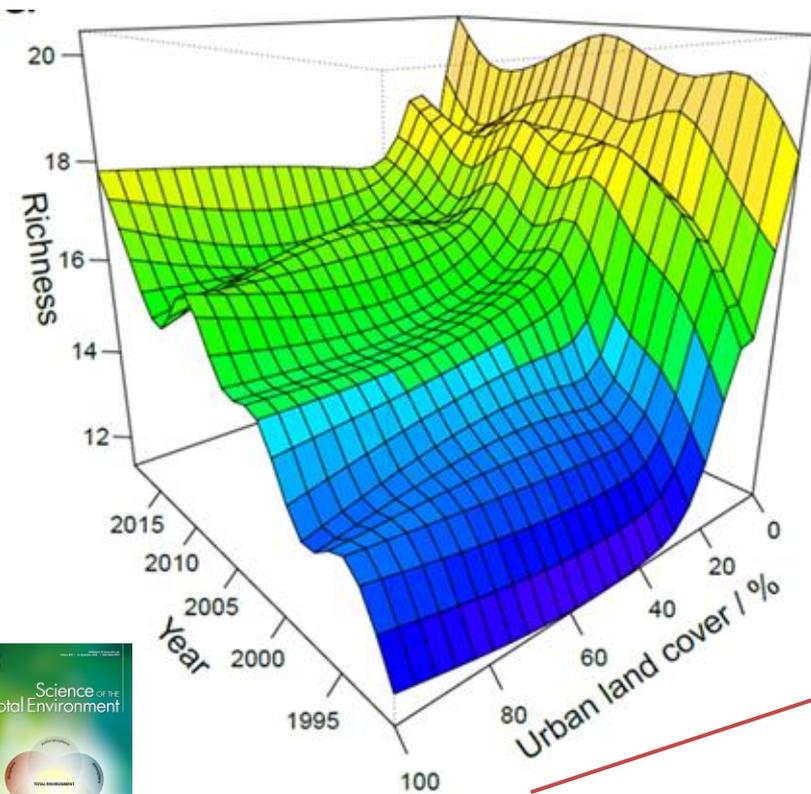
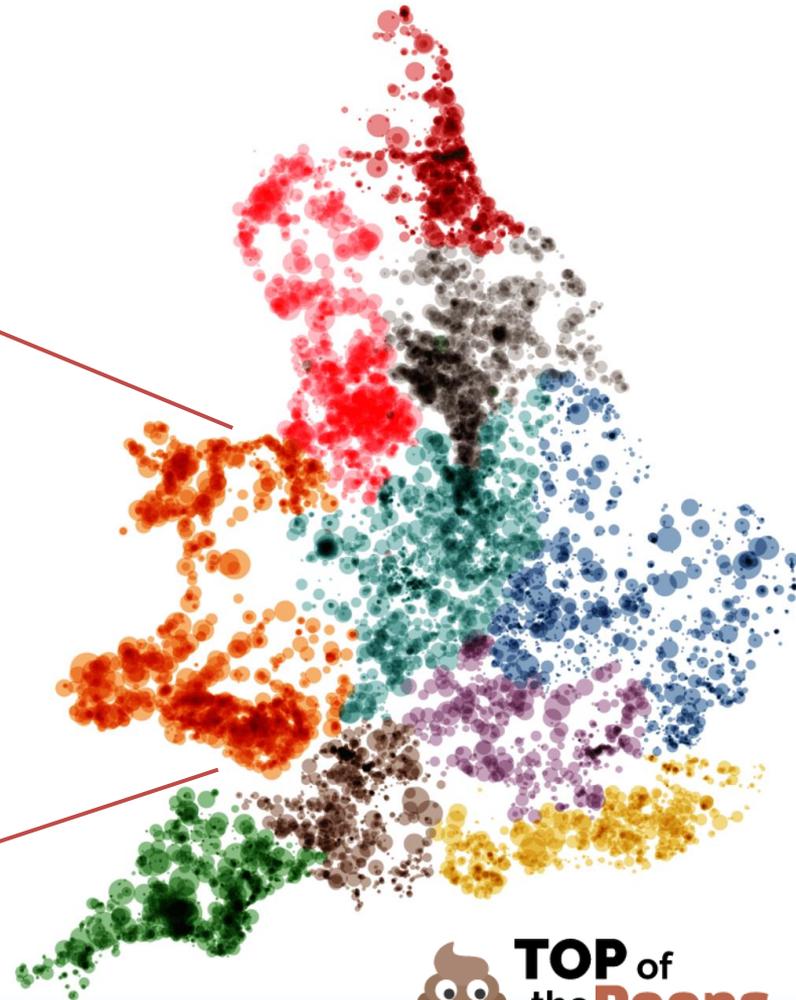


Recent trends and emerging issues in urban river quality

Steve Ormerod



?



Welsh rivers had 100,000 sewage spills in a year

By George Herd
BBC News

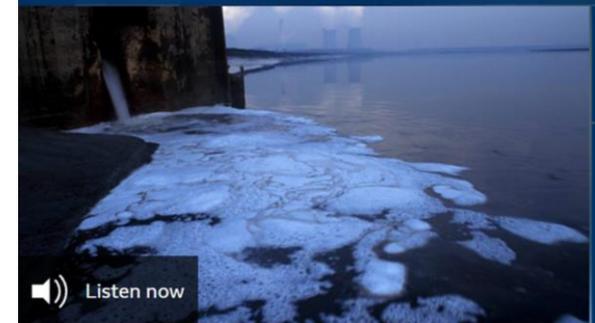
13 April



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Britain's Dirty Rivers

Campaigners say the state of Britain's rivers is worsening. Over half of them polluted by sewage. There's also a problem with agricultural run-off and chemicals. What can we do?

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Science & Environment

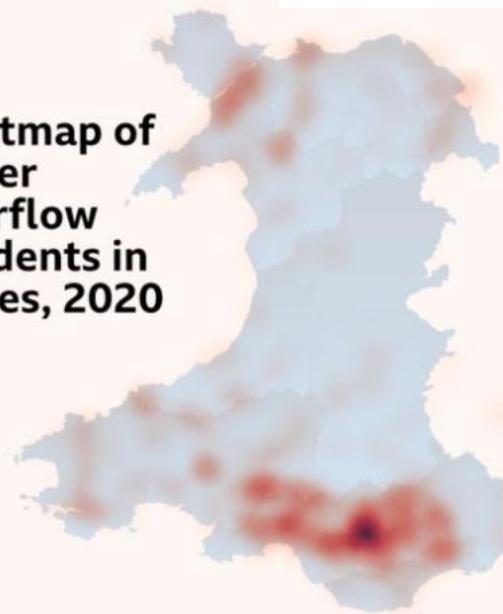
Water pollution: How clean are the UK's rivers and lakes?

By Eme Stallard
BBC News

1 day ago



Heatmap of sewer overflow incidents in Wales, 2020



House of Commons

Environmental Audit Committee

Water quality in rivers

Fourth Report of Session 2021–22

Report, together with formal minutes relating to the report

Ordered by the House of Commons to be printed 5 January 2022

Wales' dirty secret?

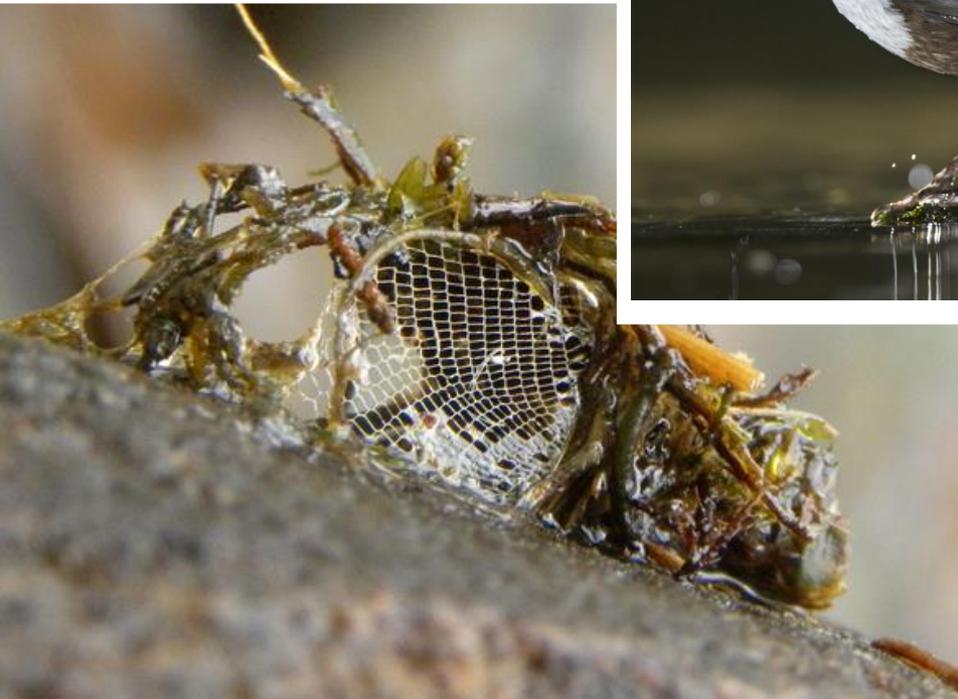
Sewage discharges from combined sewer overflows

106,094

spills into rivers in 2020

872,976 hours of discharge across Wales

Source: Welsh Water



Scope

- River quality: the narrative and the evidence
- Post 1990 recovery and recent slowdown
- Some possible causes: POPs, pharma, plastics, phosphorus - possibly
- Comments and questions



1970s: 70% of S Wales rivers
classed as 'grossly polluted'



Large-scale, long-term trends in British river macroinvertebrates

IAN P. VAUGHAN and STEVE J. ORMEROD

Catchment Research Group, Cardiff School of Biosciences, Cardiff University, Cardiff, CF10 3AX, UK

Data over 20 years, 200k samples and 20k locations across England and Wales showed major improvement in urban rivers after the Urban Wastewater Treatment Directive

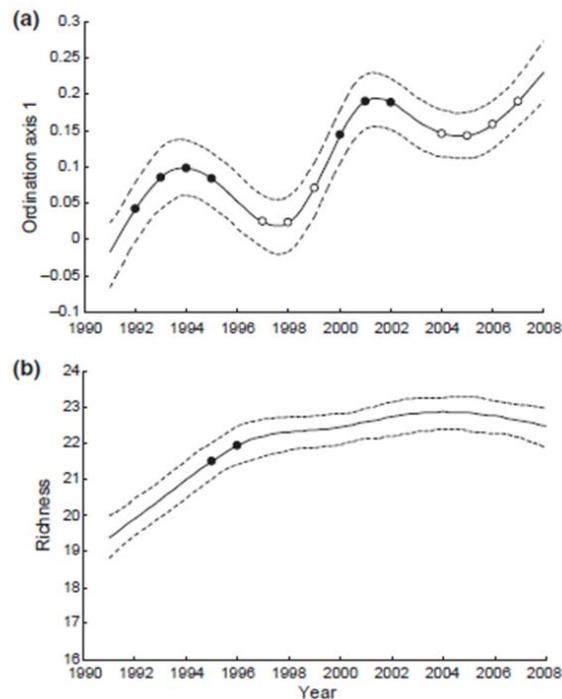
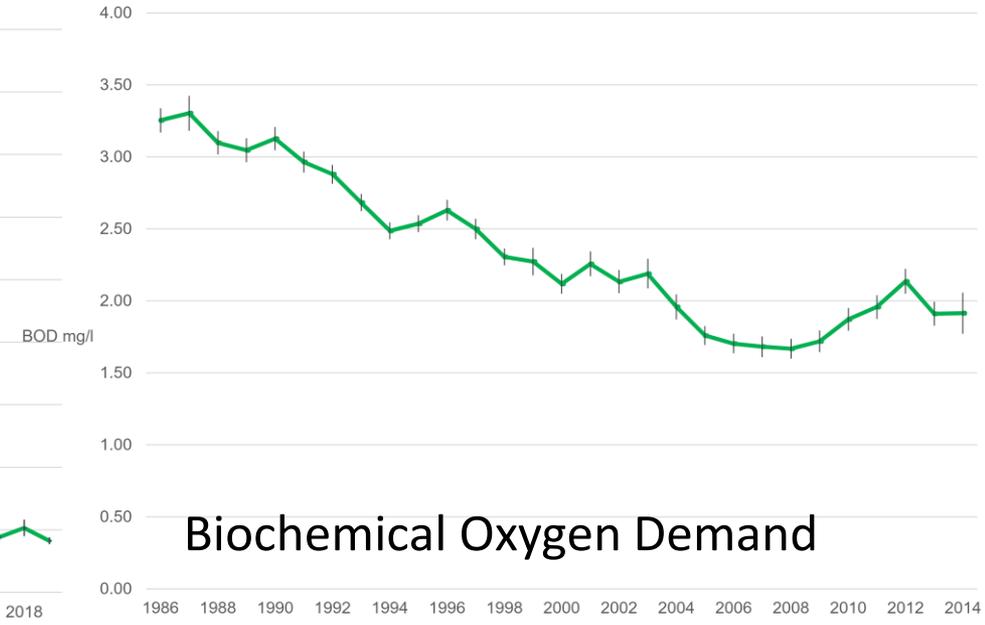
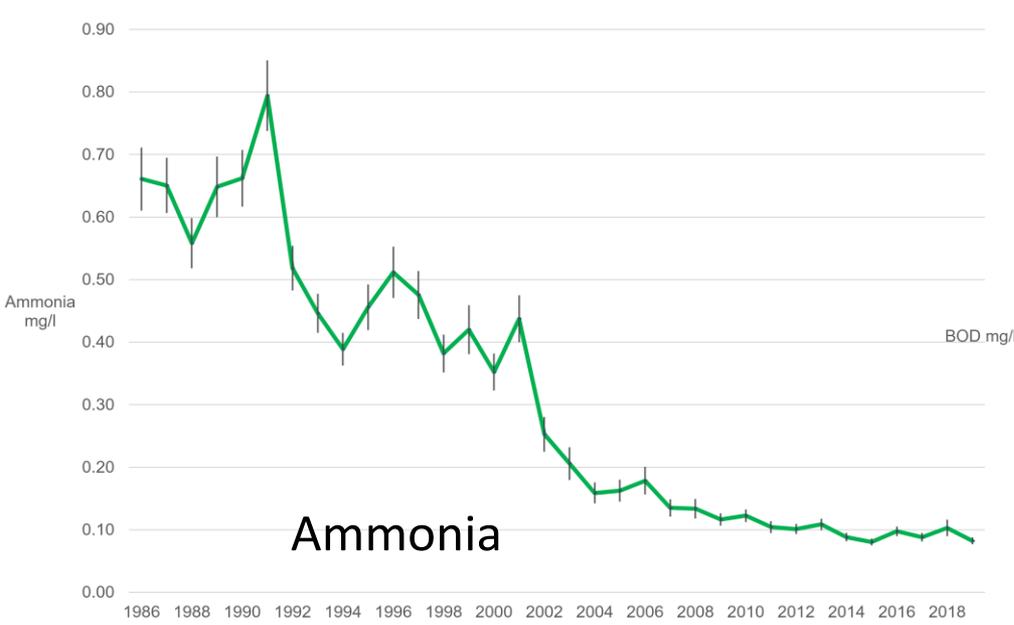


Fig. 1 Invertebrate trends for England and Wales during 1991–2008, representing as (a) CA1 scores and (b) taxonomic richness. Solid lines represent the post-stratified estimate and dashed lines the bootstrapped 95% confidence limits, whilst circles denote statistically significant changes in the gradient of the curve: either a greater rate of increase or reduced rate of decline (open circles), or a reduced rate of increase or greater rate of decline (filled circles).



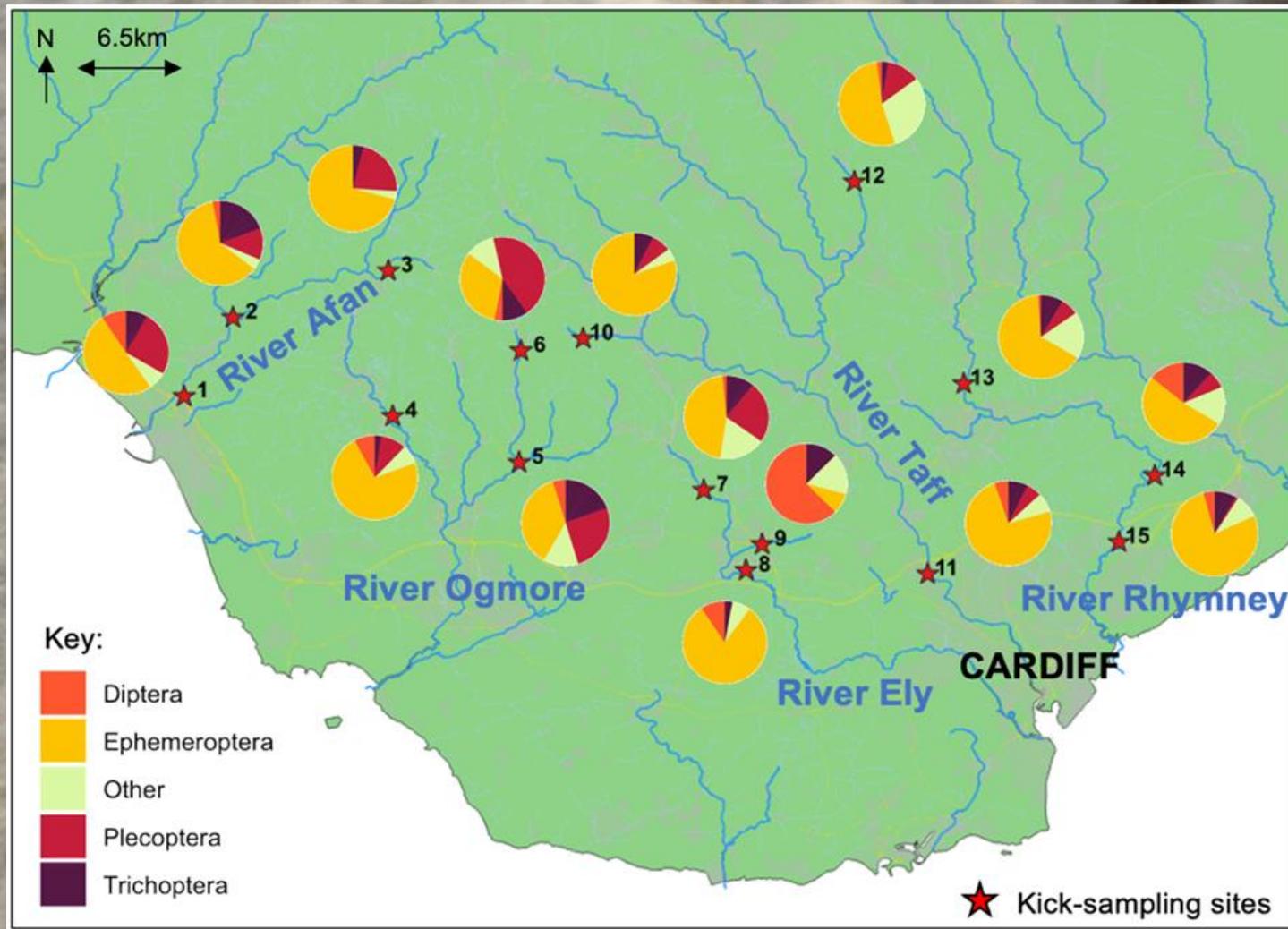
Insanitary 'organic pollution' has declined – especially along urban rivers



Environment Agency 'Harmonised Monitoring'
~ 130 sites and 000s of samples

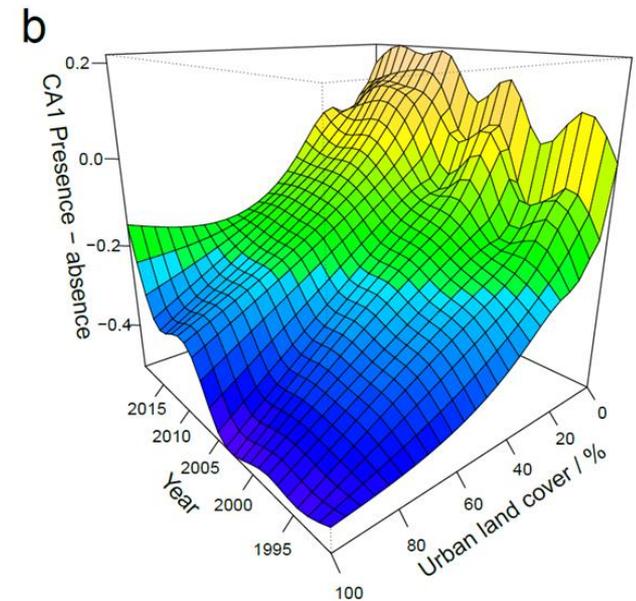
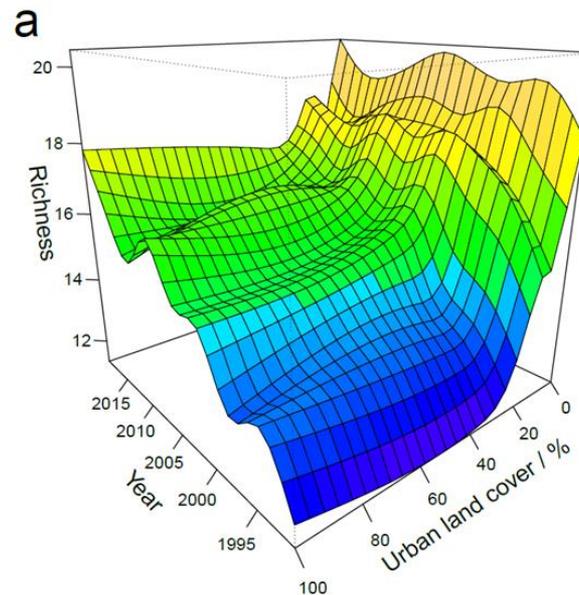
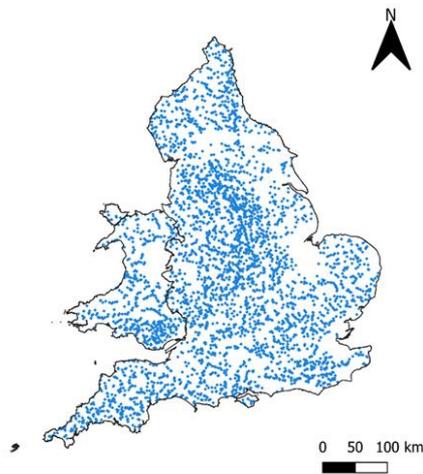


Long-term population recovery of Dippers in urban South Wales in relation to river quality and prey use



Evidence of biological recovery from gross pollution in English and Welsh rivers over three decades

Emma Pharaoh^a, Mark Diamond^b, Steve J. Ormerod^a, Graham Rutt^c, Ian P. Vaughan^{a,*}

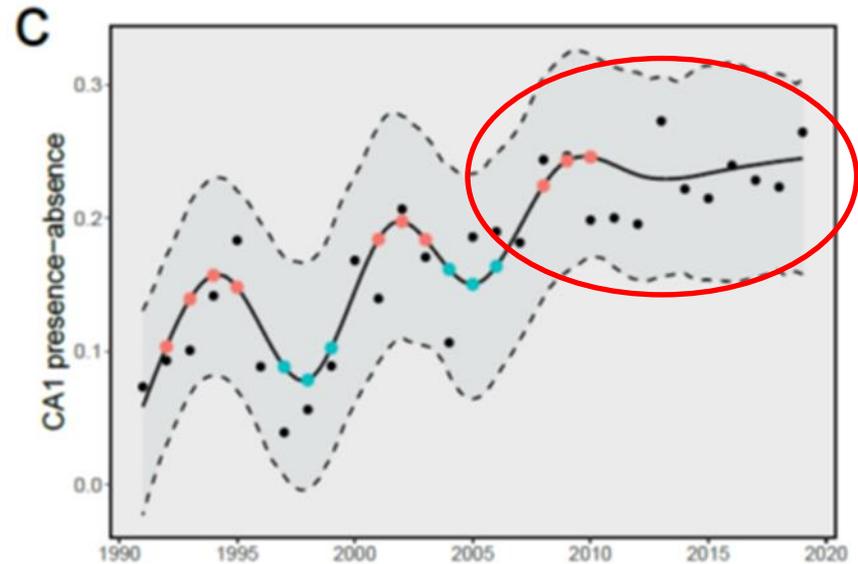
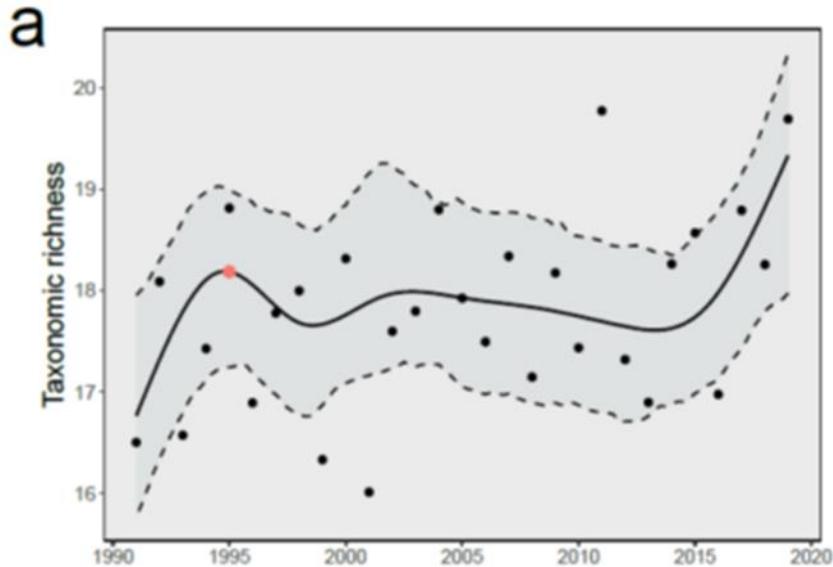


CLEAN IT UP

Pollution and climate change hamper biological recovery of rivers

Growth in the number of riverbed creatures slows

“Improvements appear to have slowed, possibly reflecting the effects of emerging water quality problems from combined sewer overflows, agriculture, climate change and new forms of pollution – such as microplastics or pharmaceuticals”



Effects of point-source PCB contamination on breeding performance and post-fledging survival in the dipper *Cinclus cinclus*

S.J. Ormerod^{a,*}, S.J. Tyler^b, I. Jüttner^c

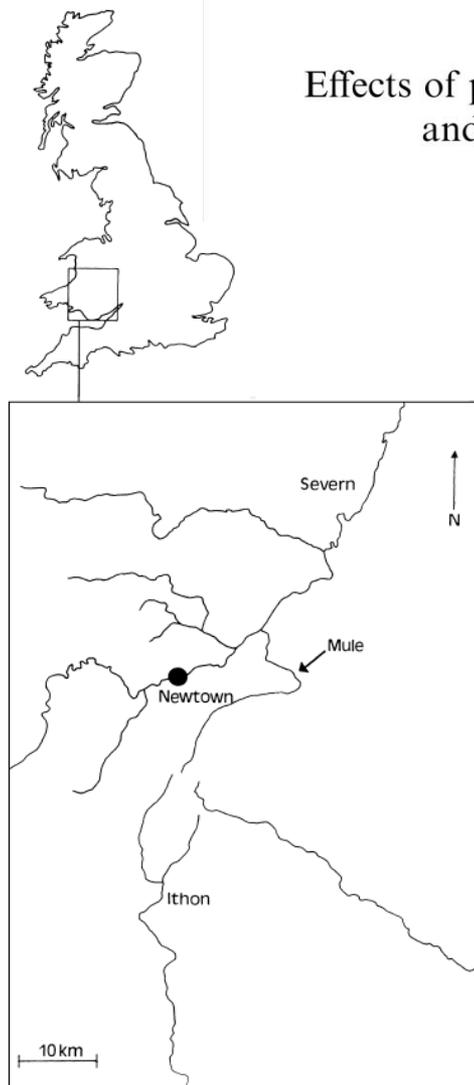


Fig. 1. The study area. The inset figure shows rivers used as references for the Afon Mule (arrowed) and the solid circle shows the location of Newtown (52°31' N, 3°11' W).

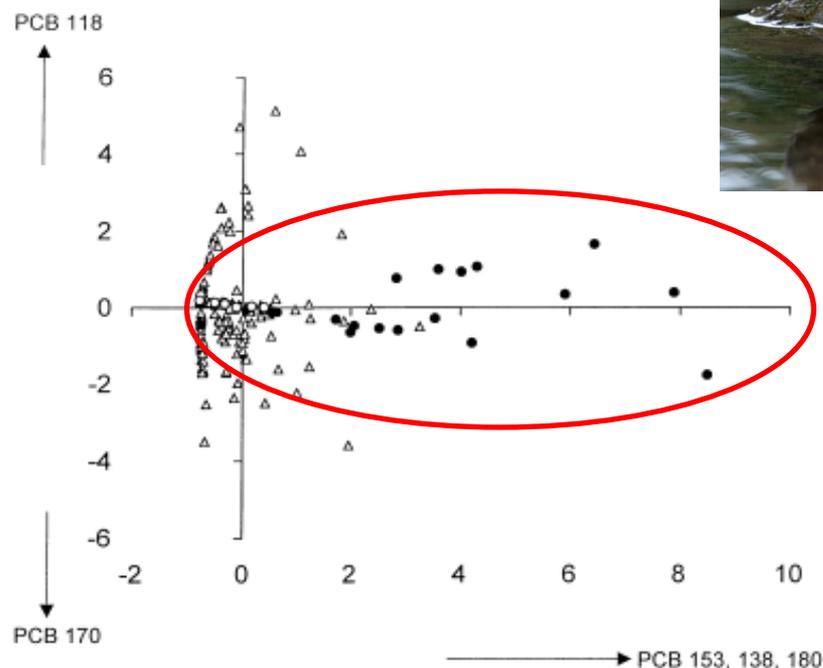


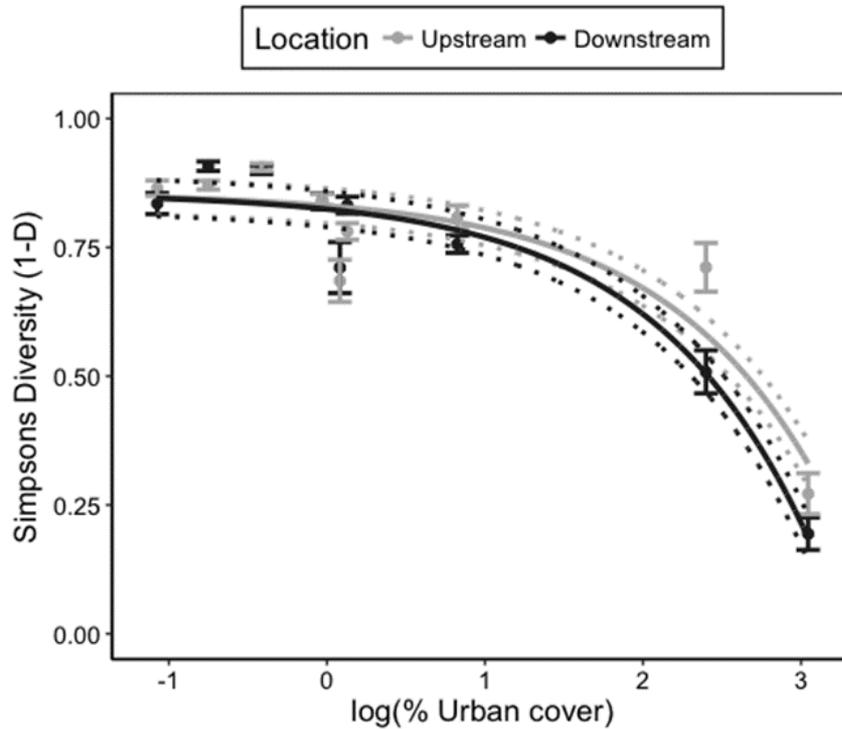
Fig. 2. Principal component analysis of PCB congeners in dipper eggs collected from the lower Afon Mule (solid circles), upper Afon Mule (open circles) and other Welsh rivers (triangles) during 1990–93. Scores on principal component 2 (*y*-axis) have been plotted against principal component 1 (*x*-axis) for each egg. See Table 2 for the congener-specific correlates with each axis.



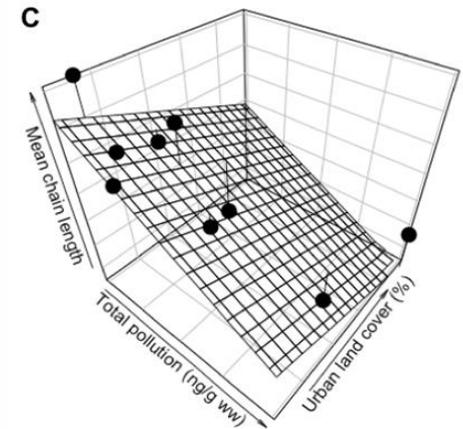
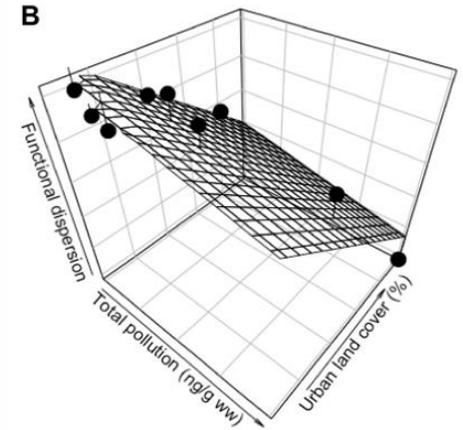
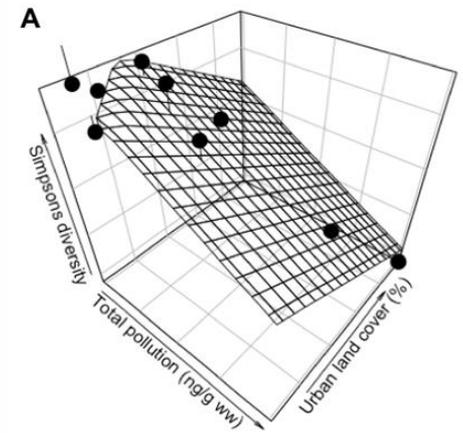


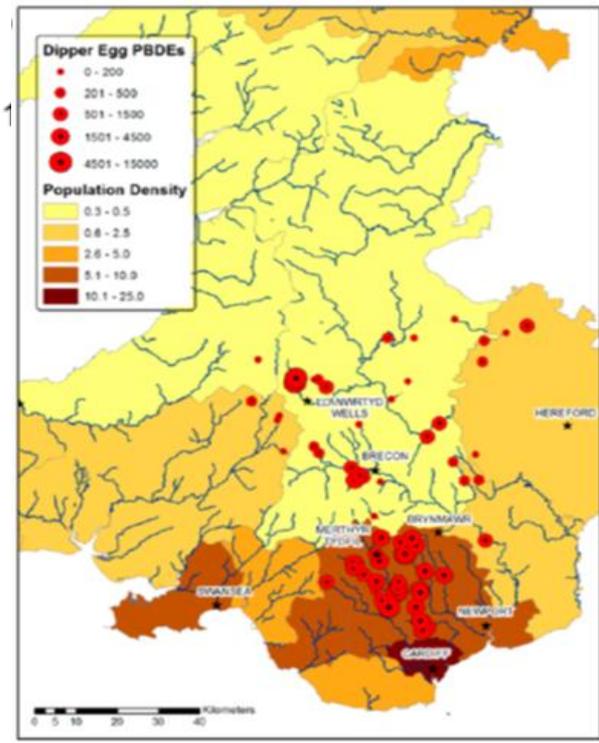
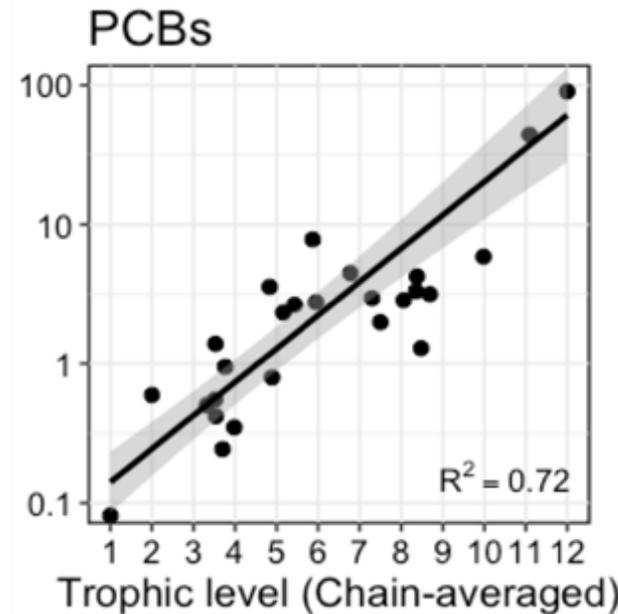
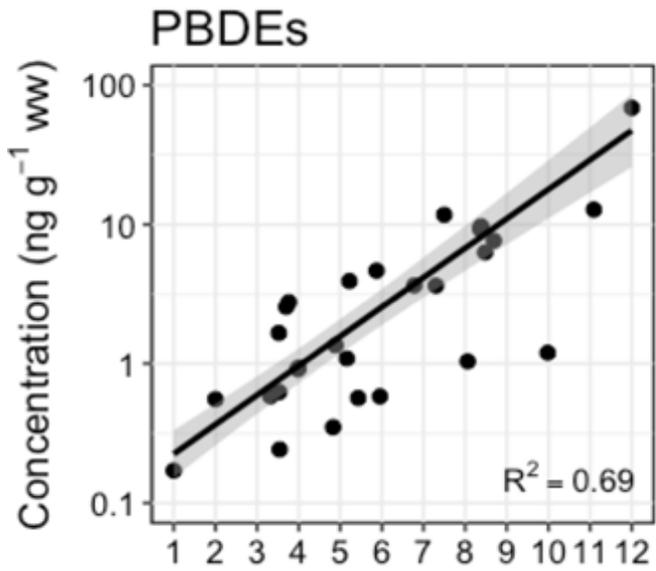
Persistent contaminants as potential constraints on the recovery of urban river food webs from gross pollution

Fredric M. Windsor^{a, b, *, 1}, M. Glória Pereira^c, Charles R. Tyler^b, Steve J. Ormerod^a



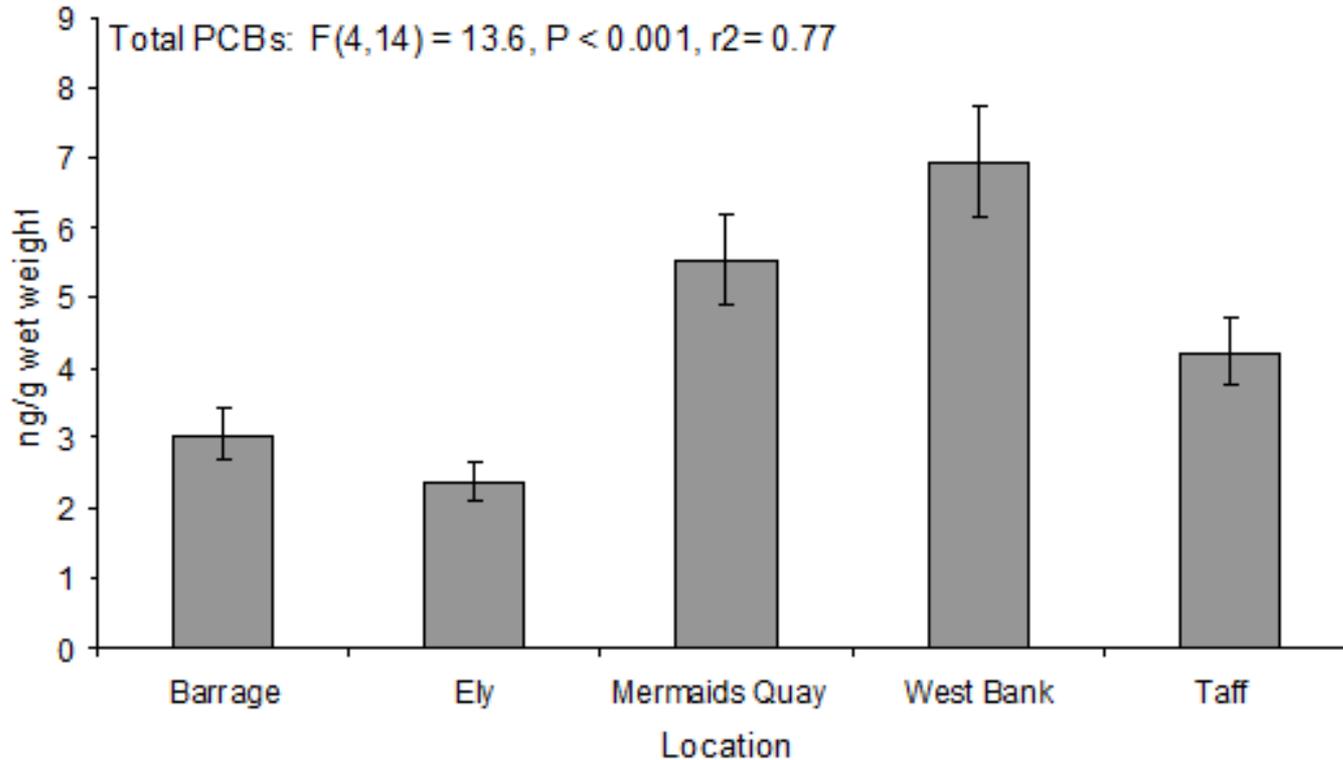
Measures of food web structure





Legacy pollutants are still widespread and increase through Welsh river food webs (Windsor, Ormerod and others: various papers)

Total PCB concentrations in zebra mussels Cardiff Bay



(Lower than PCB concentrations at various sites in France, Italy, Netherlands, USA, Canada...)





Environmental Pollution

Volume 220, Part B, January 2017, Pages 1447-1455



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Widespread, routine occurrence of pharmaceuticals in sewage effluent, combined sewer overflows and receiving waters ☆

Paul Kay ^a, Stephen R. Hughes ^{a,1}, James R. Ault ^b, Alison E. Ashcroft ^b, Lee E. Brown ^a

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<https://doi.org/10.1016/j.envpol.2016.10.087>

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Science of The Total Environment

Volume 755, Part 1, 10 February 2021, 143560



Potential role of veterinary flea products in widespread pesticide contamination of English rivers

Rosemary Perkins ^a, Martin Whitehead ^b, Wayne Civil ^c, Dave Goulson ^a

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Water Research

Volume 42, Issue 13, July 2008, Pages 3498-3518



The occurrence of pharmaceuticals, personal care products, endocrine disruptors and illicit drugs in surface water in South Wales, UK

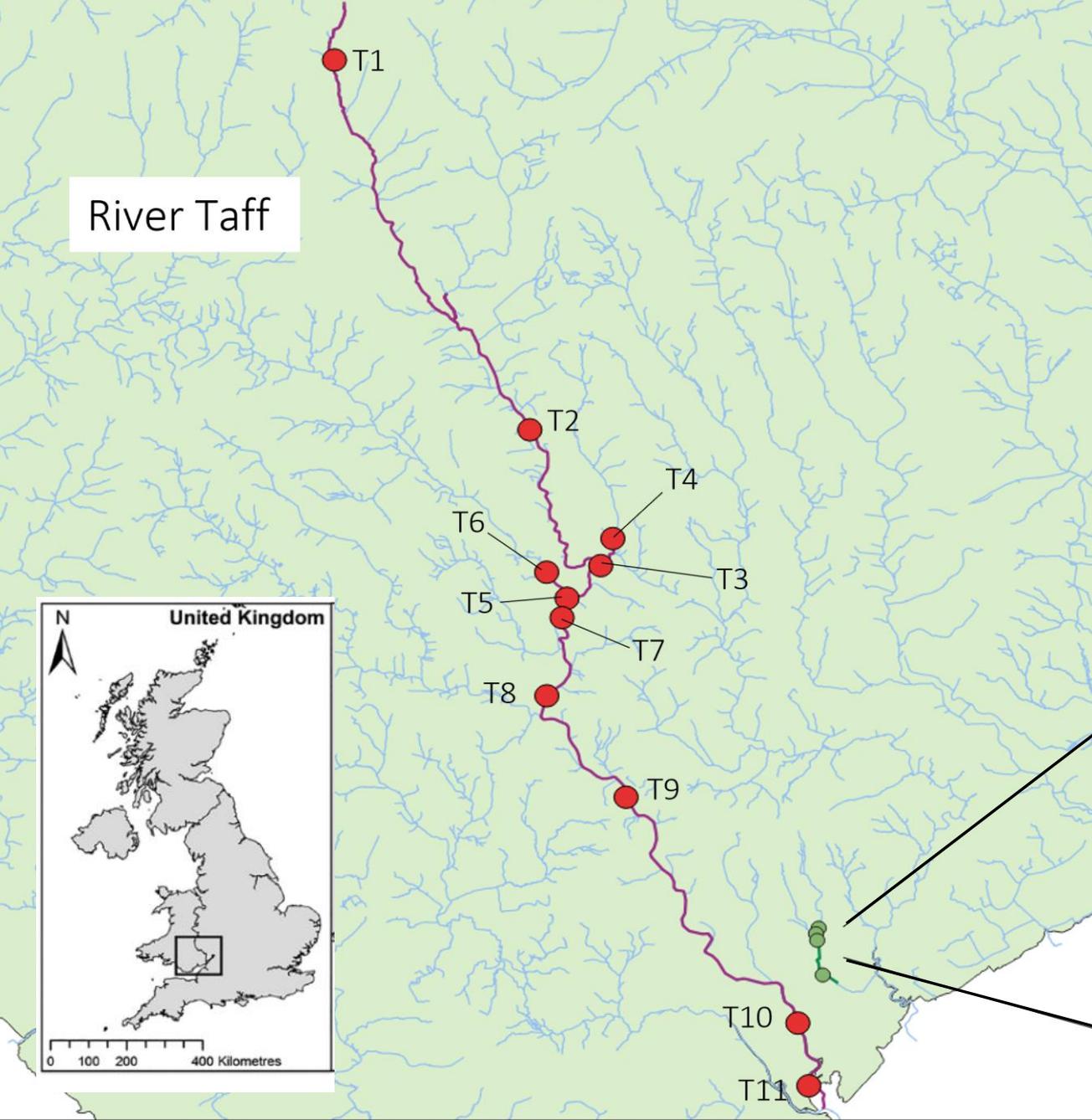
Barbara Kasprzyk-Hordern ^{a, b}, Richard M. Dinsdale ^b, Alan J. Guwy ^b

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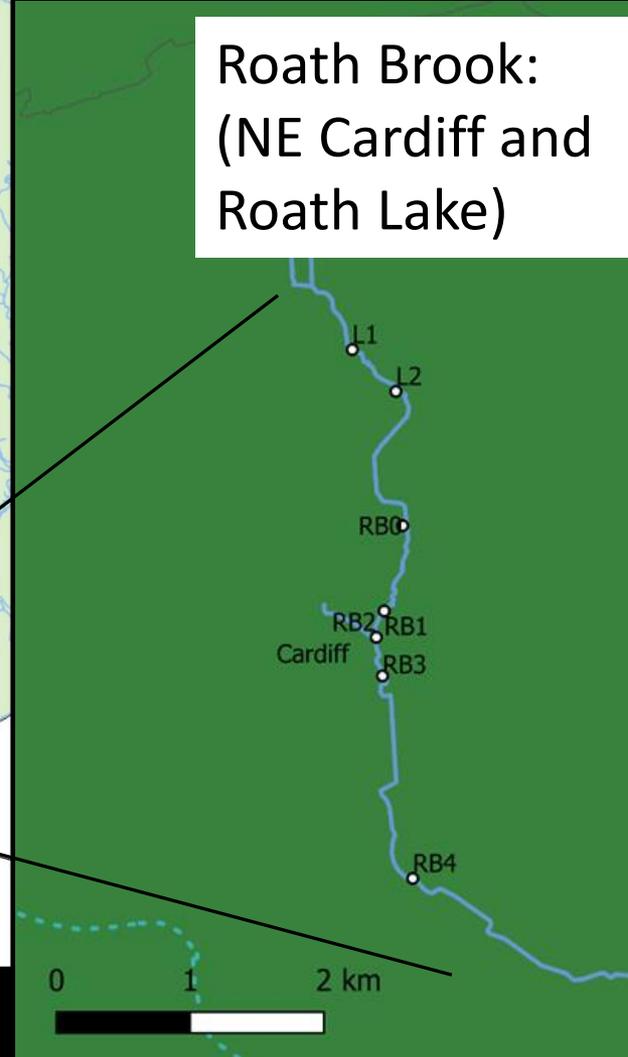
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Veterinary/human pharmaceuticals in the Taff/Rhymney drainage in 2021/2022



Roath Brook: (NE Cardiff and Roath Lake)



Some commonly occurring compounds in the Taff/Roath Brook system (UHPLC, methanol extraction)

Compound Name	Abbreviation	% Presence	Broad Categorisation
Amisulpiride	Amsl	51.19	Antipsychotic
Amitriptyline	Amtr	46.43	Chronic painkiller
Atenolol	Atnl	44.05	Antihypertensive
Benzoyllecgonine	Bnzy	36.90	Cocaine metabolite
Caffeine	Cffn	83.33	Stimulant
Carbamazepine	Crbm	80.95	Antiepileptic
Citalopram	Ctlp	65.48	SSRI antidepressant
Diazinon	Dznn	16.67	Insecticide
Diclofenac	Dclf	65.48	NSAID painkiller
Diuron	Dirn	51.19	Herbicide
Erythromycin	Eryt	53.57	Antibiotic
Fexofenadine	Fxfn	96.43	Antihistamine
Fipronil	Fprn	58.33	Insecticide
Fipronil Sulfone	Fp_S	26.19	Insecticide
Imidacloprid	Imdc	53.57	Insecticide
Irbesartan	Irbs	78.57	Antihypertensive
Lamotrigine	Lmtr	91.67	Anticonvulsant/antiepileptic
Lidocaine	Ldcn	63.10	Local anaesthetic
Naproxen	Nprx	36.90	NSAID painkiller
Paracetamol	Prct	75.00	NSAID painkiller
Permethrin	Prmt	3.57	Insecticide (pharmaceutical use)
Propiconazole	Prpc	27.38	Pharmaceutical antifungal/Fungicide
Sertraline	Srtr	36.90	SSRI antidepressant
Sotalol	Stll	55.95	Beta blocker
Sulfapyridine	Slfp	78.57	Antibacterial (veterinary)
Terbutryn	Trbt	21.43	Herbicide
Trimethoprim	Trmt	57.14	Antibiotic
Valsartan	Vlsr	63.10	Antihypertensive
Venlafaxine	Vnlf	70.24	SNRI antidepressant

The most common broad classification of compounds found are psychiatric medications (7), followed by insecticides (5), cardiac medications (4) and painkillers (4).

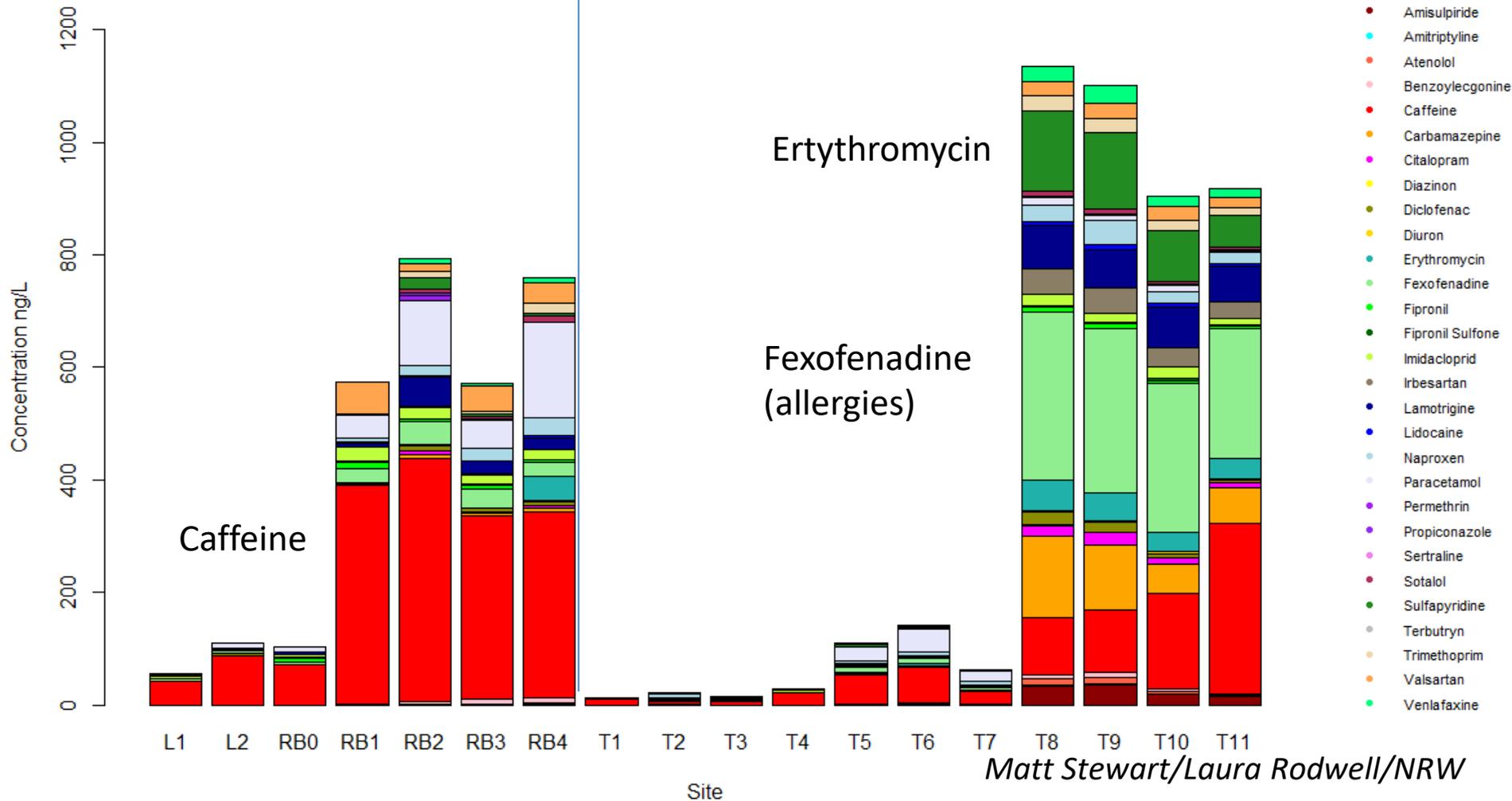
Pharmaceutical compounds in two Cardiff rivers in 2021/22



Roath Brook



Taff







Of ~ 20m tonnes of plastic entering the world's oceans annually, at least 80% arrives via rivers (2020)

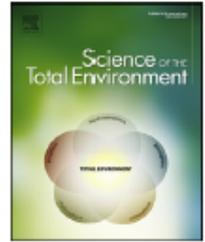
By 2017 1-2.5 m tonnes was microplastic (IUCN).



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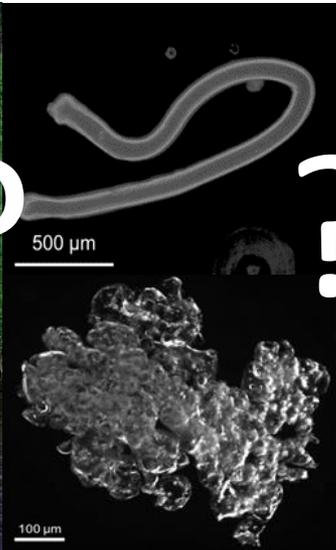


Microplastic ingestion by riverine macroinvertebrates

Fredric M. Windsor^{a,b,*}, Rosie M. Tilley^a, Charles R. Tyler^b, Steve J. Ormerod^a

^a School of Biosciences, Cardiff University, Sir Martin Evan Building, Cardiff CF10 3AX, UK

^b Department of Biosciences, University of Exeter, Geoffrey Pope Building, Exeter EX4 4PS, UK



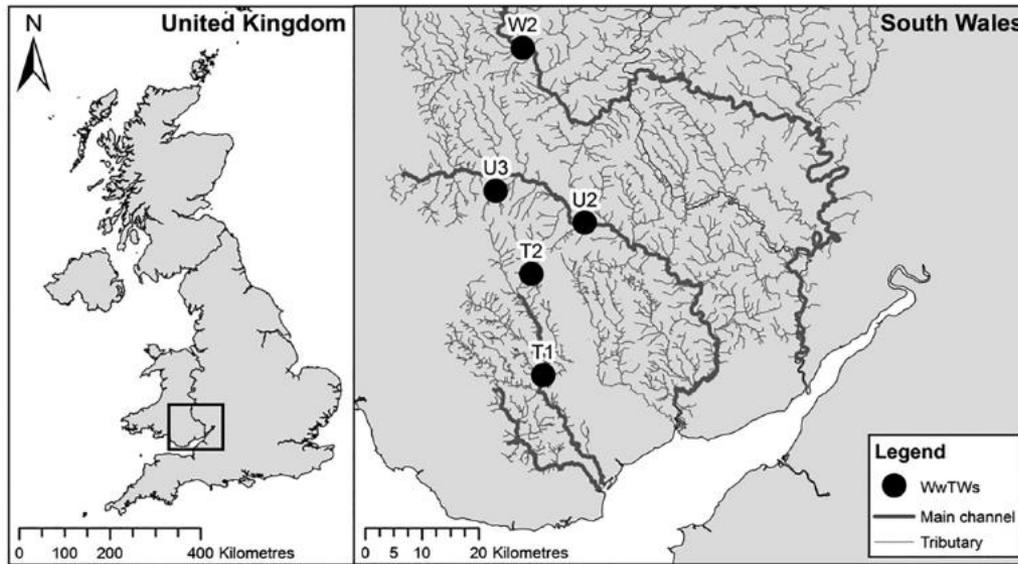
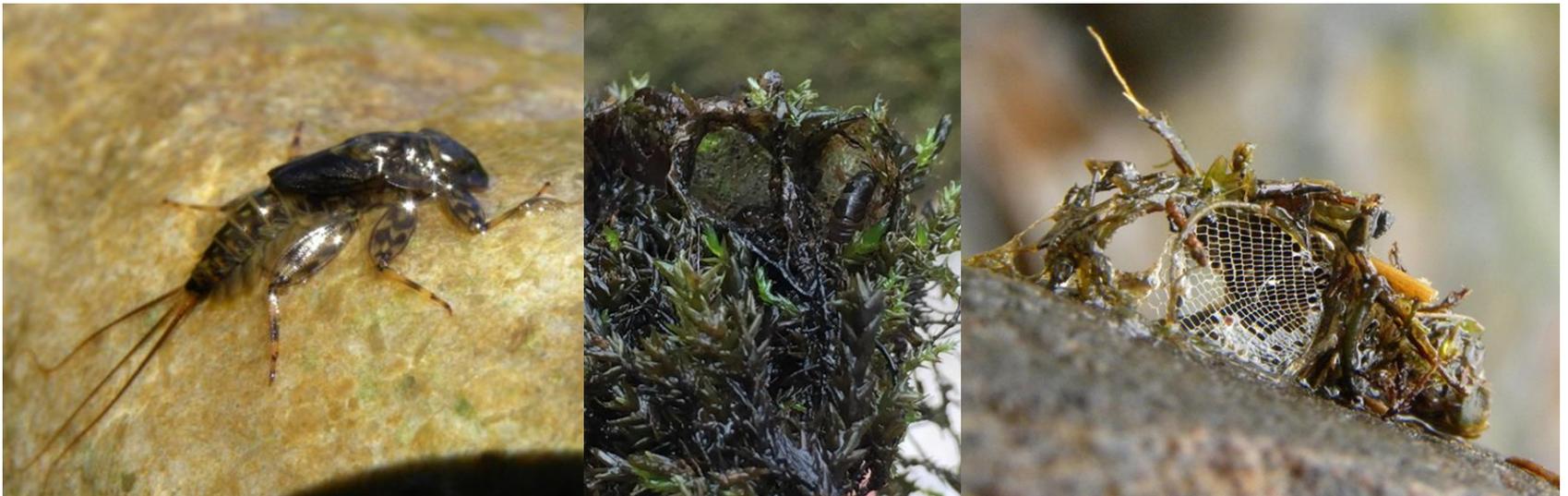


Fig. 1. Location of sample sites across South Wales. Taff (T1, T2), Usk (U2, U3) and Wye (W2) river catchments. Site labels reflect a coding scheme adopted for a wider distribution of sample sites across South Wales.

- Upstream/downstream of WTW works in 2016
- Microplastics found in in 50% of all insects
- Subsequently corroborated



Three invertebrate families sampled in 2016 – repeated with more taxa in 2021



Plastic ingested at 14/15 of sites investigated.

Mostly fibres (polyester, PVA...)

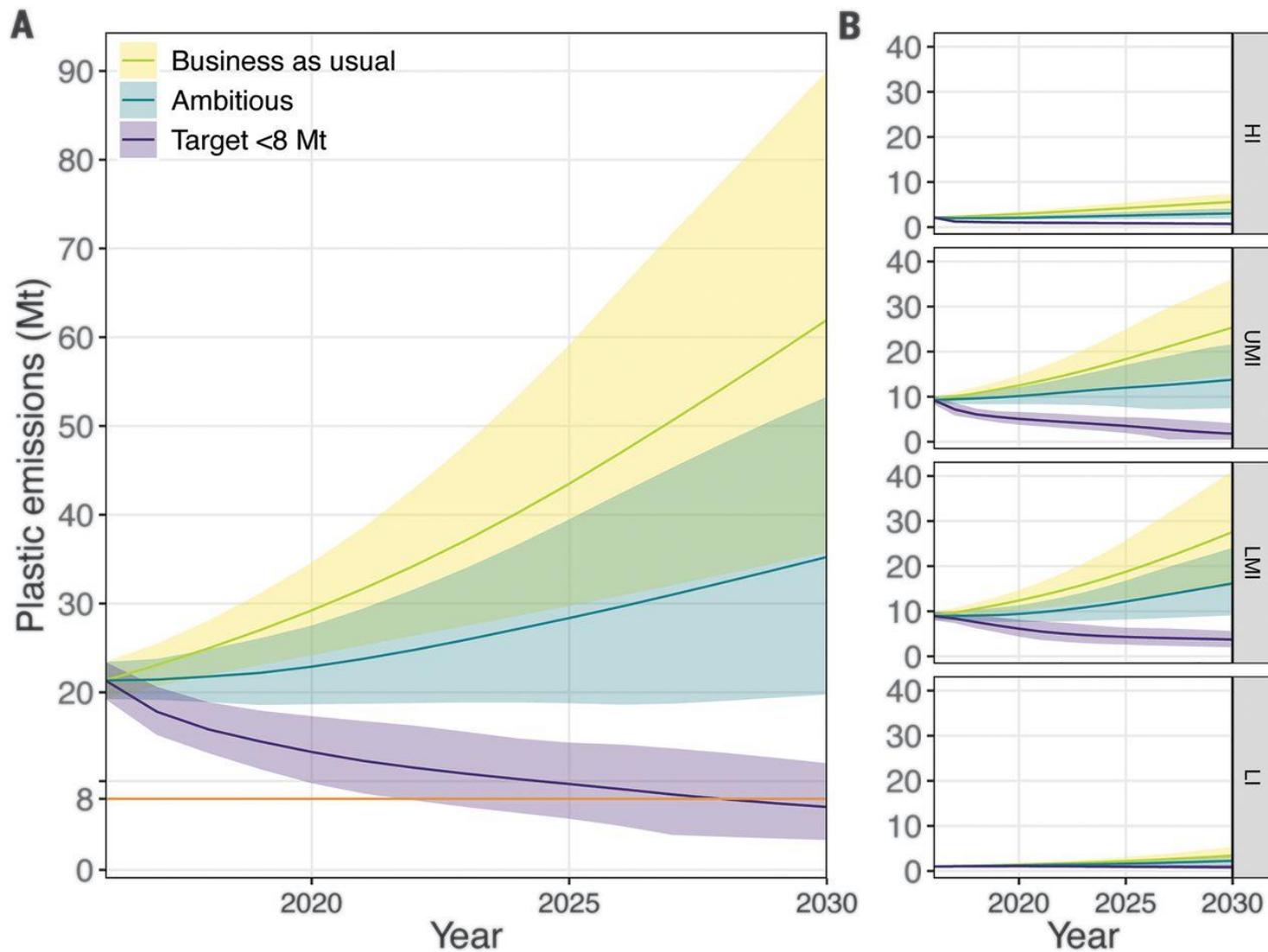
Based on plastic in prey and daily energy needs:

Chicks likely to be fed 5-8,000 microplastic fragments before fledging

Adults likely to ingest ~ 200 microplastic fragments per day from invertebrates

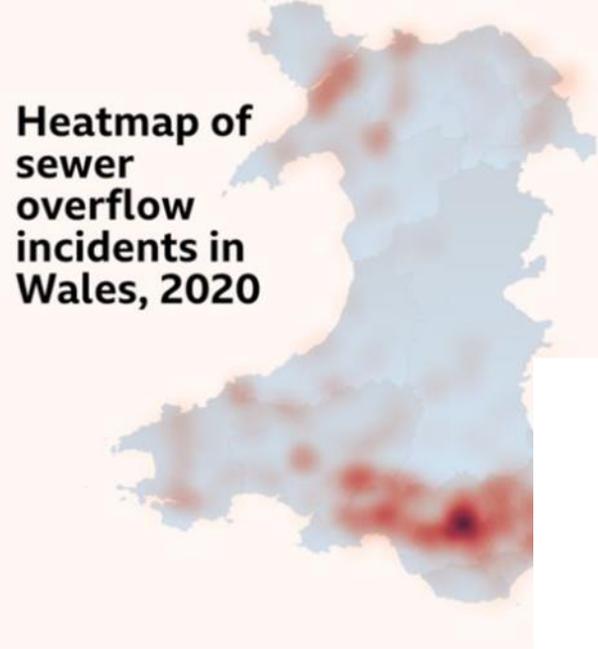
Effects unknown





Annual global plastic emissions into aquatic ecosystems in million metric tons (Mt) from 2016 to 2030 (A) and for each income status (B) as defined by the World Bank. Orange horizontal line represents the target of <8 Mt, which is a frequently cited statistic in global policy discussions as unacceptable (Borelle et al. 2020; Science)

Heatmap of sewer overflow incidents in Wales, 2020



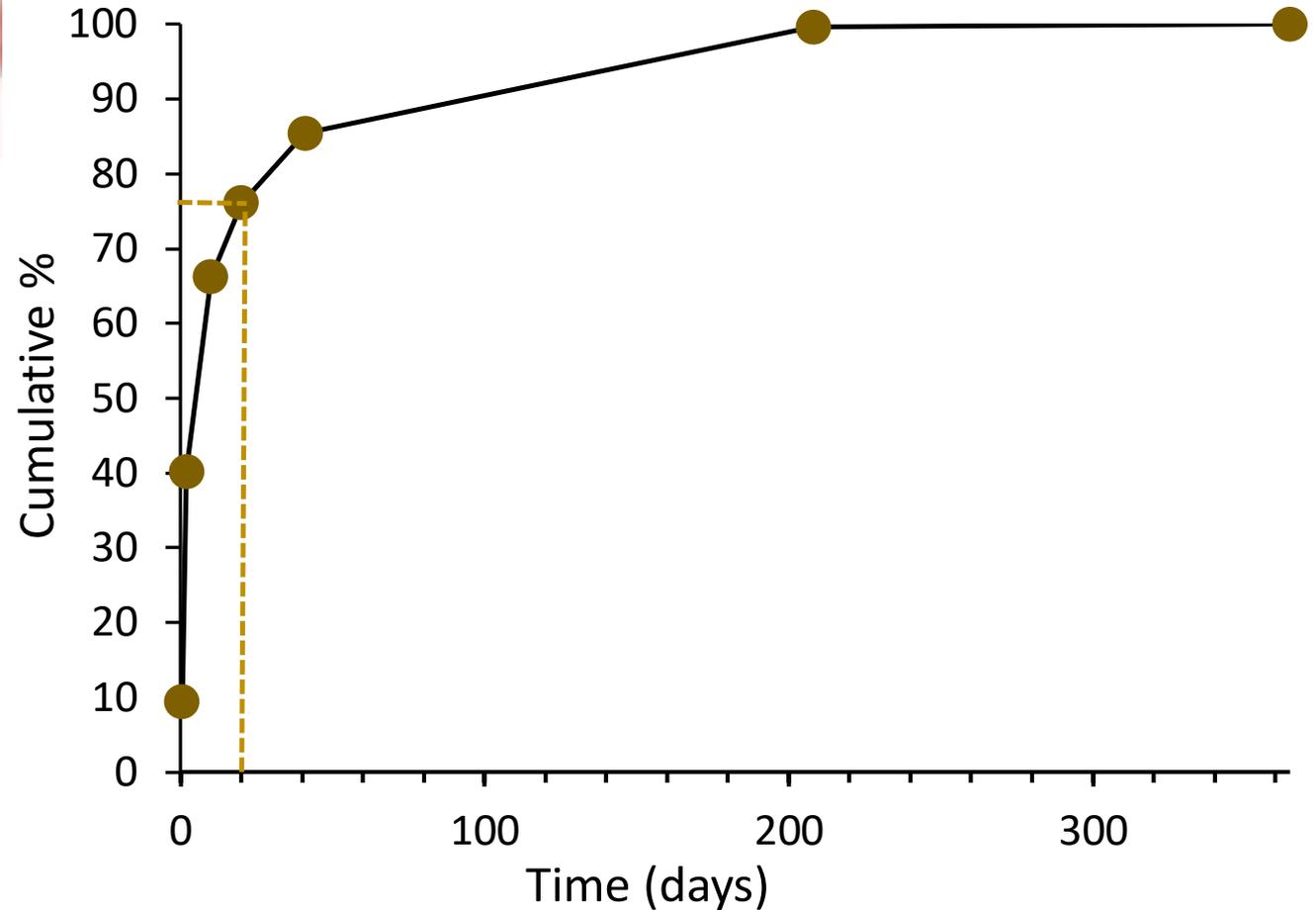
Wales' dirty secret?

Sewage discharges from combined sewer overflows

106,094

spills into rivers in 2020

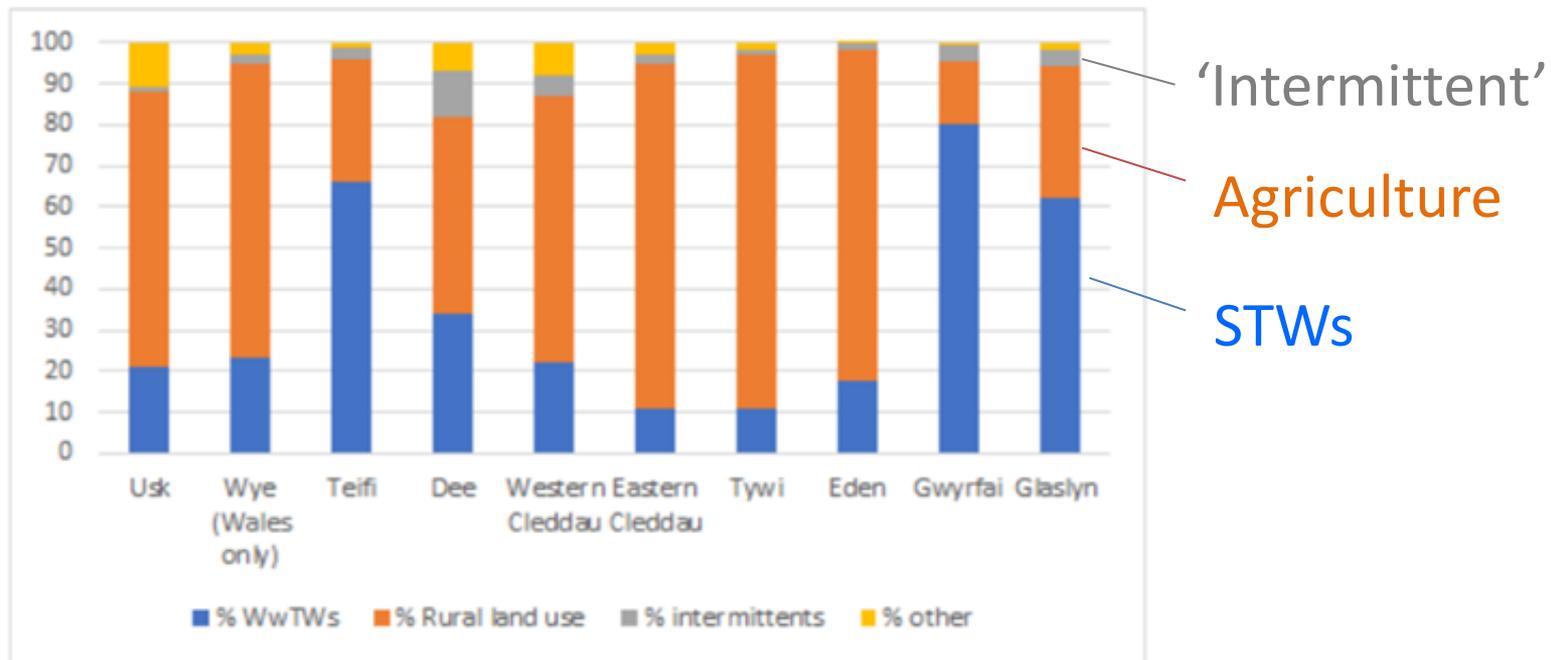
Cumulative frequency of CSOs by spill duration (2020)



Problems with CSOs...

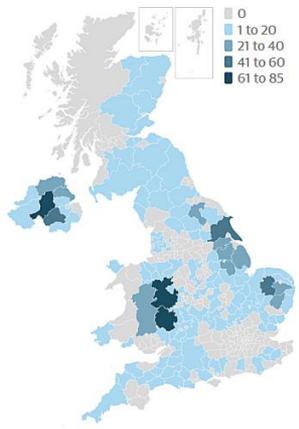
P loadings to SAC rivers using SAGIS (DCWW)

% sector contributions of load (kg/d) Cyfoeth Naturiol Cymru Natural Resources Wales

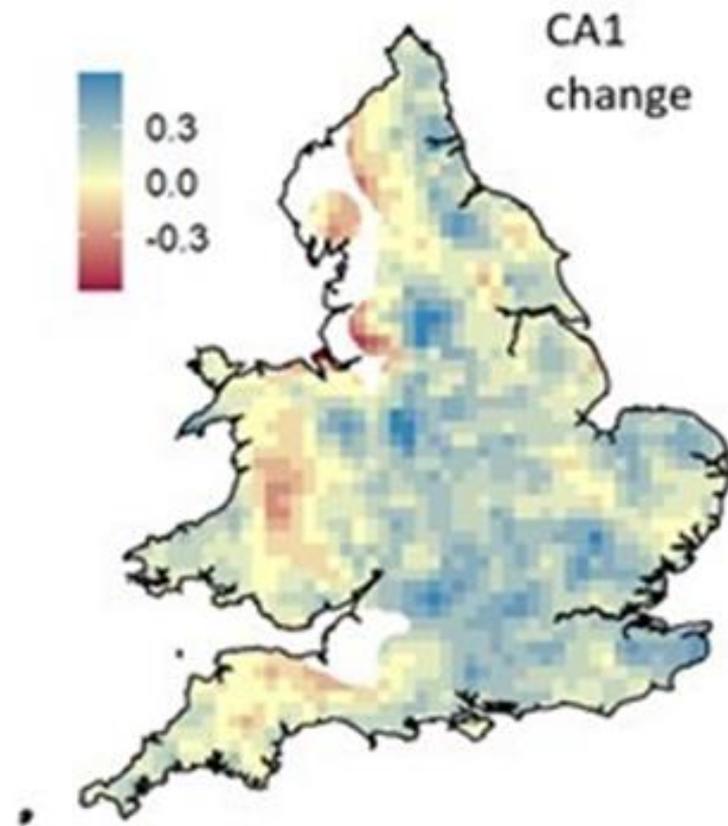
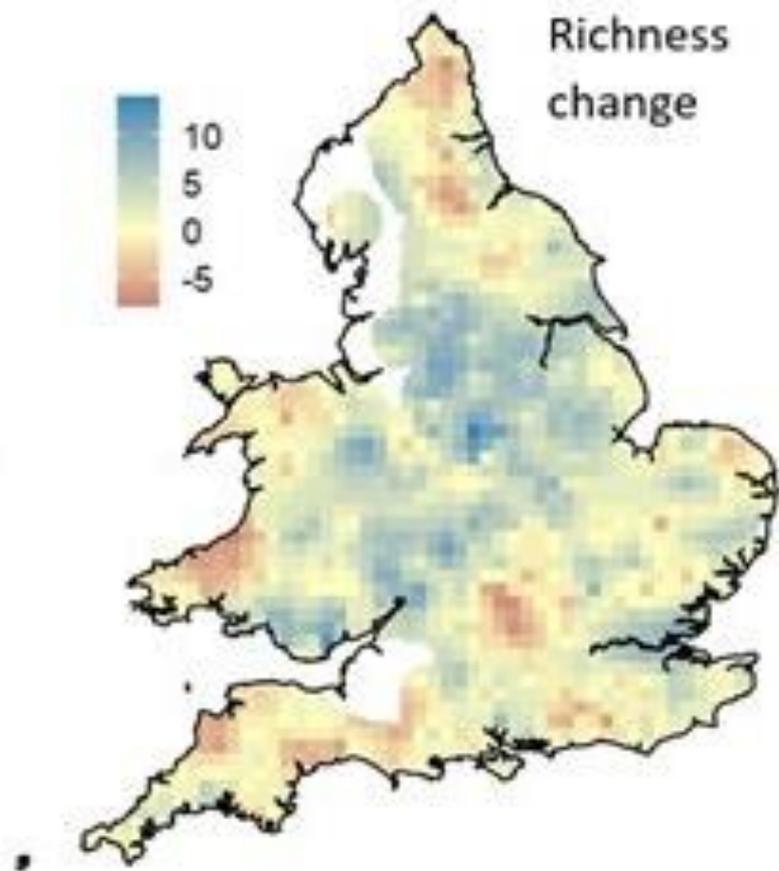


River Wye SAC

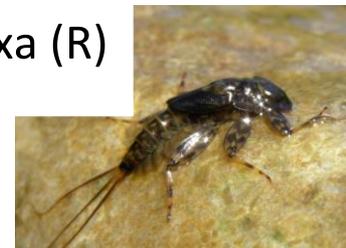
Number of permits for intensive poultry farming by local authority since 2002

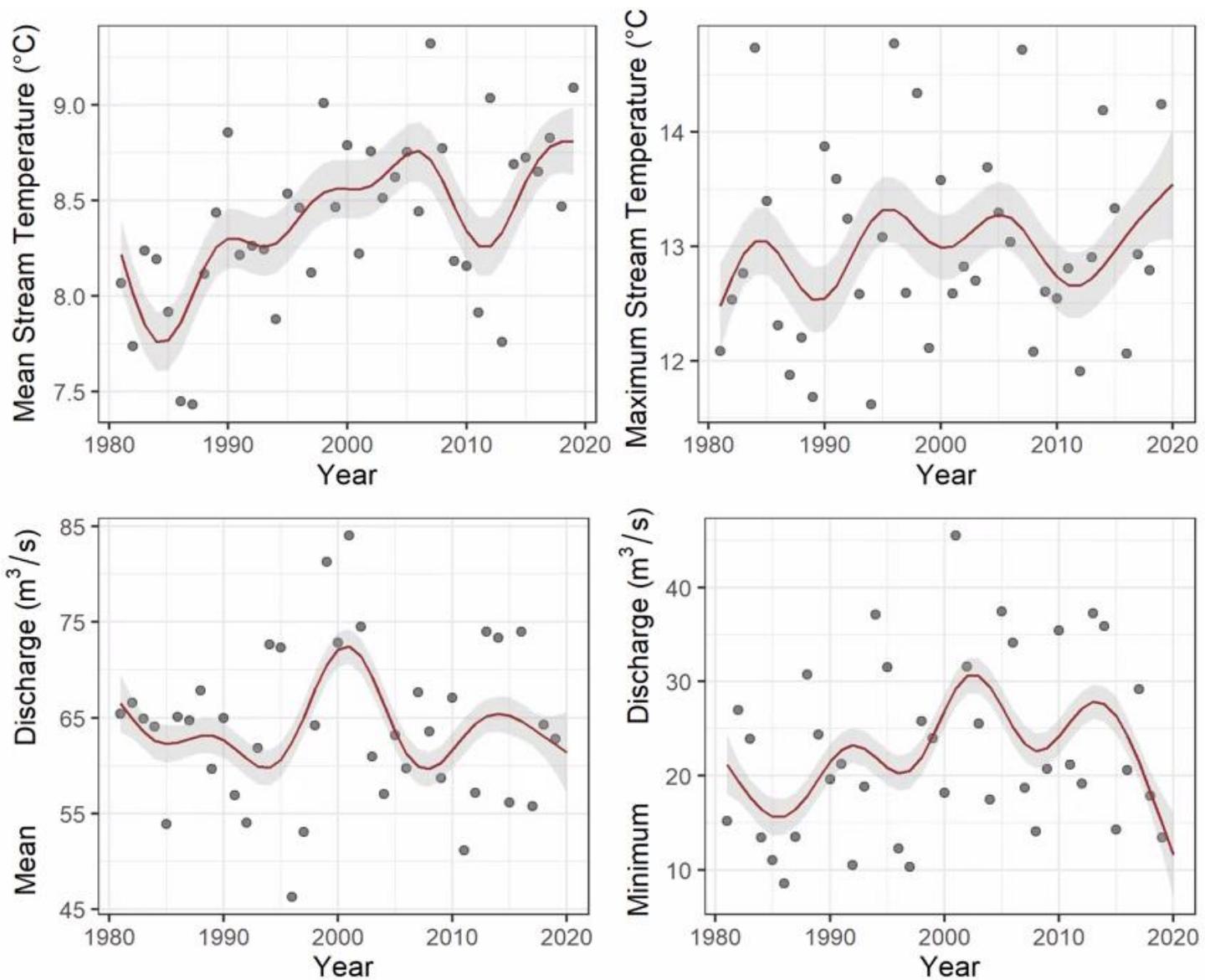


Guardian graphic | Source: Bureau of Investigative Journalism



Changes in invertebrate richness (L) and shifts to cleaner water taxa (R) across England and Wales (1990-2019; Emma Pharaoh et al.)





Stream temperature and discharge trends at Lyn Brianne over 40 years
(Fiona Joyce)

Perspectives:

- River quality has multiple facets. We need:
- to accelerate work in some key areas – notably pharmaceuticals
- a clearer case on which to base investment – for example CSOs vs STWs
- to expect some problems to deepen (eg plastics)
- constructive action in the agricultural sector



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