RIVERFLY CENSUS CONCLUSIONS

River Axe

Salmon & Trout Conservation

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REPORT OUTLINE

OUR KEY POINTS

The 'take home' messages and recommendations from our survey on the River Axe

WHAT WE'VE DONE

A summary of the Riverfly Census process and objectives

WHAT WE'VE FOUND

A site-by-site presentation of the S&TC Riverfly Census results on the Axe

OUR THOUGHTS

We use our findings to discuss potential key issues on the river

ACKNOWLEDGEMENTS & CONTACT

Work commissioned from Aquascience Consultancy Ltd. We thank them for their professionalism, rigour and assistance throughout the Riverfly Census.

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At Salmon & Trout Conservation, we see a world where wild fish have pollution-free places to live, with plenty to eat.

OUR KEY POINTS

The Salmon & Trout Conservation (S&TC) Riverfly Census has revealed the River Axe is experiencing similar types of stress throughout the catchment; namely sediment, nutrient and chemical. Despite the similarities, the sources appear to be quite different, with agricultural inputs in the upper catchment and urban inputs lower down.

- Greater effort should be made to reduce sediment loading in the upper Axe catchment. Sediment pressure was exhibited by the invertebrate communities throughout the river during our survey. To meet SAC/SSSI conservation objectives and improve water quality it is critical land management is improved, particularly in 'high risk' sediment areas just upstream of the designation boundary.

- Although land use is clearly divided between agricultural and urban in the catchment, additive effects from poor water quality in the upper river cannot be ruled out in the lower urban sections. Therefore, it is essential that the river is considered as a whole and effort is not only focussed on the mid to lower designated SAC/SSSI area.

- Stress from chemical pressure in the lower reaches was regularly indicated, with substantial recovery in the spring months not taking place. Further investigation should be made into quantifying the types of chemicals prevalent to identify whether they are originating from treated sewage effluent, agricultural sources or urban run-off. Such knowledge would be invaluable for creating an effective chemicals strategy in the catchment.

WHAT WE'VE DONE

The Riverfly Census was created to collect much needed high-resolution, scientifically robust data about the state of our rivers and the pressures facing them. We frequently talk about missing flylife and lack of fish compared to the 'good old days', but anecdotal evidence like this has little weight in environmental decision making.

> "Without data you're just another person with an opinion"
>
> W. Edwards Deming

River insects spend the majority of their lives in the water as nymphs, making them brilliant indicators of river health. Their continuous exposure to water makes examining them much more informative than spot chemical samples. Every invertebrate is unique, and each requires a specific set of conditions to thrive.

The Riverfly Census utilises the invertebrate assemblage: presence, absence and abundance of certain invertebrates, to indicate the types of stress our rivers are experiencing. The composition of the invertebrate community in the sample allows a biometric score to be calculated, which provides a surrogate, or direct scale, of physical chemical impact. Below are the biometrics used and the type of stress they indicate.

BIOMETRIC GLOSSARY

PSI

Proportion of Sediment-sensitive Invertebrates

A measure of stress caused by excess fine sediment on the invertebrate community

TRPI

Total Reactive Phosphorus Index

A relatively new metric developed to indicate pressure from phosphorus pollution

SPEAR

SPEcies At Risk

A measure to assess the impact of exposure to pesticides, herbicides and complex chemical toxicants on the invertebrate community

LIFE

Lotic-invertebrate Index for Flow Evaluation

A metric to assess the impacts of flow related stress on invertebrate communities which live in flowing water

SI

Saprobic Index

A measure to indicate stress on the invertebrate community caused by organic pollution

CENSUS METHOD

SCOPE

The Riverfly Census has spanned three years. It began in 2015, with 12 rivers across England. Multiple sample sites were carefully selected on each river.

SAMPLE

Kick-sweep sampling was completed in spring and autumn to EA guidelines, at all sample sites. Sampling and species-level identification were carried out by professional external consultants, Aquascience Consultancy Ltd.

STUDY

Species presence/absence data was inputted into Aquascience's biometric calculator to obtain scores against key stress types. The data was then evaluated in a whole catchment context to pinpoint likely suspects contributing to river deterioration.

MAKE A STAND

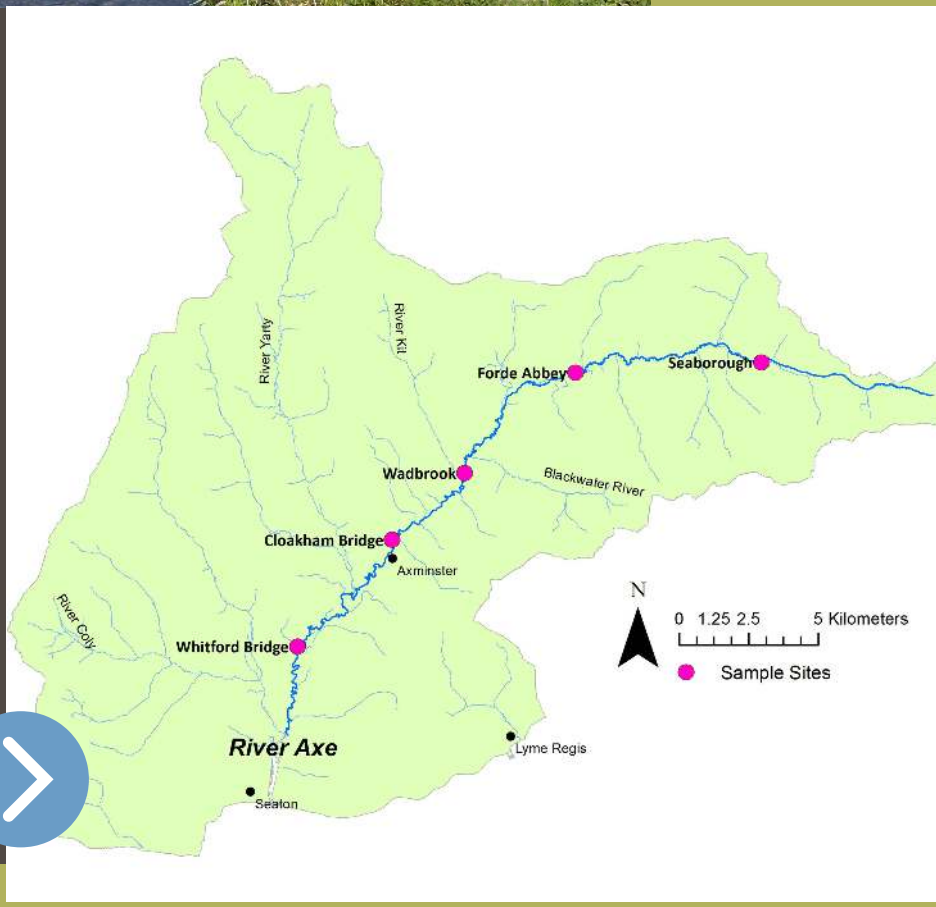
The data was compiled, and is being reported to stakeholders and policy makers, to improve management and conservation of our rivers.

Results

Riverfly Census sampling on the Axe began in 2015 and continued for three years on five sites: Seaborough, Forde Abbey, Wadbrook, Cloakham Bridge and Whitford Bridge.

Cloakham Bridge could not be sampled in autumn 2017 due to unfavourable sampling conditions.

The locations of our sample sites are shown on the map, represented by pink circles.



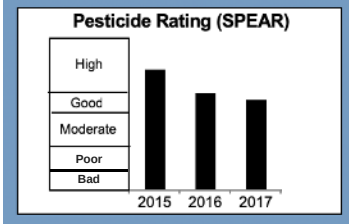
1 WHAT WE'VE FOUND
Seaborough

At Seaborough slight nutrient stress was indicated by the invertebrate community throughout spring. In autumn, the site was unimpacted apart from in 2017, where a slight impact occurred.

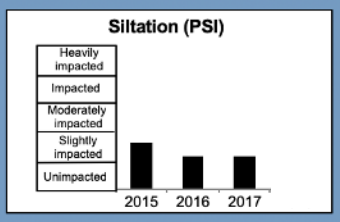
A slight impact from sediment was indicated during spring throughout the three years surveyed. Sediment impact was also slight in autumn 2015 and autumn 2016, but in 2017 a moderate impact peak occurred.

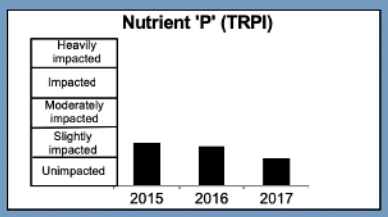
The complex chemical biometric, SPEAR, failed the proposed WFD standard in autumn 2015 and autumn 2016 (Beketov et al. 2009). Some recovery in spring did occur.

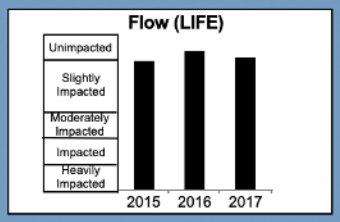
SPRING BIOMETRICS

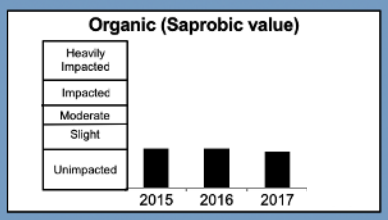


	2015	2016	2017
BMWP	205	161	118
ASPT	6.61	6.44	6.21
Annual Mayfly Sp. Richness	11	6	12
Total Abundance	1053	519	-
EPT	23	17	11
CCI	10.10	11.45	-
LIFE	7.98	8.17	8.05
PSI	68.29	77.19	78.05
SPEAR	55.18	43.84	40.88
TRPI	71.43	73.08	81.25
Saprobic	1.80	1.79	1.72

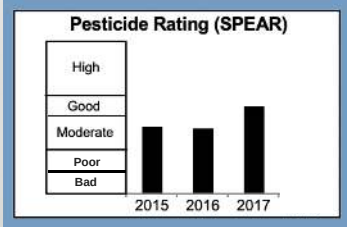




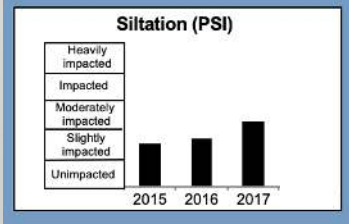


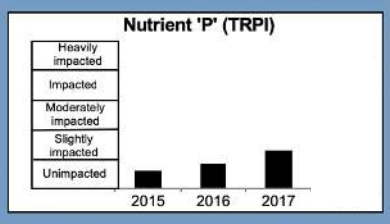


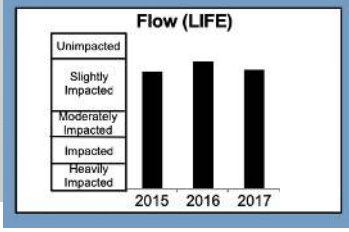
AUTUMN BIOMETRICS

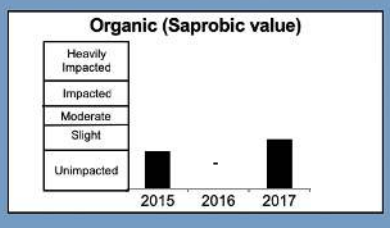


	2015	2016	2017
BMWP	122	120	159
ASPT	5.54	5.45	5.89
Annual Mayfly Sp. Richness	11	6	12
Total Abundance	560	844	887
EPT	10	10	16
CCI	11.67	8.06	15.56
LIFE	7.75	7.96	7.79
PSI	70.45	66.67	55.22
SPEAR	30.28	29.48	39.45
TRPI	88.89	83.33	75.00
Saprobic	1.78	-	1.99







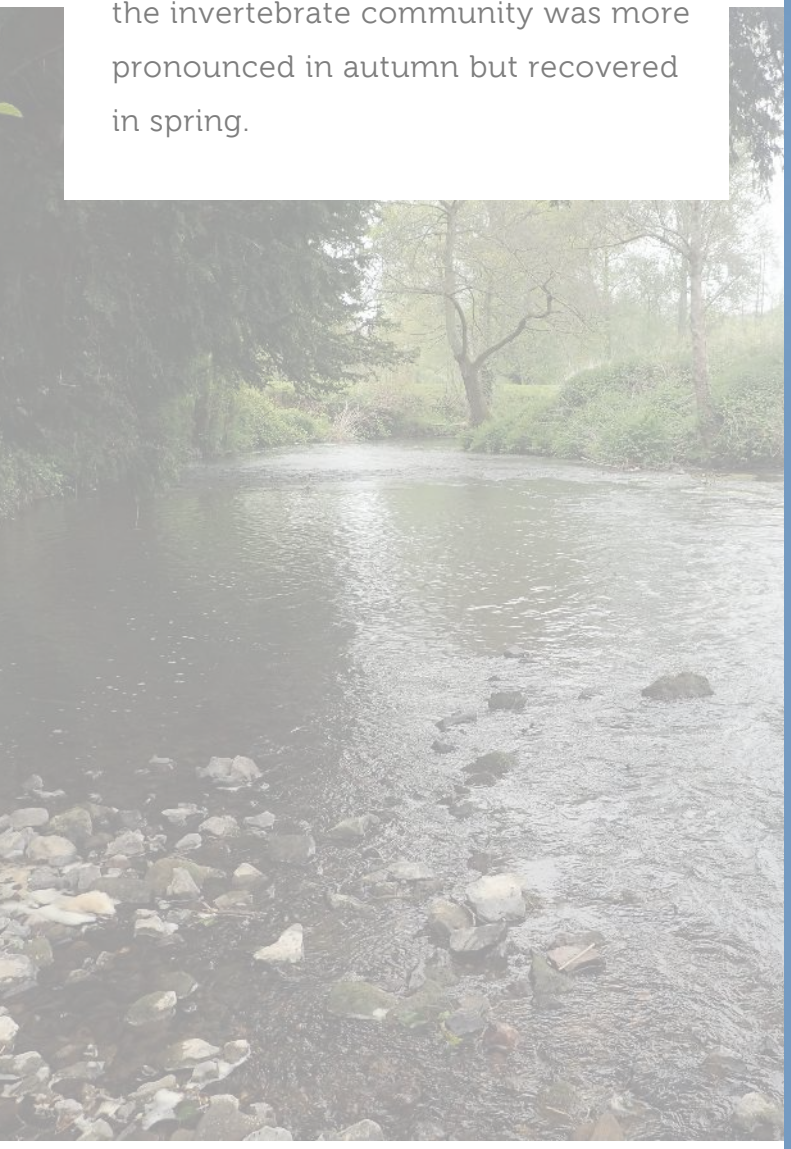


2 WHAT WE'VE FOUND
Forde Abbey

The LIFE biometric revealed minimal impact from flow stress on the invertebrate community at Forde Abbey during 2015-2017.

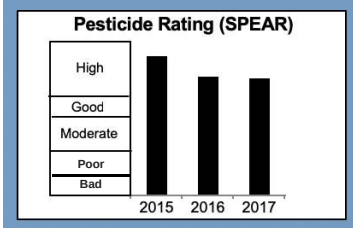
The impact of nutrient stress in spring and autumn was slight in the first two survey years, but absent in 2017. Stress from excess fine sediment had the most impact in 2017 for both seasons.

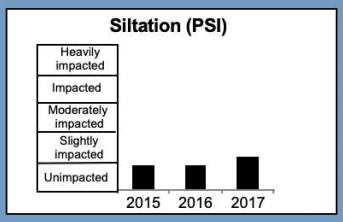
All results were above the proposed WFD threshold for SPEAR. Impact on the invertebrate community was more pronounced in autumn but recovered in spring.

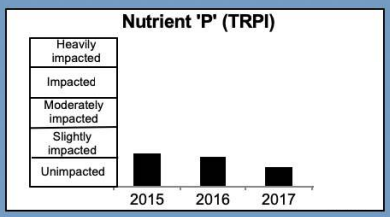


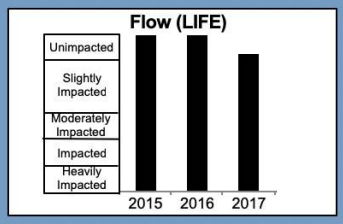
SPRING BIOMETRICS

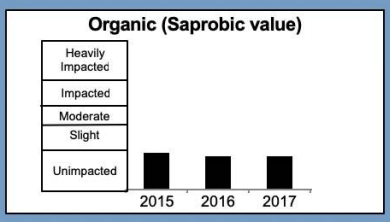
	2015	2016	2017
BMWP	156	172	152
ASPT	7.43	6.62	6.61
Annual Mayfly Sp. Richness	8	7	8
Total Abundance	785	616	490
EPT	21	20	14
CCI	10.63	12.73	-
LIFE	8.46	8.48	8.12
PSI	83.61	83.33	77.08
SPEAR	62.52	53.13	52.67
TRPI	78.26	80.00	87.50
Saprobic	1.74	1.66	1.67





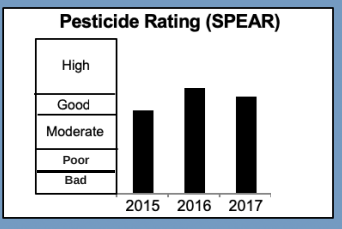


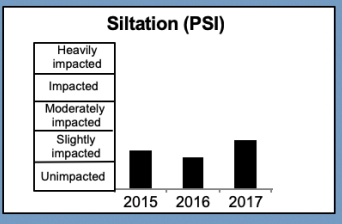


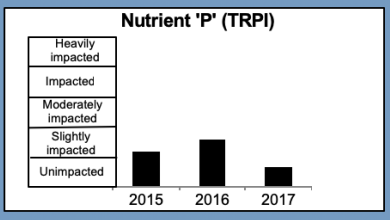


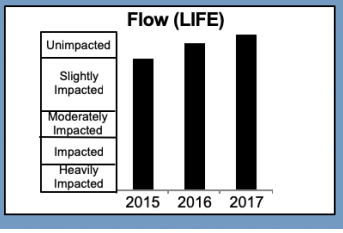
AUTUMN BIOMETRICS

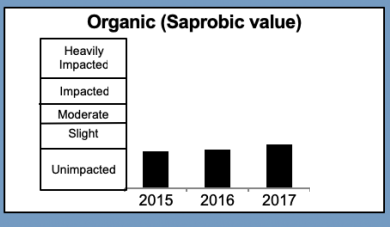
	2015	2016	2017
BMWP	161	216	112
ASPT	5.75	6.97	6.22
Annual Mayfly Sp. Richness	8	7	8
Total Abundance	686	964	507
EPT	14	19	10
CCI	13.13	23.20	10.26
LIFE	8.00	8.29	8.43
PSI	74.14	78.87	66.67
SPEAR	37.10	47.18	43.55
TRPI	76.92	68.75	87.50
Saprobic	1.74	1.78	1.87









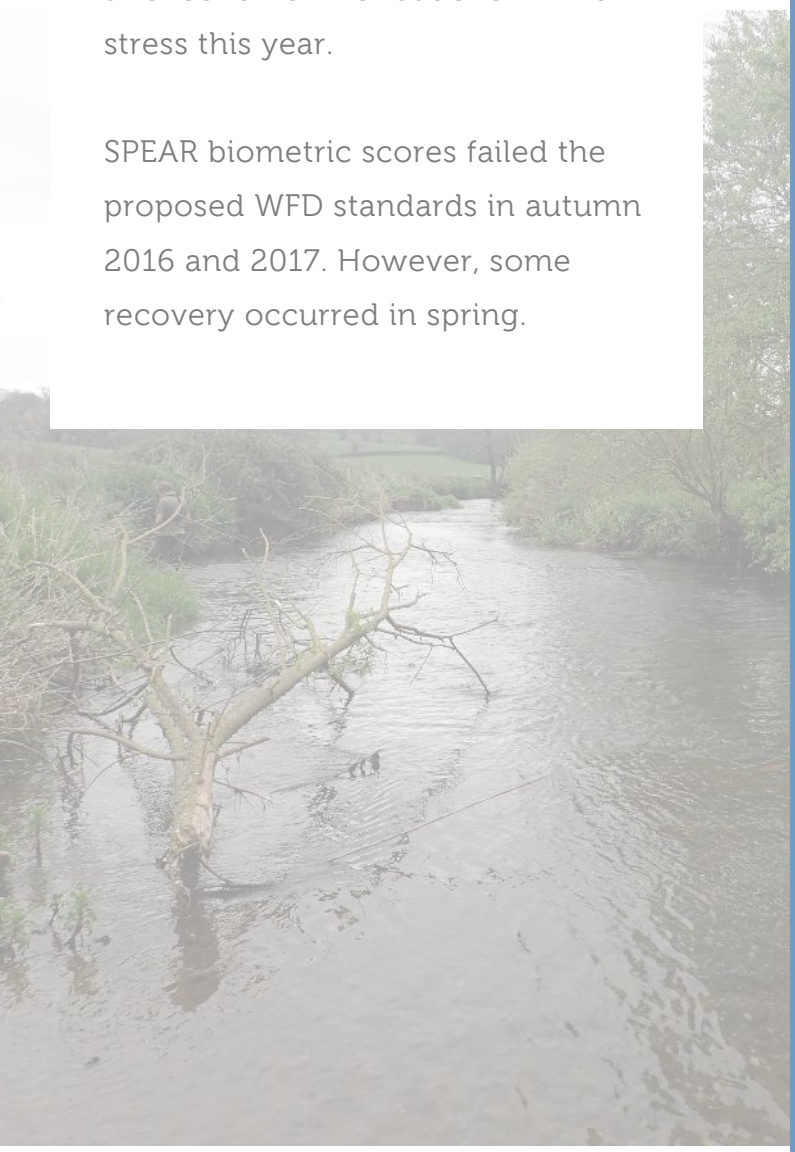


3 WHAT WE'VE FOUND
Wadbrook

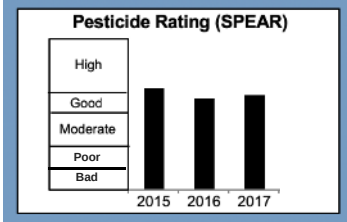
The invertebrate community at Wadbrook experienced stress from excess sediment in autumn 2016 and 2017, where moderate impact peaks occurred. Slight flow stress was also indicated throughout autumn, potentially suggesting flow was not sufficient to move excess sediment off of river gravels.

Nutrient stress was notable in autumn, with a moderate impact score occurring every year. In spring, impact was slight in 2015 and 2016 but absent in 2017, which is possibly a reflection of the reduction in flow stress this year.

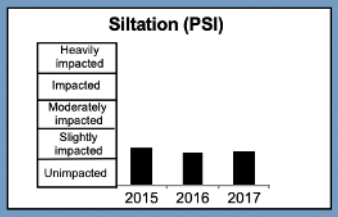
SPEAR biometric scores failed the proposed WFD standards in autumn 2016 and 2017. However, some recovery occurred in spring.

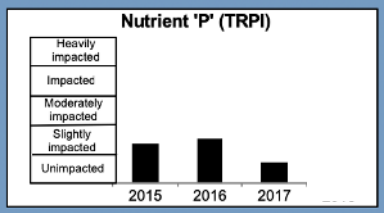


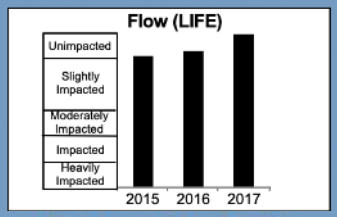
SPRING BIOMETRICS

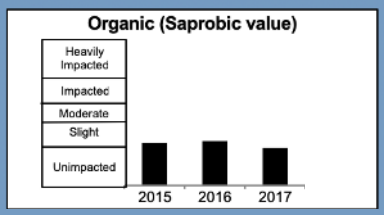


	2015	2016	2017
BMWP	191	163	158
ASPT	7.07	6.27	6.58
Annual Mayfly Sp. Richness	8	9	8
Total Abundance	1633	775	760
EPT	20	16	16
CCI	17.03	13.03	-
LIFE	8.06	8.14	8.46
PSI	74.03	77.42	76.27
SPEAR	46.34	41.55	43.46
TRPI	74.07	70.37	86.36
Saprobic	1.86	1.90	1.75

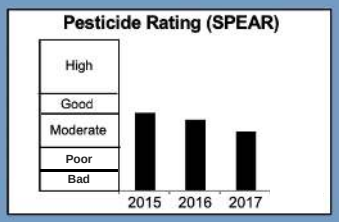




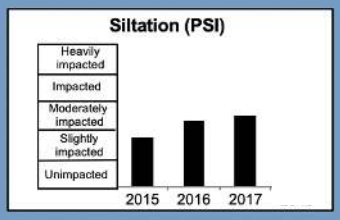


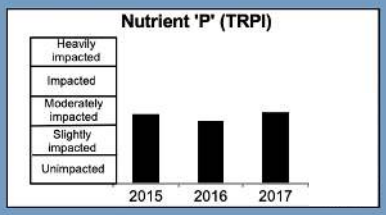


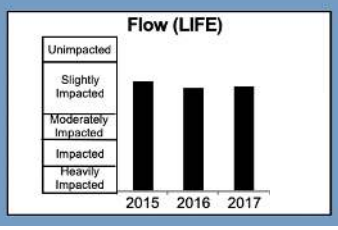
AUTUMN BIOMETRICS

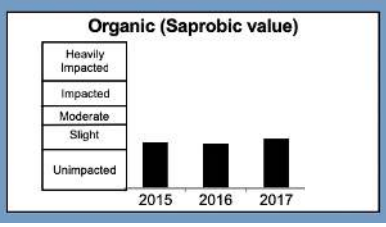


	2015	2016	2017
BMWP	154	188	188
ASPT	5.92	5.88	5.88
Annual Mayfly Sp. Richness	8	9	8
Total Abundance	663	809	865
EPT	14	15	15
CCI	15.83	14.45	14.88
LIFE	7.63	7.51	7.54
PSI	65.57	54.43	51.16
SPEAR	35.70	32.79	27.38
TRPI	53.33	57.89	52.38
Saprobic	1.95	1.91	2.01









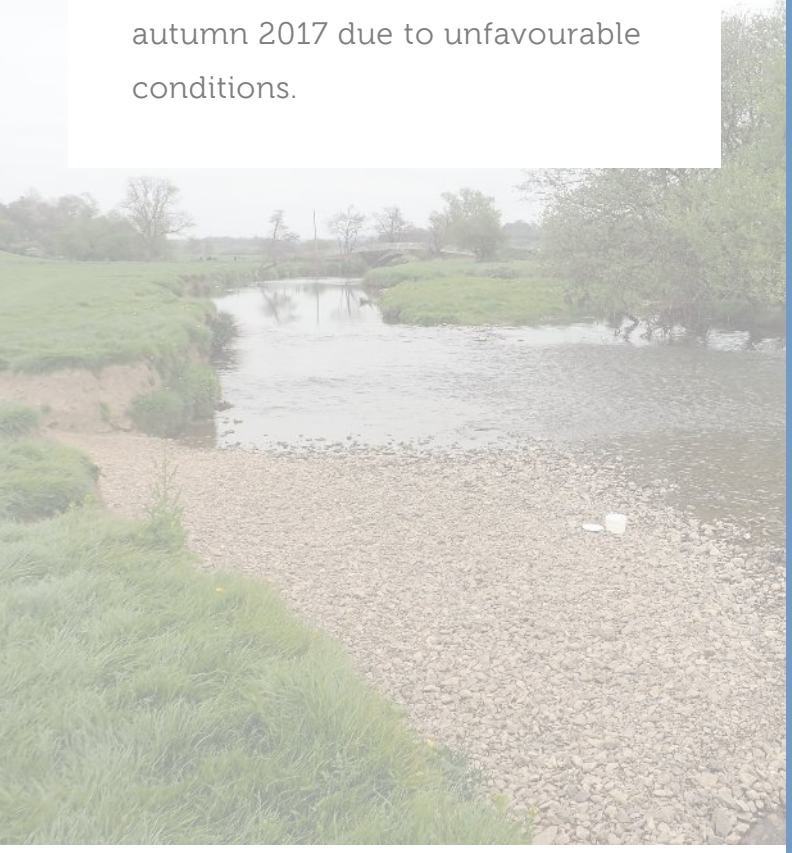
4 WHAT WE'VE FOUND
Cloakham Bridge

At Cloakham Bridge slight stress from flow was indicated by the invertebrate community in autumn. A moderate impact from sediment stress was also present.

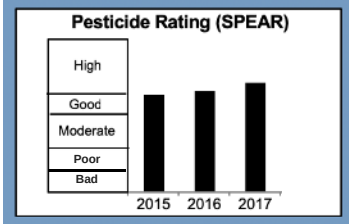
Nutrient stress was moderate in autumn 2016 but was absent in autumn 2015. The opposite occurred in spring, with a peak in 2015 followed by minimal stress from nutrients in 2016 and 2017.

The complex chemical biometric, SPEAR, showed a notable impact from chemicals in autumn, but some recovery in spring occurred indicating a seasonal impact.

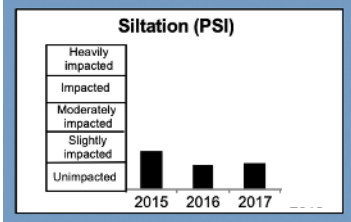
This site could not be sampled in autumn 2017 due to unfavourable conditions.

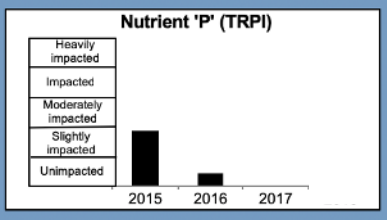


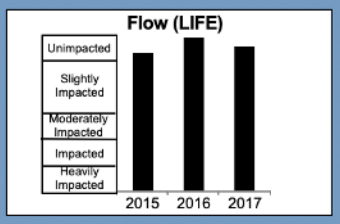
SPRING BIOMETRICS

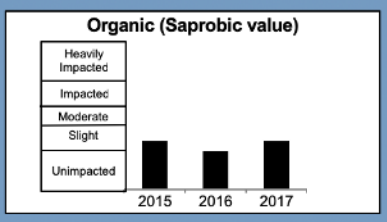


	2015	2016	2017
BMWP	139	127	158
ASPT	6.62	6.68	6.87
Annual Mayfly Sp. Richness	10	7	-
Total Abundance	770	490	638
EPT	18	12	18
CCI	11.96	10.00	-
LIFE	8.15	8.45	8.27
PSI	73.53	82.98	82.76
SPEAR	43.89	45.46	49.39
TRPI	63.16	91.67	100.00
Saprobic	1.97	1.77	1.97

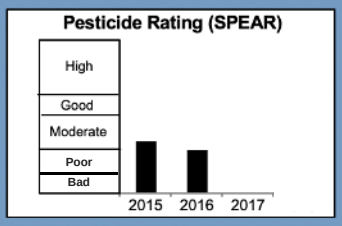




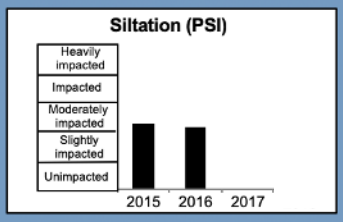


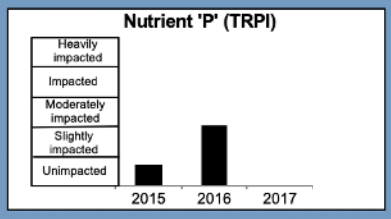


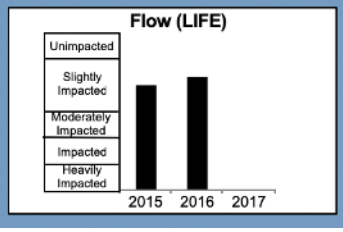
AUTUMN BIOMETRICS

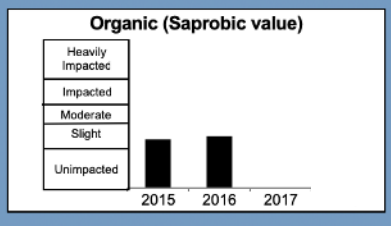


	2015	2016	2017
BMWP	114	114	_
ASPT	5.18	5.18	_
Annual Mayfly Sp. Richness	10	7	_
Total Abundance	422	765	_
EPT	8	7	_
CCI	7.89	9.21	_
LIFE	7.48	7.65	_
PSI	55.32	57.14	_
SPEAR	23.57	19.51	_
TRPI	85.71	60.00	_
Saprobic	1.97	2.05	_









5 WHAT WE'VE FOUND
Whitford Bridge

The invertebrate community at Whitford Bridge showed concerning levels of nutrient stress in autumn throughout the survey period. Impact in spring was less pronounced, with a slight impact score each year.

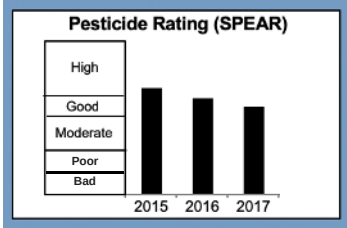
Flow stress was consistently apparent at Whitford Bridge during the survey.

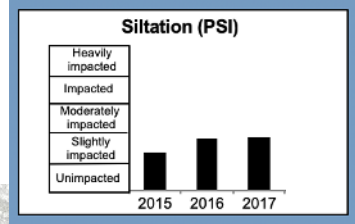
A slight impact from excess fine sediment consistently occurred throughout spring. The impact was moderate in 2015 and 2016, but reduced to slight in 2017.

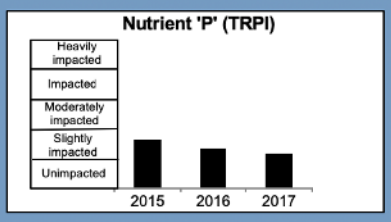
Chemical impact was moderate every year in autumn and failed the proposed WFD standard. The WFD SPEAR standard was met in spring throughout the survey, but some stress from chemicals was still present.

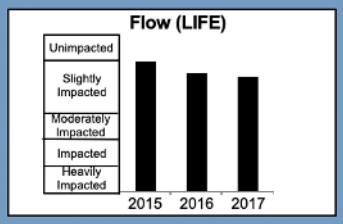
SPRING BIOMETRICS

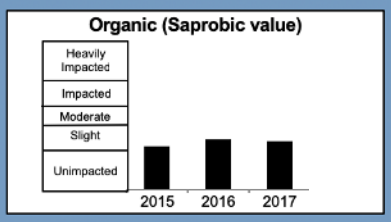
	2015	2016	2017
BMWP	193	161	160
ASPT	7.15	6.44	5.93
Annual Mayfly Sp. Richness	8	7	7
Total Abundance	1063	676	790
EPT	22	16	16
CCI	13.00	13.16	-
LIFE	8.00	7.77	7.70
PSI	73.42	64.41	63.49
SPEAR	48.03	43.18	39.55
TRPI	68.00	74.07	77.27
Saprobic	1.88	1.99	1.97





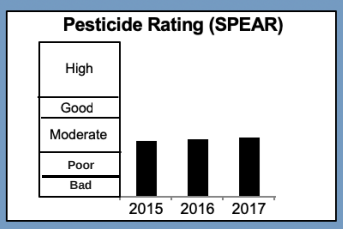


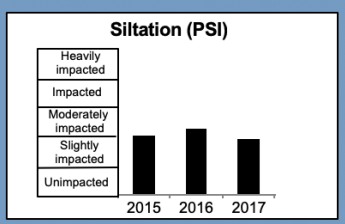


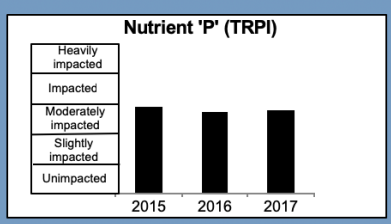


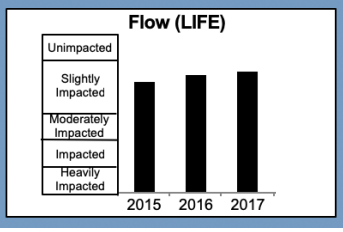
AUTUMN BIOMETRICS

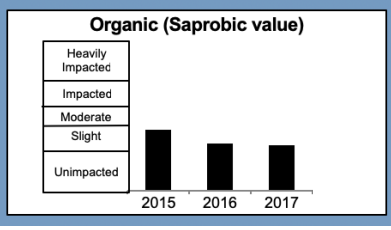
	2015	2016	2017
BMWP	143	137	137
ASPT	5.50	5.71	5.96
Annual Mayfly Sp. Richness	8	7	7
Total Abundance	457	667	486
EPT	8	10	12
CCI	8.48	9.55	16.85
LIFE	7.58	7.74	7.78
PSI	59.62	55.74	62.71
SPEAR	24.55	25.41	26.25
TRPI	42.86	46.15	45.45
Saprobic	2.22	1.93	1.92











Discussion

The mid to lower reaches of the River Axe are designated as both a Special Area of Conservation (SAC) and a Site of Special Scientific Interest (SSSI). These designations imply that the river should have the highest possible level of protection to preserve its biological integrity.

Some positive findings from the survey included evidence of good elver runs in to the river, something that we only observed in the Axe and Camel. Additionally, no faunal invasive species were detected in our three years of sampling. However, overall our Riverfly Census results have indicated that the river, particularly in the lower reaches, is being subjected to various pressures threatening water quality and in turn the invertebrate assemblages that live there.

The invertebrate community consistently exhibited stress from excess fine sediment throughout the survey. No sample site was completely free from evidence of sediment impact; this was indicated clearly in our underwater bed photographs as well as the PSI signatures (Fig. 1).

Fig. 1 - Spring 2017 riverbed photgraph at Cloakham Bridge (top left), Wadbrook (top right) and Seaborough (bottom) showing evidence of excess fine sediment loading

Land used for maize cropping in the northeast of the catchment has increased in the past two decades (Fig. 2). This activity promotes sediment run-off and could be responsible for sediment stress scores at the Forde Abbey site. Modelling by Natural England (2014) identified this area to be high-risk for sediment loading to the river (Fig. 3).

Although not highlighted as a high risk fine sediment area, our furthest upstream site, Seaborough also exhibited sediment issues. The land surrounding this site is mainly used for pastoral agriculture which may be introducing sediment to the river through increased run-off as a result of top soil compaction by cattle (Fig. 2).

Overall, sediment signatures were slightly more pronounced downstream in the SAC/SSSI region, which may be a result of additive loading on top of existing sediment from the upper reaches.

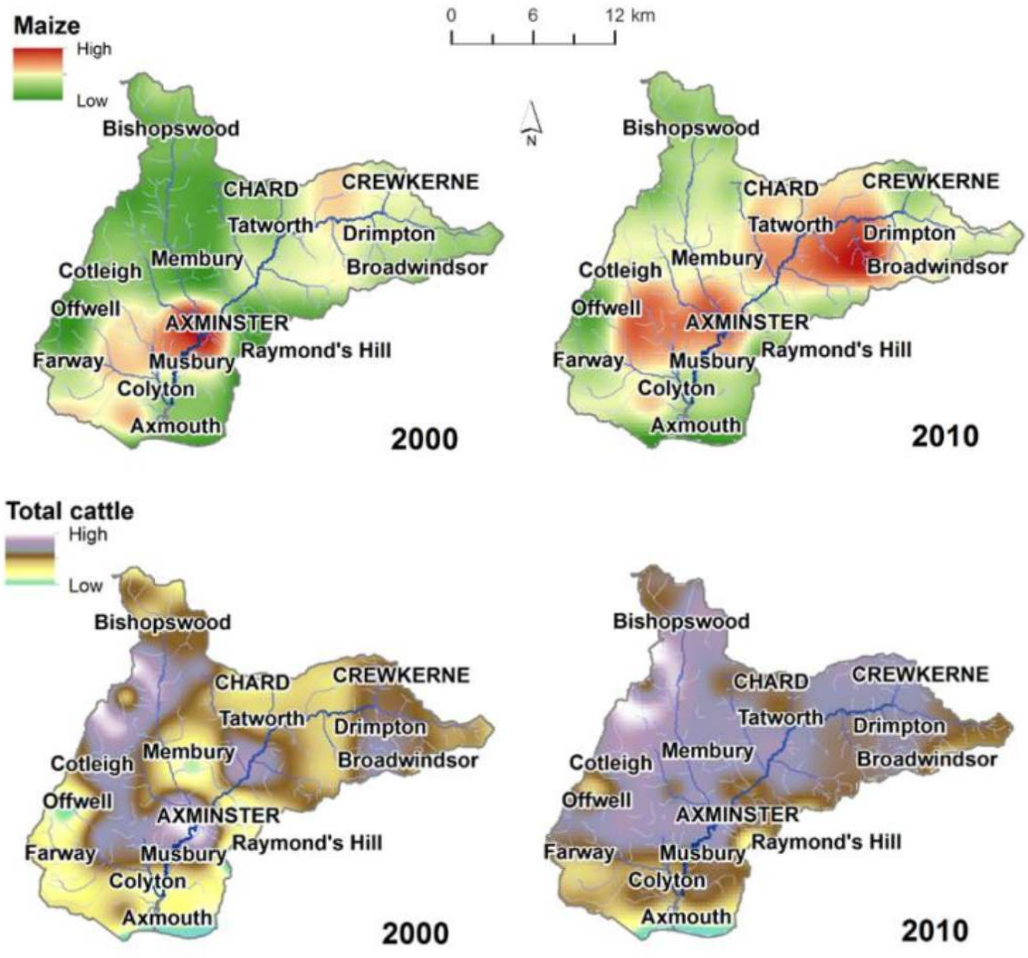


Fig. 2 - Changes in total area of land being cultivated for maize and cattle from 2000 to 2010 in the River Axe catchment from Agricultural Census data (REFERENCE)

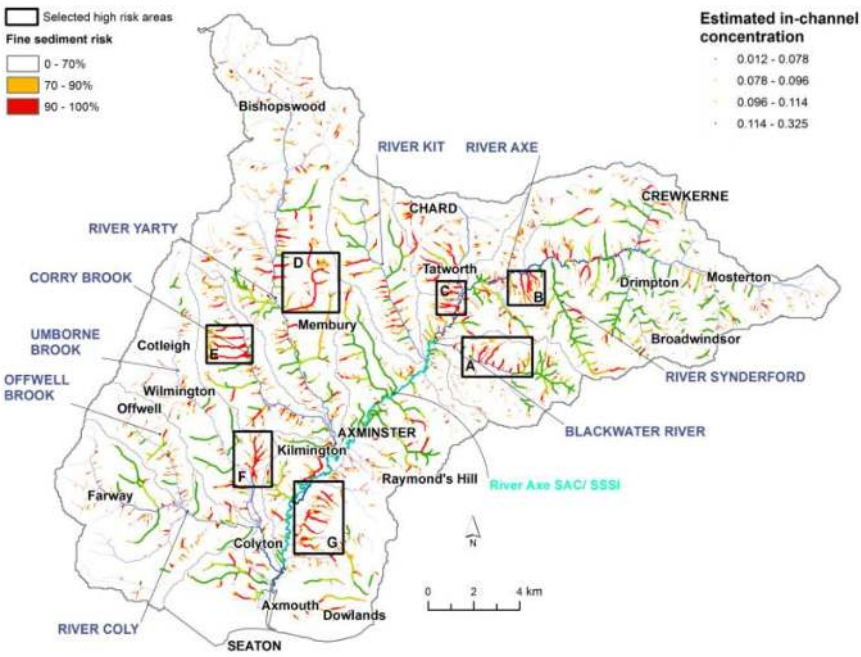


Fig. 3 - Modelled fine sediment risk in the Axe catchment using SCIMAP at 10m resolution, Forde Abbey site located within black box marked 'B' (Natural England, 2014)

Whitford Bridge, the furthest downstream Riverfly Census site, exhibited moderate impact from nutrient stress. This impact was less pronounced in spring, potentially as a result of plant uptake (Jarvie et al. 2006). The major town Axminster is located between Cloakham Bridge and Whitford Bridge, so population density is greatest in this part of the catchment. Kilmington sewage works provides waste water treatment for this area. Treated sewage effluent provides a significant source of biologically available phosphate, which may explain the concerning TRPI scores at Whitford Bridge.

Chemical stress was also prevalent throughout the river during the survey. The downstream sites (Wadbrook, Cloakham Bridge and Whitford Bridge did not undergo as much recovery in spring as the upstream sites (Seaborough and Forde Abbey), which may be a result of differing land use. The upper Axe catchment is mainly agricultural, so chemicals may originate from veterinary medicines or crop treatments and be delivered to the river through increased run-off in wetter autumn months. The middle to lower catchment is mostly urban, so chemical inputs to the river may be more regular and less seasonal, originating from treated sewage effluent and road run off. Natural absorption of water through the ground is typically prevented in urban areas as surfaces are mostly impermeable. This increases the volume and velocity of run-off, and means chemicals are less likely to be filtered out (Walsh et al. 2012).

FINAL WORD

Many of our rivers lack historical reference points, making it difficult to know exactly what optimal conditions in our rivers should look like. It is only with a reliable 'benchmark' of health that we can properly quantify deterioration or recovery, and only with robust long term monitoring can we truly understand the changes occurring in our freshwater systems.

We hope the Riverfly Census has gone some way towards helping to address these missing 'reference points' by providing the first species-level baseline for many of the rivers surveyed. But this is just the first step! We welcome working with local groups to better understand the possible pressures and moving towards a more sustainable future for our waterways.

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