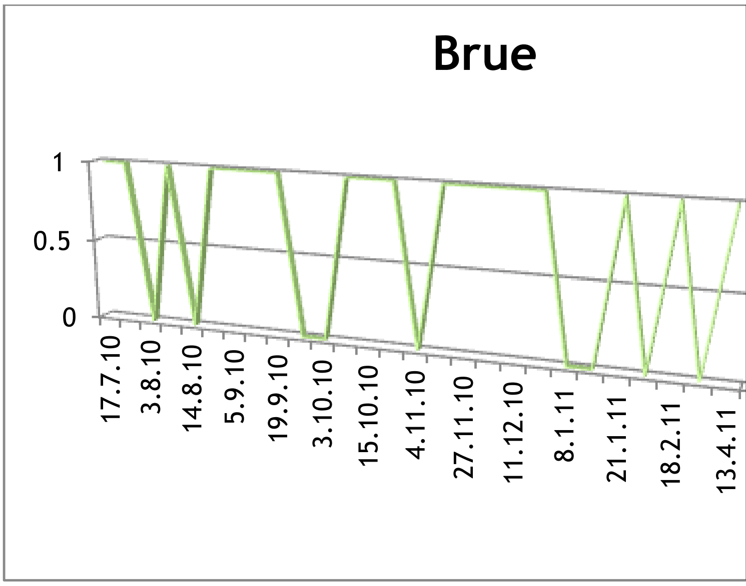


Table 9: Days of positive finds on the Brue site

This chart shows illustrates the days (not all dates are shown) that signs were found in the study area. I.e. if signs were found nearby at other sites on the Brue on the same day, this would be only counted as one, as it is likely the same otter. It shows that in this small area, there were not many weeks that did not show signs. The longest time is the 19.9.10 to the 3.10.10 (three weeks).

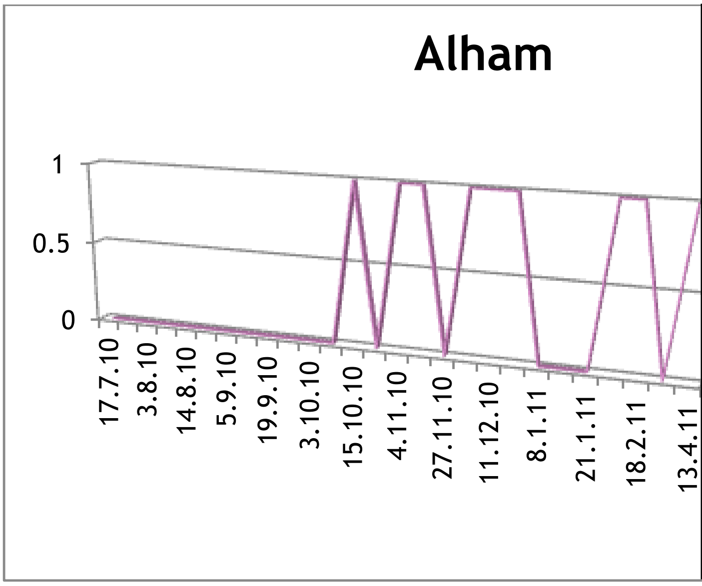


Table 10: Days of positive finds on the Alham

This table shows that until October the site was not used as a sprainting site, either because it was not preferred, or because an otter was not present.

The lack of spraint during weeks 8.1.11, 16.1.11 and 21.1.11 corresponds similarly to the same weeks on the Brue. This follows a period of extreme weather when snow melt combined with rain to produce very high and heavily silted river water.

4.3 Water testing

4.3.1 Oxygen

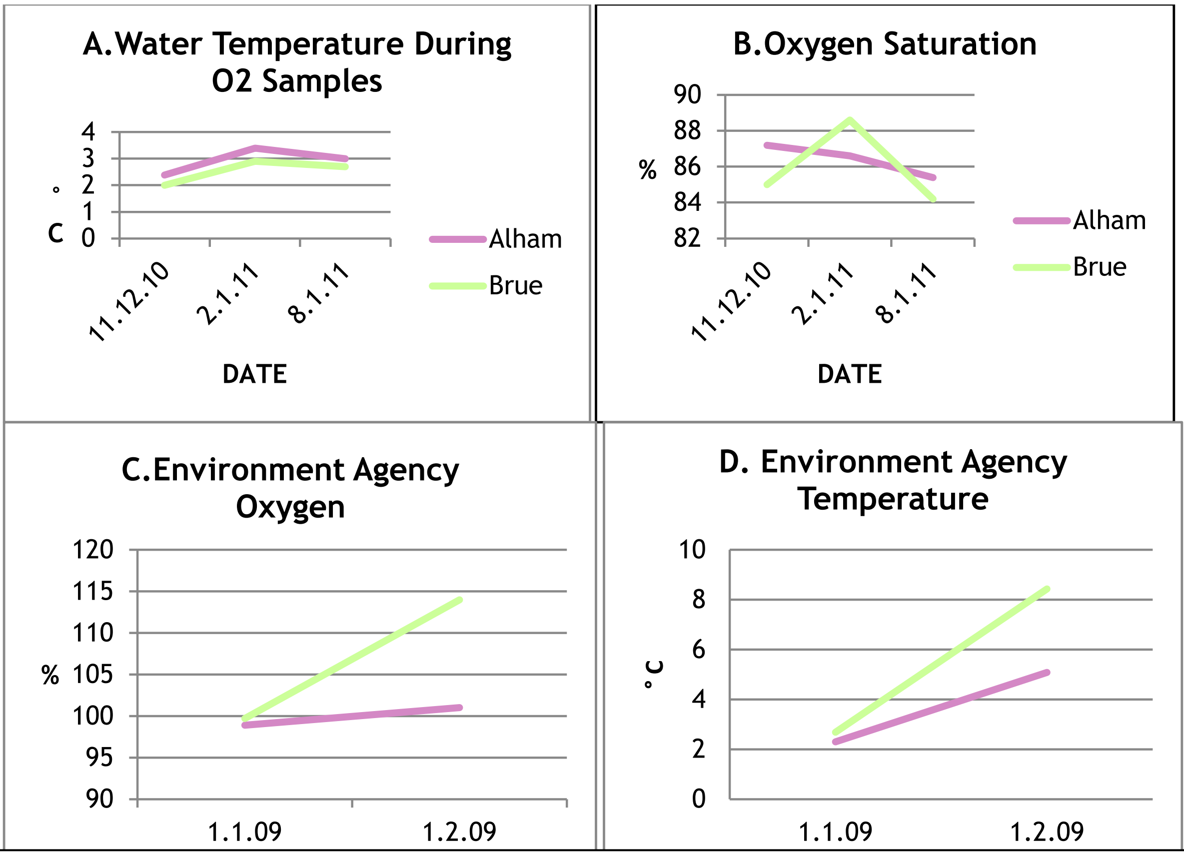


Table 11: Oxygen saturation on the survey sites

Oxygen saturation for the River Brue ranges from 84.2% to 85% and the River Alham from 85.4% to 85%. Both rivers are therefore of similar oxygen saturation and are rated as ‘good.’ The samples were both taken from the main sites during January 2011. Water temperature was from 2.39°C to 3.4°C at the Alham site and 2°C to 2.9°C at the Brue site.

The Environment Agency (EA) recorded oxygen levels during 2009. C and D show the findings for January and February. The sites, Alford (the Brue) and the Alham - Brue confluence, both are downstream from the main study areas. The Brue ranges from 2.3°C to 5.06°C for temperature and 98.9% to 101% and the Alham-Brue confluence from 2.69°C to 8.43°C for temperature and oxygen at 99.7% to 114%. The EA data is not directly comparable as it is for the previous year. However, it does give some level of comparison. Oxygen levels in the water are related to temperature, normally the dissolved oxygen increases with a decreasing temperature. However, the process of oxygenating rivers is influenced by many other factors such as pollution, dilution (pollution related to water volume), sedimentation, turbulence, sunlight reaching the water surface, air temperature and air pressure. Photosynthesis, respiration and decomposition are also important factors According to the information below, this rates both rivers as excellent. Oxygen levels in a healthy river may increase in the summer due to longer days and the increased photosynthesis of plants.

Below 60%: poor quality

60-79%: acceptable for most stream animals

80-125%: excellent for most stream animals

125% or more: too high

www.waterontheweb/under/waterquality/oxygen

4.3.2 Nutrient and chemical and pH testing

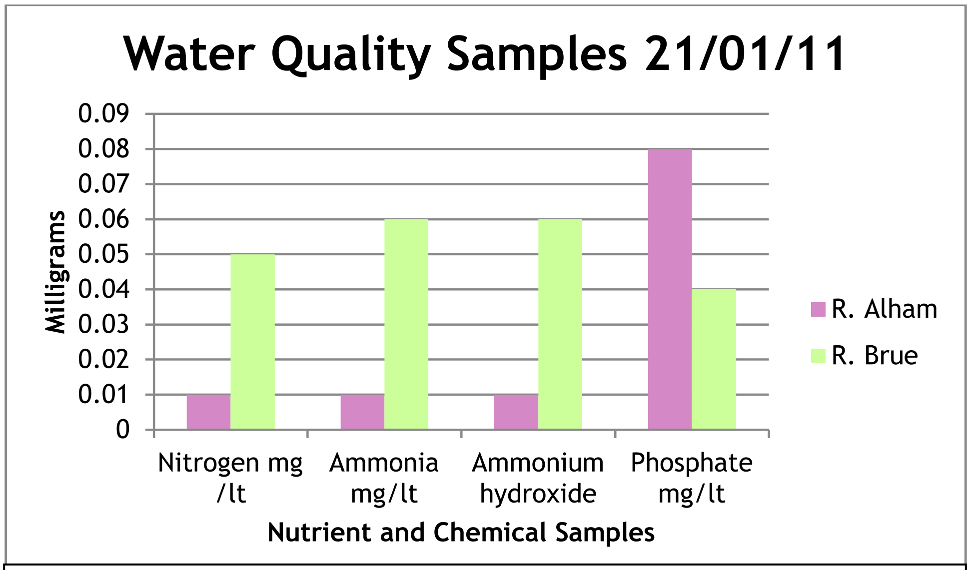


Table 12: Chemical and nutrient testing from the two main sites

Levels are higher at Bruton for nitrogen, ammonia and ammonium, but less for phosphate.

Nutrient levels of nitrogen and phosphate are within very low catorgories according to the environment agency grading. Please see appendix.

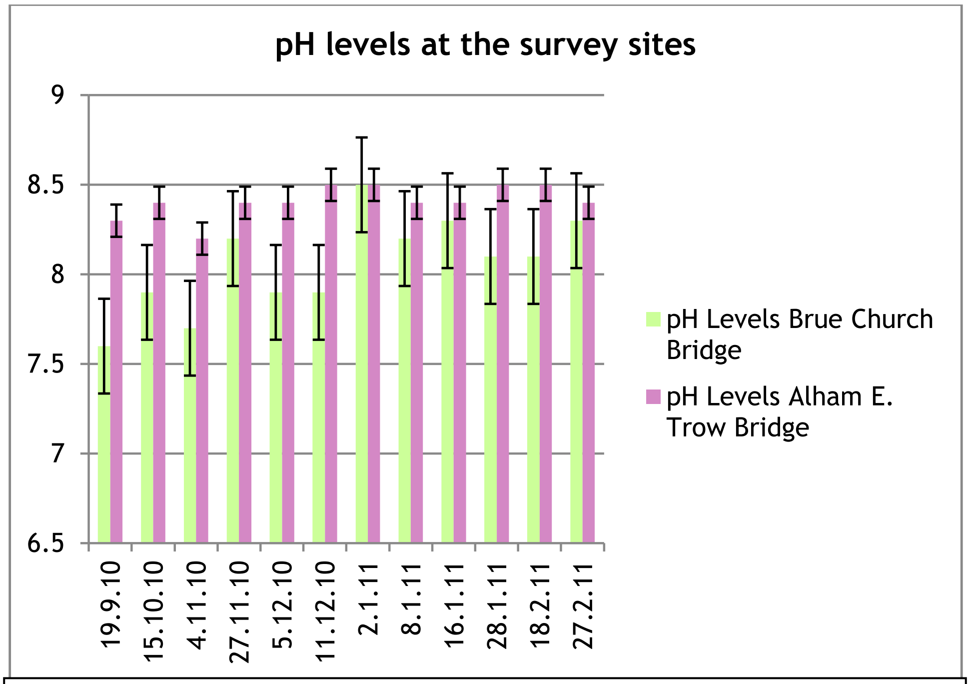


Table 13: pH levels at the survey sites.

There is some variation is the pH ranging from 7.6 to 8.5 for the Brue and 8.2 to 8.5 for the Alham. The average for the Brue is 8.05 and for the Alham 8.5. These compare to the EA data where the average pH for the Brue at Alford is 8.05 and for the Alham/Brue confluence 8.3 (see appendix for raw data).

4.4 Environment Agency Classification

The Environment Agency (EA) monitors the River Brue at intervals along the river (see appendix 8.7) for a condensed and amended selection of the raw data supplied). Chemical, nitrate and phosphate is tested monthly at various sites. The findings are not directly comparable as they are not like for like – the collection points are different and the tests are different, however, they are sufficiently alike to give a general indication of quality. The EA testing sites are both downstream of the main study sites but in terms of quality their results could be considered superior as the testing equipment is more sophisticated (see discussion for more analysis).

Table 14: River Alham: Redlands Farm ST643363			Data from 2009
Chemistry	Biology	Nitrates	Phosphates
B: Good	B: Good	4: Moderate	3: Moderate

Table 15: River Brue/Alham Confluence: ST607337			Data from 2009
Chemistry	Biology	Nitrates	Phosphates
A: Very good	B: Good	4: Moderate	5: Very High

Table 16: River Brue: ST540348 – ST606328			Data from 2009
Chemistry	Biology	Nitrates	Phosphates
A: Very good	B: Good	4: Moderate	5: Very High

The data shows chemistry and biology levels to be good or very good, whilst nutrient levels are moderate to very high.

4.5 Biological monitoring

Table 17: Rating of BWMP and ASPT			
BMWP		ASPT	
BMWP Score	**Quality**	**ASPT**	**Quality**
Over 150	A.Very good biological quality	Over 5.4	Very good
101-150	B. Good biological quality	4.81 - 5.4	Good
51-100	C. Fair biological quality	4.21 - 4.8	Fair
16-50	D. Poor biological quality	3.61 - 4.2	Poor
0-15	E. Very poor biological quality	3.6 or less	Very poor

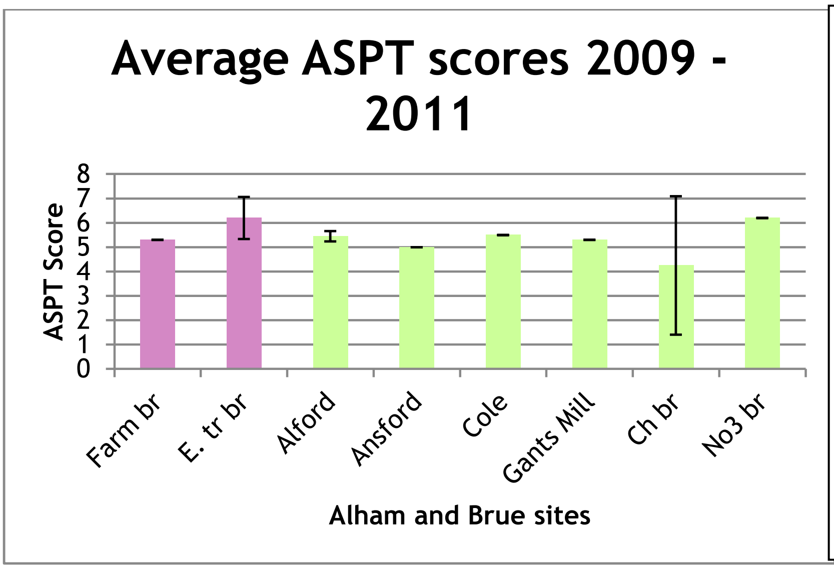


Table 18: Average ASPT scores from surveyors scores and EA scores

River Alham

River Brue

The range is similar, averaging between 4 and 6 (see appendix for data).

The EA did not provide BMWP scores for all its data.

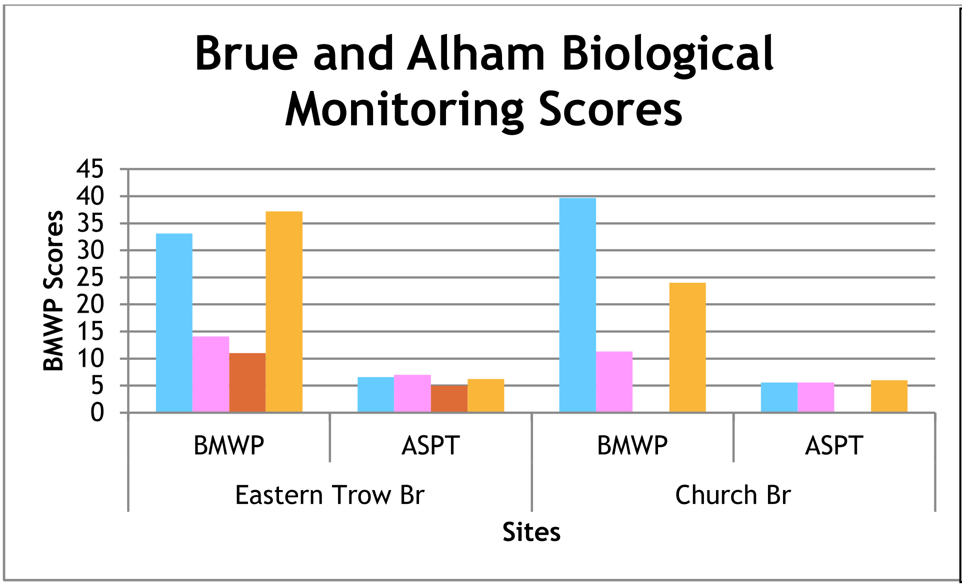


Table 19: Comparison of seasonal differences in scores from the two main survey sites.

April 2010

Sept 2010

Jan 2011

Apr 2011

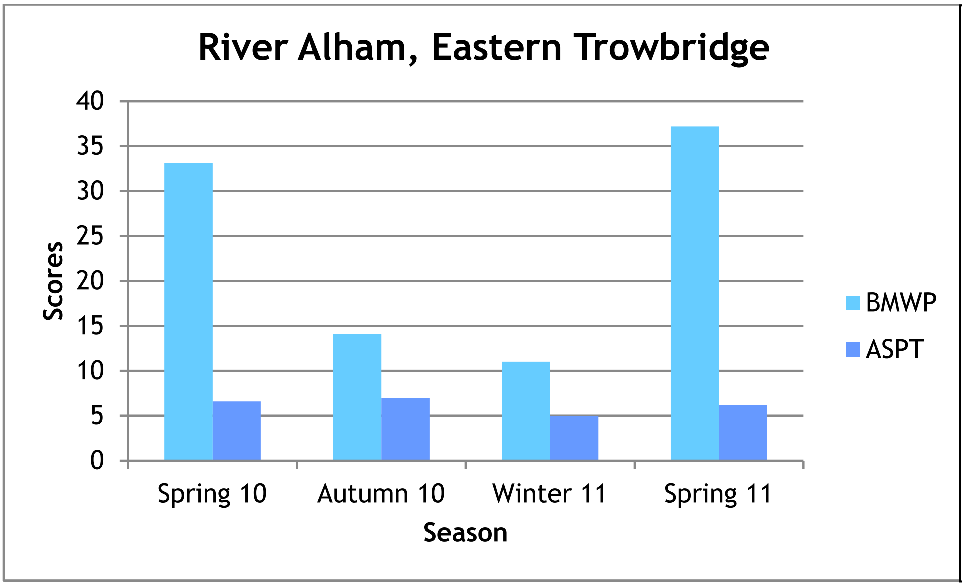


Table 20: Scores from Eastern Trowbridge, River Alham

High ASPT scores in comparision to low BMWP scores.

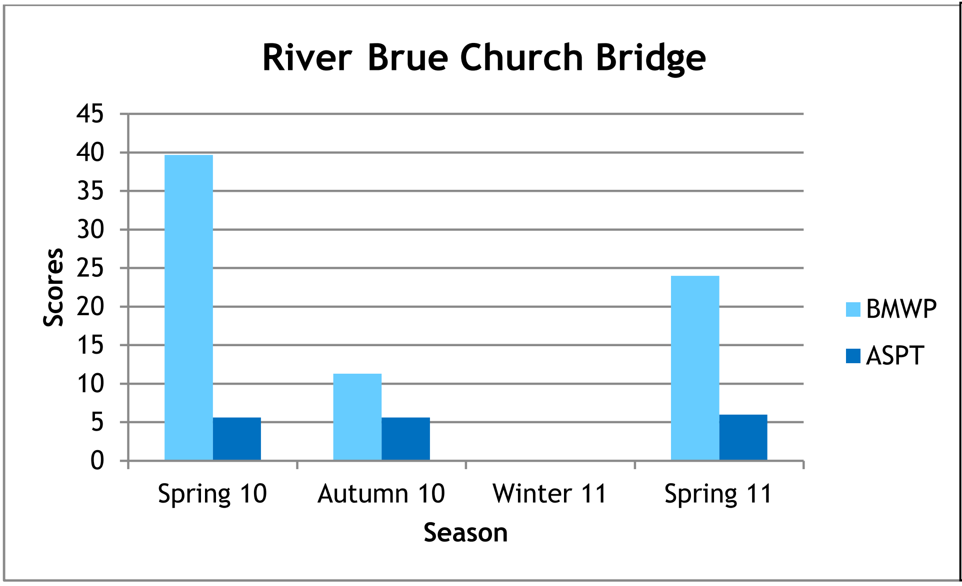


Table 21: Scores from Church Bridge, River Bruton.

High ASPT scores compared to low BMWP scores. Winter 2011 no species were present giving zero scores for both.

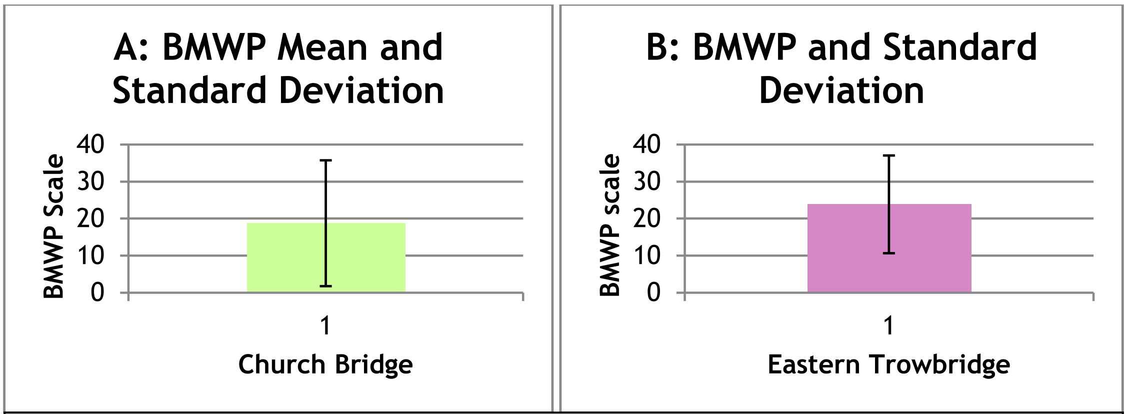


Table 22: Average BMWP scores for both sites

Both sites show a very low average score of poor. The Eastern Trowbridge site has a higher average score.

4.6 Otter prey – fish analysis

The Environment Agency complete fish surveys along the Brue, usually by electro-fishing techniques. The charts below show the results of these surveys. However, the data is taken from different years, the earliest from 2004 up to 2010 (see appendix 8.6 for raw data).

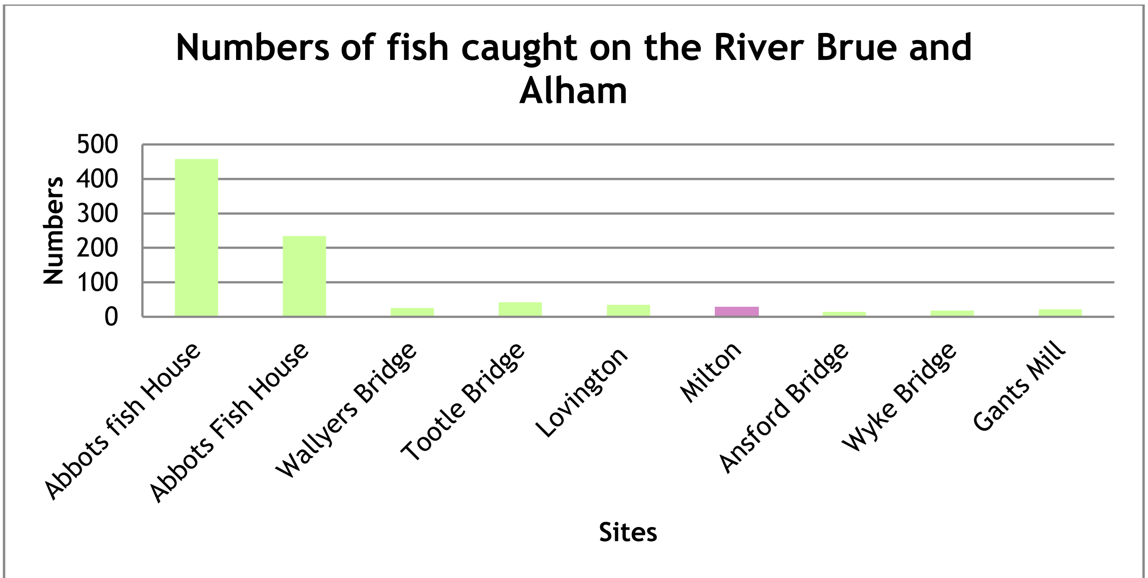


Table 23: Numbers of fish caught on the River Brue and Alham

There can be seen a general trend for the number of fish to diminishing further upstream. See appendix for actual data. Milton Bridge is on the Alham

Data supplied by the Environment Agency 2010 & 11

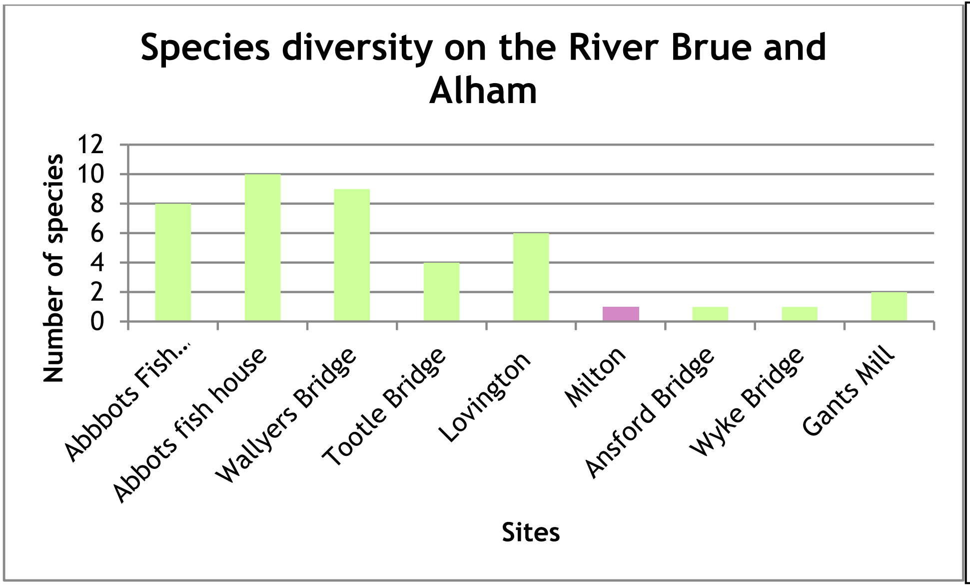
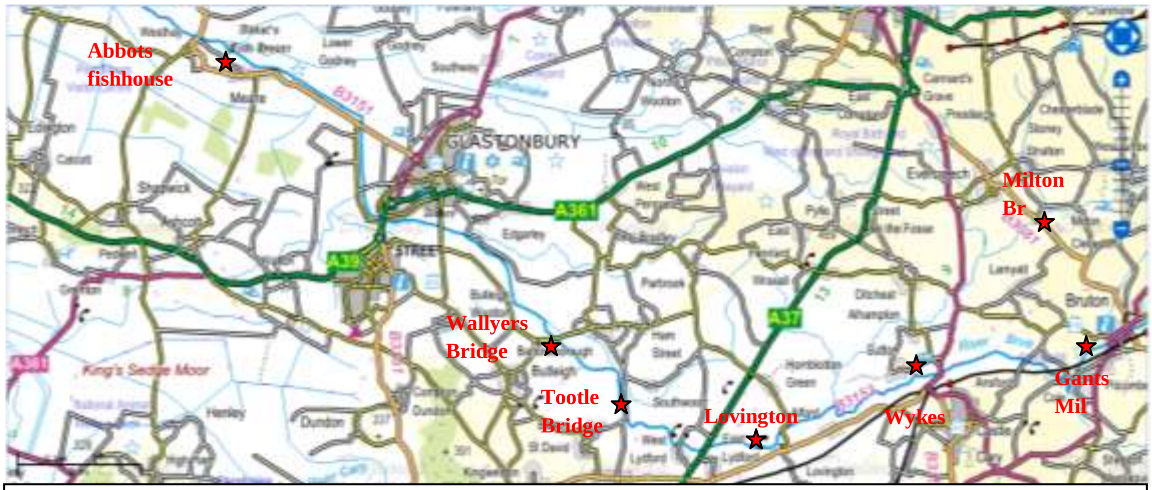


Table 24: Number of fish species caught on the Brue and Alham

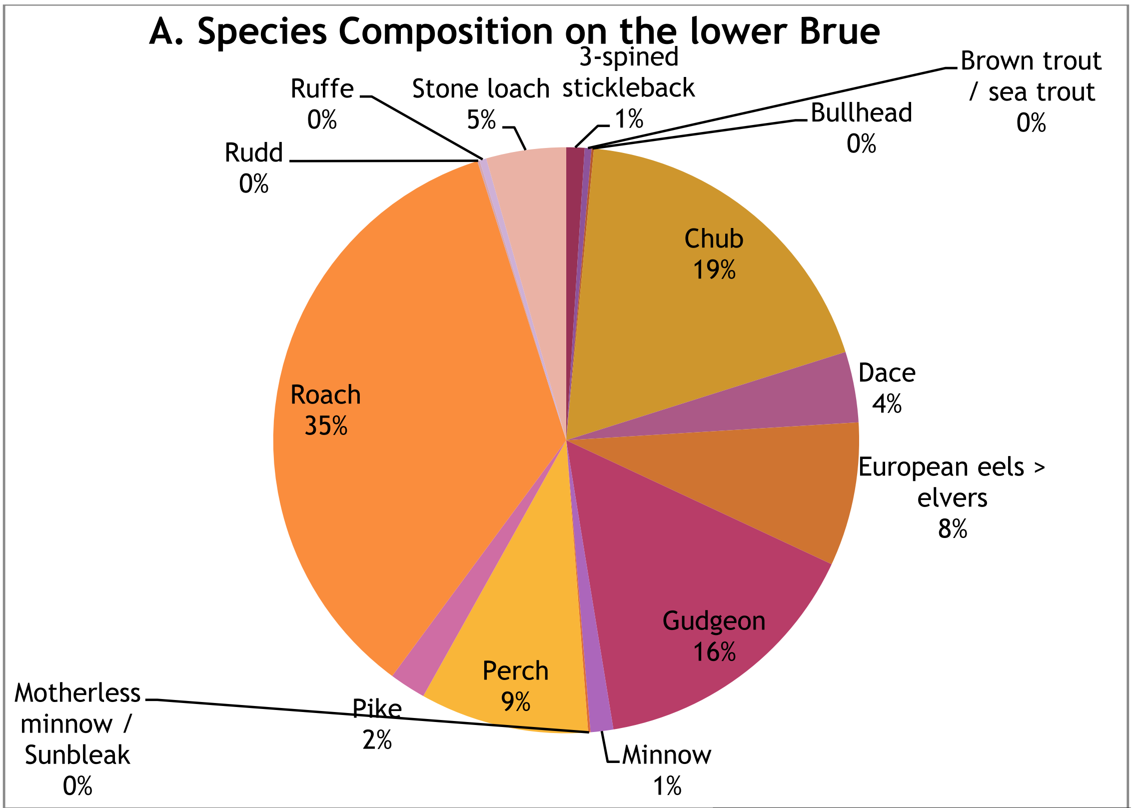
Generally the diversity of fish also diminishes the further upstream



Picture 16: Map of the EA fish sampling sites.

Where the A37 (Fosseway) crosses the Brue, Lydford weir is situated.

Map from digimap: http://digimap.edina.ac.uk



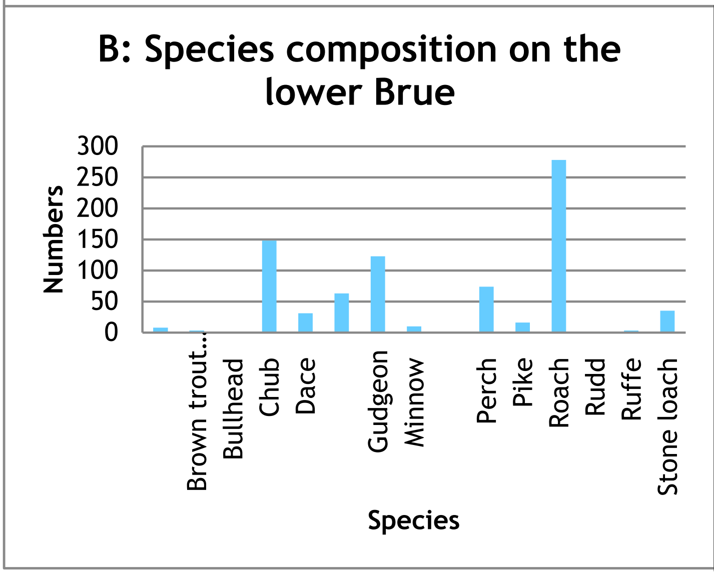
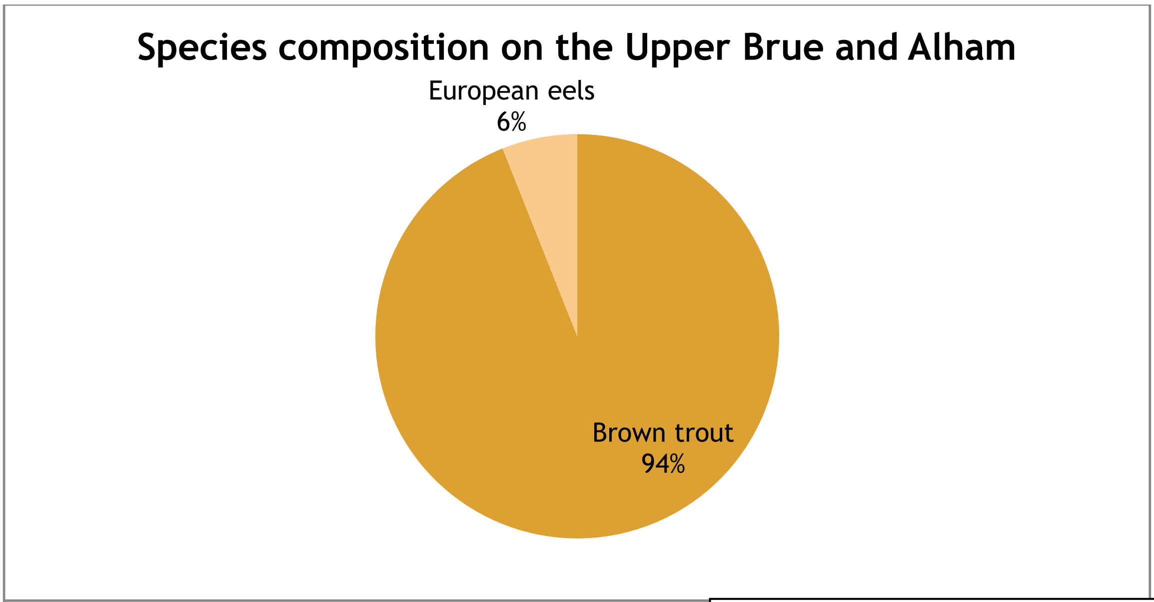


Table 25 A & B: Species composition on the lower Brue

West of the Fosseway there is a good mixture of cyprinid fish and percid species.



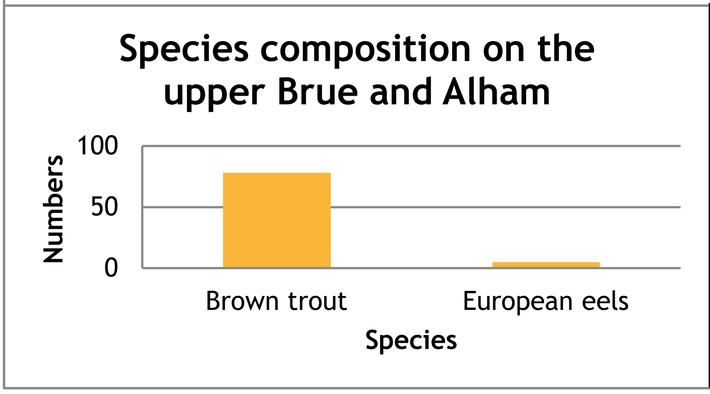


Table 26: Species composition on the upper Brue and Alham.

The species composition is mostly made up of Brown trout. Eel were present (5) only at Gants Mill.

See appendix 8.6 for further detail.

5.Discussion

5.1 Habitat

An Otters first requirement is for adequate food, it's second is for resting up sites and somewhere to nurture cubs safely.

The habitat provides the basis for both of these. The habitat provides the environment in which prey can thrive and secondly provides couches and holts.

Couches can be as simple as a bramble patch or thick vegetative growth. It can also be holes in walls or gaps in other man made features. Holts need a more secretive location where the cubs cannot become prey whilst the bitch is hunting. Both sites provide a selection of riparian habitat that provides cover in the form of thick undergrowth and occasional woodland.

Above Bruton lies an extensive woodland, which must provide numerous suitable sites and paths can be seen leading to the river, one which was sprainted so a likely otter path.

Picture 17: Cogley Wood above Bruton.

Provides good sites for resting up and cub rearing places.

Picture: Google Maps

The species of riparian tree is important. The traditional bankside trees such as willow and alder provide no opportunities of shelter, their roots growing in a thick fibrous mat that is impenetrable. Mature oak, sycamore and ash provide the best sites, when the bank has eroded around their thick roots, allowing cavities for holts. Both areas provided mature trees the Alham commonly with sycamore and Bruton ash, oak and sycamore.

Picture 18: Alder tree roots can prevent bank erosion but do not provide resting sites for otters.
Picture 19: Oak roots develop cavities behind them such as this holt, upstream of Bruton.
Pictures: Jo Pearse 2010

5.2 Otter surveying

Surveying for otter spraints can be a time consuming activity. Searches of banks and rivers has to be thorough or else signs can be missed and give incorrect negative results. The river is a dynamic environment, with changing river levels, which can, after heavy rains wash away spraints, again giving incorrect negative results.

Further, new sites present additional time constraints, as more familiar sites can be checked faster, as knowledge of sprainting sites, such as a particular stone or tree stump can be rapidly checked. Often the surveyor has to make decisions regarding quality of checking to quantity of sites.

The overall study site from 2009 proved to be too large an area for one surveyor to gain any meaningful data and so by narrowing down the sites there is a loss of detail. The surveyor attempted to recruit volunteers at the Bruton site, but unfortunately was unsuccessful.

The otter is a far travelling species. Some researchers have suggested a territory may be as much as 40km, others that 8km (or less) may be more realistic. With the repopulation of otters into British rivers following their decline, territories may be more hotly contested. With an average mortality between 3 to 6 years the resident otter may change frequently. The low numbers could indicate large territory; this could be the case if prey is scarce or could indicate a high mortality rate. Little is known of the dynamics of the population, most studies being on non-typical Scottish islands. Spraint surveys tell us very little about the behaviour and ecology of the otter. Although, spraint DNA studies can show some very interesting details. Appendix 8.11 shows a DNA study in Somerset in 1998 undertaken by the Somerset Otter Group.

The studies over the three year period need to be analysed within the framework of their limitations. 2009 showed low figures, although the places checked centred around a typical sprainting area, such as under a bridge, negatives may have been more frequent as these may contain areas, where a resident otter never spraints. In 2010, the data centres around Bruton, where spriants were regular, if not exactly frequent and at Eastern Trowbridge, which was an area that was thought to have typical features of otter habitat and have typical sprainting sites.

An unexpected event was that in November 2011 fresh anal jelly was noted under Eastern Trowbridge and afterwards became a regular sprainting site. No explanation for this change can be given based on the data. However, there are a number of possibilities – the area was re populated after a death of a resident otter or that the area was being used, but not sprainted at. It has been suggested that sprainting is related to feeding and rolling, so perhaps this site was poor in both, although little changed physically in the environment in the course of the study. Extreme weather (rivers in spate; snow and ice and summer droughts) and other causes of prey shortage can send otter elsewhere in search of food, diversify their usual fish diet to one of amphibians and wildfowl. Extreme weather may also cause starvation and high mortality. This year there was an extended period of cold weather, however, the three week period of no spraints, (and also the period of zero macroinvertebrates at Bruton) relates to a period of extremely low water at Bruton, with large areas of the river bed dry and extensive sewage fungus across the river.

Pictures 20 & 21

Extensive slime at Church Bridge, Bruton during the summer and autumn months.

The upper Brue is not monitored by the Environment Agency.

The area of growth got bigger as the summer progressed.

Picture source: Jo Pearse

5.3 Water analysis

The quality of the water is important for the otter's survival, whilst it appears it can tolerate a relatively wide range of conditions, it needs abundant prey. They need to eat approximately 15% of their body weight per day, compensating for heat loss whilst hunting.

The otter at the top of the food chain relies on clean water conditions for its prey to survive. Oxygen levels tested at the site and those by the EA for downstream are all rated as good being above 80% saturation. Most macro-invertebrates depend on a good oxygen supply and these in turn provide food for otters main prey item – fish (and known to be a snack source for otters).

The water were tested in the winter, whilst the river at Bruton, is most likely to be affected by low oxygen in the summer. The surveyor reported what looked to be a pipe spilling out sewage to the EA, but at their time of visit found the pipe to be not discharging (Persornal communication Dan Applin, EA officer. Ref: 858898). An occasional leakage from a septic tank occurring particularly when the river is under strain due to low water could have a grave affect on the river fauna.

Picture 22: Pipe discharging into the Brue at Church Bridge, Bruton.

On occasions what looked to be sewage was discharging from the pipe.

Picture: Jo Pearse 2011

Chemical and nutrient testing at the sites both showed to be within good parameters. Further testing may show seasonal variations to this. The EA data recorded further downstream shows phosphorous to be elevated to very high and the nitrogen to be moderate.

Phosphorous and nitrogen from runoff and instreams may increase as the rivers travel further through agricultural lands.

5.4 Biological monitoring – macro-invertebrate studies.

The scores for the EA studies are all downstream from the main study sites so cannot be directly compared as they are not affected by low flows. The data received did not contain in most the BMWP score, only the ASPT score. In this way they are not directly comparable, but show good quality samples with a range of species.

The samples from Bruton and Eastern Trowbridge show similar ASPT ratings, but low BMWP ratings. The EA collects samples and then analyses them at the lab with experienced biologists and in this way are more likely to have a higher rate of identification. This can explain some of the differences yet not all, for example the sample taken by the surveyor in

Autumn 2010 and Winter 2011. The autumn score for Bruton was very low and in Winter no macro-invertebrates were found. The Brue at Bruton is not far from its source and has a small catchment, it therefore is affected by extremely low flows in dry months.

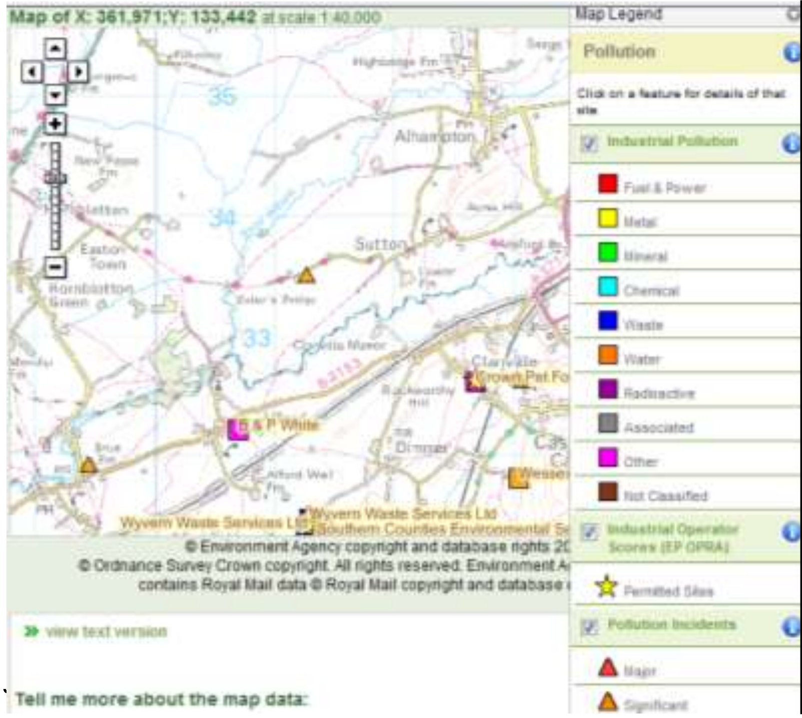
A problem with the BMWP is where a single mayfly or caddis fly can elevate the ASPT, but not the BMWP and give a skewed rating to the river.

It is possible that pollution and low levels caused a decline in macro-invertebrates over the summer. Few species can tolerate drought or sudden spates. During the summer months many macroinvertebrates will have passed their immature stage and flown away. Any that were left may have been affected by the extreme weather in the month preceding the winter sample (snow and freezing temperature). These affects will be more pronounced in the head waters of Bruton.

An inflow of sewage or other pollutants can cause a build up of bacteria. Sewage fungus occurs as a macroscopic growth, forming white or light brown slime over the substrate. The sewage fungus community of *syndra*, *navicula* and *fragilaria* are all found in the EA lists for the Brue, although again this is further downstream.

5.5 Pollution events

The EA reports on cases where they have found to be pollution events that have had a significant impact on the rivers. This does illustrate that pollution to the water courses does occur and could be a factor in the health of macroinvertebrates.

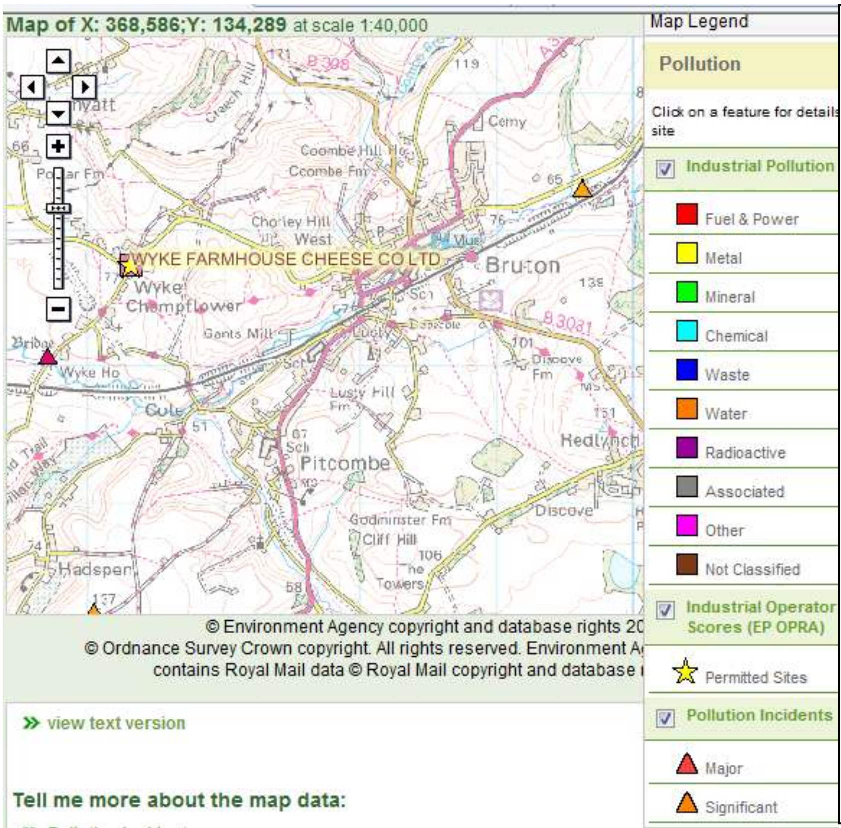


Picture 23: Pollution events on the River Alham

The Environment reports on investigated pollution events. Not far downstream from the survey site there was a significant impact to the environment from general wastes in 2002.

Picture source: Environment Agency

Environment Investigated Pollution Incidents River Alham				
Site	**Date**	**Environmental Impact**	**Pollutant**	**Impact to water**
Bolters Lane	05-12-2002	Significant	General biodegradable materials & wastes	Significant



Picture 24: Pollution incidents on the River Brue

Three events are listed on the EA website. The event at Wyke is listed as having a major impact to the river and in 2005 an event of significant impact occurred upstream of Bruton.

Picture source: Environment Agency

Environment Investigated Pollution Incidents River Brue				
Site	**Date**	**Environmental Impact**	**Pollutant**	**Impact to water**
Brewham Road (above	25-09-2005	Significant	Agricultural materials and wastes	Significant

Bruton)				
Wyke	18-06-2004	Major	General biodegradable materials and wastes	Major
Alford See map above	19-06-2002	Significant	Oils & fuels	Significant

Data from the environment Agency http://maps.environment-agency.gov.uk/wiyby/wiybyController?latest=true&topic=pollution&ep=query&lang=_e&x=365717.9166666667&y=134035.0&scale=8&layerGroups=5&queryWindowWidth=25&queryWindowHeight=25

5.6 Fish availability

Fish are highly mobile and can to a degree avoid pollution. The eel is an exception as it is very sedentary during its time in fresh water which can be up to 20 years. Eels are otters preferred food and have been in massive decline since the 1970’s.

The data supplied by the EA shows a typical composition for lowland rivers with a range of cyprinid and percid fish, the upper Brue is dominated by trout. Eels to do not feature much in either groups and this is worrying as otters main prey item.

As the rivers lose altitude they flow through a number of dams, such as the ones below, which may impede fish migration.

Weirs on the Alham. Picture 25: Near Sparkford and 26 the weir at Alford (Alham/Brue confluence).

Picture source: Jo Pearse 2010




Pictures 27 & 28 showing weirs at Lydford, XX Bruton and XX Bruton dam.

Smaller weirs can only be navigated at high flows when fish are in danger of injury from the fast current. The massive weir at Lydford is a problem for fish migration.

Picures: Jo Pearse except Bruton Dam www.somersetrivers.org

At the sites surveyed upstream of the Fosseway, apart from the 5 eels at Gants Mill, trout was the only other fish on the menu. Otter are opportunist hunters, showing a preference for slower moving cyprinid and eel. The otter will prey on trout, but these are faster moving and to catch them uses much more energy (Kruuk et al 1993). In a study by Jacobsen (2005) of spraint analysis, cyprinids constituted 67% of food items. Even after stocking the river with trout (stocked fish being slower moving and prone to predation by birds) cyprinids continued to be the main food item (67-99%). Percids were not favoured and occasionally frogs were a major item.

Overall, otters have a negative preference for trout if other prey are available (Erlinge 1968) however there appears to be little studies on when only trout are available.

6.Conclusion

Rivers are dynamic and obscure environments. Unlike lakes or ponds, pollution, evidence of otters and even features may be washed away without trace quickly and efficiently.

Otters similarly are dynamic creatures and certainly obscure. The linear world they inhabit means that the surveyor has to travel considerable distance that would not be needed for other mammals such as a fox whose territory could easily be patrolled.

Mortality of otters is another problem affecting the surveyor as is the eventual dispersal of cubs. With just spraints to work with it is impossible to build much of a picture. Along a stretch of water, you are not concerned with a 'population' but rather one otter, or perhaps a dog otter with a bitch otter or two's territory overlapping. In a 20km stretch of water only one otter may inhabit it and where the boundaries are is unknown to the surveyor.

Relating the otter spraints to water quality brought some unexpected results, firstly the sudden appearance of regular spraints at the site that had consistently shown no spraints, but also the deterioration of the water at Bruton – the site regularly sprainted.

Future climate change is likely to bring about more summer droughts and poorer water quality influencing otter dispersal and affecting the long term prospects of the species in upper river catchments (Barbosa *et al.*, 2003).

All hypothesis remain unproven as it is not possible to accurately fix the dynamics of the otter on the upper Brue catchment.

6.1 Hypothesis

1. Otter use (as indicated by spraints) of a site is correlated to water quality
   The overall outcome of the water quality reports (chemical, biological and nutrients) were conflicting. It is likely the closeness to the source at Bruton and possible local pollution has affected the water.
2. Otter use of a site is correlated to prey availability
   During the course of the study the sites were both became used, so no correlations could be made.
3. Otter use of a site is correlated to habitat quality.
   It appears that both sites have reasonable quality habitat.

6.2 Recommendations of further study

1. For further study, a wider area would be more useful, although this would need more surveyors to accomplish.
2. Incorporated two day surveys once a season would provide a ‘snapshot’ of overnight activity on the second night and give an indication of actual numbers.
3. Once monthly oxygen and nutrient monitoring, particularly during the summer months
4. Spraint analysis on prey items to see the proportion of trout in the diet.
5. Comparison study of upper and lower Brue.

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8. Appendix

8.1 Oxygen and temperature data

	R. Alham		R. Brue	
DATE	%	C	%	C
11.12.10	87.2	2.39	85	2
2.1.11	86.6	3.4	88.6	2.9
8.1.11	85.4	3	84.2	2.7

8.2 Nutrient and chemical analysis

	R. Alham	R. Brue
Nitrogen mg /lt	0.01	0.05
Ammonia mg/lt	0.01	0.06
Ammonium	0.01	0.06
Phosphate mg/lt	0.08	0.04

8.3 pH Levels

	Brue	Alham		
Date	Church	E. Trow	Bolters	Alhampton
19.9.10	7.6	8.3		
15.10.10	7.9	8.4	8.4	
4.11.10	7.7	8.2		8.2
27.11.10	8.2	8.4		
5.12.10	7.9	8.4		
11.12.10	7.9	8.5		
2.1.11	8.5	8.5		
8.1.11	8.2	8.4		
16.1.11	8.3	8.4		
28.1.11	8.1	8.5		
18.2.11	8.1	8.5		
27.2.11	8.3	8.4		
AVERAGE	8.058333	8.408333		
ST DEV	0.264432	0.090034		