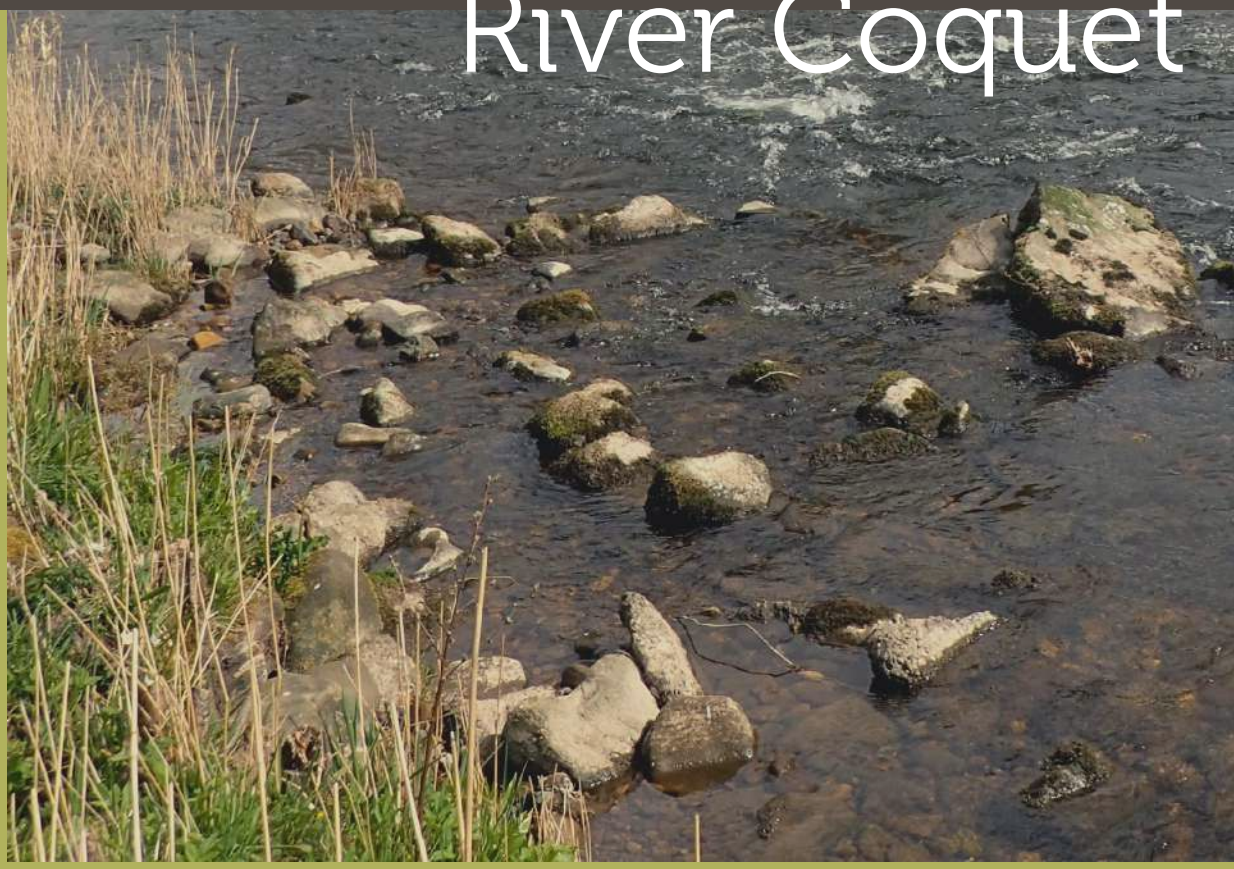
RIVERFLY CENSUS CONCLUSIONS

River Coquet



Salmon & Trout Conservation

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REPORT OUTLINE

OUR KEY POINTS

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

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 Coquet

OUR THOUGHTS

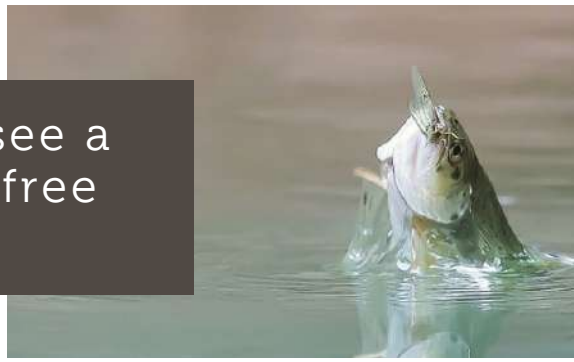
We use our findings to discuss potential key issues on the river

ACKNOWLEDGEMENTS & CONTACT

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

Report composed by Lauren Mattingley. For Riverfly Census enquiries contact: lauren@salmon-trout.org

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 on the Coquet has shown the river to be in relatively healthy condition in the upper reaches. Especially at our Cragend Farm site, which was one of the best performing sites for invertebrate diversity out of the entire Riverfly Census. Things were slightly less positive in the lower sites, which were showing some signs of ecological stress. Here are our findings and recommendations to improve water quality in the Coquet:

- There is a notable change in water quality between Cragend Farm and Felton. Riverbed photography indicates that this is potentially nutrient related. It would be worth further investigating this 'pinch-point' further to identify the source and begin tackling the problem.

- Cragend Farm is a biologically healthy site that should be preserved, continuing species-level monitoring here would be extremely valuable to ensure there is no deterioration.

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 impact 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

WHAT WE'VE DONE

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.

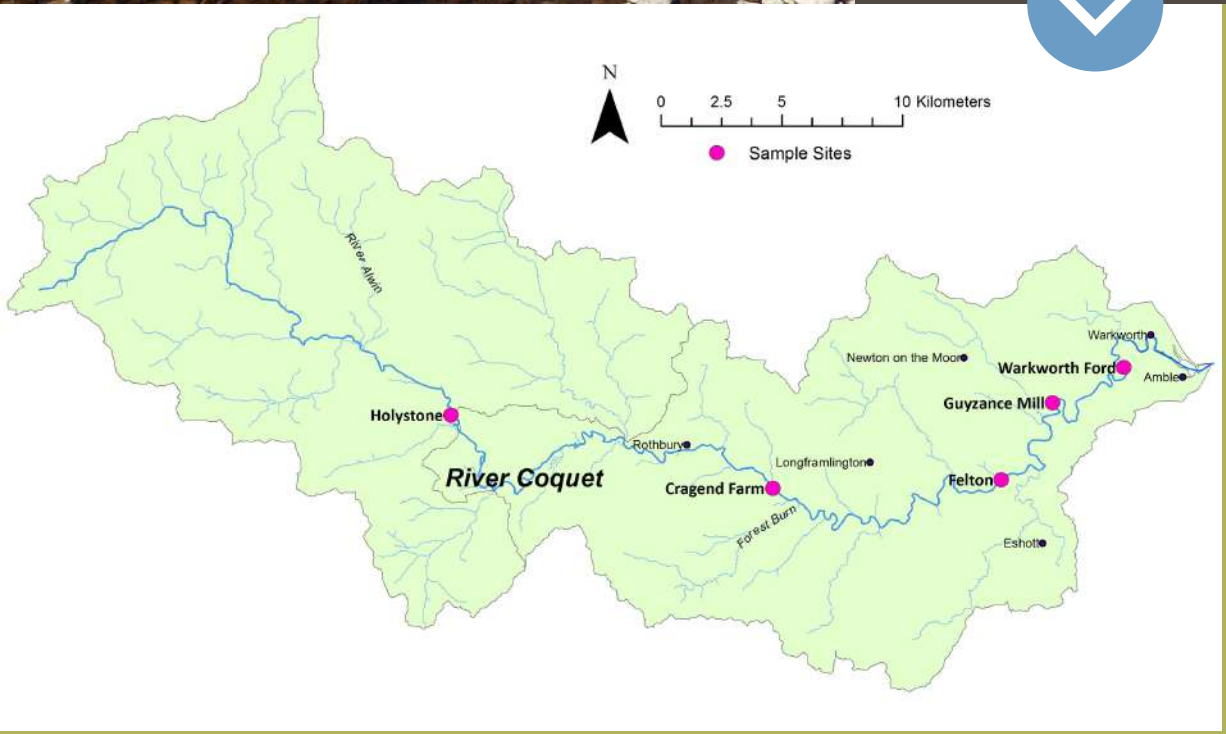
MAKE A STAND

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 Coquet began in 2015 and continued for three years on five sites: Holystone, Cragend Farm, Felton, Guyzance Mill and Warkworth Ford.

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

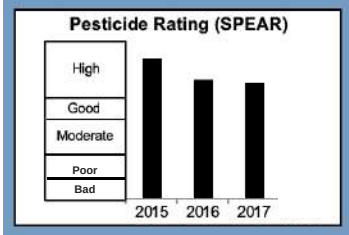


1 WHAT WE'VE FOUND
Holystone

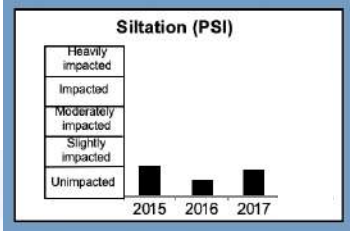
Some nutrient stress was exhibited by the invertebrate community at Holystone. A borderline moderate peak occurred in autumn 2015, but this was a single occurrence in during the three years sampled.

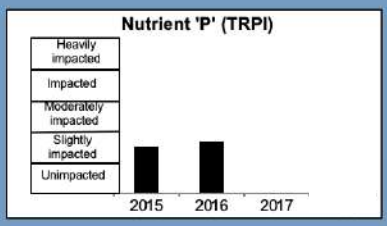
Sediment stress was minimal with no concerning peaks. Chemical stress was also not indicated, all SPEAR signatures passed the proposed WFD standard by Beketov et al. (2009).

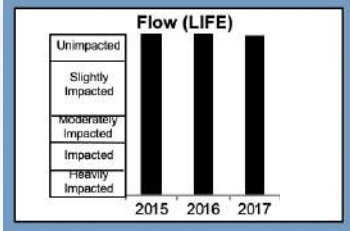
SPRING BIOMETRICS

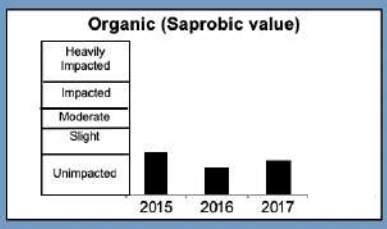


	2015	2016	2017
BMWP	182	159	132
ASPT	7.00	6.91	6.29
Annual mayfly sp. richness	8	6	5
Total Abundance	904	549	477
EPT	20	20	15
CCI	17.21	15.68	8.33
LIFE	8.50	8.50	8.46
PSI	79.69	89.09	82.69
SPEAR	61.84	52.16	50.61
TRPI	70.00	67.50	100.00
Saprobic	1.84	1.51	1.67

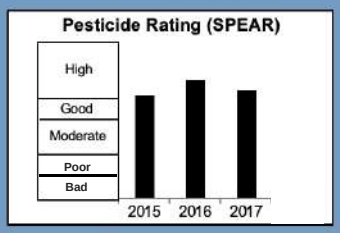




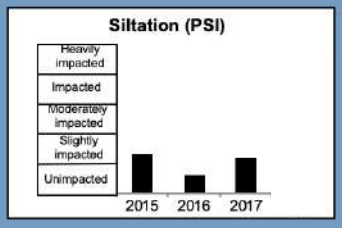


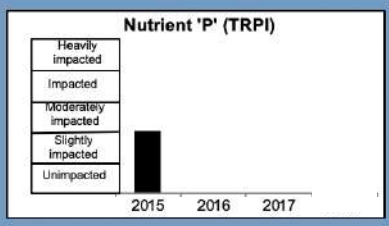


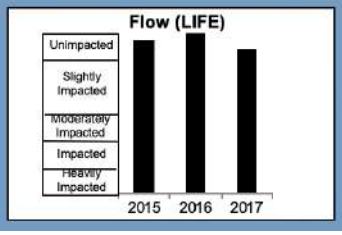
AUTUMN BIOMETRICS

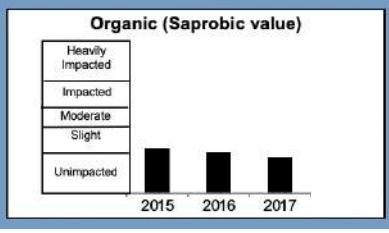


	2015	2016	2017
BMWP	106	150	86
ASPT	5.80	7.14	5.73
Annual mayfly sp. richness	8	6	5
Total Abundance	981	850	320
EPT	12	17	10
CCI	8.82	9.21	15.91
LIFE	8.36	8.69	8.21
PSI	74.14	87.93	76.09
SPEAR	45.07	52.60	47.86
TRPI	59.71	100.00	100.00
Saprobic	1.87	1.79	1.68









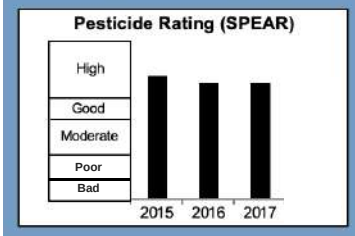
2 WHAT WE'VE FOUND
Cragend Farm

Overall Cragend Farm was a relatively healthy site.

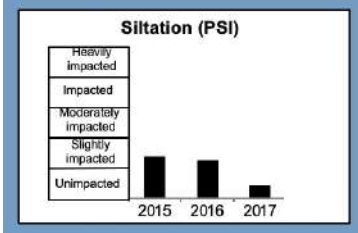
Nutrient stress on the invertebrate community was only pronounced in spring 2015. Sediment stress was minimal in both seasons throughout the survey period.

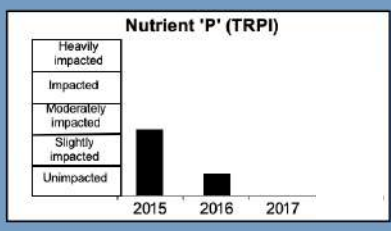
No stress from chemicals was exhibited, all samples were above the proposed WFD threshold.

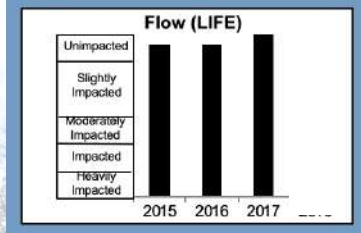
SPRING BIOMETRICS

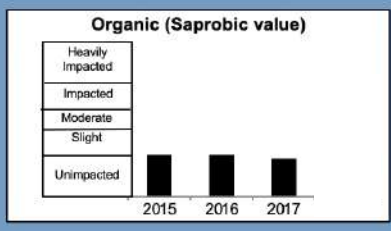


	2015	2016	2017
BMWP	156	190	124
ASPT	6.78	6.55	6.53
Annual mayfly sp. richness	9	11	10
Total Abundance	755	1055	735
EPT	18	26	16
CCI	14.81	14.70	9.09
LIFE	8.30	8.30	8.69
PSI	72.73	75.34	91.38
SPEAR	54.24	50.94	50.62
TRPI	58.23	85.71	100.00
Saprobic	1.80	1.78	1.73

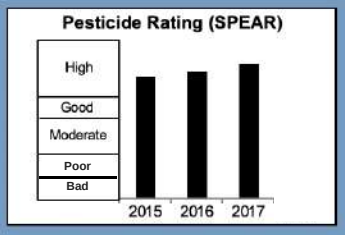




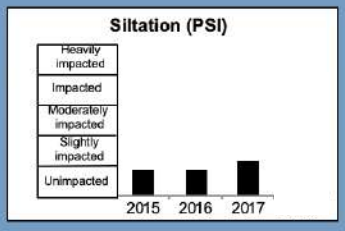


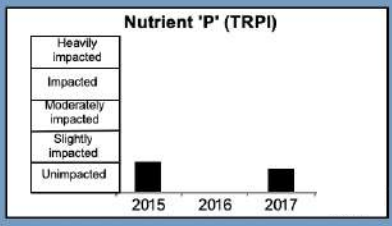


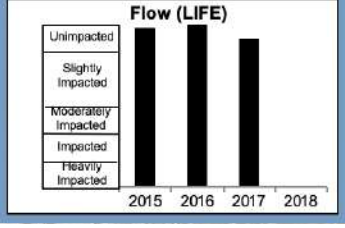
AUTUMN BIOMETRICS

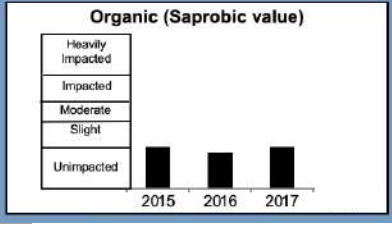


	2015	2016	2017
BMWP	181	137	209
ASPT	6.24	6.52	6.74
Annual mayfly sp. richness	9	11	10
Total Abundance	1188	1028	957
EPT	23	19	23
CCI	14.22	9.29	17.67
LIFE	8.45	8.62	8.24
PSI	83.13	83.33	77.22
SPEAR	53.39	55.46	58.74
TRPI	81.00	100.00	84.62
Saprobic	1.80	1.70	1.80









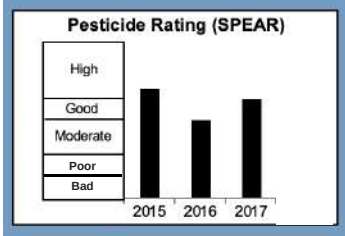
3 WHAT WE'VE FOUND
Felton

At Felton some nutrient stress was present, particularly in 2015 where an impacted peak occurred in autumn.

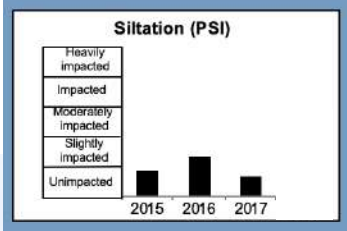
Sediment stress was minimal.

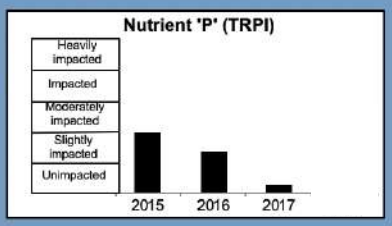
Spring 2016 was close to the WFD SPEAR threshold for chemicals, but all signatures during the three year survey were above.

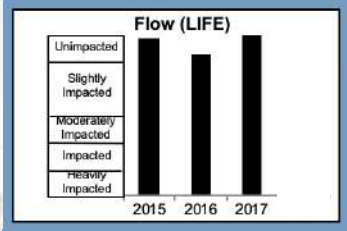
SPRING BIOMETRICS

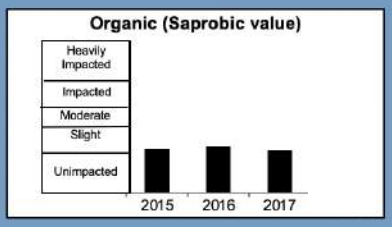


	2015	2016	2017
BMWP	179	131	150
ASPT	6.63	5.95	6.52
Annual mayfly sp. richness	7	6	6
Total Abundance	710	861	907
EPT	23	14	19
CCI	16.57	8.61	9.75
LIFE	8.42	8.13	8.69
PSI	84.06	74.51	87.10
SPEAR	48.49	34.38	43.66
TRPI	60.69	73.89	95.83
Saprobic	1.85	1.89	1.82

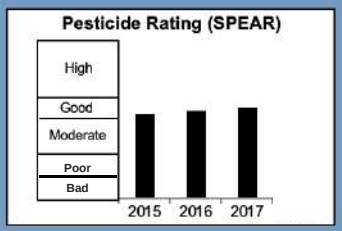




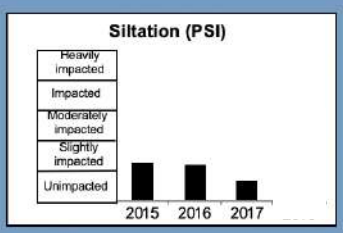


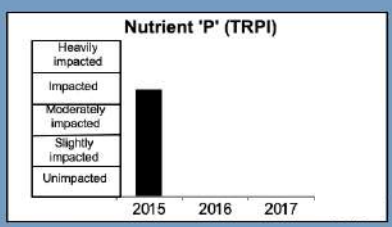


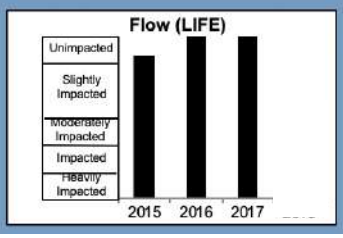
AUTUMN BIOMETRICS

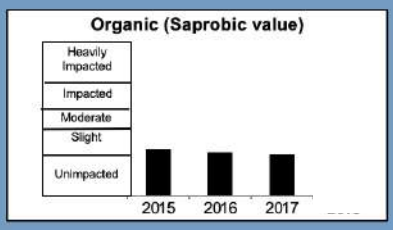


	2015	2016	2017
BMWP	136	165	93
ASPT	5.91	6.11	5.81
Annual mayfly sp. richness	7	6	6
Total Abundance	568	2515	561
EPT	16	18	11
CCI	8.41	12.60	5.57
LIFE	8.14	8.60	8.55
PSI	75.81	76.39	86.96
SPEAR	36.68	38.81	40.41
TRPI	31.25	100.00	100.00
Saprobic	1.89	1.84	1.78







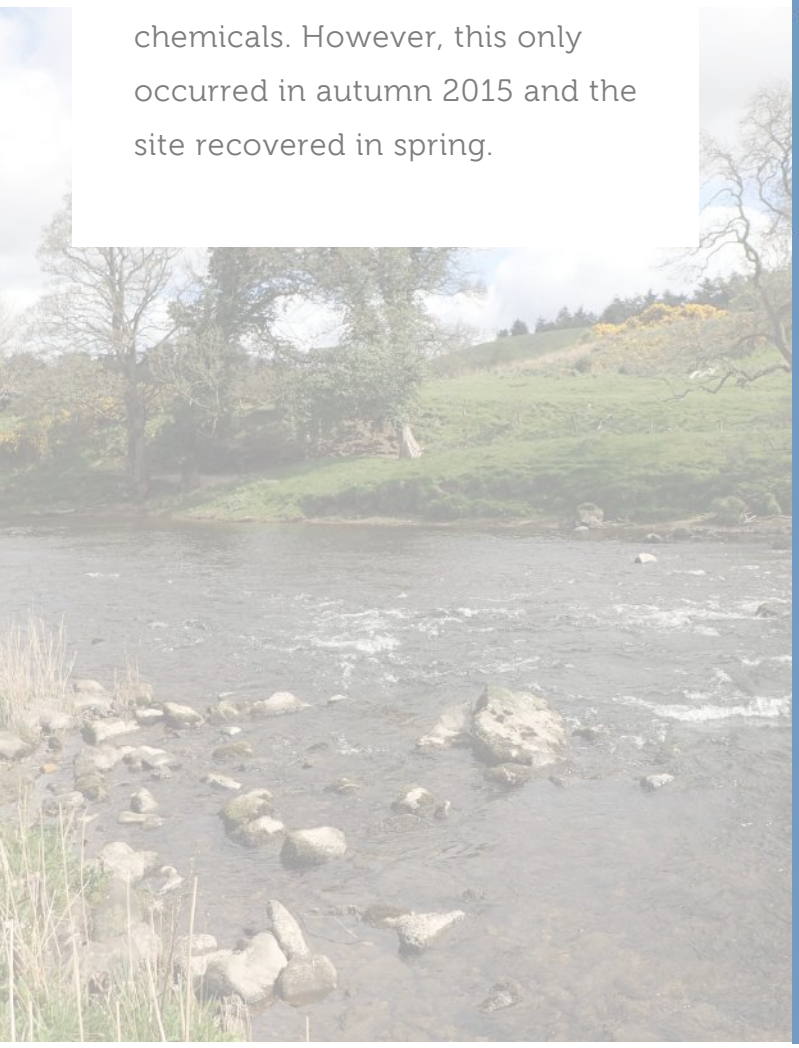


4 WHAT WE'VE FOUND
Guyzance Mill

The invertebrate community exhibited minimal stress from excess fine sediment at Guyzance Mill.

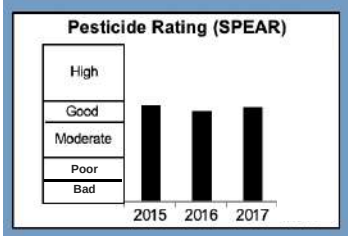
Stress from excess nutrients was notable in 2015, with a moderate impact peak in spring and an impacted peak in autumn. The following two years exhibited some nutrient stress but it was less pronounced than 2015.

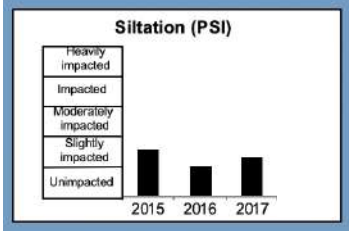
Guyzance Mill was the first site to fail the proposed WFD standard for chemicals. However, this only occurred in autumn 2015 and the site recovered in spring.

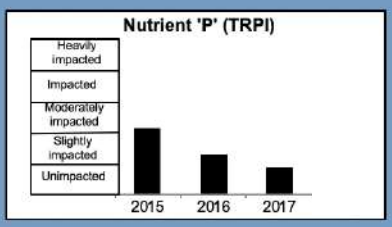


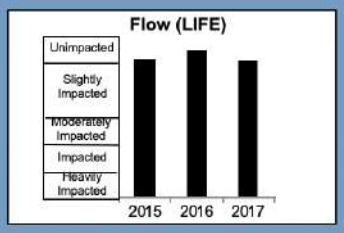
SPRING BIOMETRICS

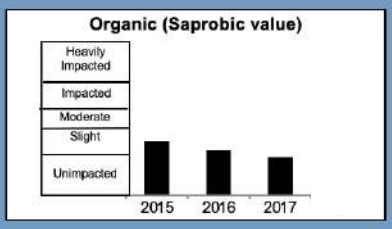
	2015	2016	2017
BMWP	163	135	170
ASPT	6.27	5.87	5.86
Annual mayfly sp. richness	6	8	8
Total Abundance	1027	1222	916
EPT	17	16	19
CCI	8.33	14.84	11.85
LIFE	8.07	8.24	8.06
PSI	69.70	79.41	73.85
SPEAR	42.71	39.67	41.93
TRPI	58.22	75.00	82.61
Saprobic	2.04	1.85	1.72





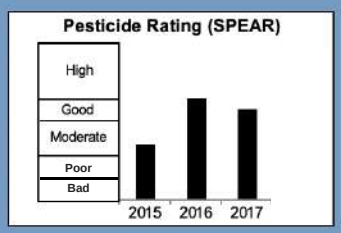


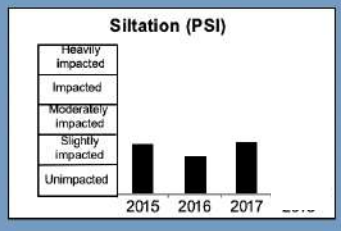


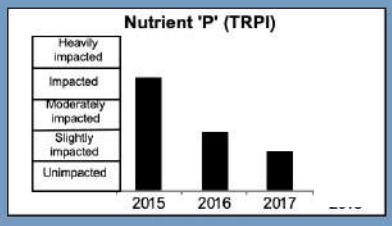


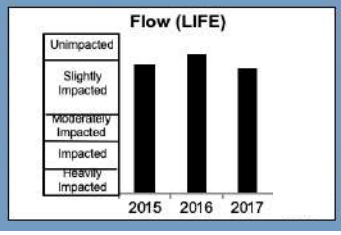
AUTUMN BIOMETRICS

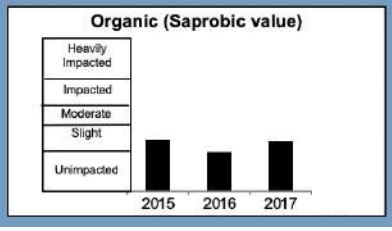
	2015	2016	2017
BMWP	129	148	156
ASPT	5.38	6.17	5.78
Annual mayfly sp. richness	6	8	8
Total Abundance	872	583	461
EPT	10	17	12
CCI	9.17	9.13	11.55
LIFE	7.92	8.10	7.86
PSI	66.67	75.00	65.45
SPEAR	24.64	44.80	39.89
TRPI	27.27	61.82	75.00
Saprobic	2.02	1.76	1.97









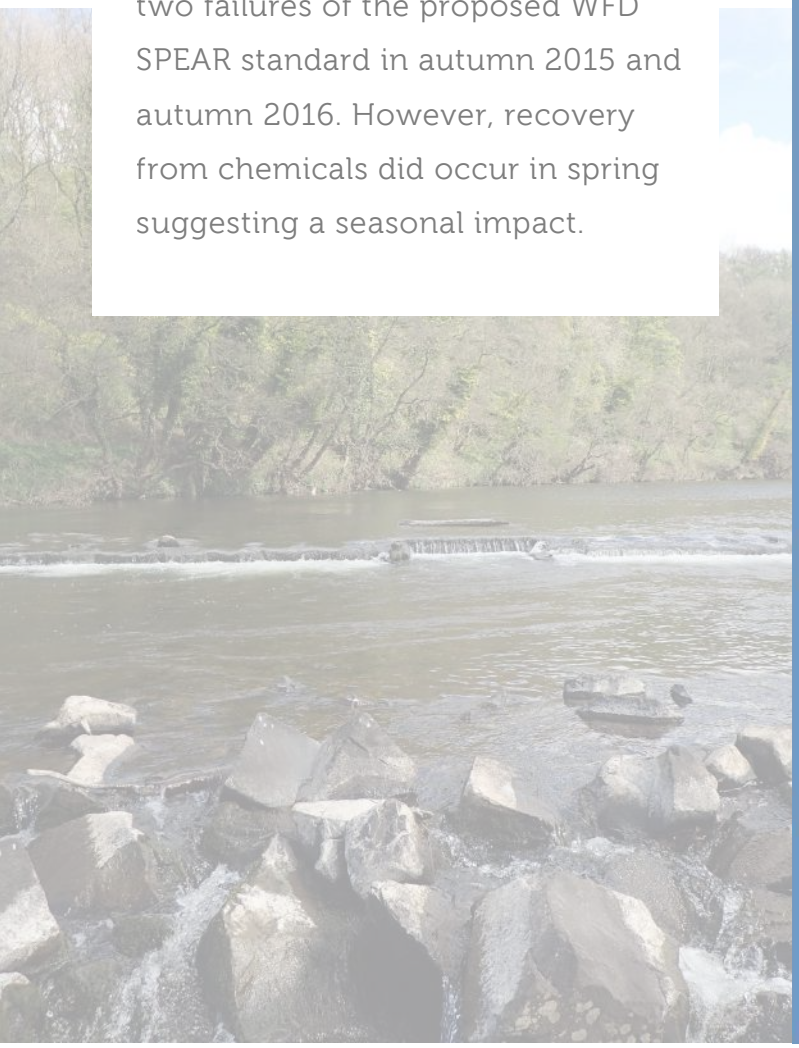


5 WHAT WE'VE FOUND
Warkworth Ford

Warkworth Ford was the only site on the Coquet that we detected a moderate impact from excess fine sediment on the invertebrate community.

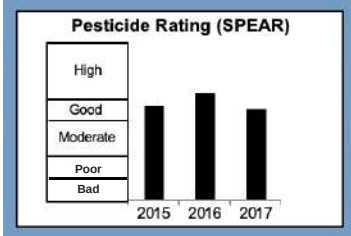
Stress from excess nutrients was considerable throughout autumn, all scores showed a moderate impact or greater, with a concerning impacted peak in 2015. Nutrient stress was less pronounced in spring, but a borderline moderate impact was detected in 2015

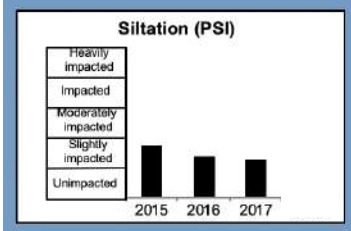
Chemical stress was present, with two failures of the proposed WFD SPEAR standard in autumn 2015 and autumn 2016. However, recovery from chemicals did occur in spring suggesting a seasonal impact.

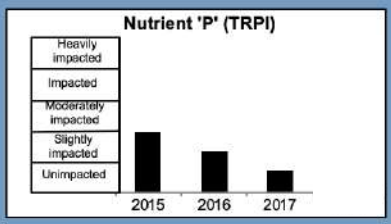


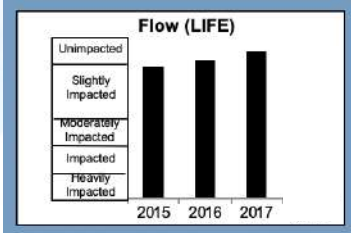
SPRING BIOMETRICS

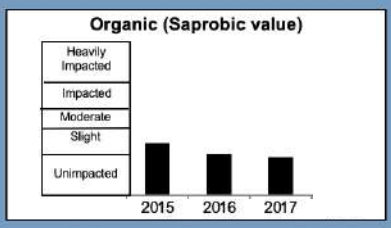
	2015	2016	2017
BMWP	149	126	133
ASPT	5.96	6.00	6.05
Annual mayfly sp. richness	9	6	9
Total Abundance	675	606	773
EPT	17	18	15
CCI	14.28	8.64	7.62
LIFE	7.96	8.07	8.23
PSI	66.13	73.21	75.00
SPEAR	41.34	46.73	40.04
TRPI	60.83	73.91	86.36
Saprobic	2.00	1.81	1.74





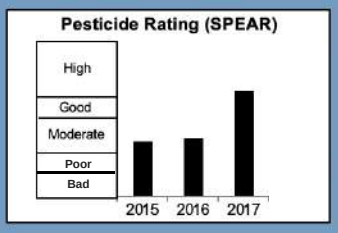


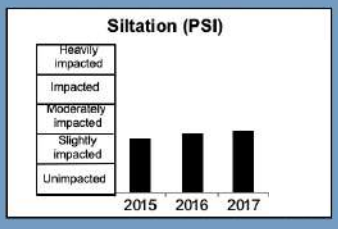


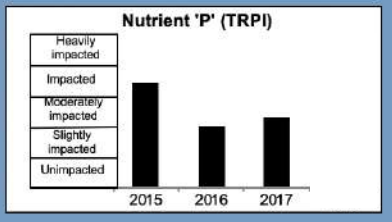


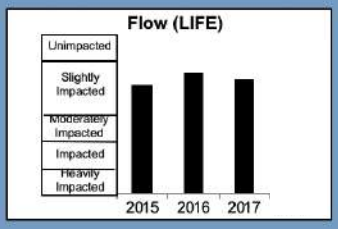
AUTUMN BIOMETRICS

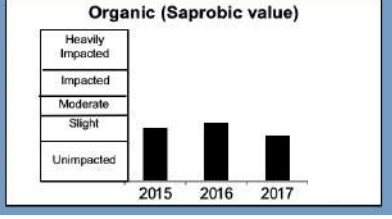
	2015	2016	2017
BMWP	126	95	159
ASPT	5.48	5.00	6.12
Annual mayfly sp. richness	9	6	9
Total Abundance	1309	519	342
EPT	13	8	14
CCI	7.17	4.40	15.75
LIFE	7.55	7.79	7.64
PSI	63.77	60.00	58.82
SPEAR	24.14	26.04	47.20
TRPI	32.00	60.00	54.55
Saprobic	2.05	2.15	1.89











Discussion

Overall, the Coquet was one of the most healthy rivers surveyed in the Riverfly Census. The upper Coquet sites, Holystone and Cragend Farm, exhibited good water quality biometric signatures and invertebrate diversity. Despite this, water quality did deteriorate down the catchment with ecological stress indicated from Felton onwards. Warkworth Ford, the lowest site we sampled on the river, exhibited the greatest pressure from chemicals and phosphorus. Urban land-use does increase in the catchment towards the estuary, so these signatures may be a result of the cumulative effect of sewage treatment works down the river. Industrial activity also increases down the Coquet catchment and agriculture switches from managed grassland to arable, potentially explaining the increase in chemical stress on the invertebrate community at Guyzance Mill and Warkworth Ford (Fig. 1).

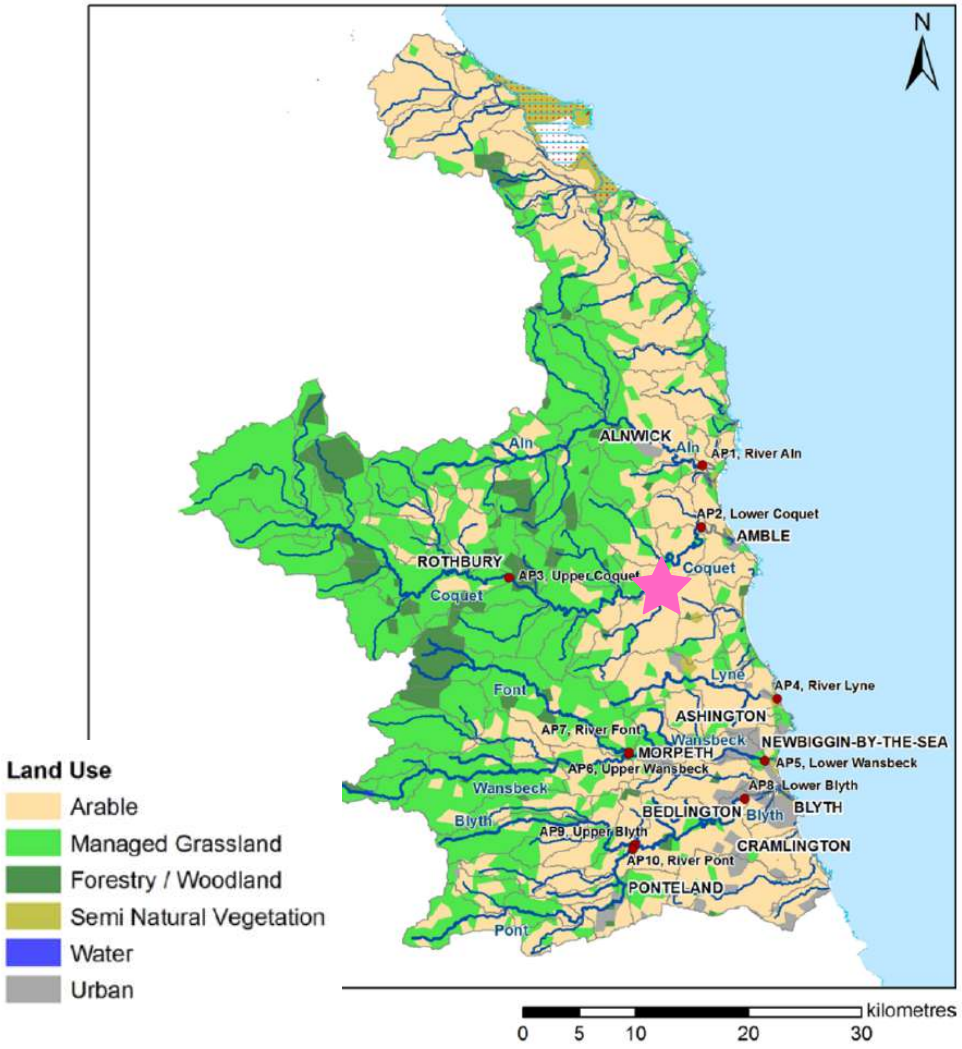


Fig. 1 - Land use in the Northumberland rivers catchments, the Coquet catchment is indicated by a pink star. Environment Agency, 2013.

Cragend Farm had some of the best invertebrate profiles out of the entire Riverfly Census. Riverfly diversity was consistently good over the three years surveyed, particularly for upwing species where flat-bodied mayflies, indicators of clean, fast-flowing water, were prevalent (Fig. 2).

Fig. 2 - Ecdyonurus (flat-bodied mayfly) adult present at Cragend Farm

Interestingly, the sites downstream from Cragend Farm exhibited less diversity and greater stress as indicated by the biometrics. This tells us that there is potentially some kind of ecologically damaging input between Cragend Farm and Felton. The presence of algal growth on the riverbed of Felton suggests this may be nutrient related (Fig. 3).

Fig. 3 - Riverbed photos of Cragend Farm (Left) and Felton (Right).

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.

REFERENCES

Beketov MA, Foit K, Schäfer, RB. (2009). SPEAR indicates pesticide effects in streams–comparative use of species-and family-level biomonitoring data. Environmental Pollution: 157(6) pp. 1841-1848.

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