

Dissecting large-scale spatial patterns in freshwater invertebrate species richness

Rob Briers
Edinburgh Napier University

Pond Conservation

RIVPACS group, CEH

Species richness

- Commonly measured metric in ecology
- Widely used criterion in conservation
- Complex spatial patterns in richness in many taxa
- Little known in terms of how richness patterns are composed – rare/common species
- Environmental drivers of richness for different groups

Species richness

- Spatial pattern generated by the overlap between the ranges of different species

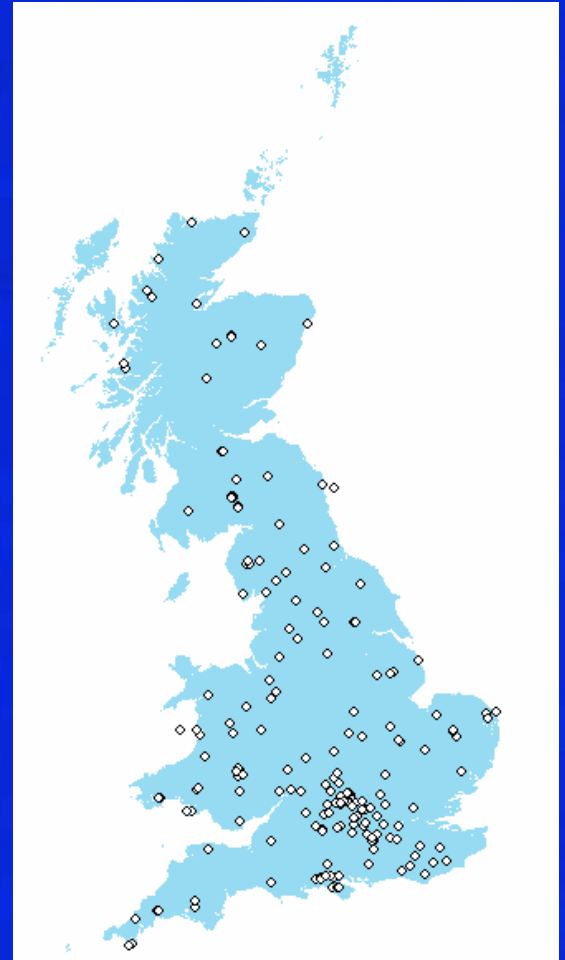
2	1	2	1	3	1	2	3	1	1	Overall
1		1		1		1	1			Sp. 1
1	1	1	1	1	1	1	1	1		Sp. 2
				1			1		1	Sp. 3

This study

- Role of rare and common species in determining richness patterns of freshwater invertebrate communities
- Spatial patterns in common and rare species richness
- Environmental determinants of richness in different subsets

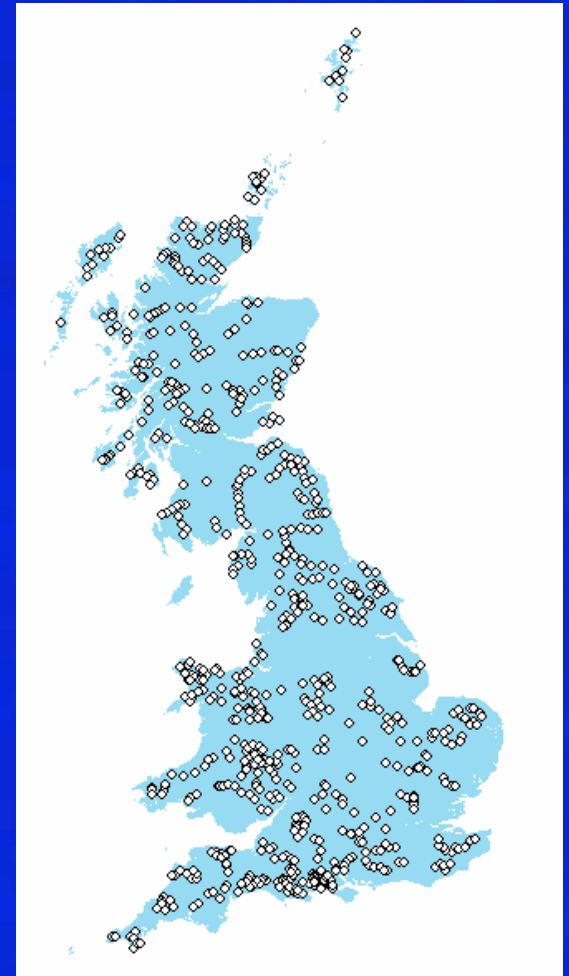
Datasets used (1)

- National scale studies
- National Pond Survey (PC)
- 254 sites, across country
- Invertebrate communities to species level (484 spp.)
- Timed pond net sampling



Datasets used (2)

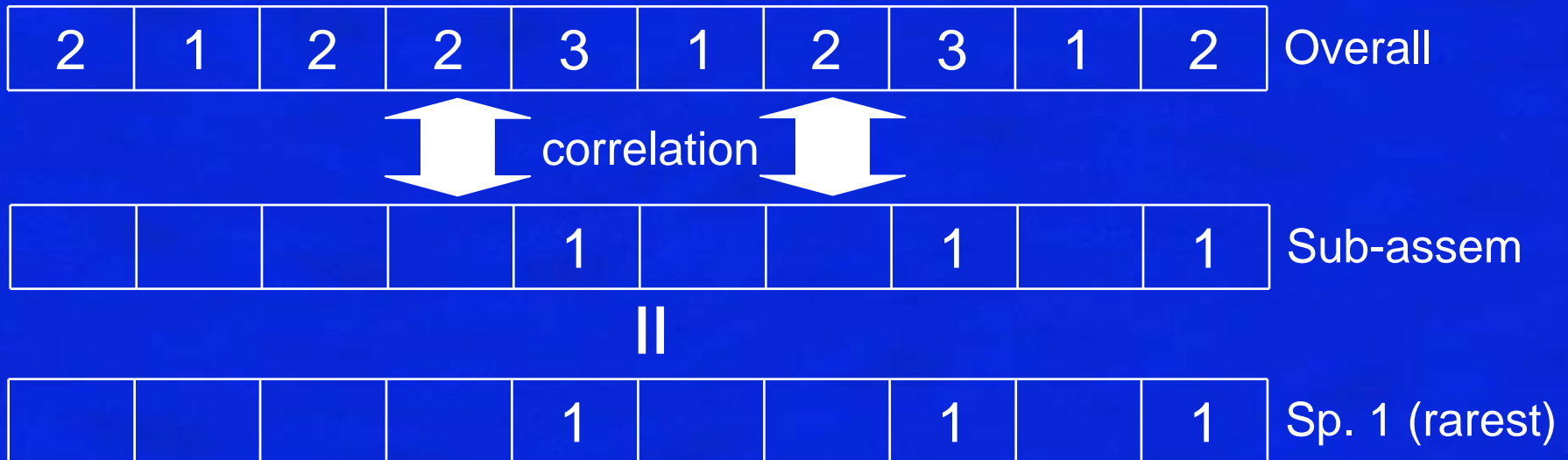
- RIVPACS dataset (CEH)
- 835 flowing water sites, across country
- Invertebrate communities to species level (660 spp. – excluded groups)
- 3 minute kick sampling



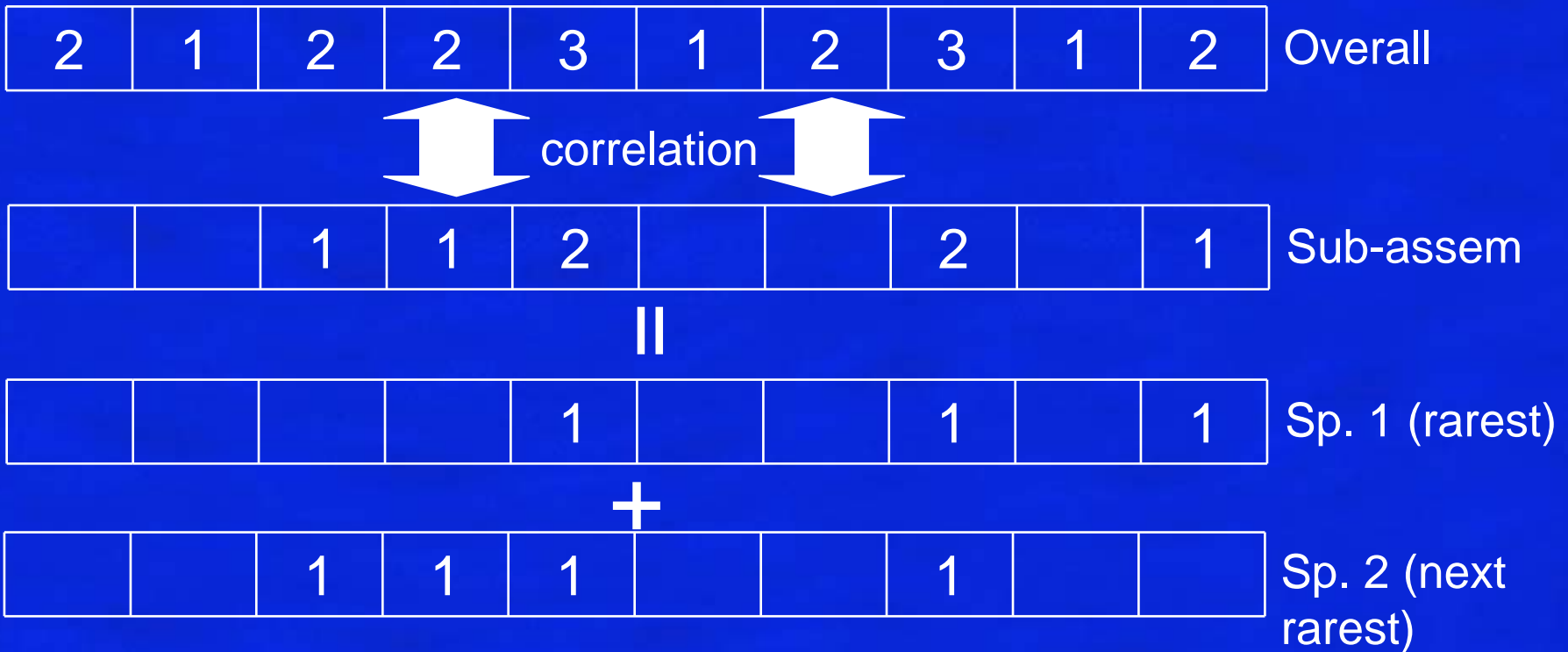
Methods – richness components

- Overall species richness of each site calculated
- Species ordered in two sequences: rare-common and common-rare (based on number of sites where present)
- Sequence of species richness patterns generated with increasing number of species
- Correlated with overall richness pattern

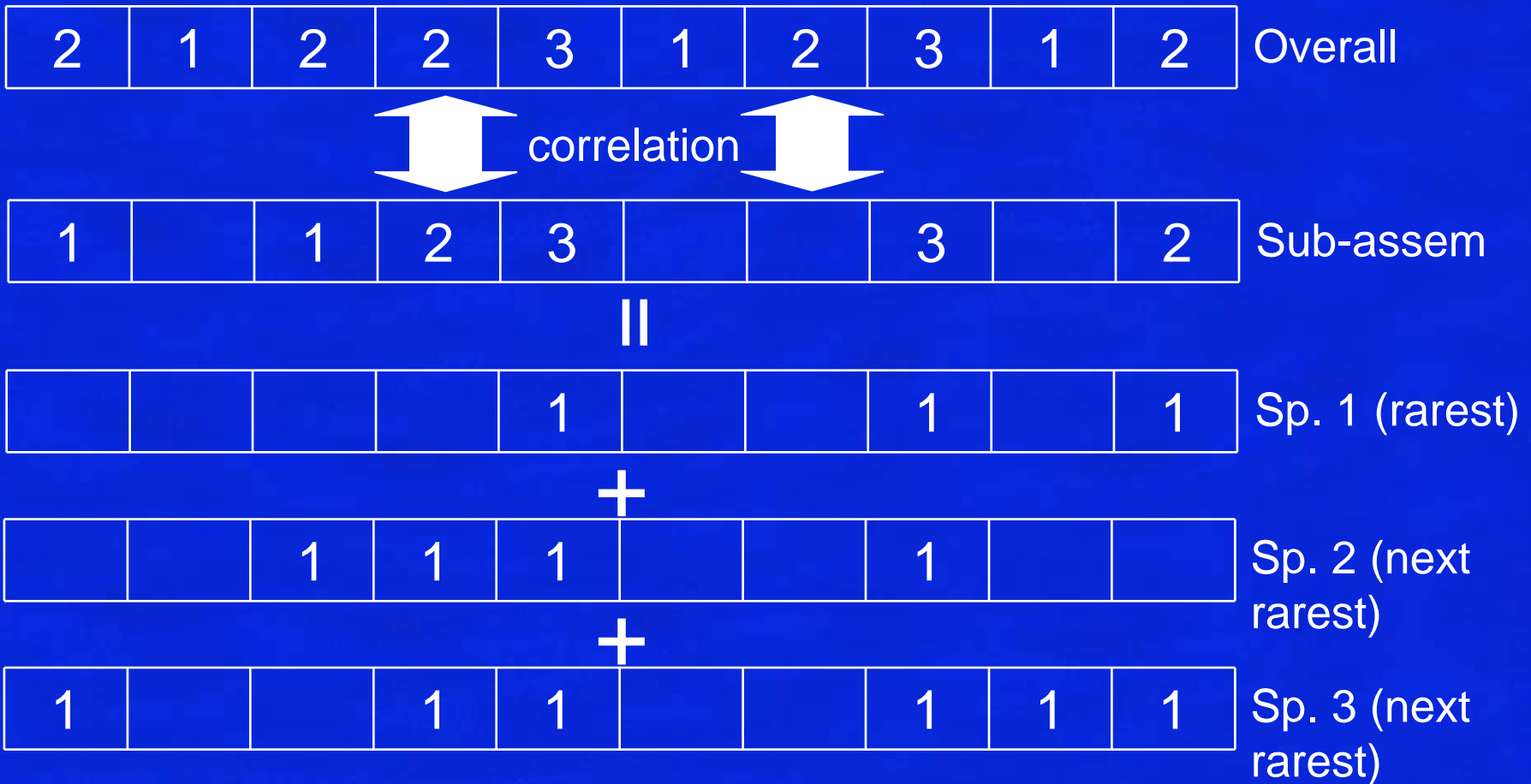
Methods – richness components



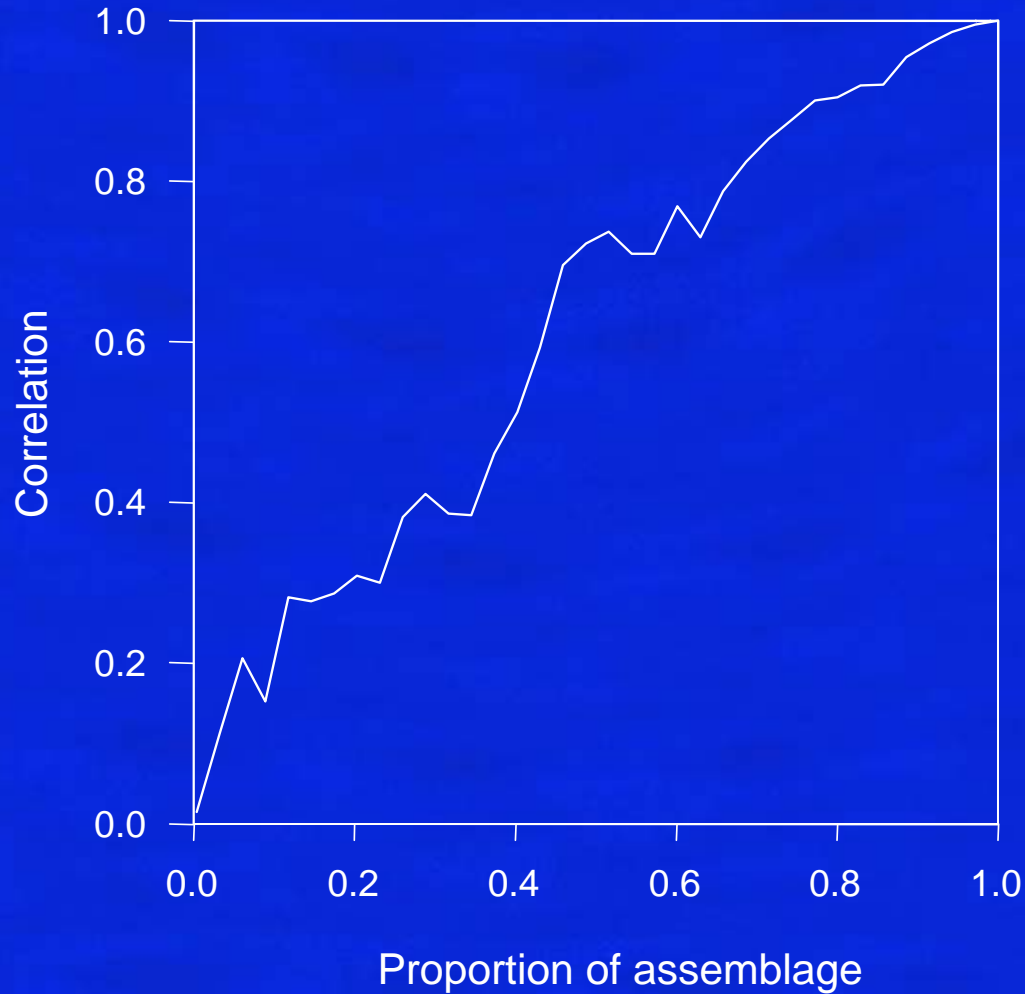
Methods – richness components



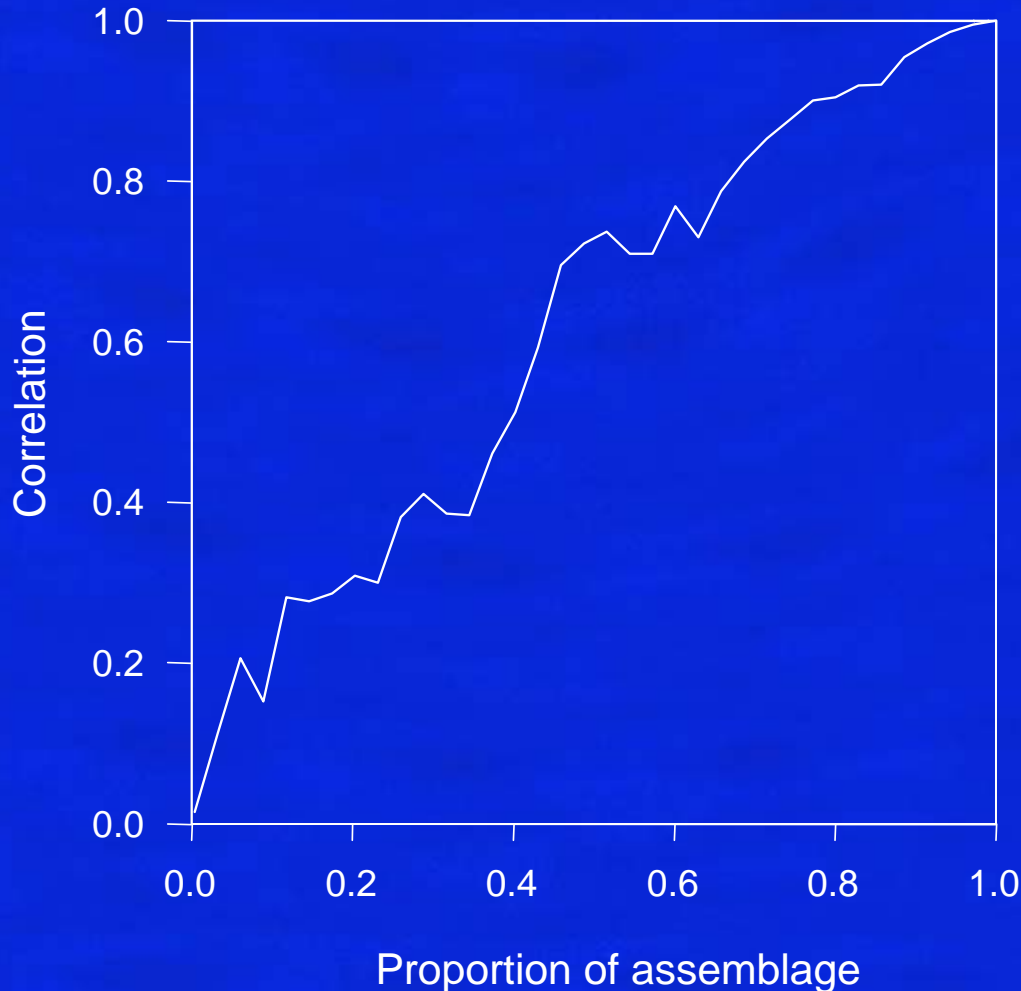
Methods – richness components



Methods – richness components



Methods – richness components



- Calculated for entire assemblage
- Then for individual taxonomic groups to examine any differences

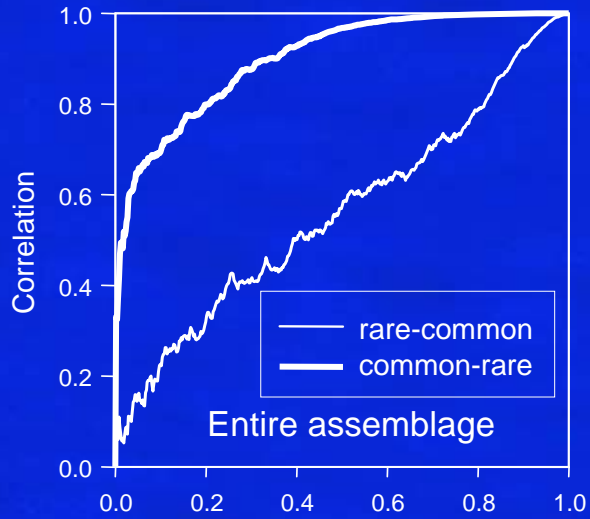
Methods – spatial patterns

- Spatial patterns in common and rare species
- Divided into quartiles 25% (Q1 - rare) & 75% (Q3 - common) based on frequency of occurrence
- Spatial autocorrelation (Moran's I) of quartile richness over different distance lags

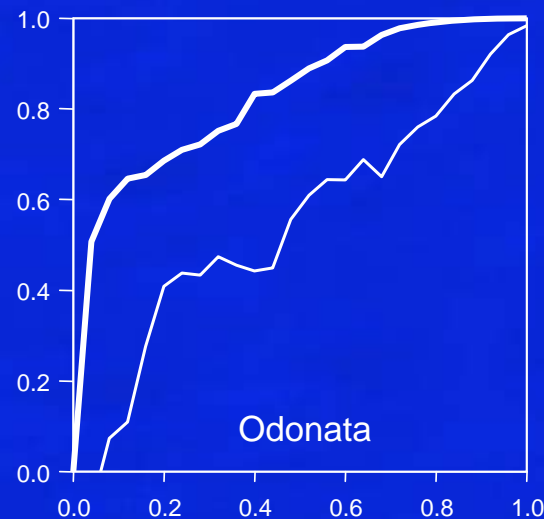
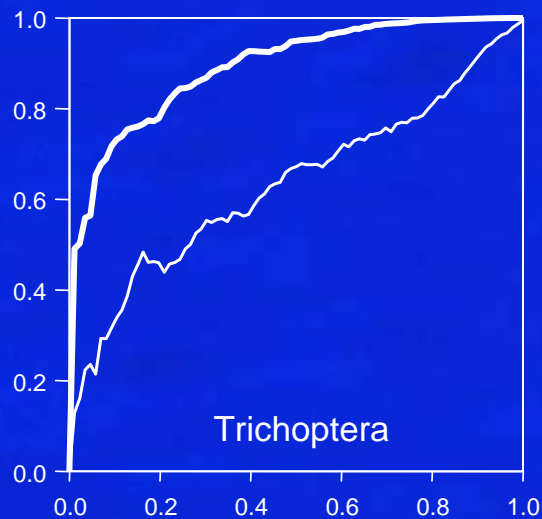
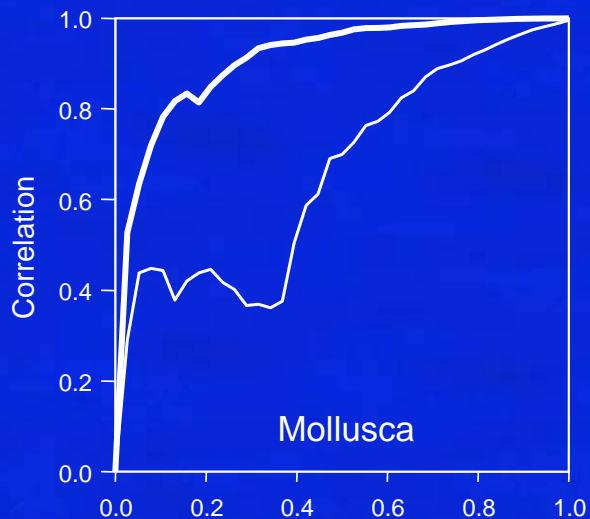
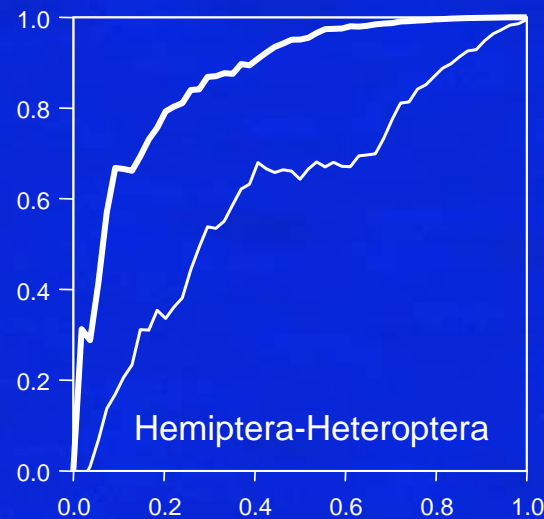
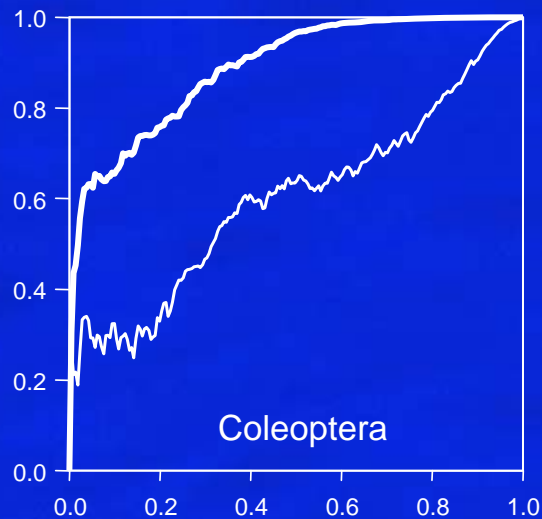
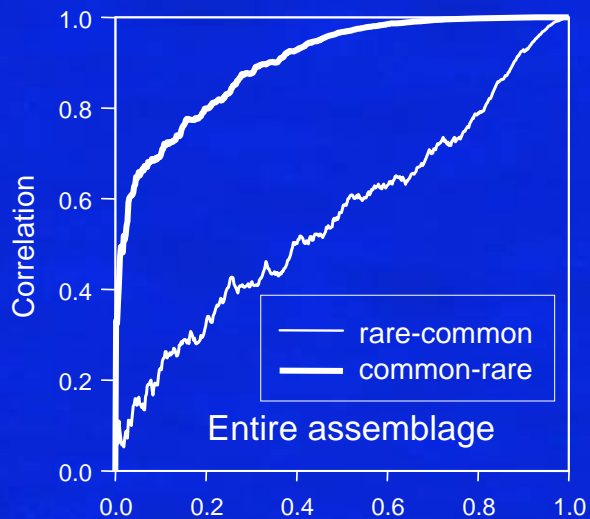
Methods – environmental drivers

- Quartile richness (Q1 = rare, Q3 = common) for each site
- Environmental variables (range depending on dataset)
- Generalised least-squares regression
 - Modelling of spatial pattern through error structure
 - Exponential spatial errors best fit to null model
 - Models evaluated using AIC

Results: National Pond Survey

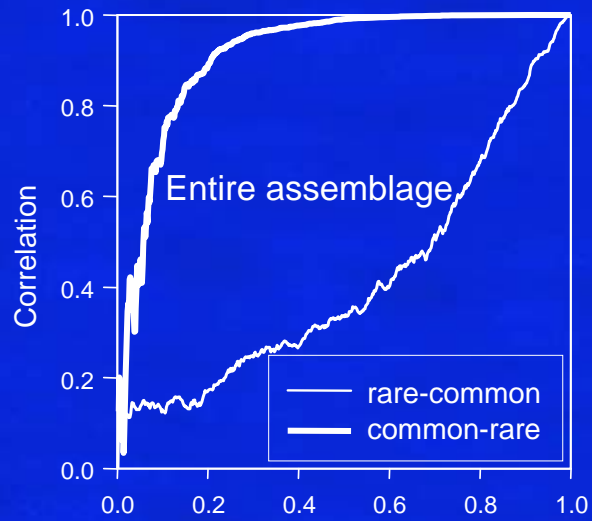


Results: National Pond Survey

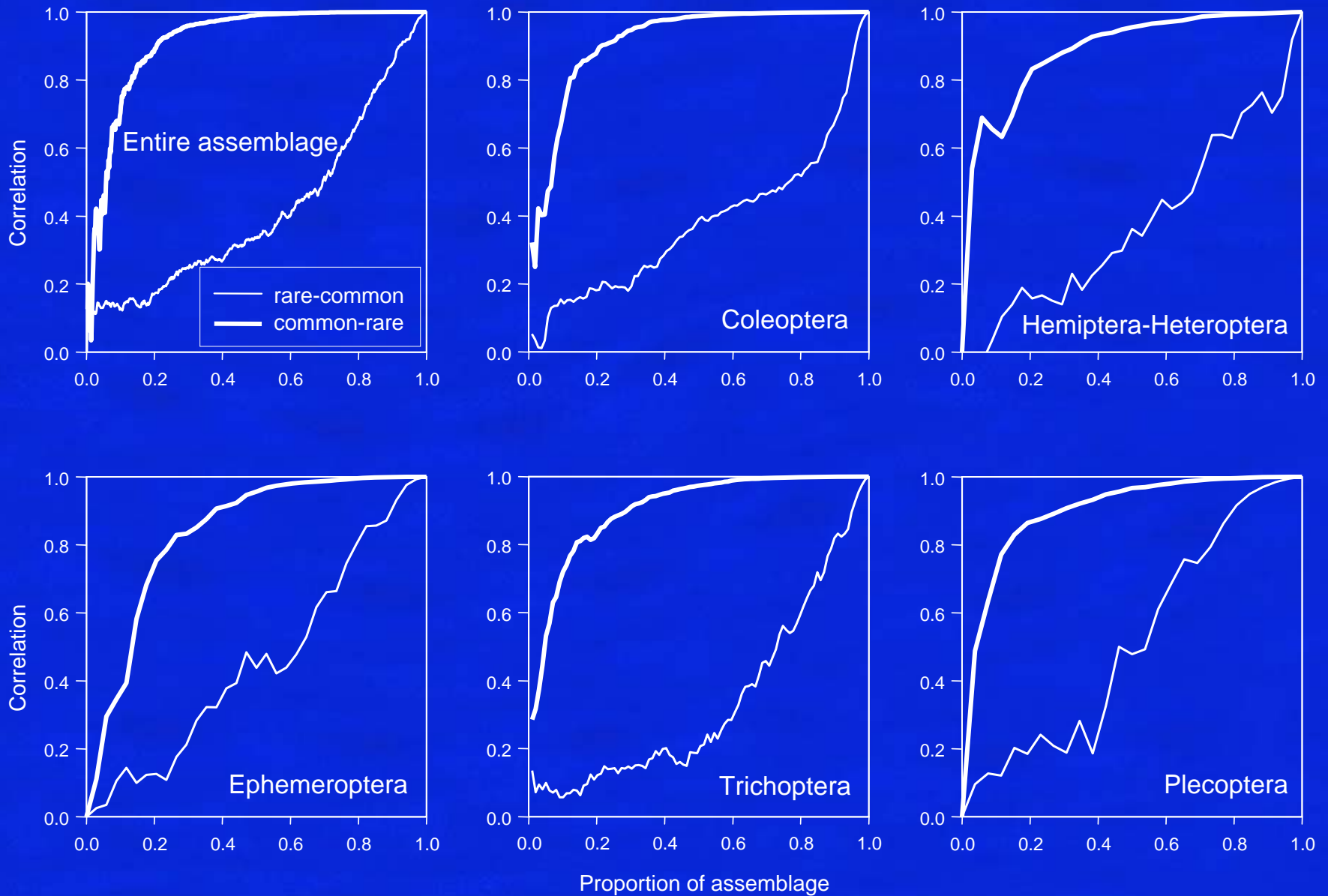


Proportion of assemblage

Results: RIVPACS dataset

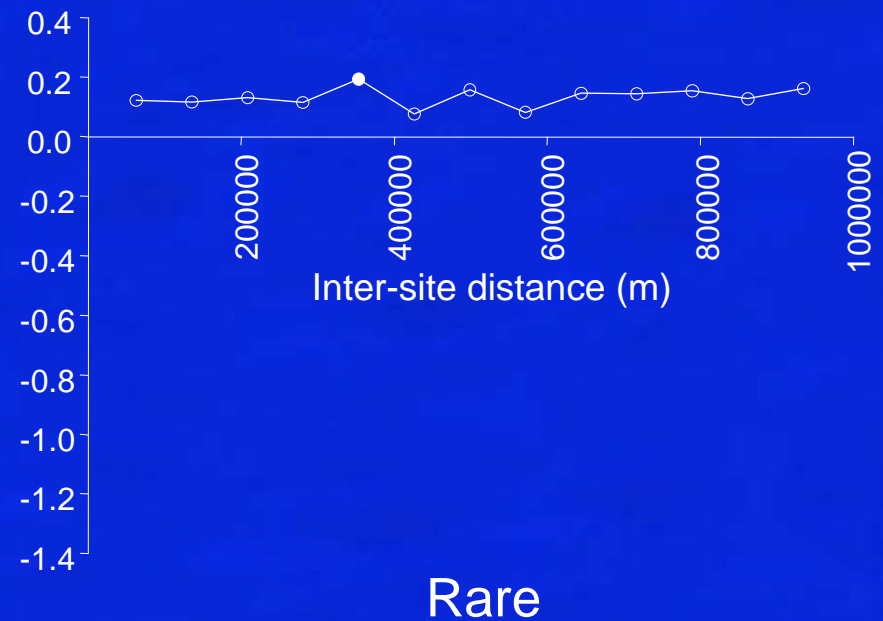
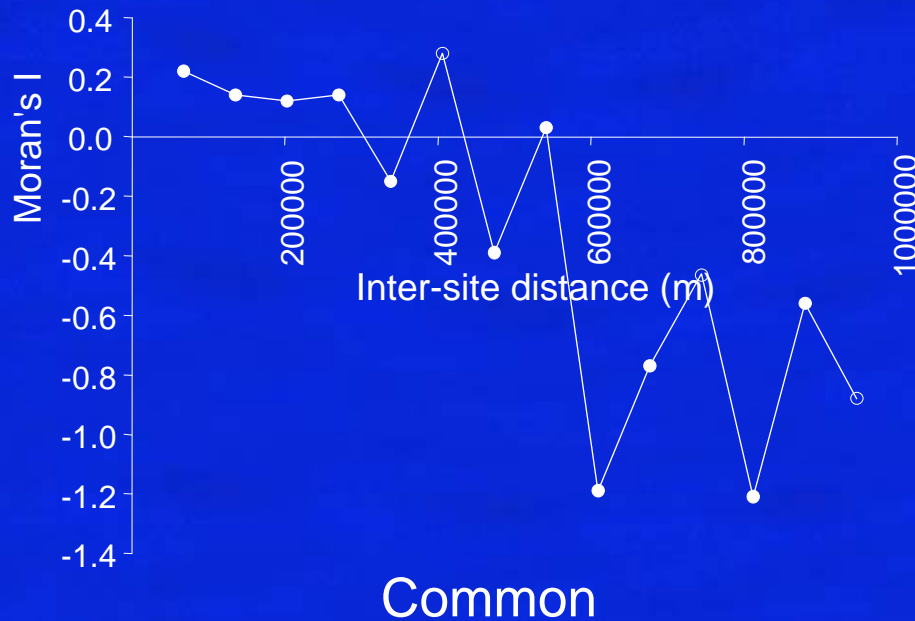


Results: RIVPACS dataset



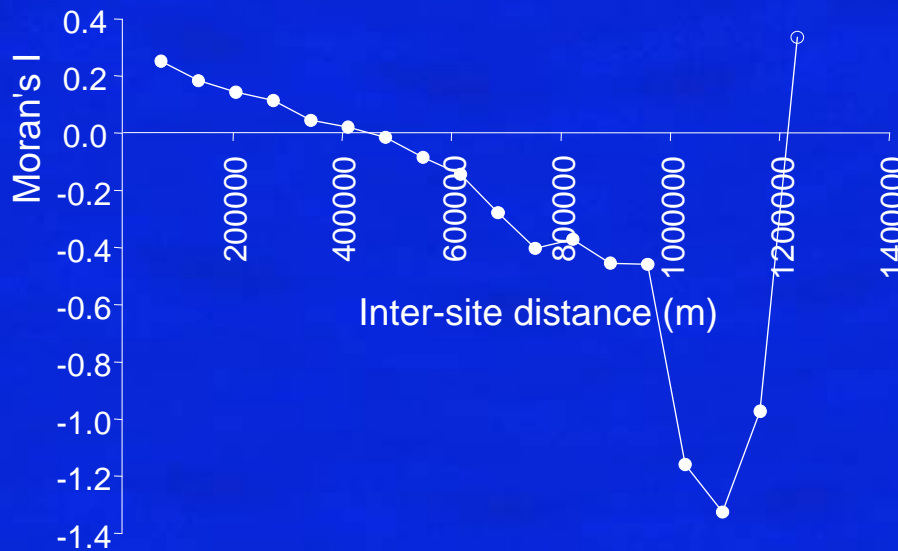
Results – spatial patterns

- National Pond Survey

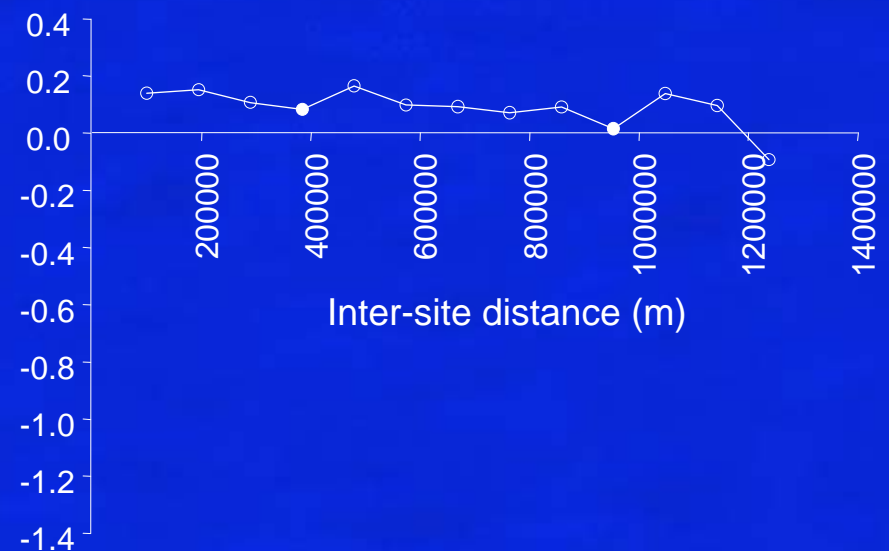


Results – spatial patterns

- RIVPACS dataset



Common



Rare

Results – environmental drivers

- NPS dataset, Q3 (common) richness

Variable	Coefficient	Significance
pH	4.55	0.0004
Area	8.70	0.007
Depth	0.02	0.028
SRP	-9.32	0.034

- Q1 (rare) richness – no significant predictors

Results – environmental drivers

- RIVPACS dataset, Q3 (common) richness

Variable	Coefficient	Significance
Air temp	7.53	<0.0001
Altitude	-0.02	0.001
Discharge	0.90	0.0005
pH	5.23	<0.0001
Slope	-0.13	0.0047
Substrate size	0.49	0.0043
Nitrate	-0.61	0.018

- Q1 (rare) richness – no significant predictors

Discussion

- Richness of common species correlates more closely with overall richness patterns than rare species
- Consistent across all taxonomic groups and both habitats
- Not due to greater amount of information (presence/absence records) contained in common species distribution patterns

Discussion

- Most of spatial pattern in species richness of freshwater invertebrate communities is driven by common species
- Strong spatial autocorrelation in common species richness, none for rare species
- Concordance between habitats in scale of pattern
- Latitudinal decline in richness for common species, no pattern for rare species

Discussion

- Environmental drivers – consistent pattern for common species in both datasets
- Factors largely reflect drivers identified at smaller spatial scales
- Important for understanding of mechanisms behind fundamental patterns of species richness and rarity
- Valuable for management and conservation of biota