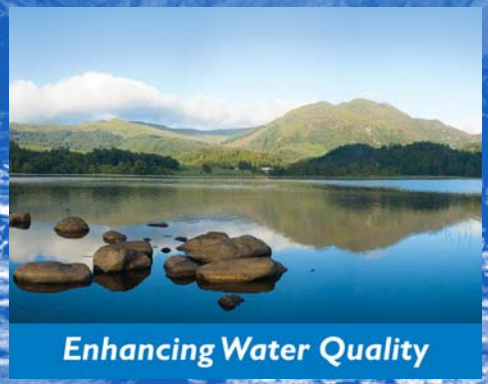
Environment – Land Use and Rural Stewardship
PROGRAMME 3



Work Package 3.4
Methods to Assess Water Quality

Simon Langan

COMMISSIONED BY

The Scottish Government

PARTNER ORGANISATIONS

BioSS

The Macaulay Institute
research today for land use tomorrow

Royal Botanic Garden Edinburgh

SAC

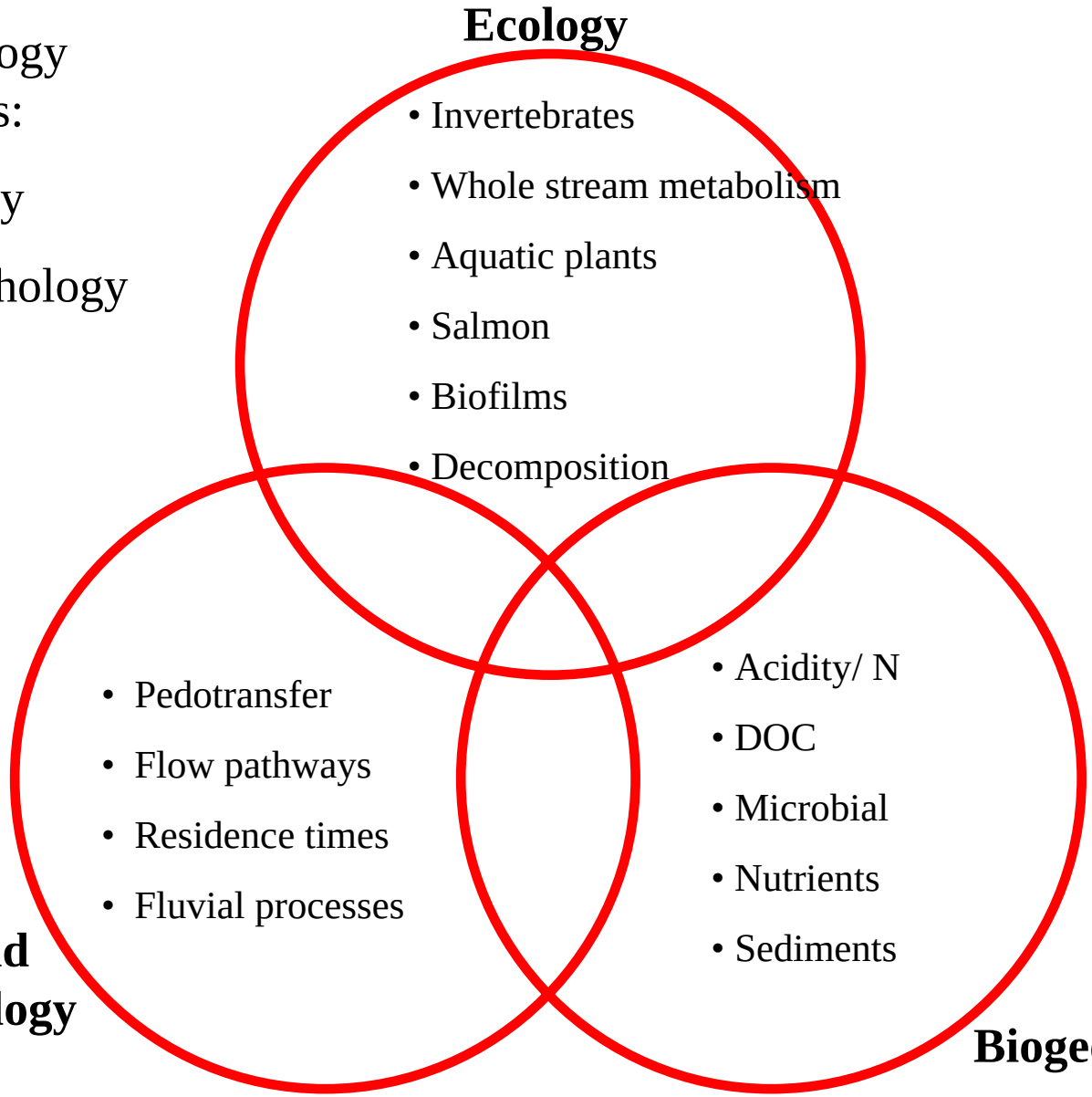
scri living technology

Component Projects

Interface of ecology with single stress:

-Biogeochemistry

- transport/morphology



Policy Relevance

- **WFD**

For Scotland there are 3081 water bodies

- Rivers – 2,008 of which 44% at risk of failing GES
- Lochs – 309 of which 66% at risk
- Groundwater – 275 of which 31% at risk
- Major pressures diffuse agricultural pollution, abstraction and dams, urban development and intensification of land use impact on morphology. (Transitional 40; Coastal 449)

- **Soils Framework Directive**
- **Bathing Waters Directive**
- **Habitats Directive**
- **Scottish Rural Development Plan, GAEC**
- **(Floods Directive)**

Title: Methods to assess water quality

Interpretation:

To provide an evidence base in support of policy requires a set of tools built around scientific methods of:

- Monitoring and surveying
- Manipulation
- Modelling

Monitoring

Why ?

- Detection of change and impact spatial/ temporal
- Improve process understanding
- Parameterise, calibrate and improve models

Uplands

- Acidity
- Nitrogen
- DOC
- Temperatures
- Fluxes

Lowlands

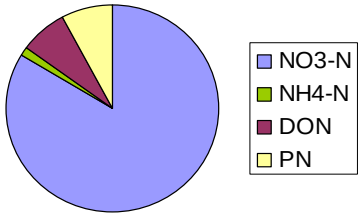
- Nutrients N and P
- Suspended solids
- Invertebrates
- Riparian interface
- Stream Metabolism
- Microbial contamination

ECN National/international network

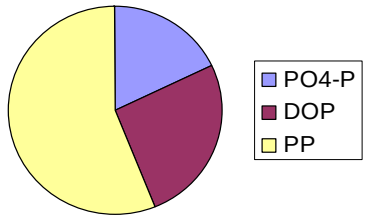
www.macaulay.ac.uk/ECN

What is the role of the field drain pathway for transfer of different nutrient forms?

N species

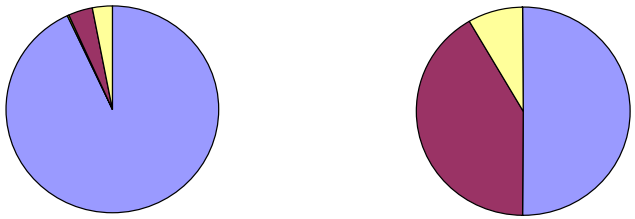


P species

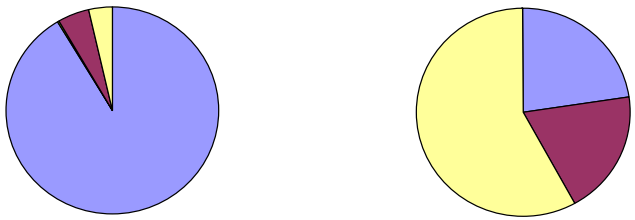


Proportions of nutrient forms contributing to loads in:

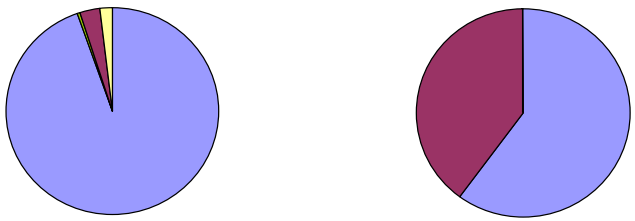
An agricultural headwater stream



Drain 1 (field runoff)



Drain 2 (field + road + yard runoff)



Drain 3 (field runoff)

Stutter, M.I., Langan, S.J. and Cooper, R.J. 2008.

Manipulation

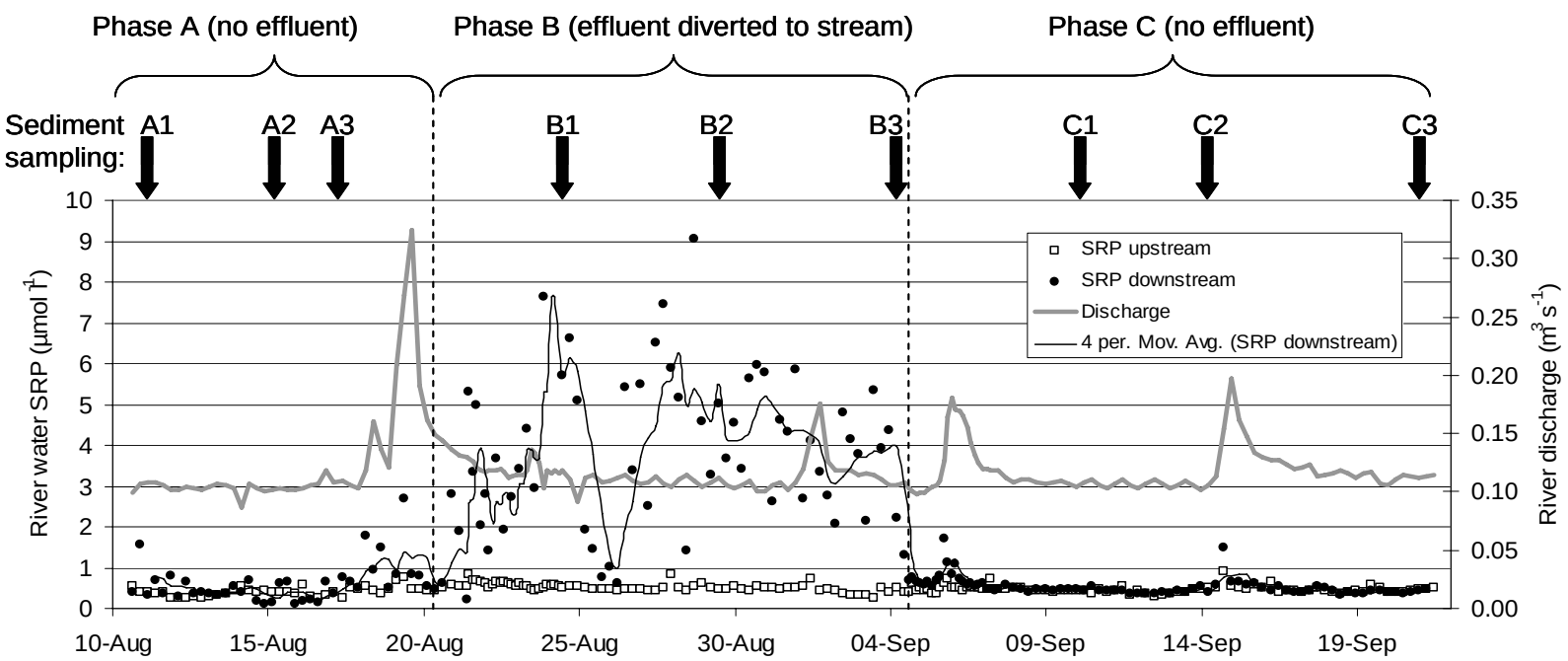
Why ?

- Dose- response relationships
- Environment quality standards for Good Ecological Status
- Restoration strategies

What ?

- Carbon and nutrient dynamics (uplands)
- Biofilms (herbicide, nutrients)
- Litter breakdown
- In-stream habitat

Manipulation



Modelling

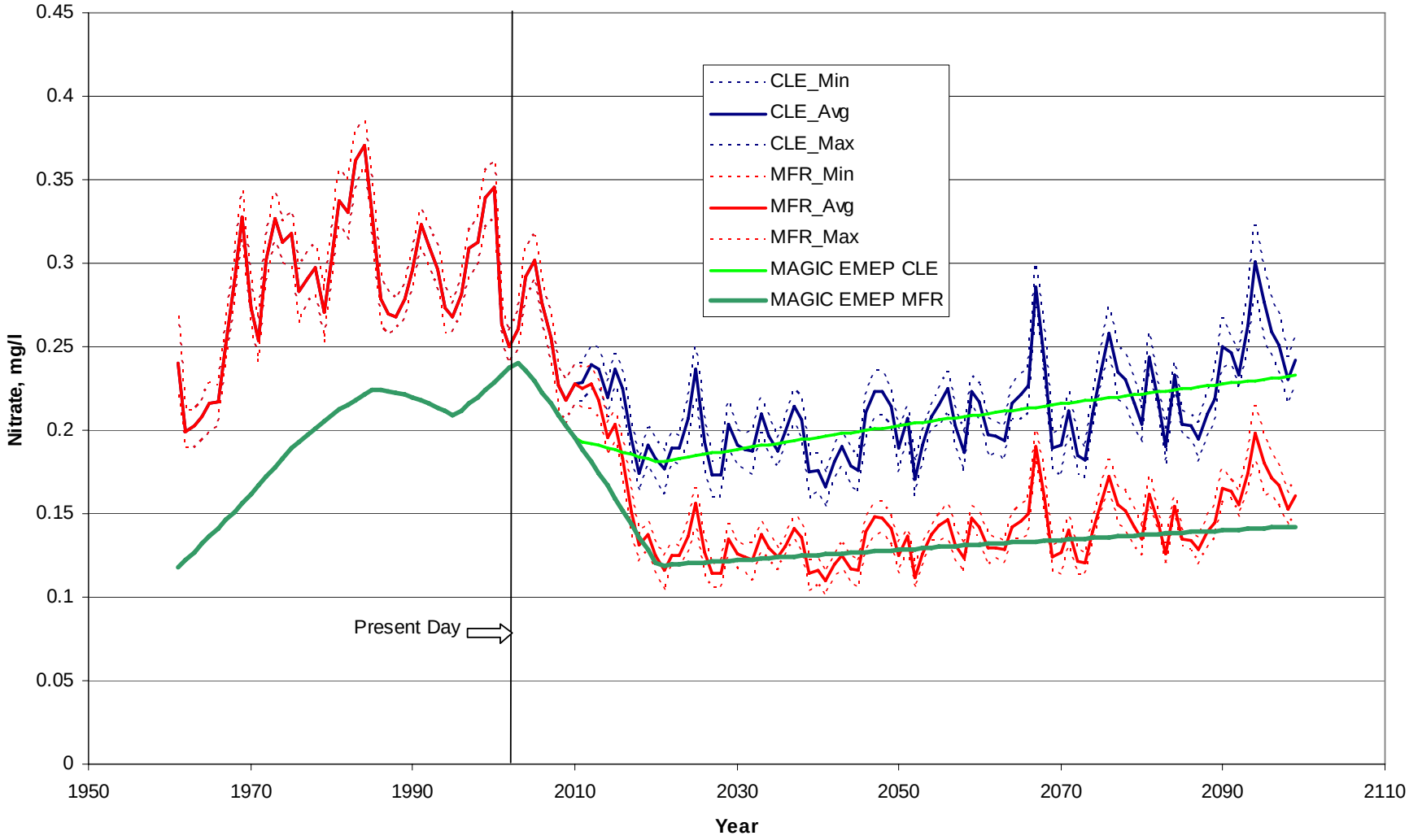
Why ?

- Scenario testing
- Identify different spatial and temporal patterns of response
- Resilience
- Feedback to monitoring and manipulation
- Reduce uncertainty
- Ecological response

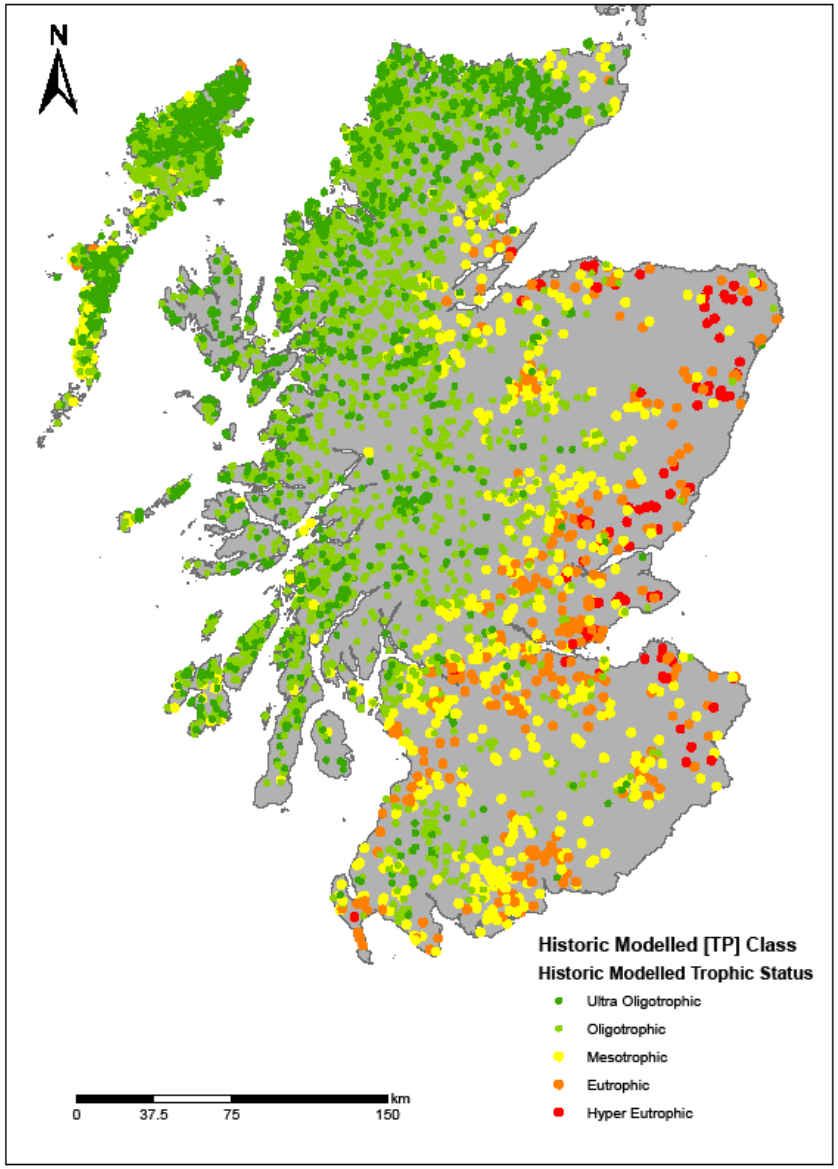
What ?

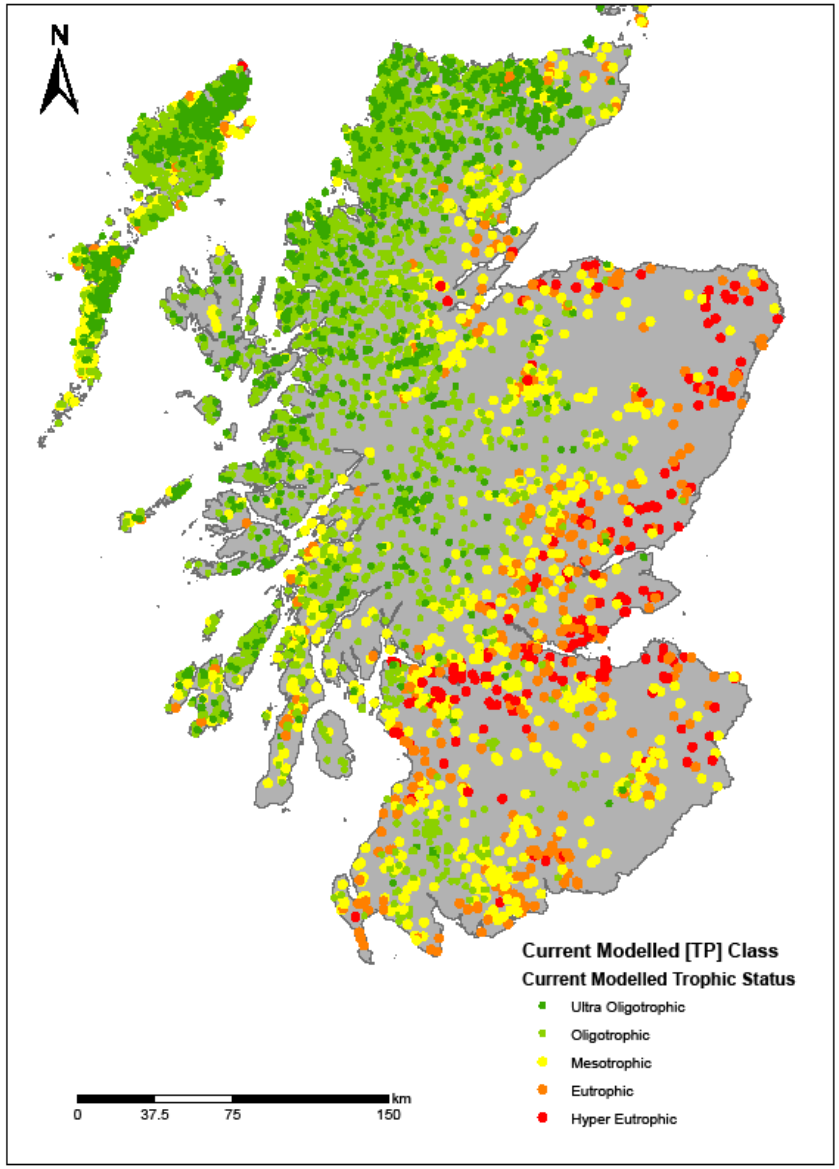
- DOC, nutrients, flows, hydraulics, (microbial, soil erosion)
- Responses and hysteresis to changed inputs/management

Modelling

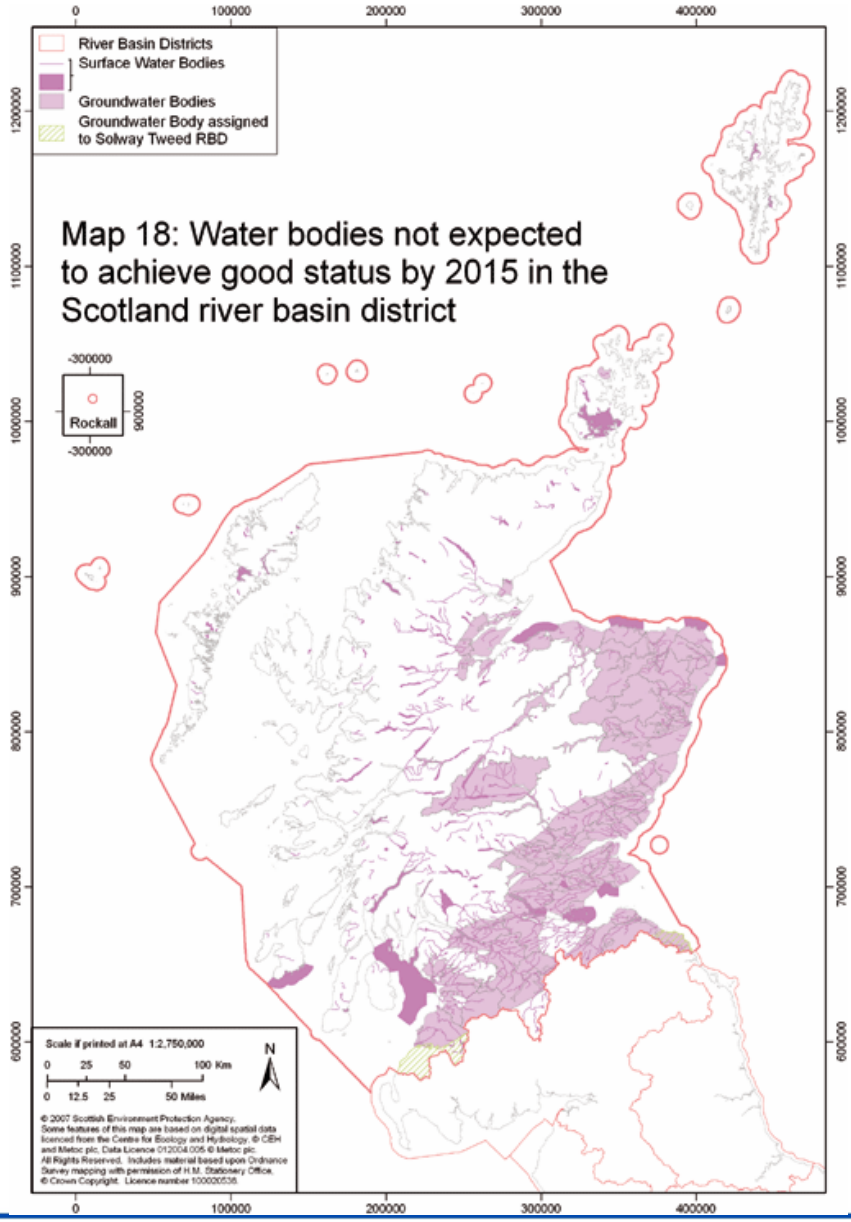

0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Nitrate, mg/l
1950
1970
1990
2010
2030
2050
2070
2090
2110
Year
Present Day
CLE_Min
CLE_Avg
CLE_Max
MFR_Min
MFR_Avg
MFR_Max
MAGIC EMEP CLE
MAGIC EMEP MFR

Modelling


N
Historic Modelled [TP] Class
Historic Modelled Trophic Status
Ultra Oligotrophic
Oligotrophic
Mesotrophic
Eutrophic
Hyper Eutrophic
0
37.5
75
150
km

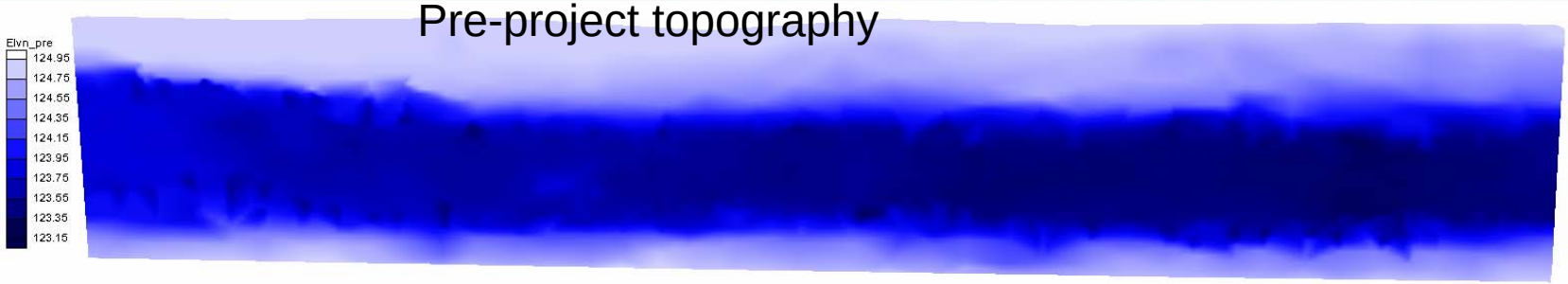

N
Current Modelled [TP] Class
Current Modelled Trophic Status
Ultra Oligotrophic
Oligotrophic
Mesotrophic
Eutrophic
Hyper Eutrophic
0
37.5
75
150
km

SEPA: Significant Water Management Issues

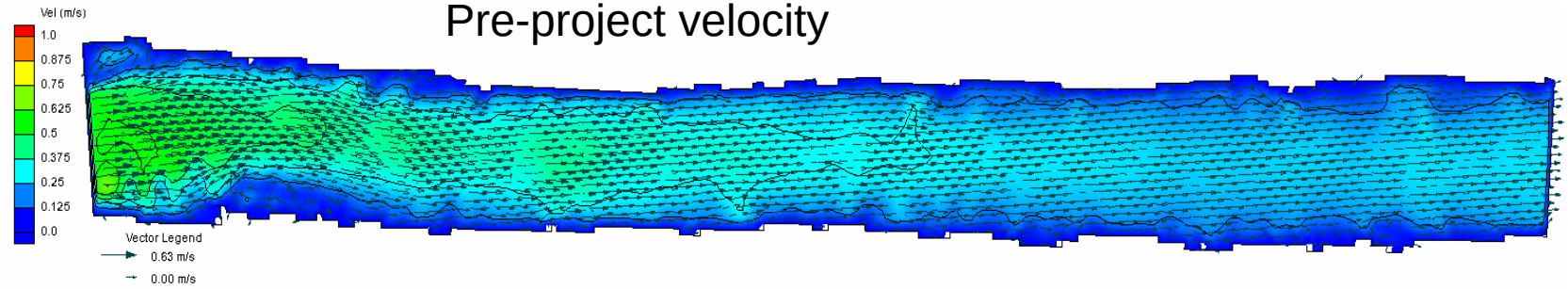


Impact of Engineering

Pre-project topography



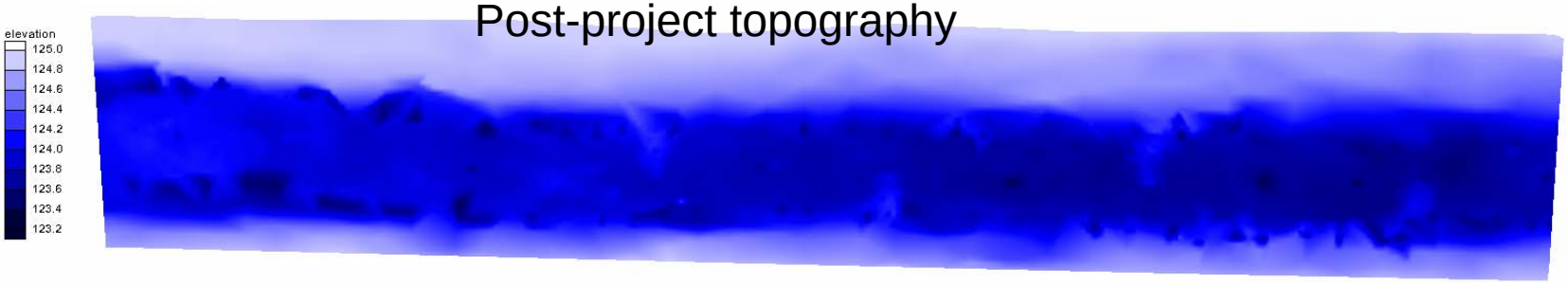
Pre-project velocity



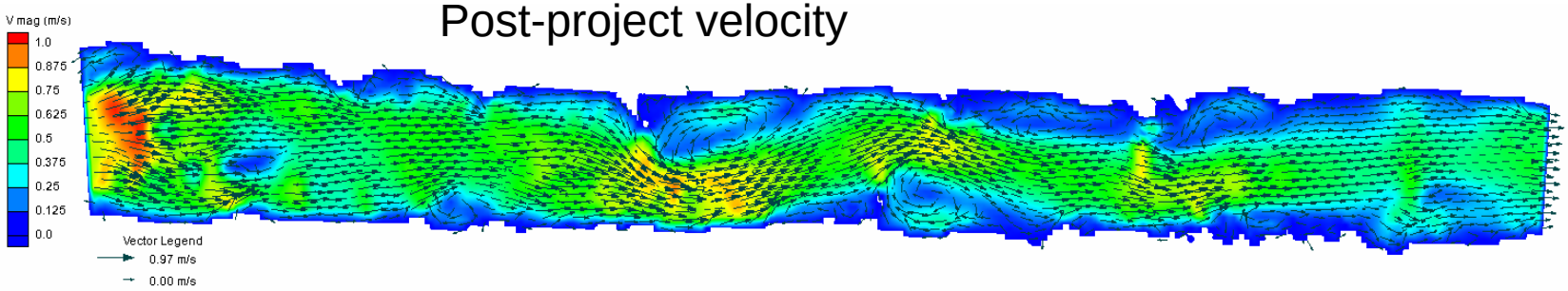
Impact of Engineering

Impact of Engineering

Post-project topography

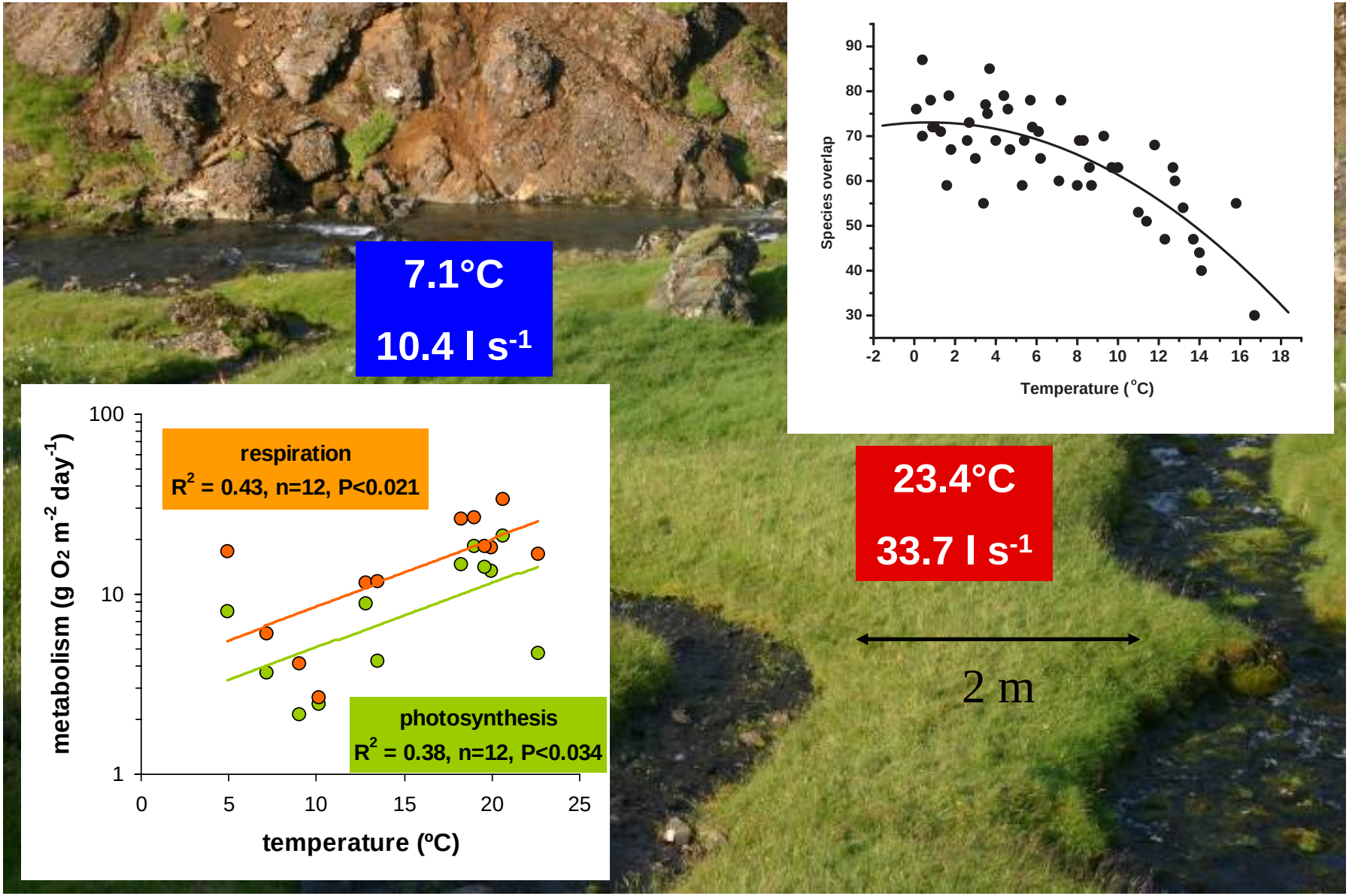


Post-project velocity

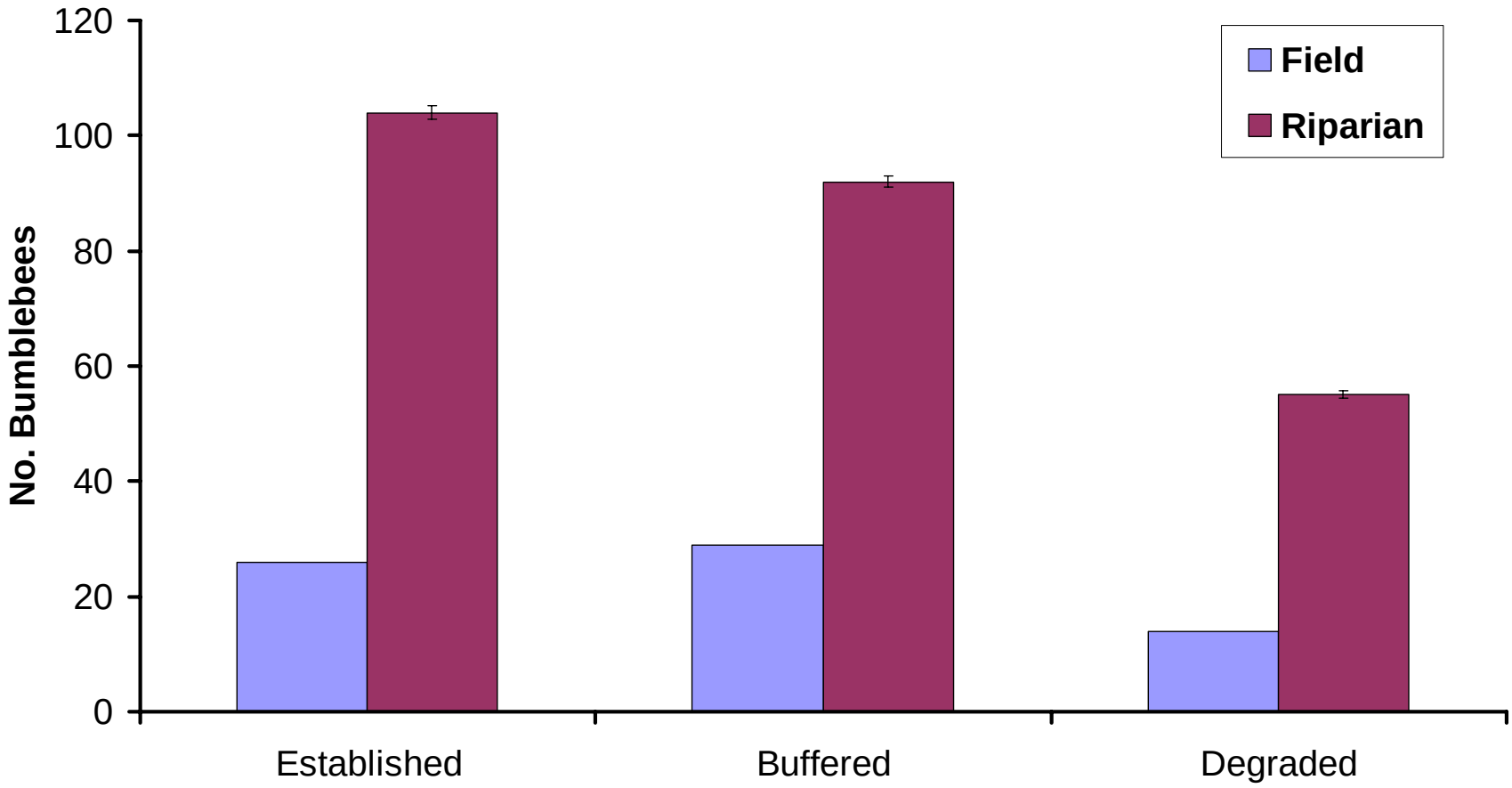


Impact of Engineering

Climate Change



More bees in riparian zone than adjacent field



Other work

- **Capacity:**
  - ECN ‘National treasure’
  - 5 associated PhD studentships
- **Funding:**
  - European project-Eurolimpacs
  - European COST Action
  - North Sea Commission- Interreg
  - DEFRA, SNIFFER, SG, SEPA, SNH
  - Finnish Environment Research
  - Leverhulme
  - Scottish & Southern Electricity

Component Projects

Interface of ecology with multiple stressors:

-Biogeochemistry

- transport/morphology