

Restoration of urban streams and ponds

Paul Wood, Department of Geography, Loughborough University.

Matthew Hill, Kate Mathers, Emma Seddon, Tom Worrall, Lynda Howard, John Gunn, Malcolm Greenwood.

Email – p.j.wood@lboro.ac.uk

Urban Aquatic Ecosystems

Outline

1. Where do they occur?

2. Why are they important?

Physically / morphologically

Ecologically / functioning

3. What can we do?

Urban aquatic ecosystems

Question

1. Where do they occur?
2. Why are they important?

Physically / morphologically

Ecologically / functioning

3. What can we do?

Answer

1. Everywhere where we are
2. Valuable resource:

Biodiversity / ecosystem
processes and services

3. Much more than in the past!

Outline

- **Sedimentation in urbanised streams**
- **Conservation and management of urban ponds**
- **Restoration approaches**
- **Reconciliation approaches**

Urban river sedimentation

1. Natural

2. Anthropogenic:

Mineral extraction

Forestry – clear cutting

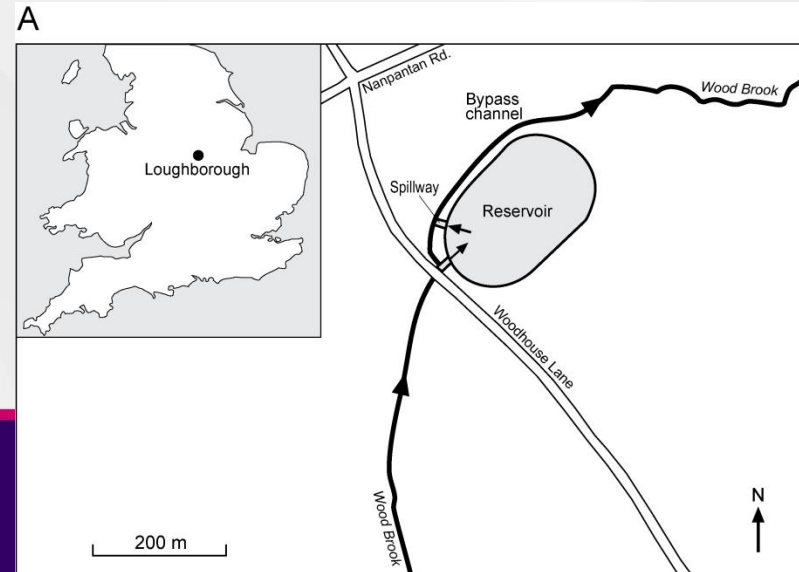
Agriculture

Urban development – construction

Dam and weir maintenance

Channel management

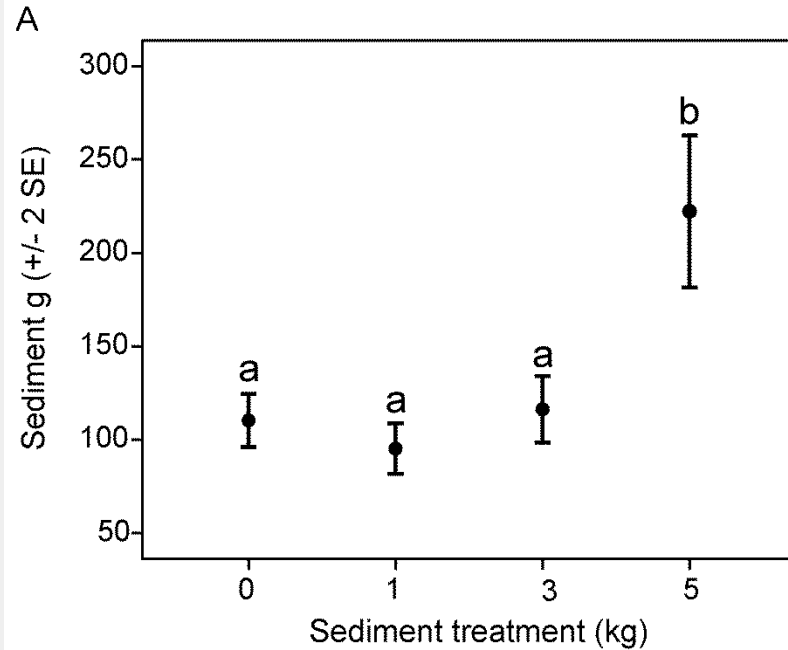
Urban river sedimentation



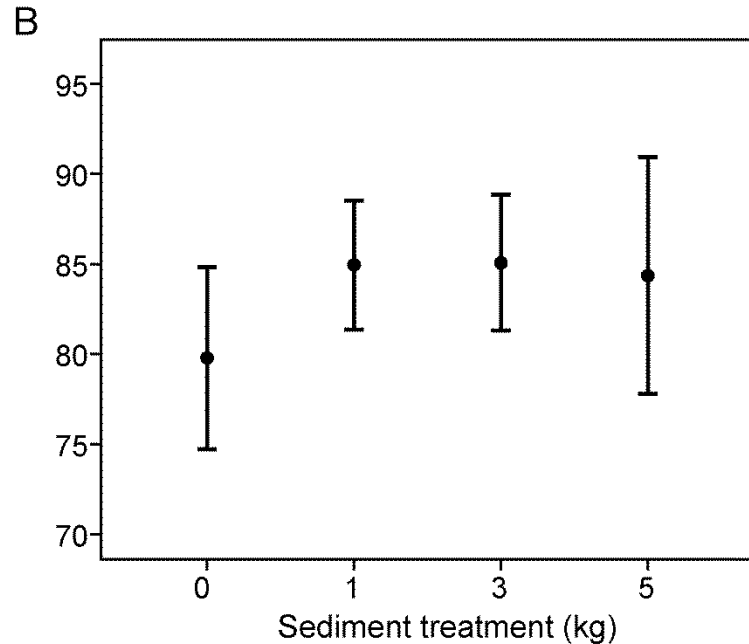
Urban river sedimentation

- **Modification of substratum composition**
- **Modification of habitat patches**
- **Clogging of substratum interstitial spaces**
- **Reduction of interstitial flow, dissolved oxygen**
- **Reduction in efficiency of photosynthesis**
- **Spawning / reproductive activity**
- **Feeding efficiency**
- **Effect on all trophic levels**

Urban river sedimentation



A – Summer Experiment



B - Autumn Experiment

Urban river sedimentation - Summer

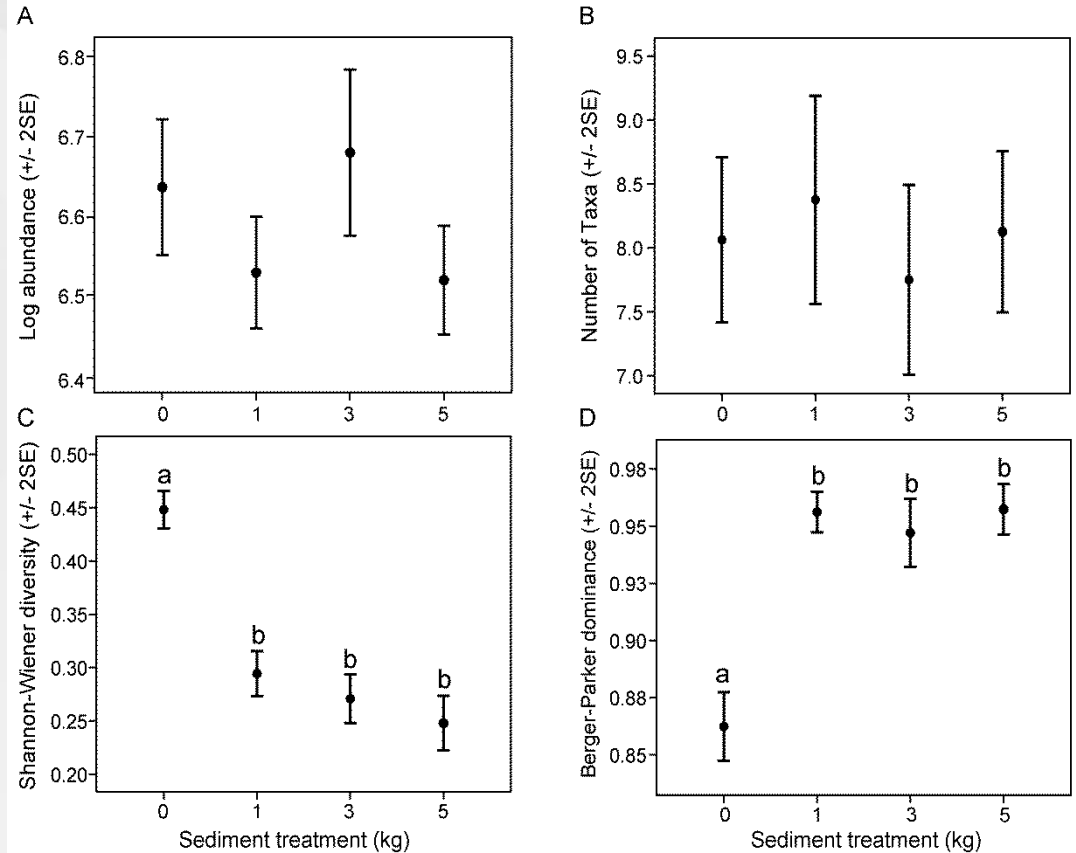
Autumn

A. Abundance

B. Richness

C. Diversity

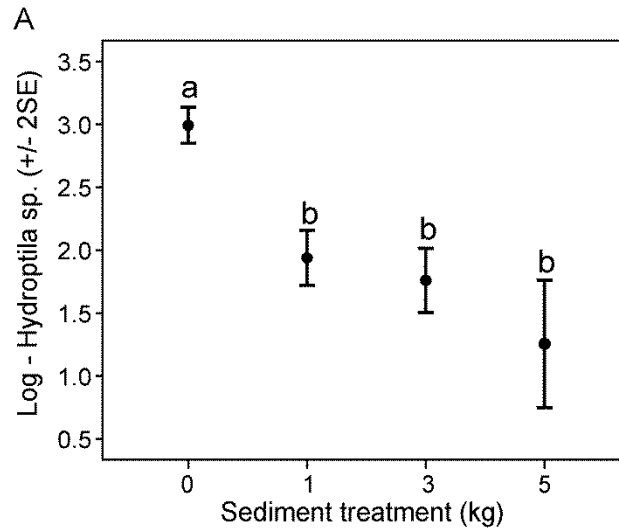
D. Dominance



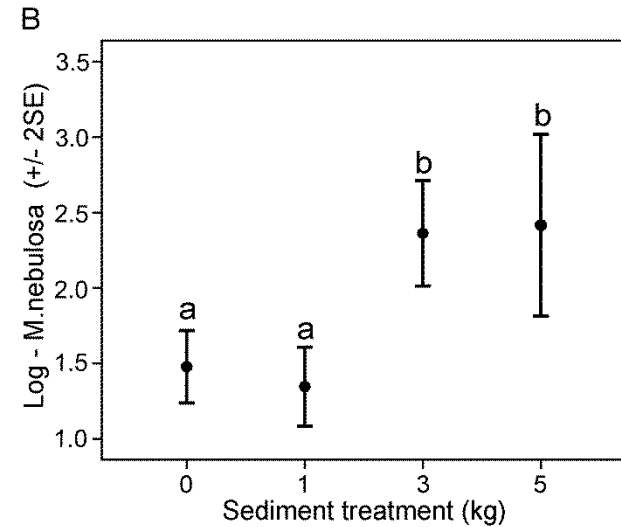
Urban river sedimentation - Summer



Hydropsyche sp.



A - decline



B - increase

Urban Mill Ponds



Urban Mill Ponds

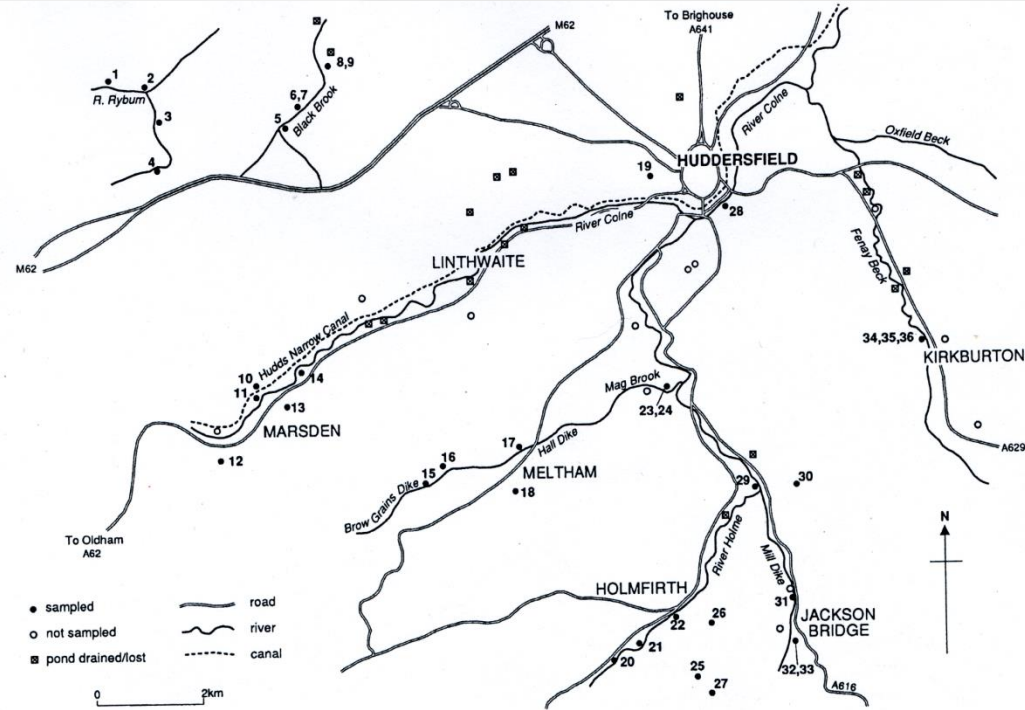


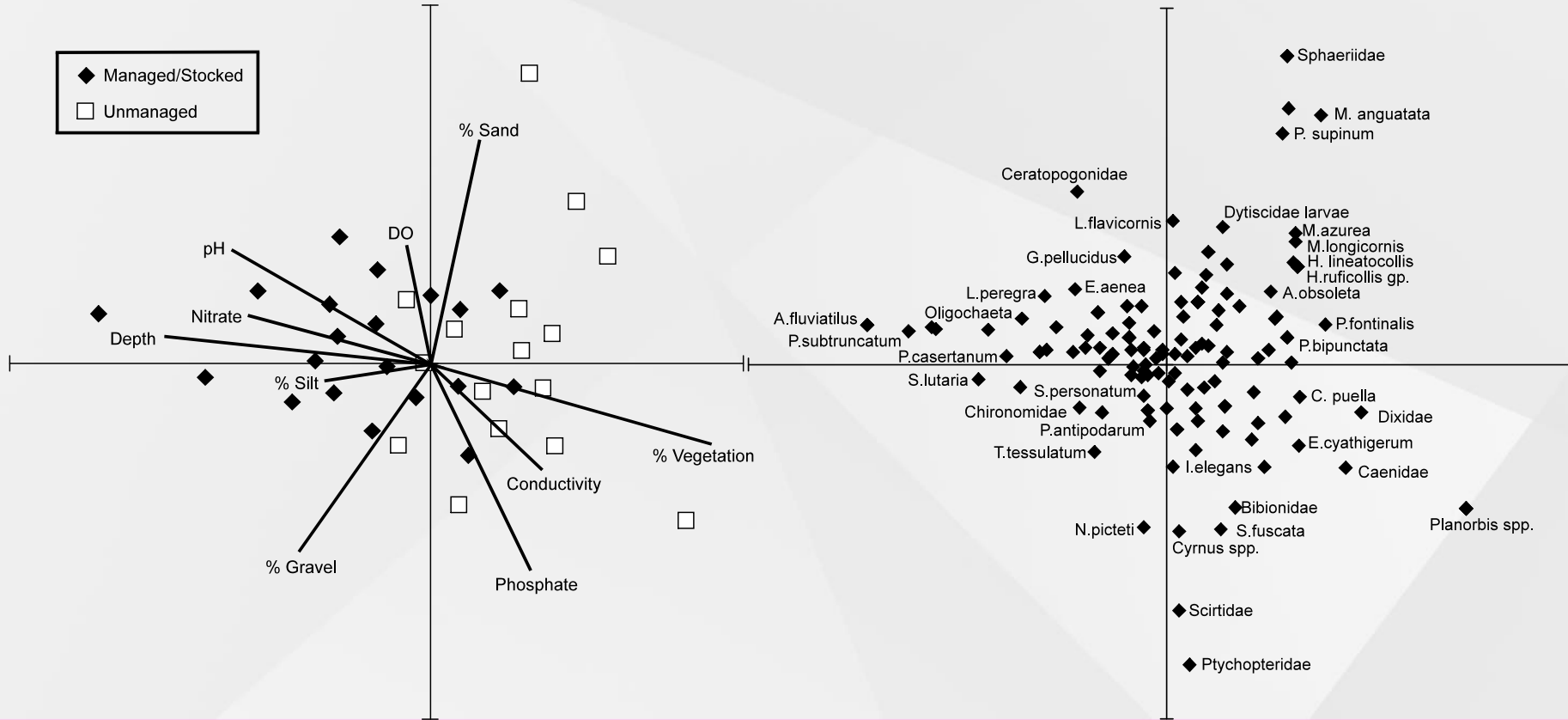
Fig. 1. Location of old industrial ponds around Huddersfield showing those ponds sampled, those not sampled, and those where the waterbody has been drained or redeveloped.



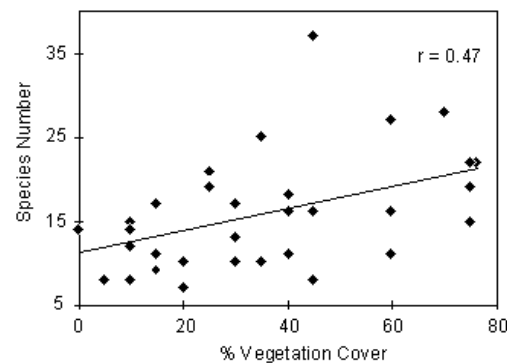
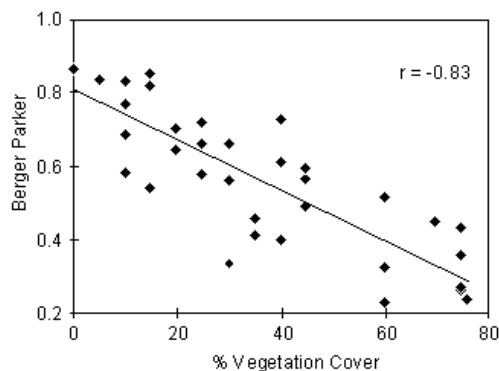
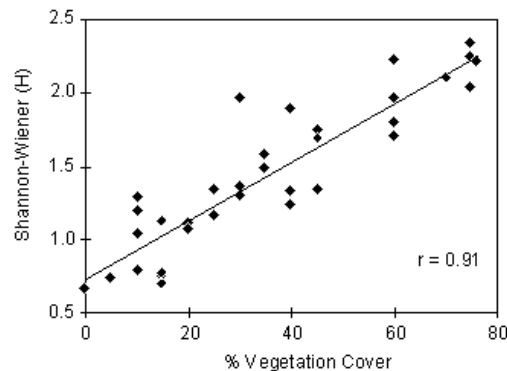
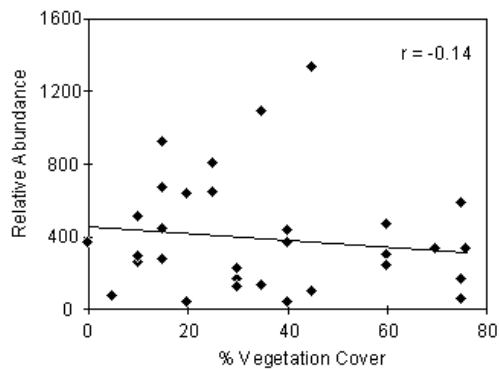
Urban Mill Ponds

Common Name	Species	No. Ponds
Brown trout	<i>Salmo trutta</i>	5
Common carp	<i>Cyprinus carpio</i>	14
Crusian carp	<i>Carassius carassius</i>	5
Goldfish	<i>Carassius auratus</i>	1
Gudgeon	<i>Gobio gobio</i>	6
Tench	<i>Tinca tinca</i>	11
Bream	<i>Abramis brama</i>	18
Minnow	<i>Phoxinus phoxinus</i>	13
Rudd	<i>Scardinius erythrophthalmus</i>	10
Roach	<i>Rutilus rutilus</i>	19
Chubb	<i>Leuciscus cephalus</i>	3
Dace	<i>Leuciscus leuciscus</i>	11
Three-spined stickleback	<i>Gasterosteus aculeatus</i>	28
Perch	<i>Perca fluviatilis</i>	7
Pike	<i>Esox lucius</i>	1

Urban Mill Ponds



Urban Mill Ponds



Policy Driver – EU Water Framework Directive

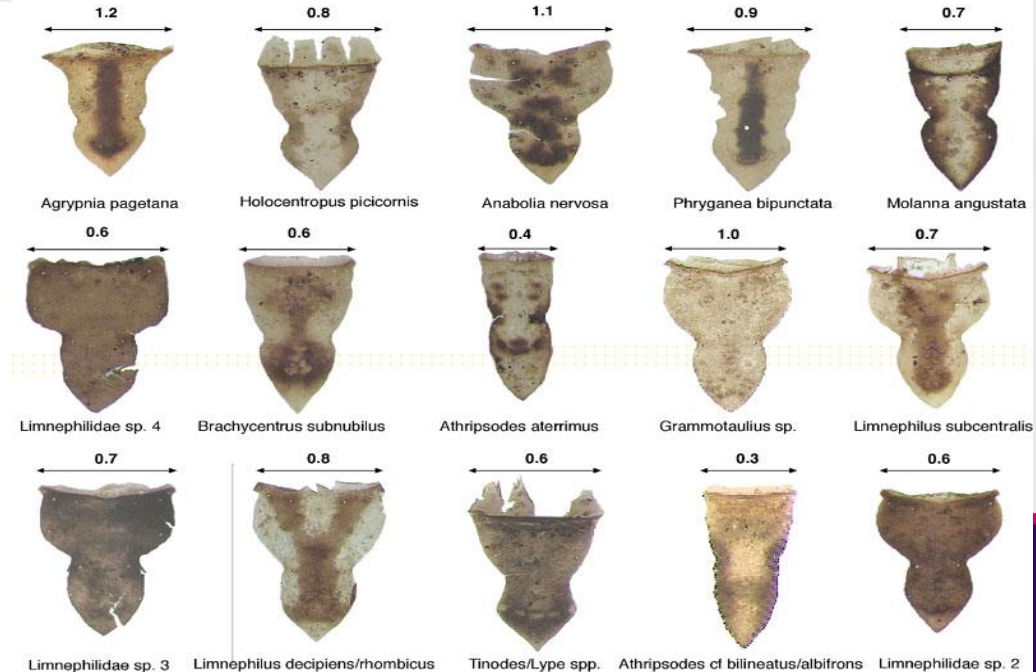
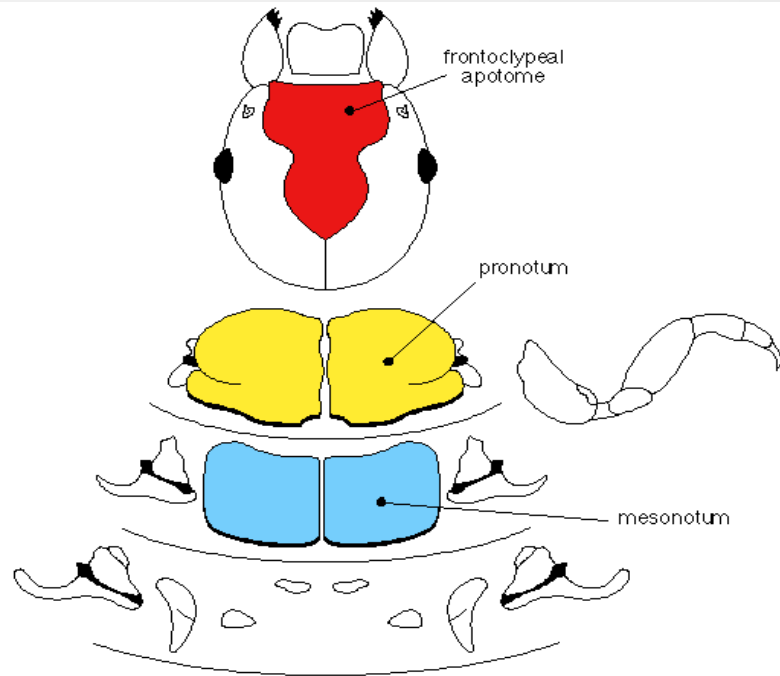
Under the EU Water Framework Directive all water bodies should aim to achieve ‘Good Ecological Status’ based on a predetermined reference condition.

Palaeoecology provides a way of establishing a reference condition. To date this has been tested on lakes and requires validation in riverine environments.

Using sub fossil macroinvertebrates

- Sub-fossil remains of some insect taxa are common and abundant in palaeochannel deposits

1. **Trichoptera** – Caddisfly larvae (Greenwood et al., 2006)



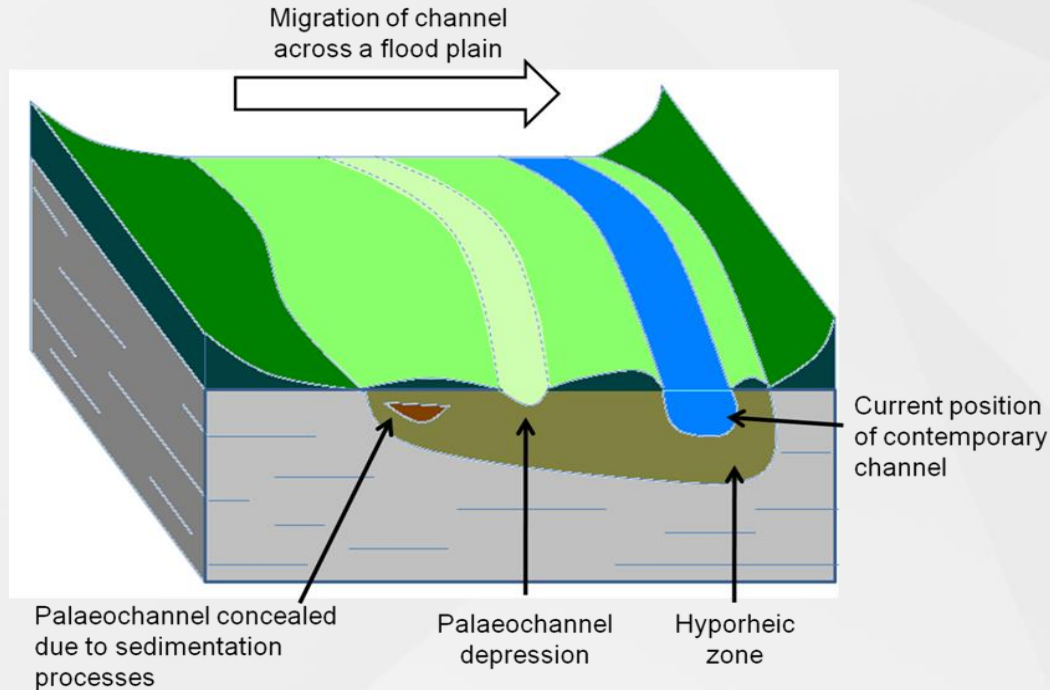
Using sub fossil macroinvertebrates

- Sub-fossil remains of some insect taxa are common and abundant in palaeochannel deposits

2. **Coleoptera** – Aquatic Beetles
(Howard et al., 2009)



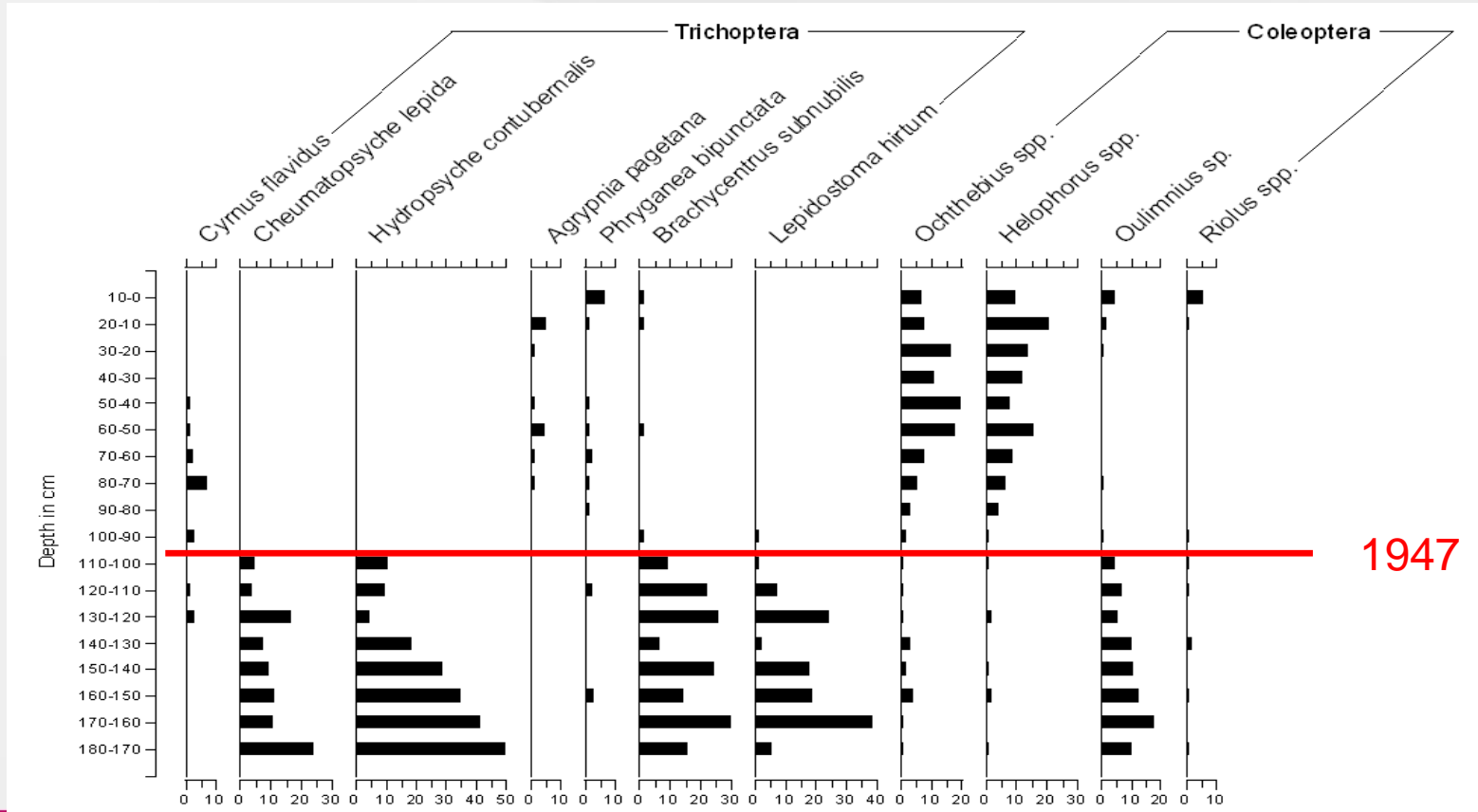
River Restoration and Reference Conditions – Putting the principle into Practice



Which reference / benchmark period?

1. Pre-human settlement
2. Pre-industrial revolution (1750)
3. Pre-land drainage (1850)
4. Pre-agricultural intensification (post 1945)

Example of a palaeoecological section from a river



River Wensum



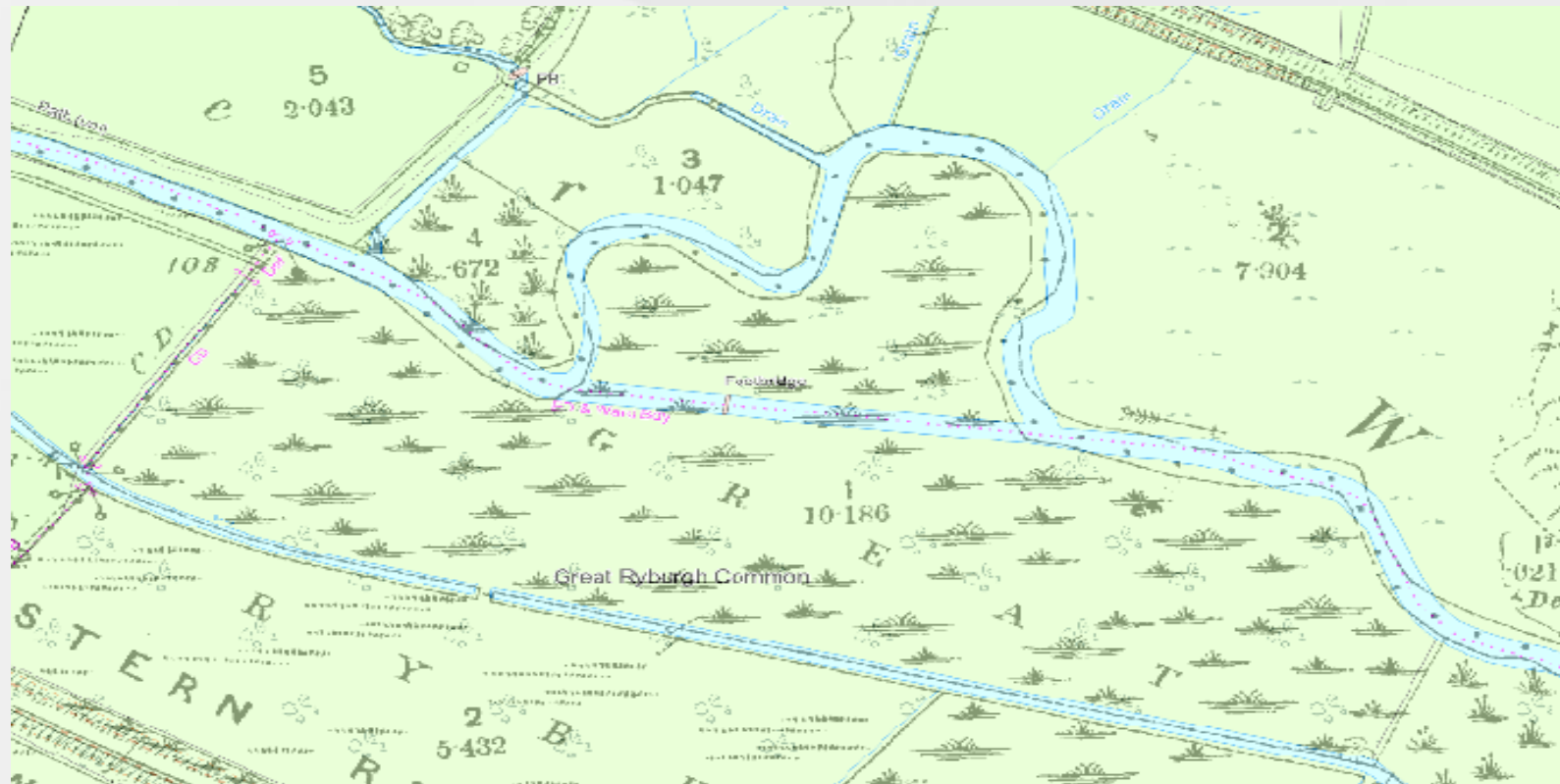
River Wensum



River Wensum - Palaeochannel



River Wensum



Sampling the Palaeochannel at the River Wensum



Sampling the Palaeochannel at the River Wensum



Sampling the Palaeochannel at the River Wensum



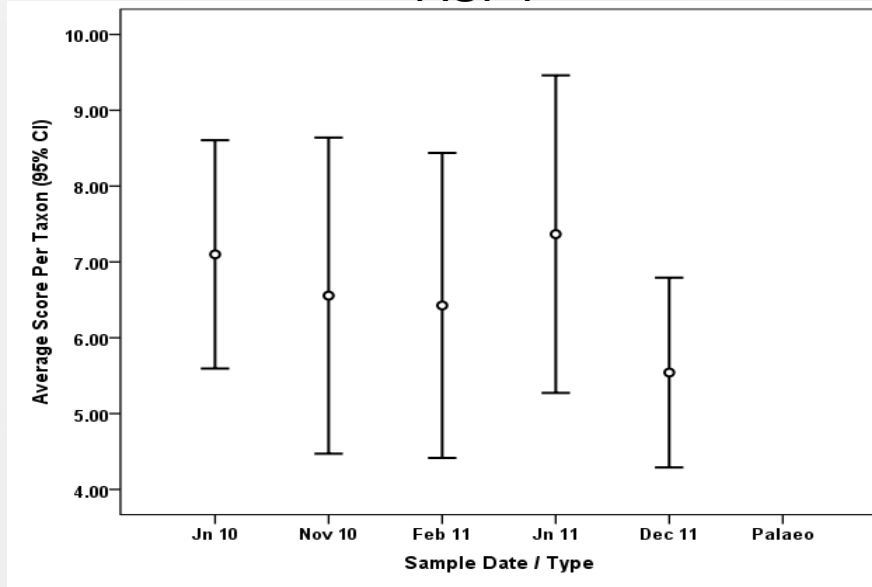
Restored Section



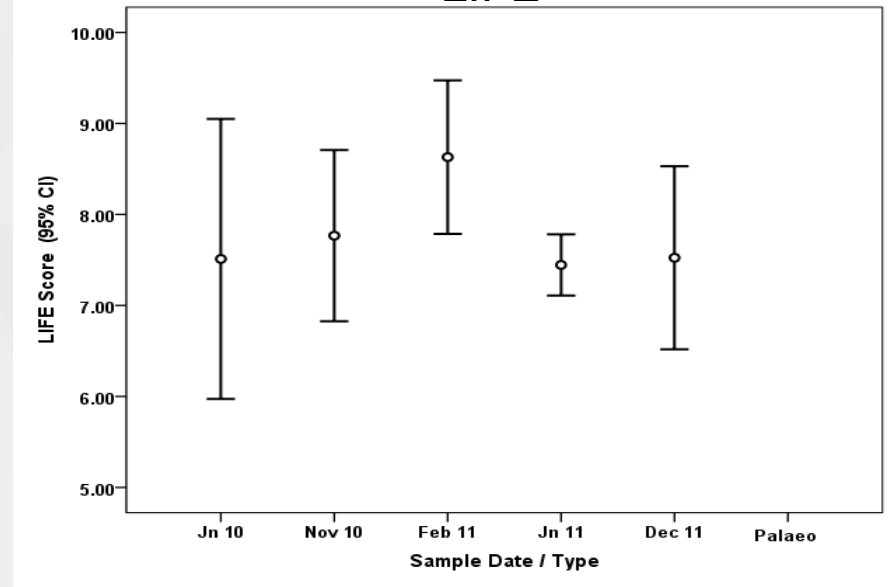
R. Wensum

Macroinvertebrate GES indicators

ASPT



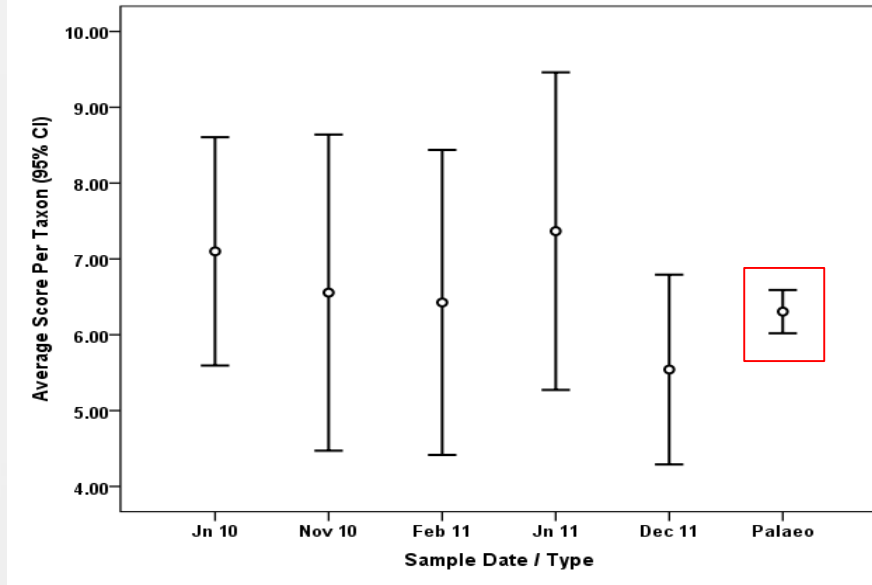
LIFE



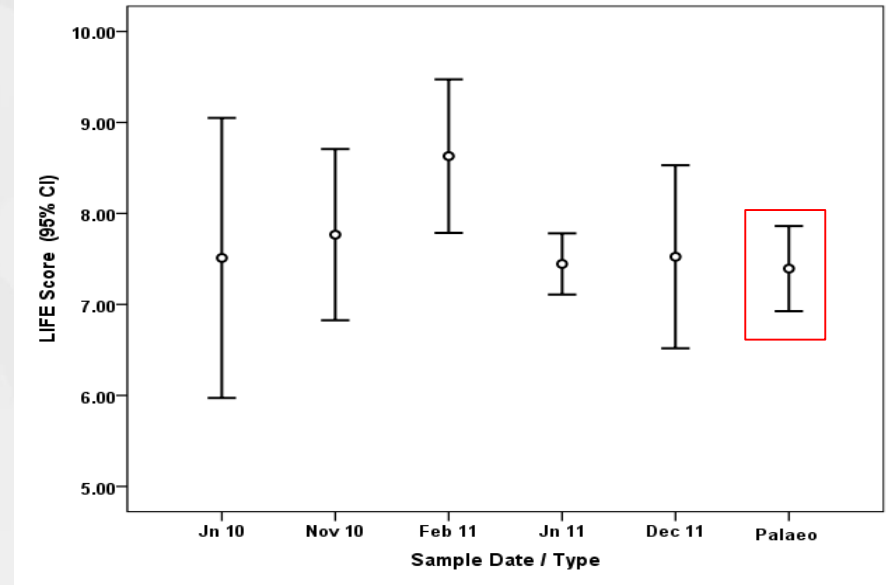
R. Wensum

Macroinvertebrate GES indicators

ASPT

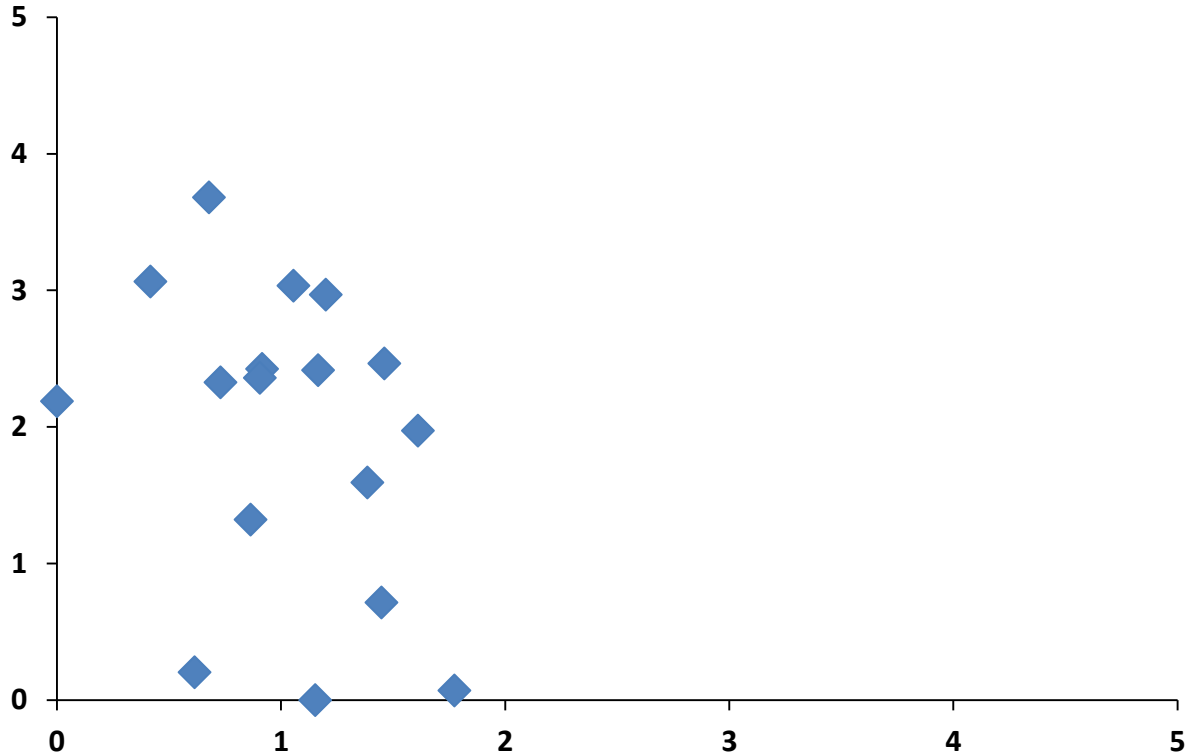


LIFE



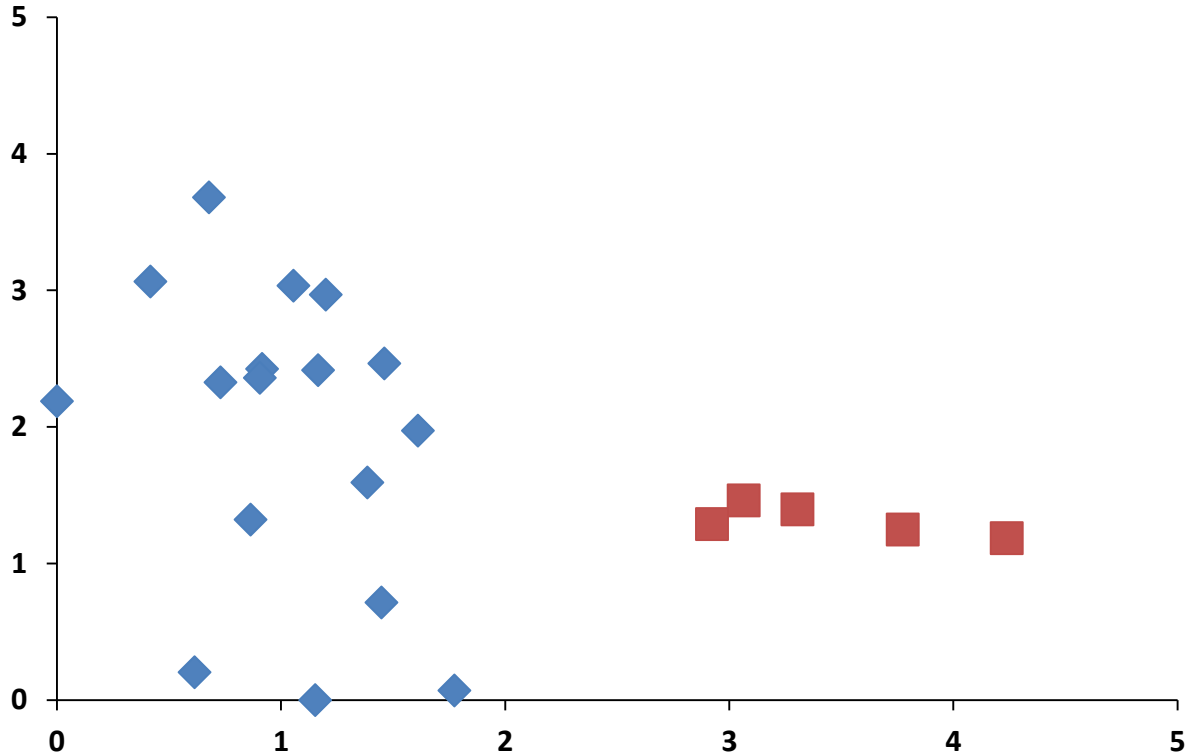
Mean ASPT and LIFE scores show no significant difference between the contemporary and the palaeo samples (Kruskal-Wallis Test $p > 0.05$)

River Wensum - Results



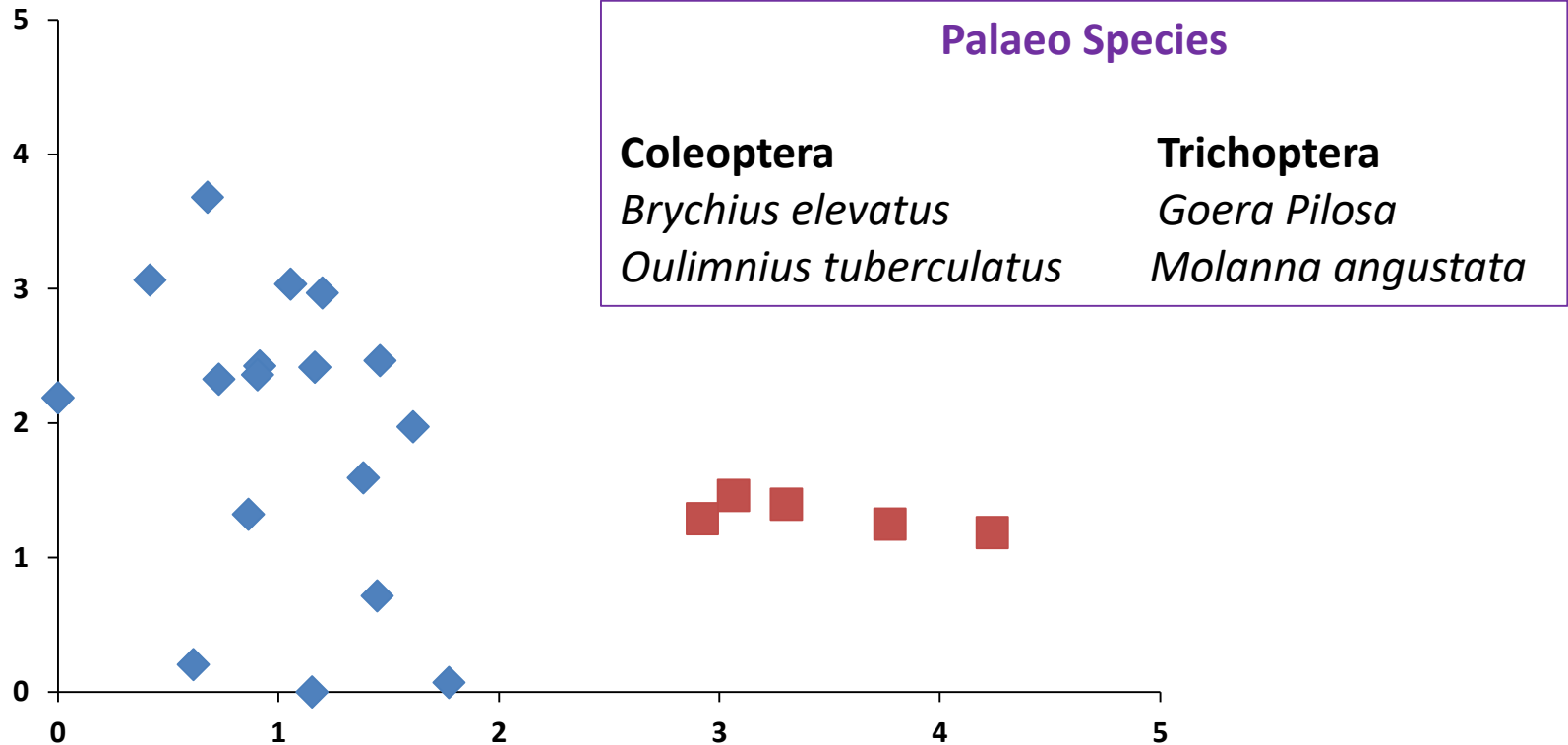
Detrended correspondence analysis of contemporary and palaeo Trichoptera and Coleoptera samples from the River Wensum

River Wensum - Results



Detrended correspondence analysis of contemporary and palaeo
Trichoptera and Coleoptera samples from the River Wensum

River Wensum - Results



Detrended correspondence analysis of contemporary and palaeo Trichoptera and Coleoptera samples from the River Wensum

Summary 1

- **Urban aquatic ecosystems are highly dynamic and do not necessarily respond to stressors in a similar way to non-urban systems.**
- **Palaeoenvironmental approaches may help to identify a range of past reference conditions, providing decision makers with a spectrum of conditions on which to base conservation and restoration strategies.**

Summary 2

- **Rather than try to restore and replicate ‘natural’ (non-urban) should alternative states (reference conditions) be considered?**
- **Should we accept that urban aquatic ecosystems are different and celebrate the unique contribution that they make?**
- **Reconciliation Ecology?**

Acknowledgements

Patrick Armitage and Geoff Petts

NERC

Nuffield Foundation

Environment Agency

Natural England

and many more!



Stenophylax permistus



Loughborough
University

#InspiringWinners since 1909