Cambridge Environmental Assessments

Do Aquatic Mesocosms Represent Real Edge-of-field Water Bodies in the UK?

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Talk structure

- Introduction to project
- Identify key questions
- Selection of landscape classes and water body types
- Preliminary results
  - Community composition in mesocosms and edge-of-field water bodies
  - Relative sensitivity of different waterbodies to pesticides using SPEAR
  - Seasonal changes in community sensitivity

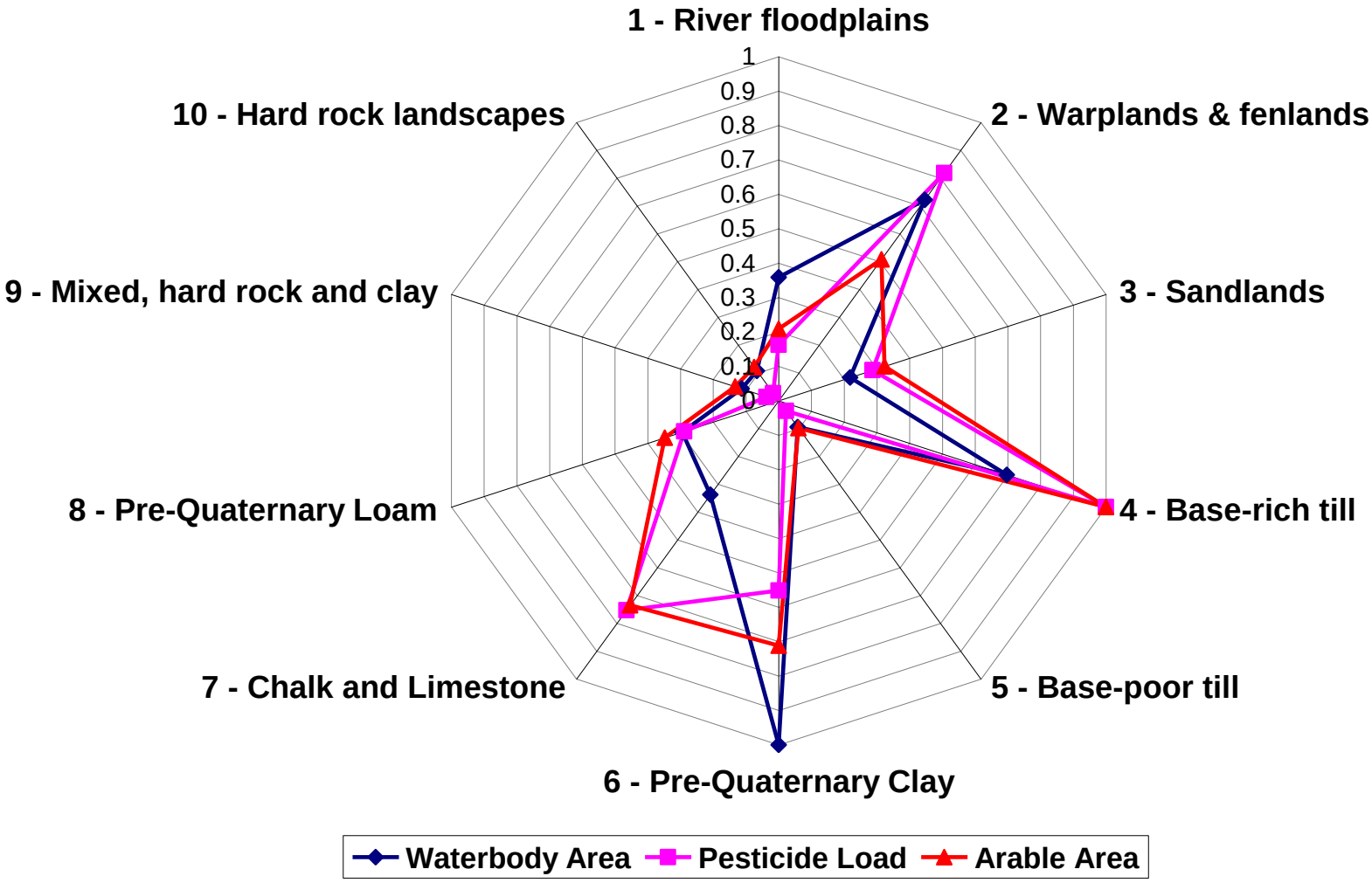
Introduction

- Data from protected waterbodies have demonstrated diverse and abundant aquatic communities.
- Mesocosms have been demonstrated to be less diverse than these waterbodies (e.g. Williams *et al*, 200?)
- Limited information on some edge-of-field water bodies e.g. ponds and ditches
- Information on real edge-of-field water bodies in the UK would allow contextualisation of effects observed in mesocosms
- Two year project, funded by PSD

Key questions

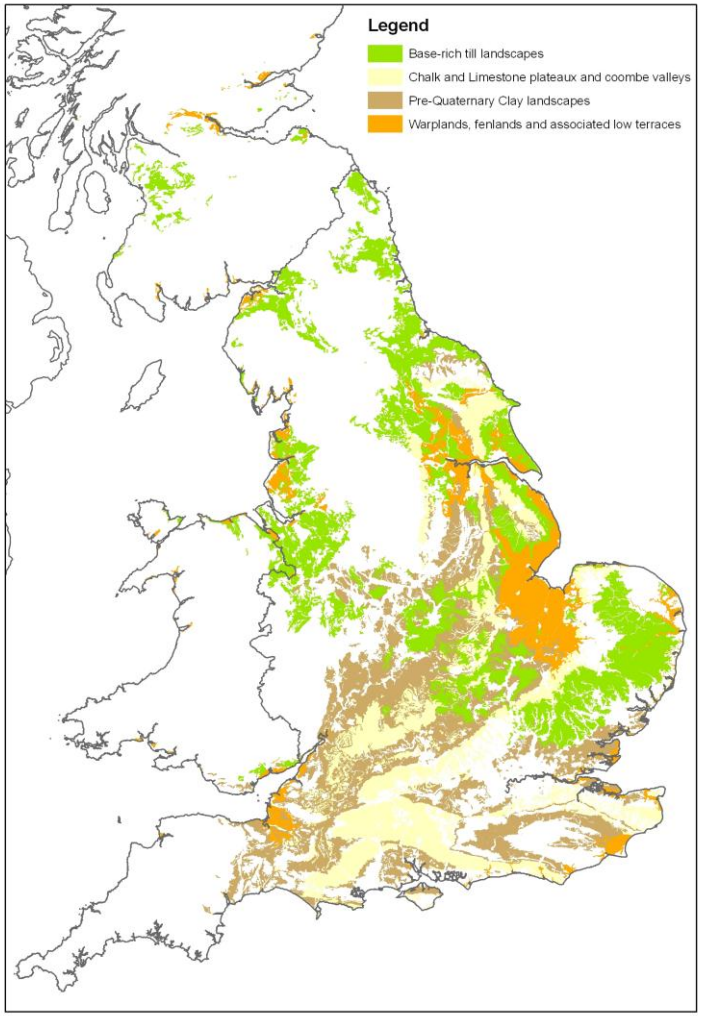
- Are mesocosms sufficiently ecologically representative of UK water bodies in the UK agricultural landscape?
- Do mesocosm studies with spring/summer applications represent the ‘worst-case’ scenario?
- Do seasonal changes in community structure increase the uncertainty associated with mesocosm endpoints when applied to autumn pesticide applications?

Landscape selection



Landscape selection

- Final landscapes selected
  - Eutrophic tills
  - Chalk and limestone
  - Pre-quaternary clays
  - Warplands and fens



Site selection

- Aerial photography and GIS used to identify potential sites
- Short list of suitable sites (>100 sites) were visited to assess representivity and suitability
- Sites selected to be representative of water bodies in arable landscapes in the UK

	Streams	Ditches	Ponds	Totals
PQ Clay	4	4	5	13
Warpland	0	6	0	6
Chalk	4	0	0	4
Eutrophic	6	0	7	13
Totals	14	10	12	36

Sampling of sites

- Monthly sampling from May 2008 for two years
- Sampling natural waterbodies and three independent mesocosm facilities
  - Macro-invertebrates
  - Zooplankton
  - Phytoplankton
  - Macrophytes
  - Physico-chemical
  - Land use assessment

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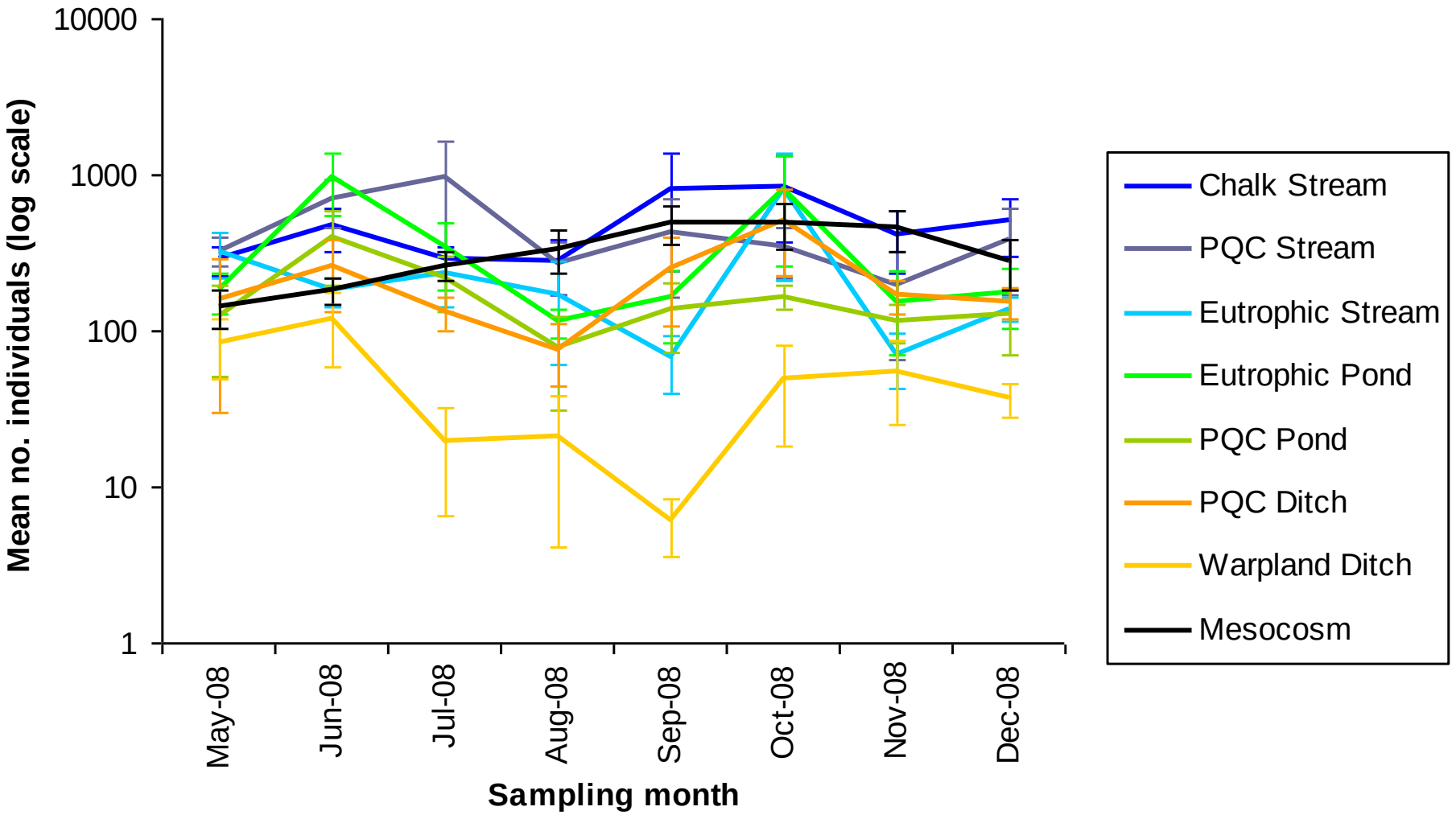
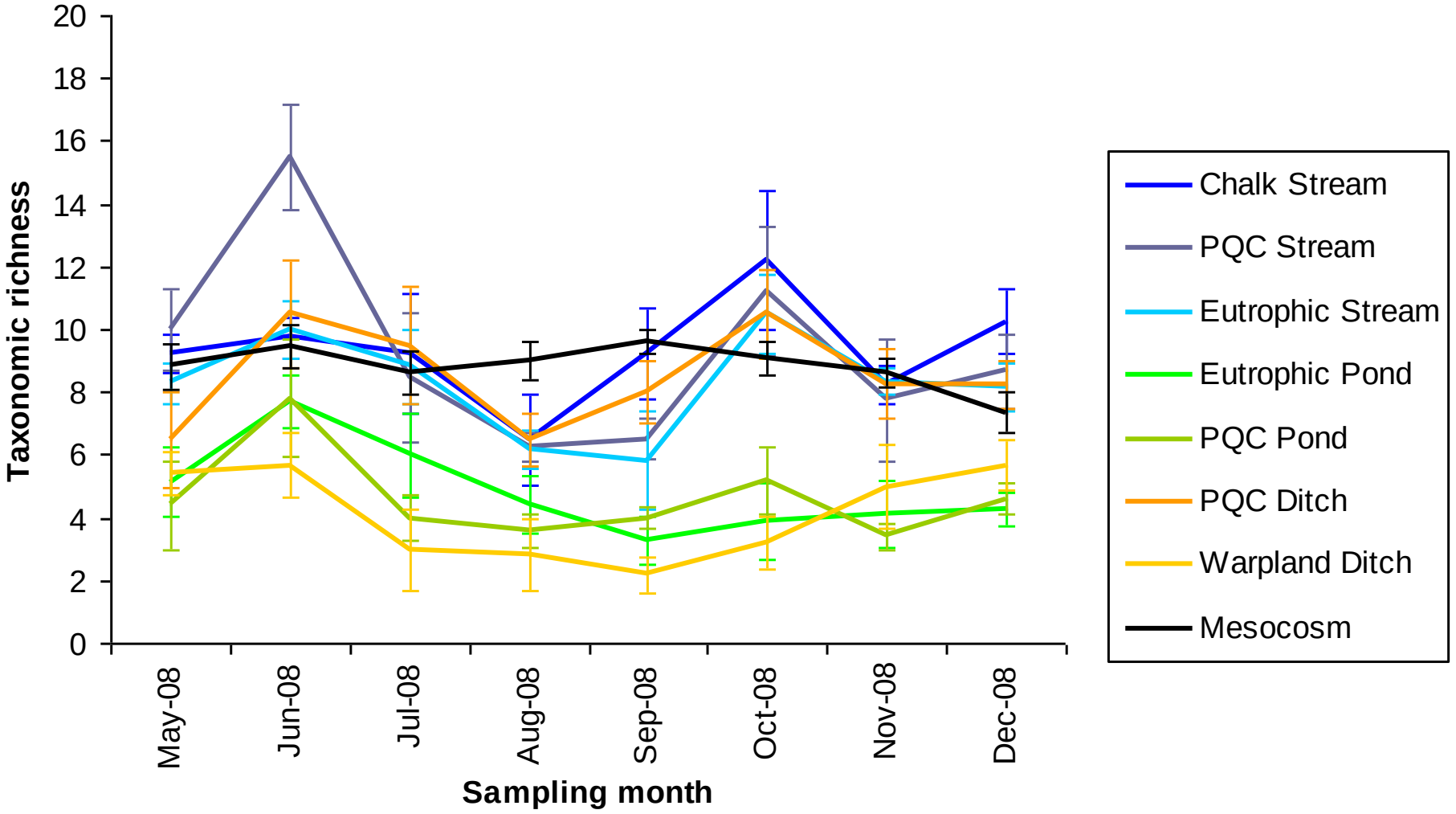
Statistical analysis

May to December 2008

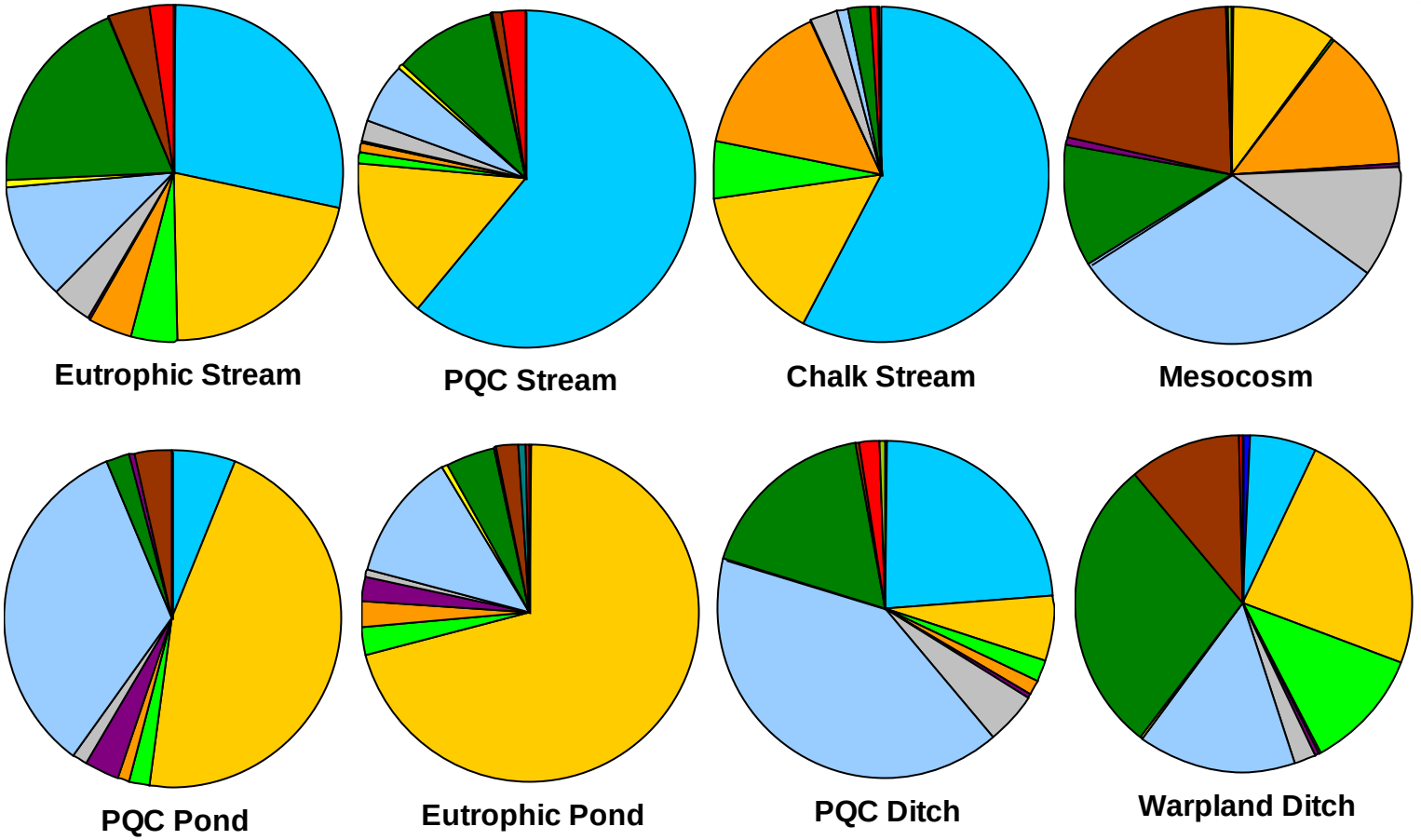
Mean abundances for field data



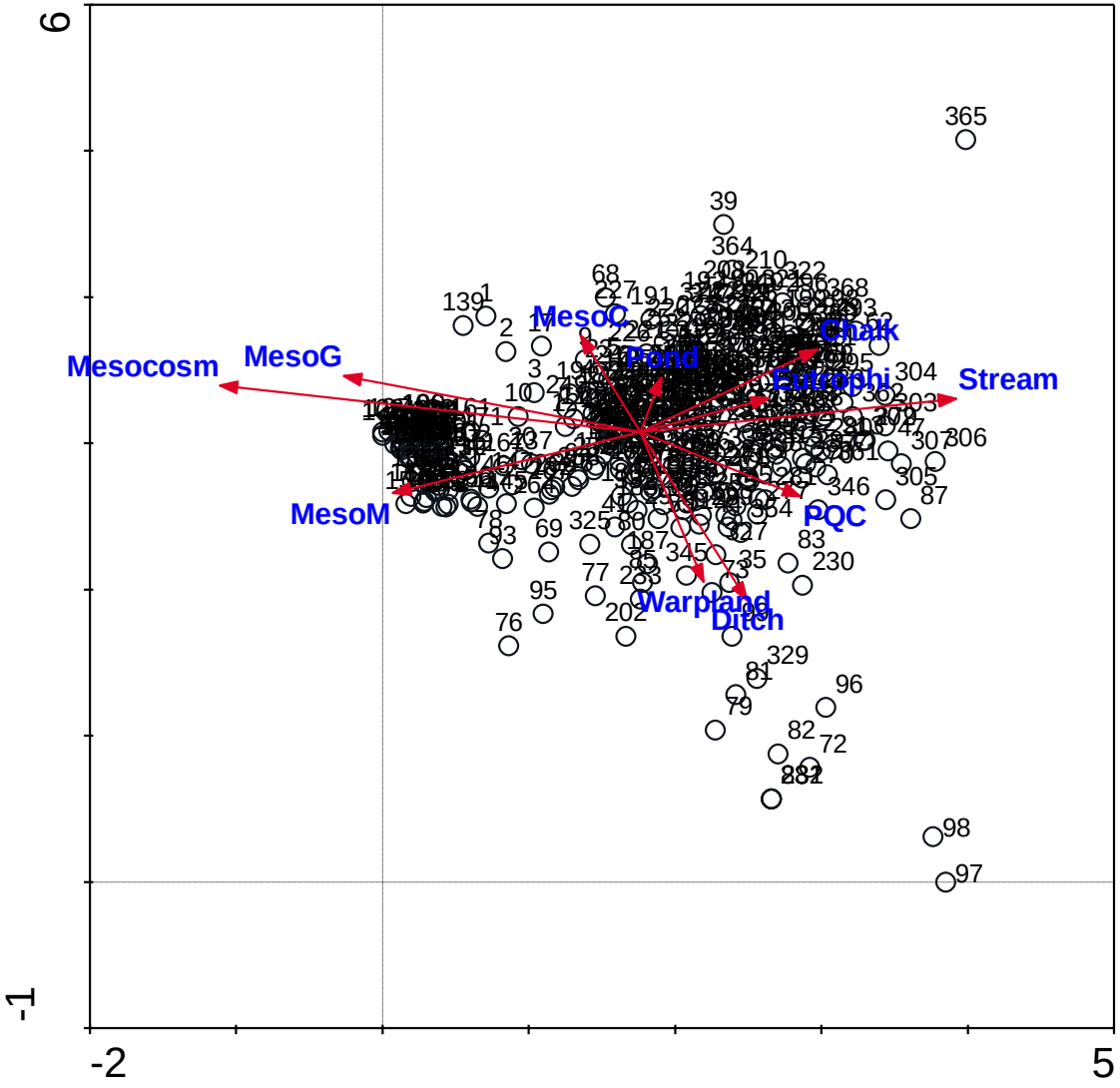
Taxonomic richness (family)



Taxonomic composition



DCA – influence of waterbody type and landscape class



Note:

All months taken together. Additional slides at end show each month separately for your information

Overview of SPEAR$_{pesticide}$ to evaluate community sensitivity

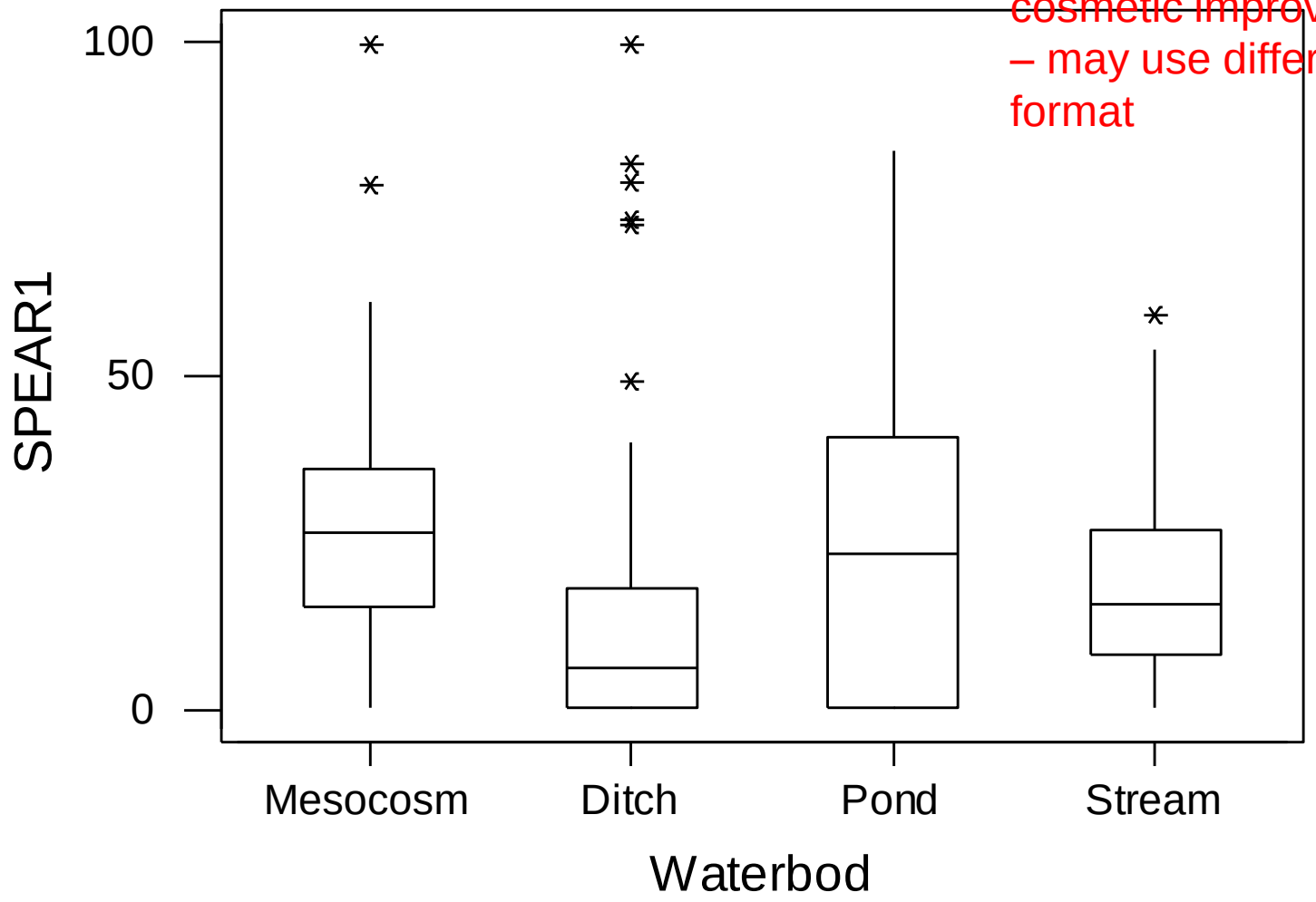
- Pesticide-specific bioindicator system linking pesticide exposure and effects (Liess *et al.*)
- Taxa are ranked according to biological traits that influence sensitivity to pesticide exposure
- Sensitivity of community is calculated from the relative abundance of each taxa
- Recent papers have provided UK specific rankings and indicate family resolution data can be used
- Information on SPEAR can be found at http://www.ufz.de/index.php?en=2122

Use of SPEAR$_{pesticide}$ to evaluate community sensitivity

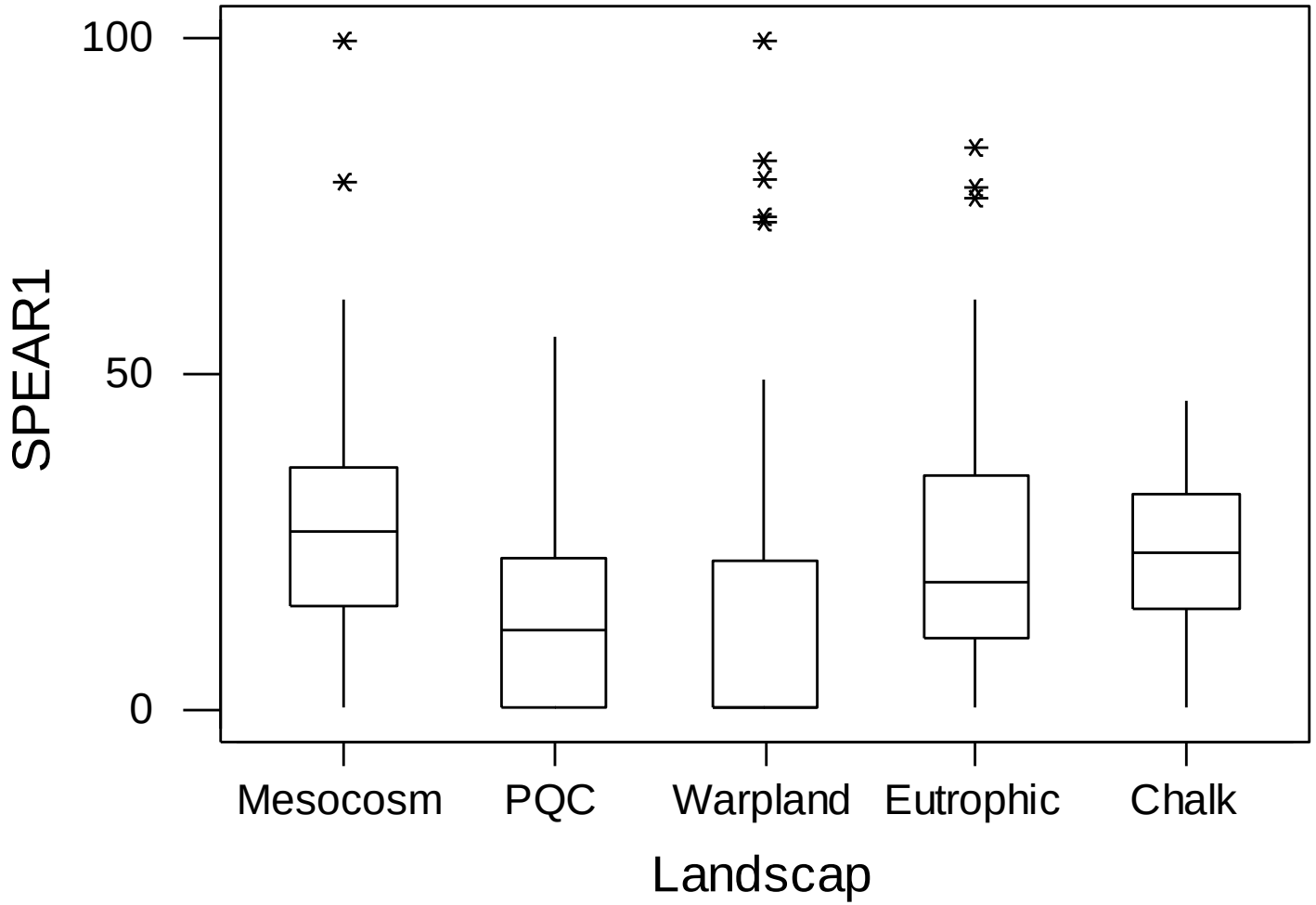
- SPEAR used here to assess similarity in sensitivity between mesocosms and edge-of-field communities
  - influence of water body type
  - influence of landscape class
  - influence of season
- 76% of individuals and 78% of taxonomic groups included in UK specific SPEAR tables (Beketov *et al.*, 2008)

Influence of water body type on sensitivity

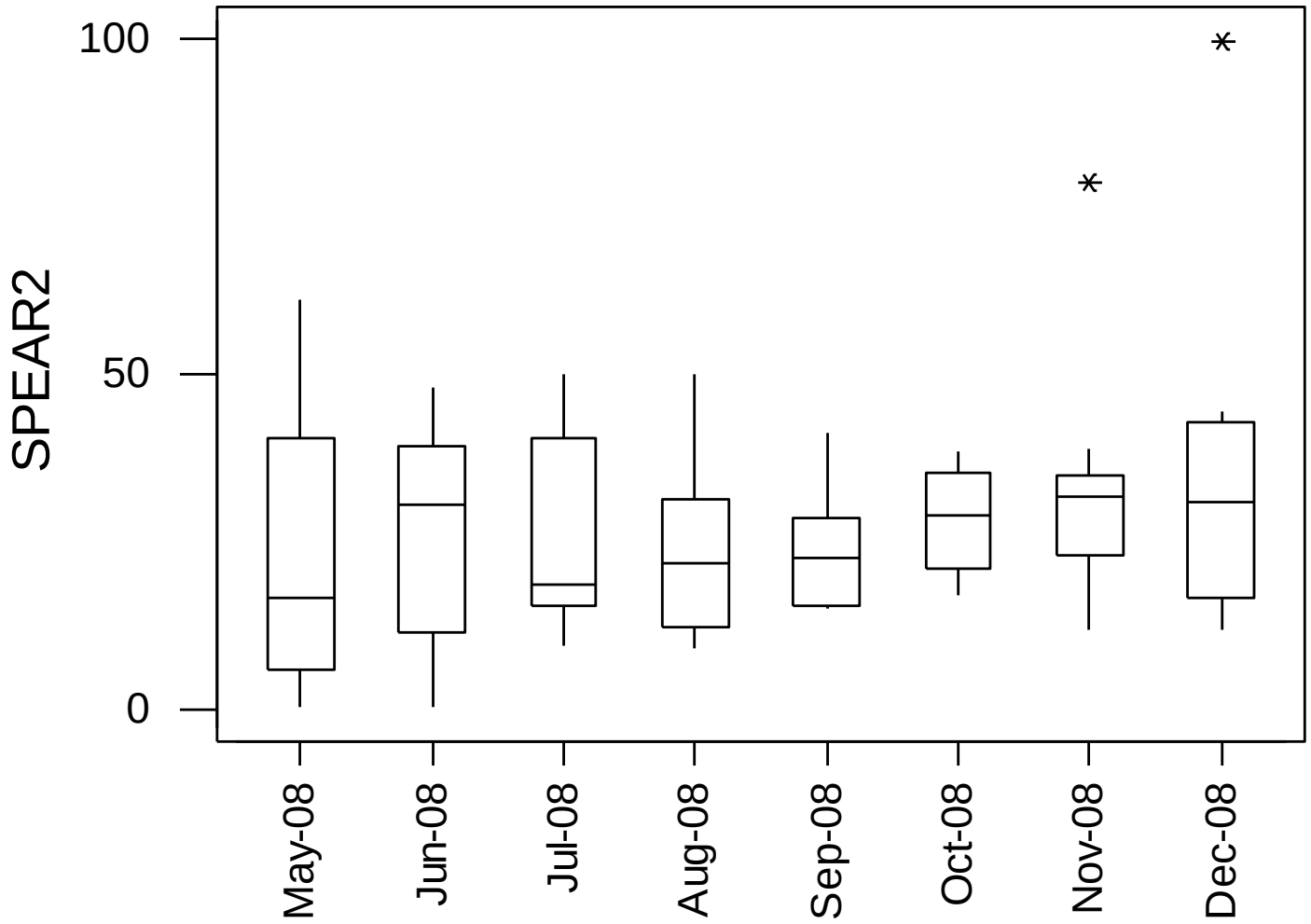
Note: graphs need cosmetic improvement – may use different format



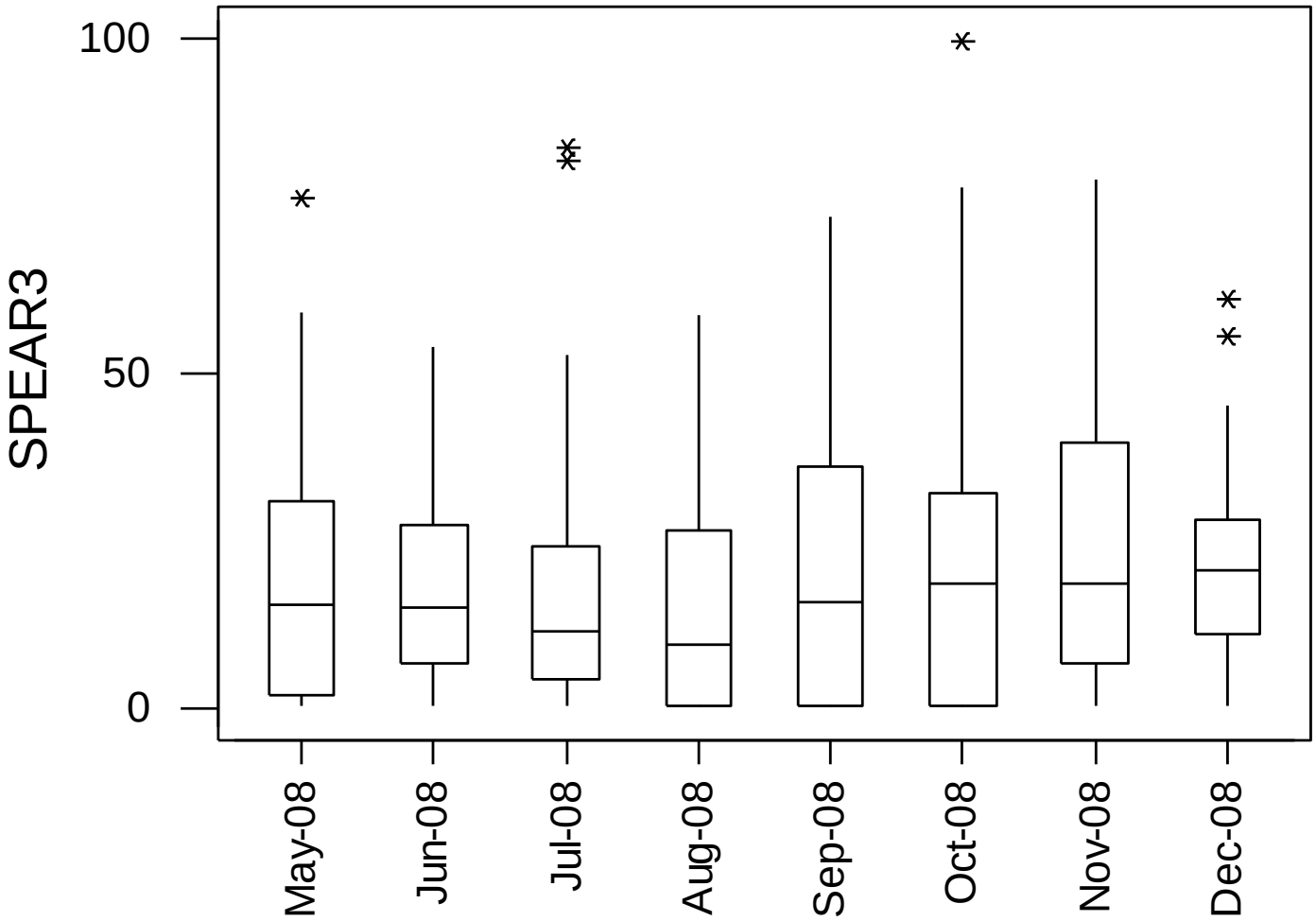
Influence of landscape class on sensitivity



Influence of season on mesocosm SPEAR$_{pesticide}$



Influence of season on edge-of-field water bodies



Summary 1

- *Are mesocosms sufficiently ecologically representative of UK water bodies in the UK agricultural landscape?*
  - Abundance and taxonomic richness similar
  - Species composition is different
  - SPEAR sensitivity is similar to ponds and greater than streams and ditches

- *Do mesocosm studies with spring/summer applications represent the 'worst-case' scenario?*
  - Mesocosm SPEAR in spring/summer is variable but may include representative sensitive taxa

Summary 2

- *Do seasonal changes in community structure increase the uncertainty associated with mesocosm endpoints when applied to autumn pesticide applications?*
  - SPEAR sensitivity, based on biological traits, indicate changes in community structure do not increase uncertainty associated with mesocosm endpoints

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Thank you for your attention

Our thanks to the Pesticides Safety Directorate, UK for their funding of this work

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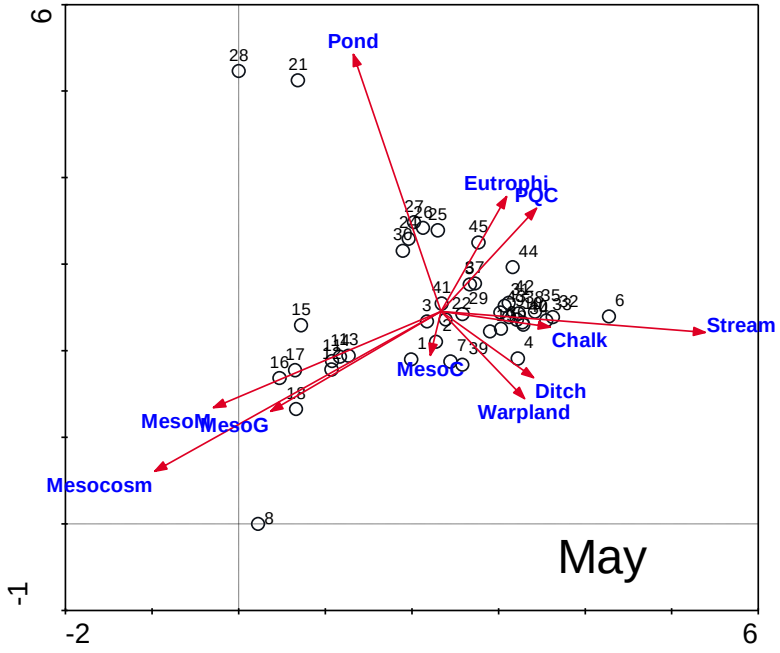
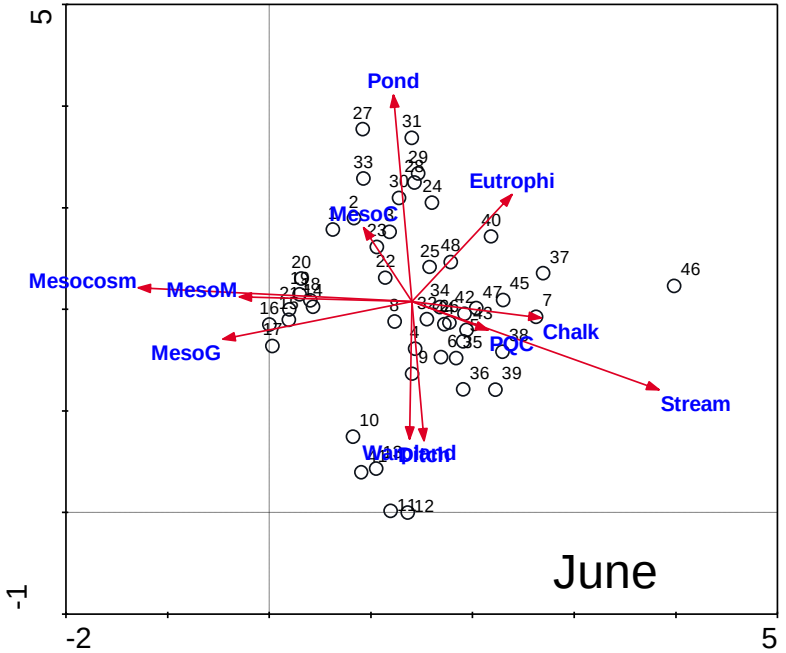

Pond
Eutrophi
POC
Stream
Chalk
MesoC
Ditch
Warpland
MesoM
MesoG
Mesocosm
May


Pond
Eutrophi
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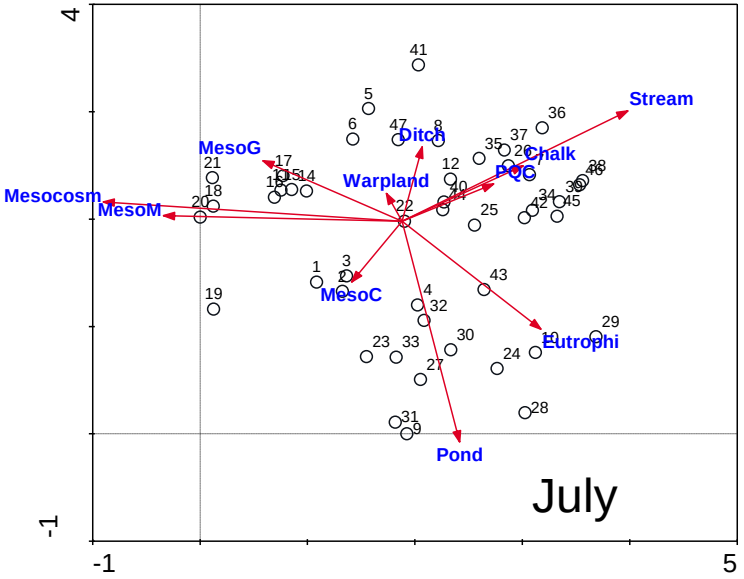
Chalk
POC
Stream
June


Stream
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Warpland
Mesocosm
MesoM
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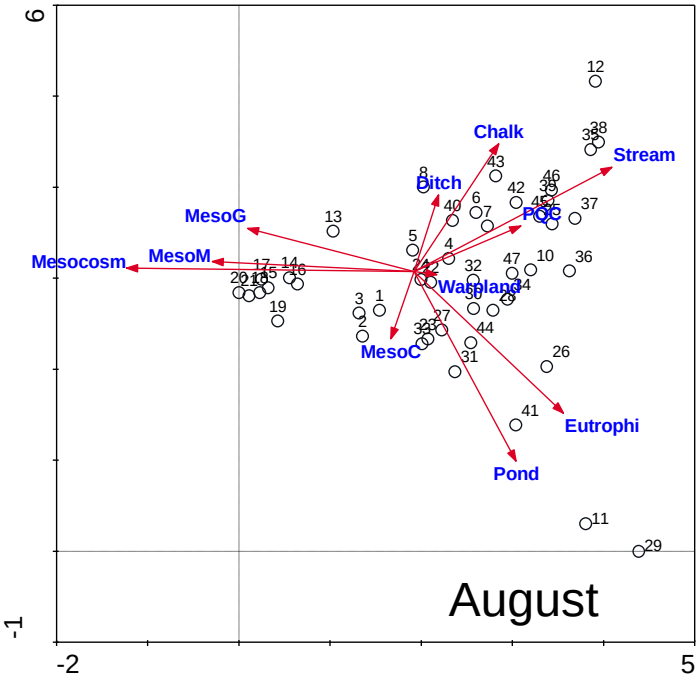
Eutrophi
Pond
July


Chalk
Stream
Ditch
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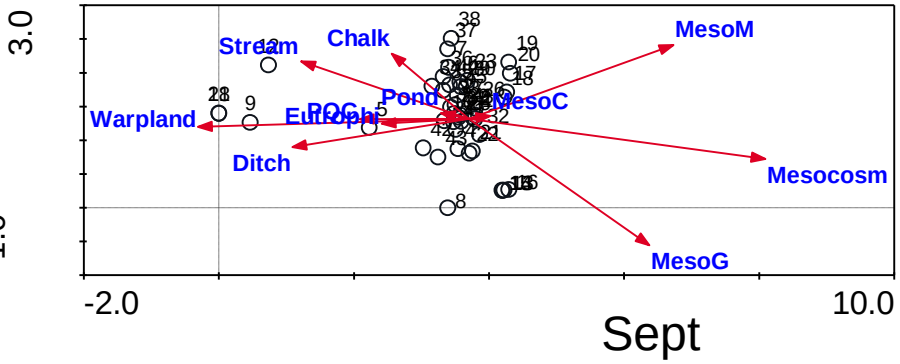
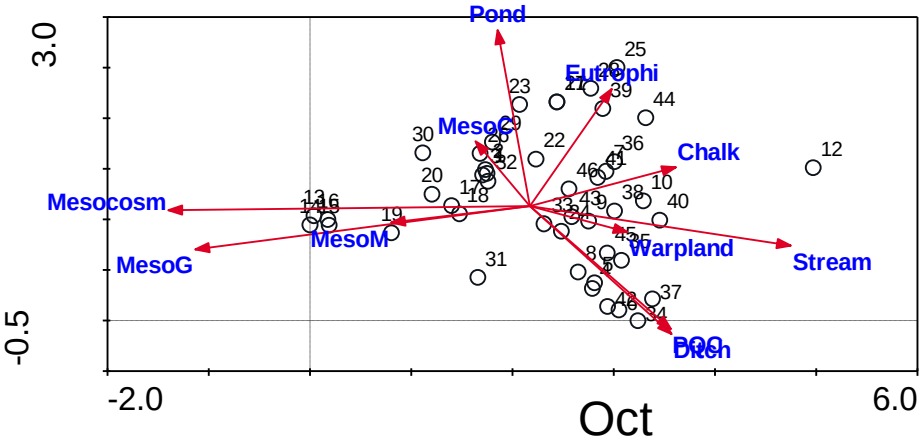
POC
Mesocosm
MesoM
Warpland
MesoC
Eutrophi
Pond
August


3.0
Stream
Chalk
MesoM
Warpland
Eutrophi
POC
Pond
MesoC
Ditch
Mesocosm
MesoG
-2.0
10.0
Sept


Pond
Eutrophi
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MesoC
Chalk
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Warpland
Stream
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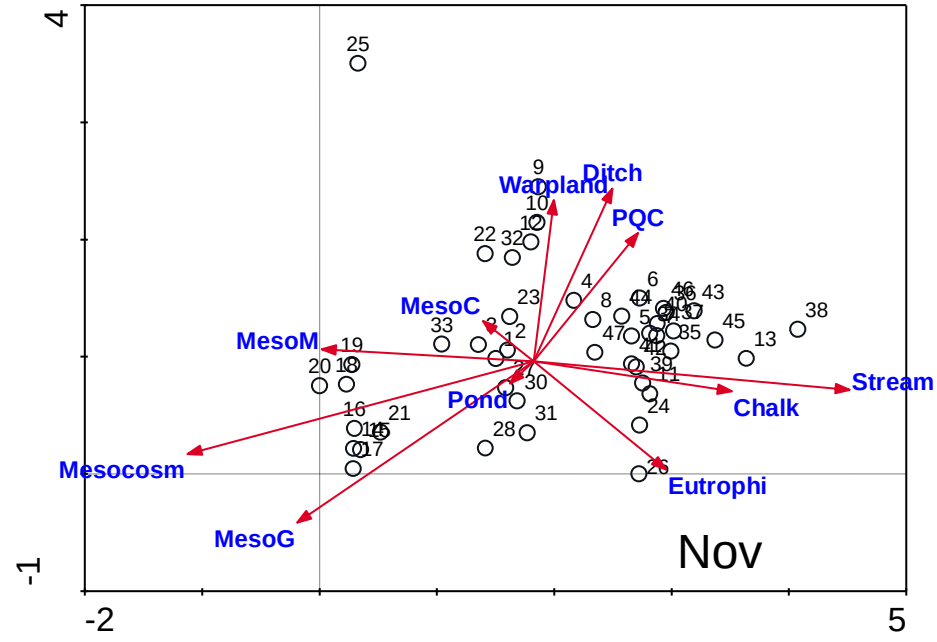
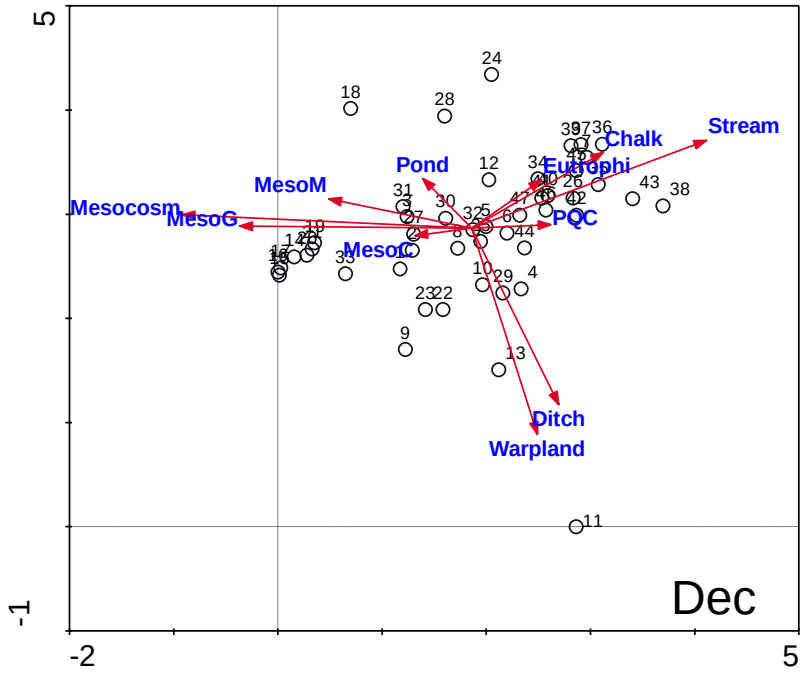
-2.0
6.0
Oct


4
Warpland
Ditch
POC
MesoC
MesoM
Stream
Chalk
Pond
Mesocosm
Eutrophi
MesoG
-1
-2
5
Nov


5
Stream
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Mesocosm
MesoG
POC
MesoC
Ditch
Warpland
-1
-2
5
Dec

Summary additional

- No. of individual in samples from mesocosms similar to most edge-of-field waterbodies
- Taxonomic richness typically highest in edge-of-field streams and mesocosms
- Mesocosm composition differs from edge-of-field water bodies, but DCA also showed evidence of clustering by waterbody type and landscape class
- 76% of individuals and 78% of taxonomic groups included in UK specific SPEAR tables (Beketov *et al.*, 2008)
- Mesocosm SPEAR compared favourably with edge-of-field waterbody types and different landscape classes