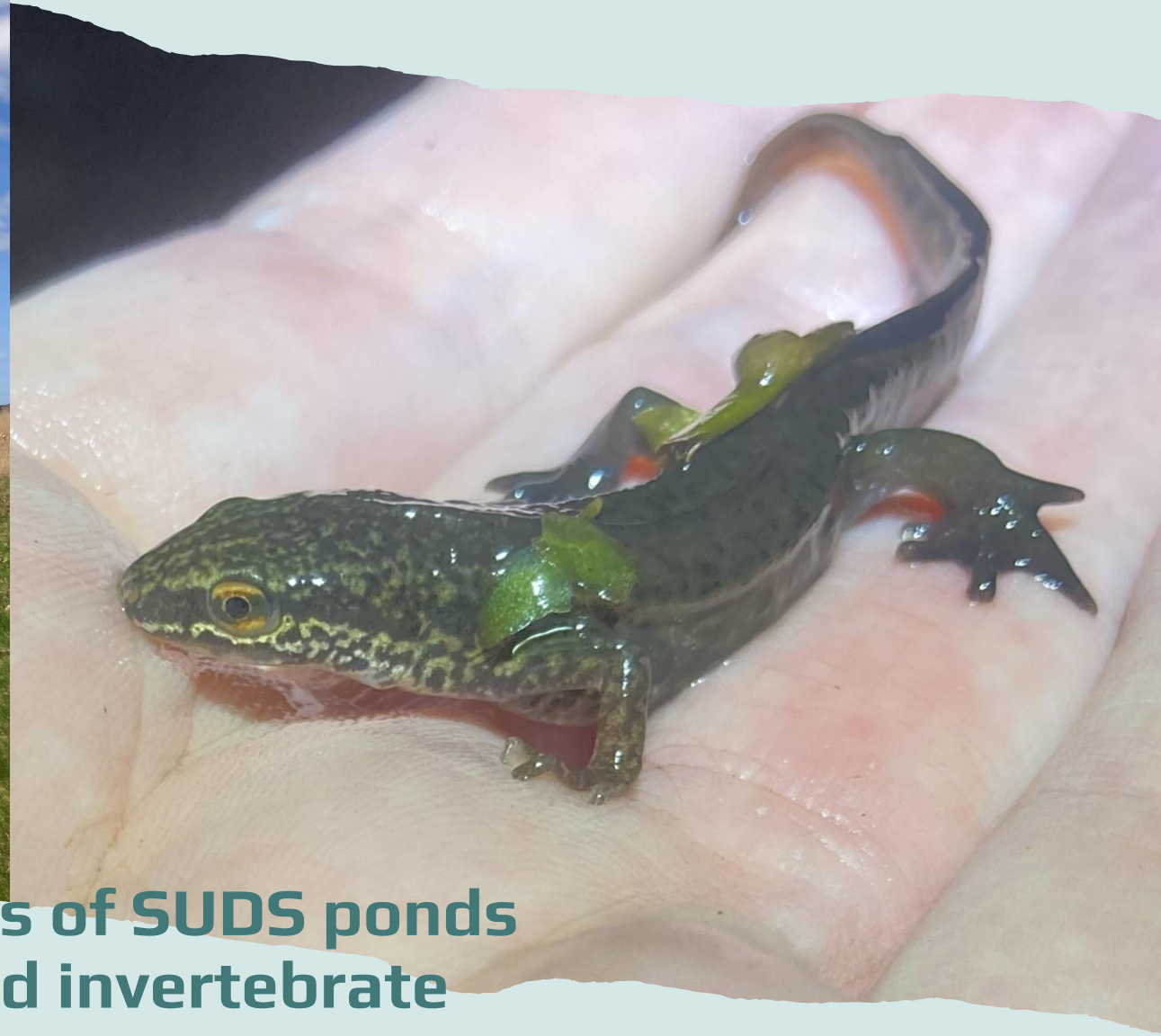


Physical and habitat characteristics of SUDS ponds and their impacts on amphibian and invertebrate communities

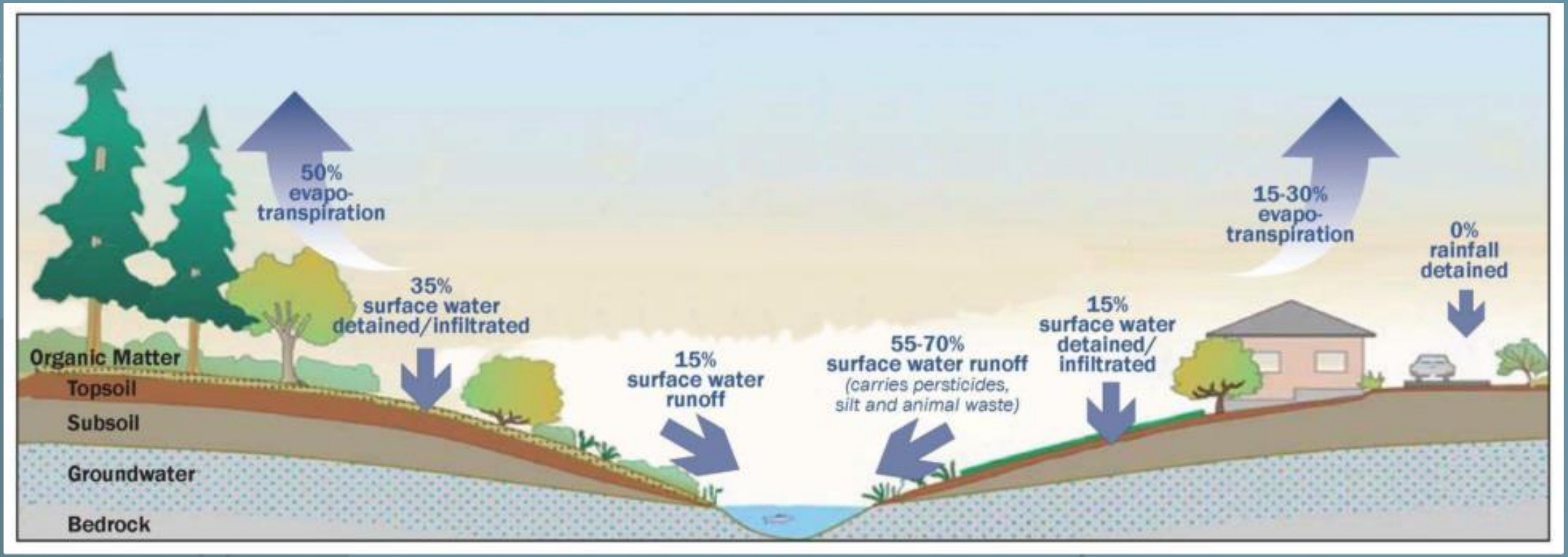
Kirsty MacArthur

Prof Rob Briers[1], Dr Jennifer Dodd[1], Prof Lesley Lancaster[2], Dr Vasilis Louca[2], Dr David O'Brien[3]

1 – Edinburgh Napier University, 2 – University of Aberdeen, 3 - NatureScot

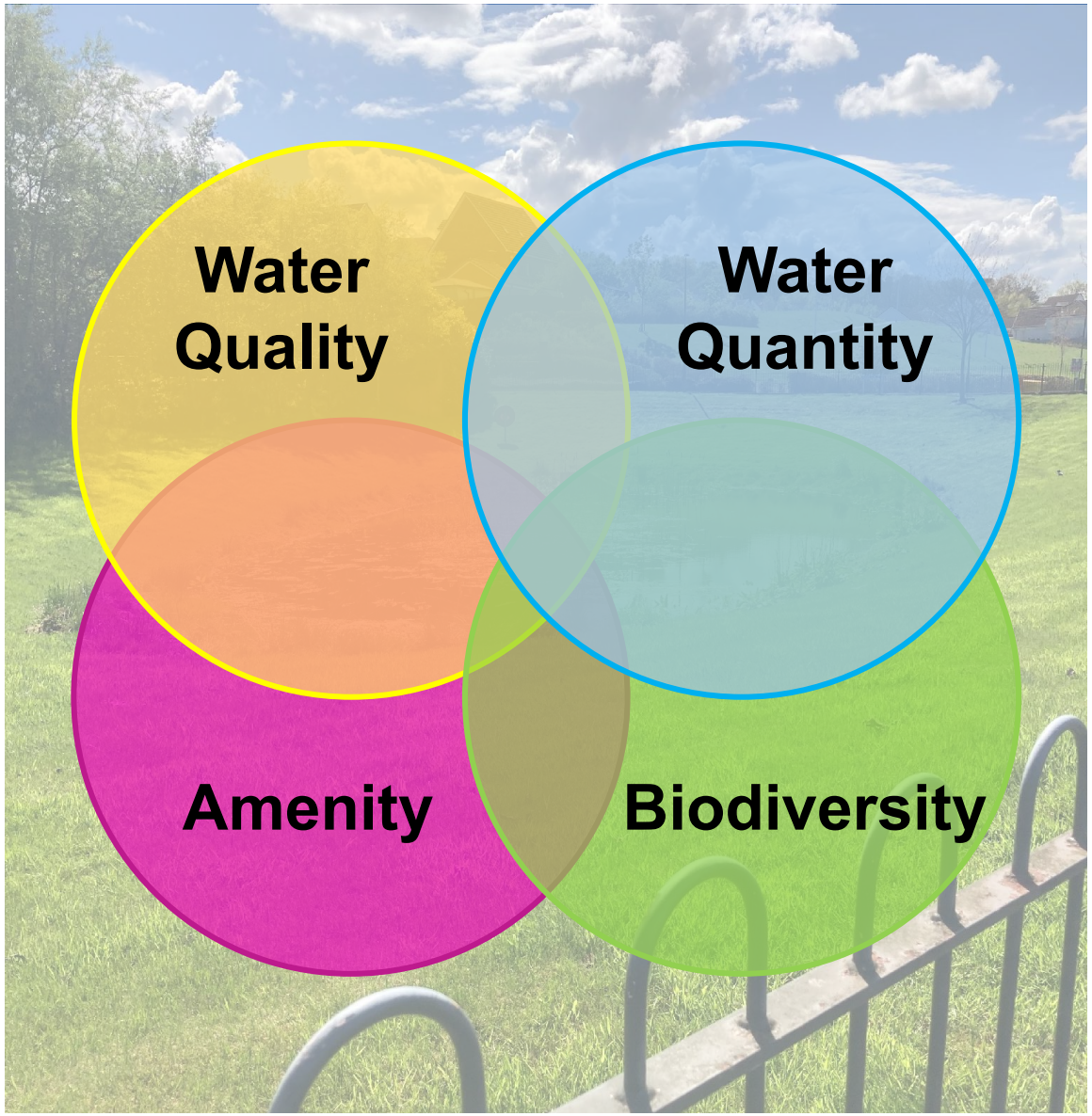
Land-use change

- Urban and Agricultural land use damaging natural environment
- Challenges for wildlife
- Global Biodiversity loss
- Freshwaters are particularly at risk



Freshwater management in Urban areas

- Increase in surface runoff due to increase in impervious surface
- Water collects pollutants from surfaces
- Proper treatment is required to prevent polluting freshwater systems

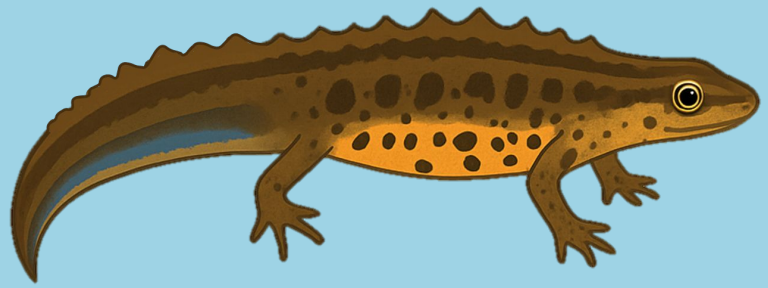


Sustainable Urban Drainage Systems

- SUDS for short
- Common man-made structures used to **intercept, store, and treat** surface runoff
- Natural processes of **sedimentation** and **filtration** by native vegetation used to clean water

Amphibian Communities

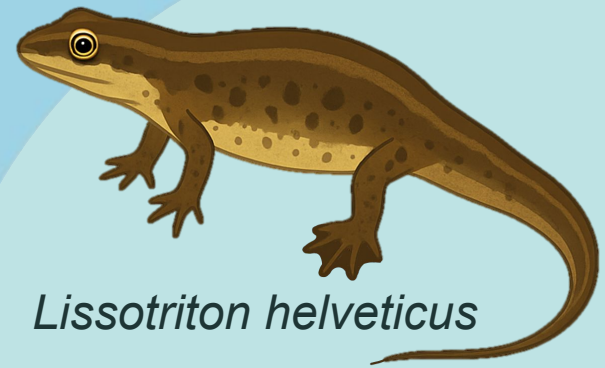
- 4 native amphibians readily inhabit SUDS ponds
- 41% of global amphibian species are threatened with extinction
- Habitat loss and fragmentation is a major threat
- SUDS supplement natural habitat and act as steppingstones



Lissotriton vulgaris

Bufo bufo

Rana temporaria



Lissotriton helveticus

Methods

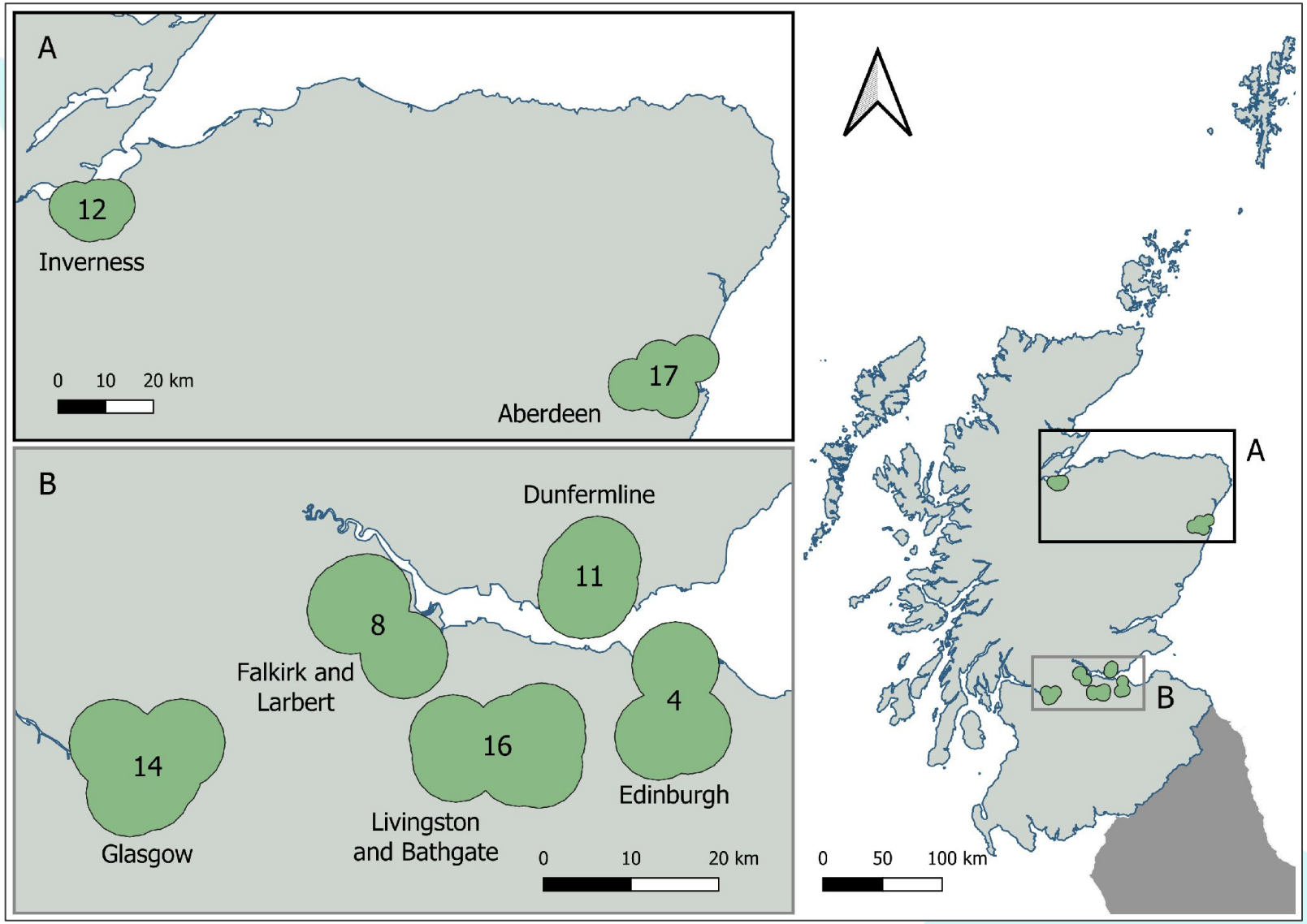
82 sites across Scotland.

Amphibian surveys conducted using visual methods, trapping (minnow traps), and opportunistic netting.

3-minute sweep netting invertebrate samples

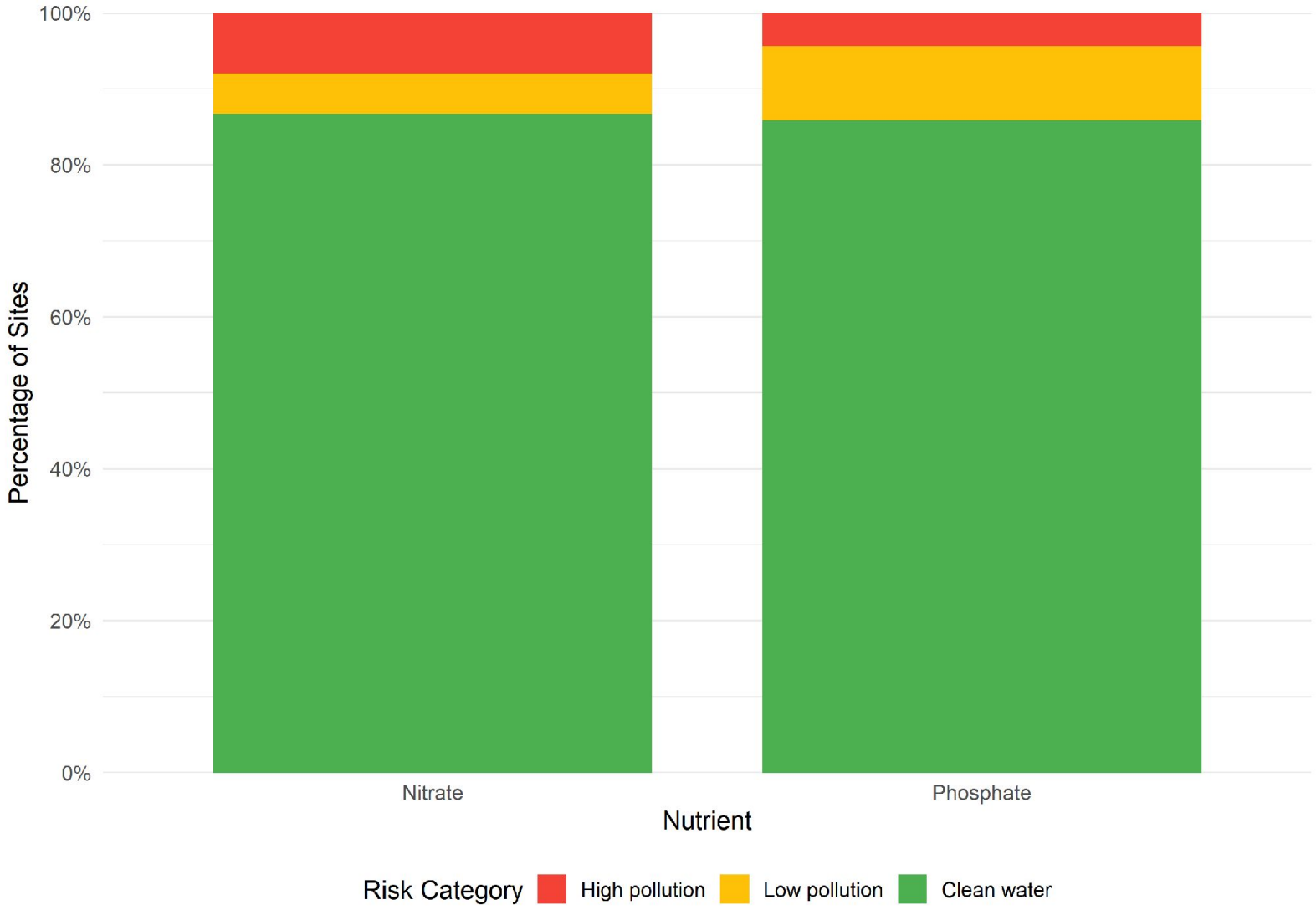
Environmental data collected:

- Pond physical characteristics – area, vegetation structure, shade, depth
- Water chemistry – conductivity, pH, nutrient concentrations
- Fish presence
- Heavy metal concentration in sediment
- Landscape factors (within 1km) – road length, length and area of other water features, percentage cover of CLC database categories



Summary

- Common Frog recorded in **52%** of ponds
- Common Toad recorded in **30%** of ponds
- Palmate Newt recorded in **50%** of ponds
- Smooth Newt recorded in **23%** of ponds (subset of total)



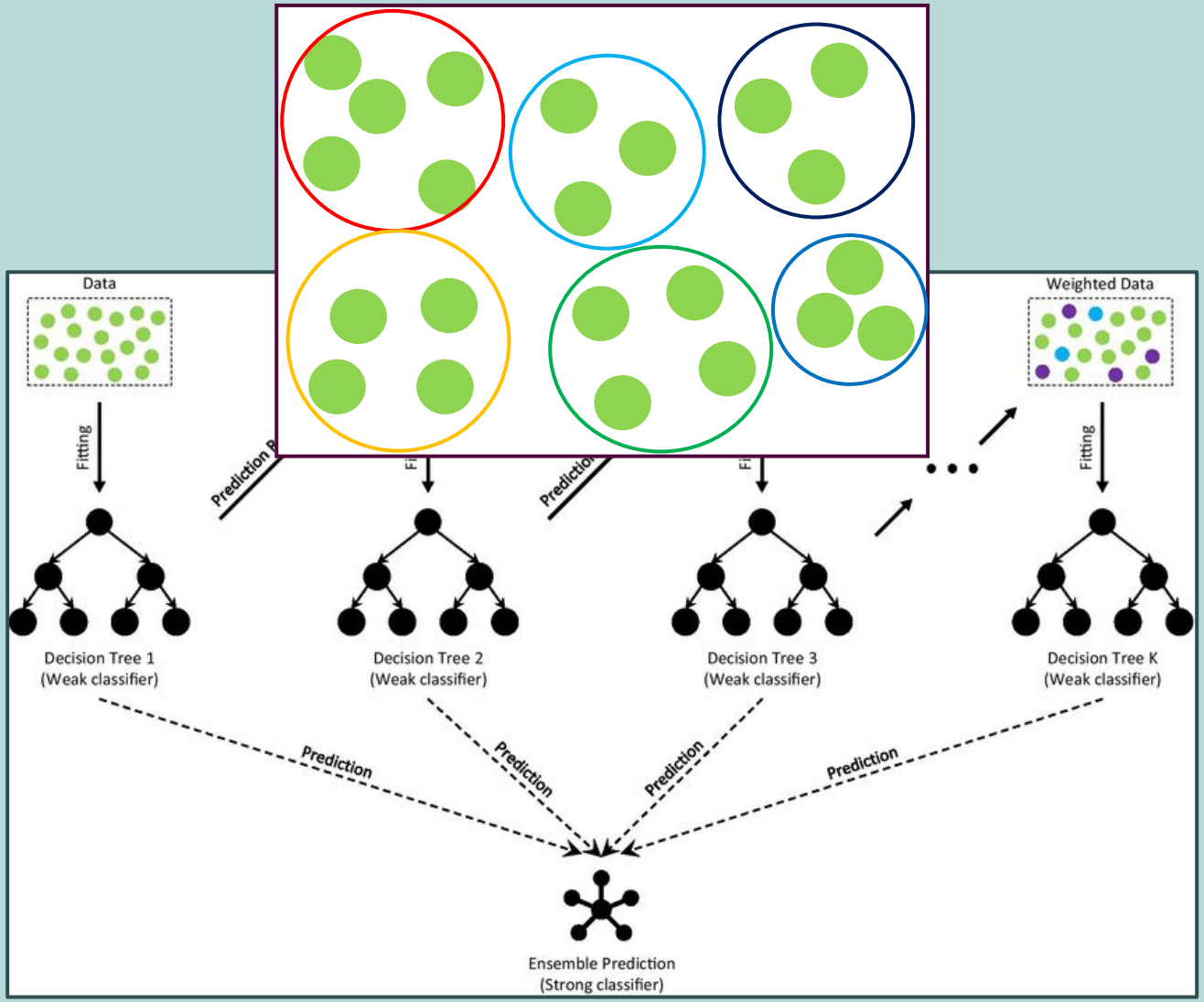
GPBoost Analysis

Gradient Boosting

- Handles non-linear effects and interactions
- Strong predictive performance even with ‘messy’ data

Gaussian Processes (GPs)

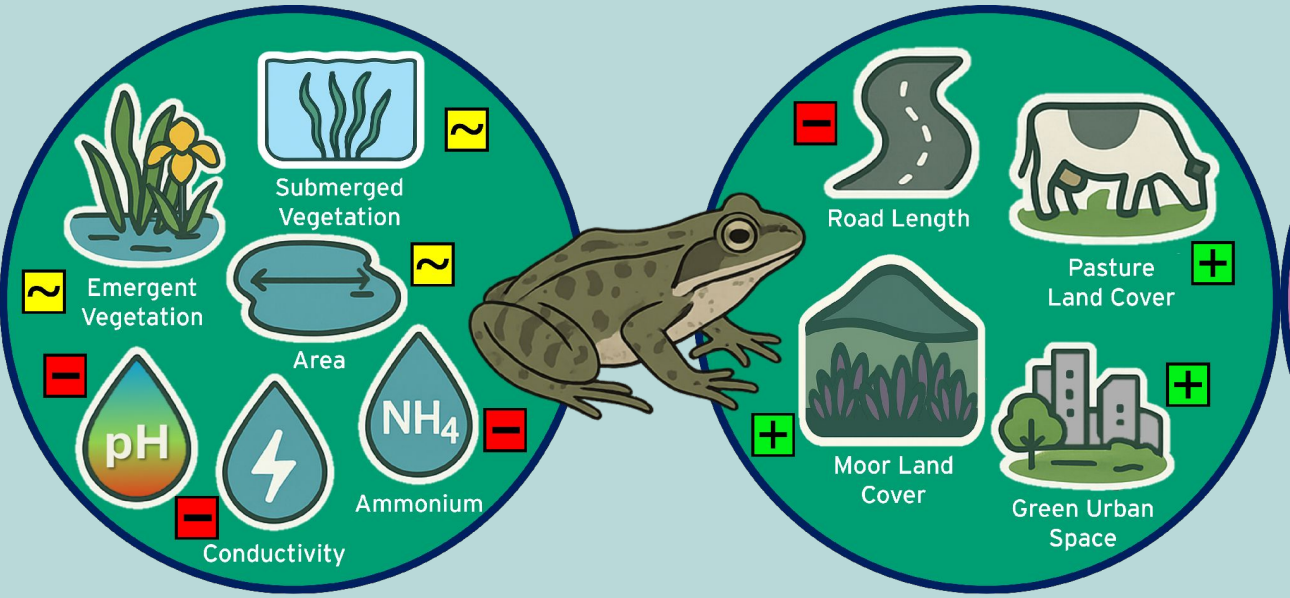
- Capture spatial, temporal, or clustered correlations
- Allow inclusion of random effects



Shared impacts

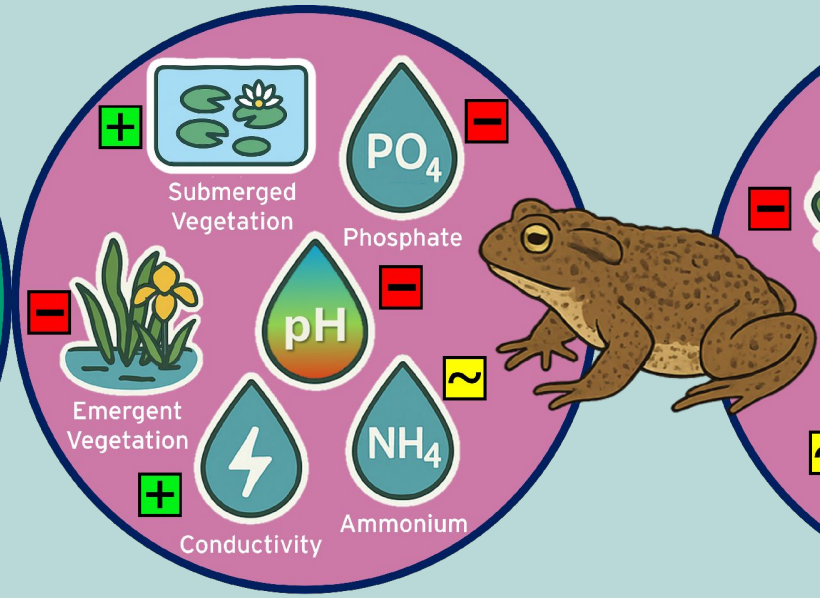
5 key variables common to most amphibians

- Conductivity mostly negative
- Road length negative
- Vegetation structure species specific effects
- Positive effect of more water in surrounding landscape

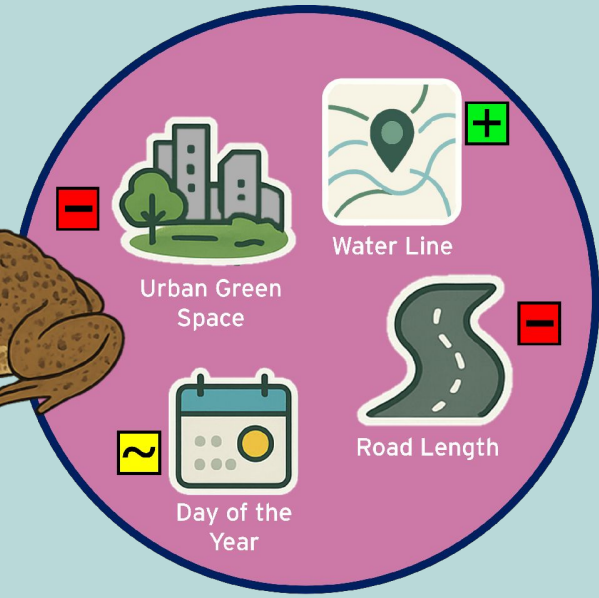


Pond Variables

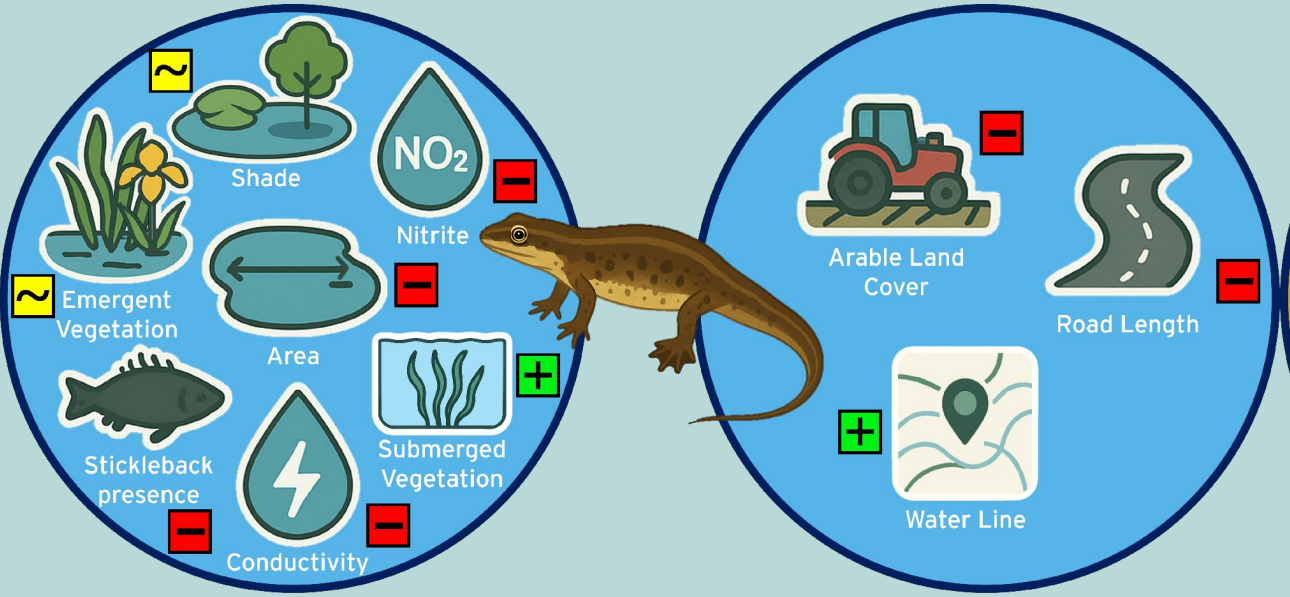
Landscape Variables



Pond Variables

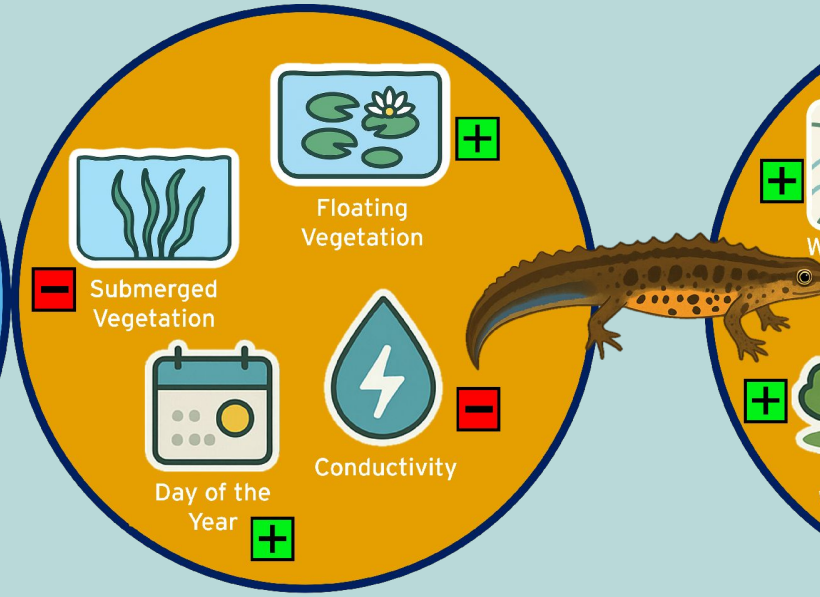


Landscape Variables

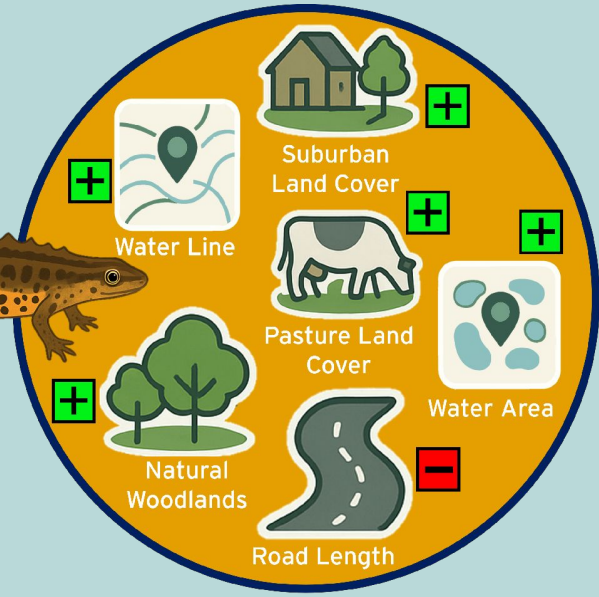


Pond Variables

Landscape Variables



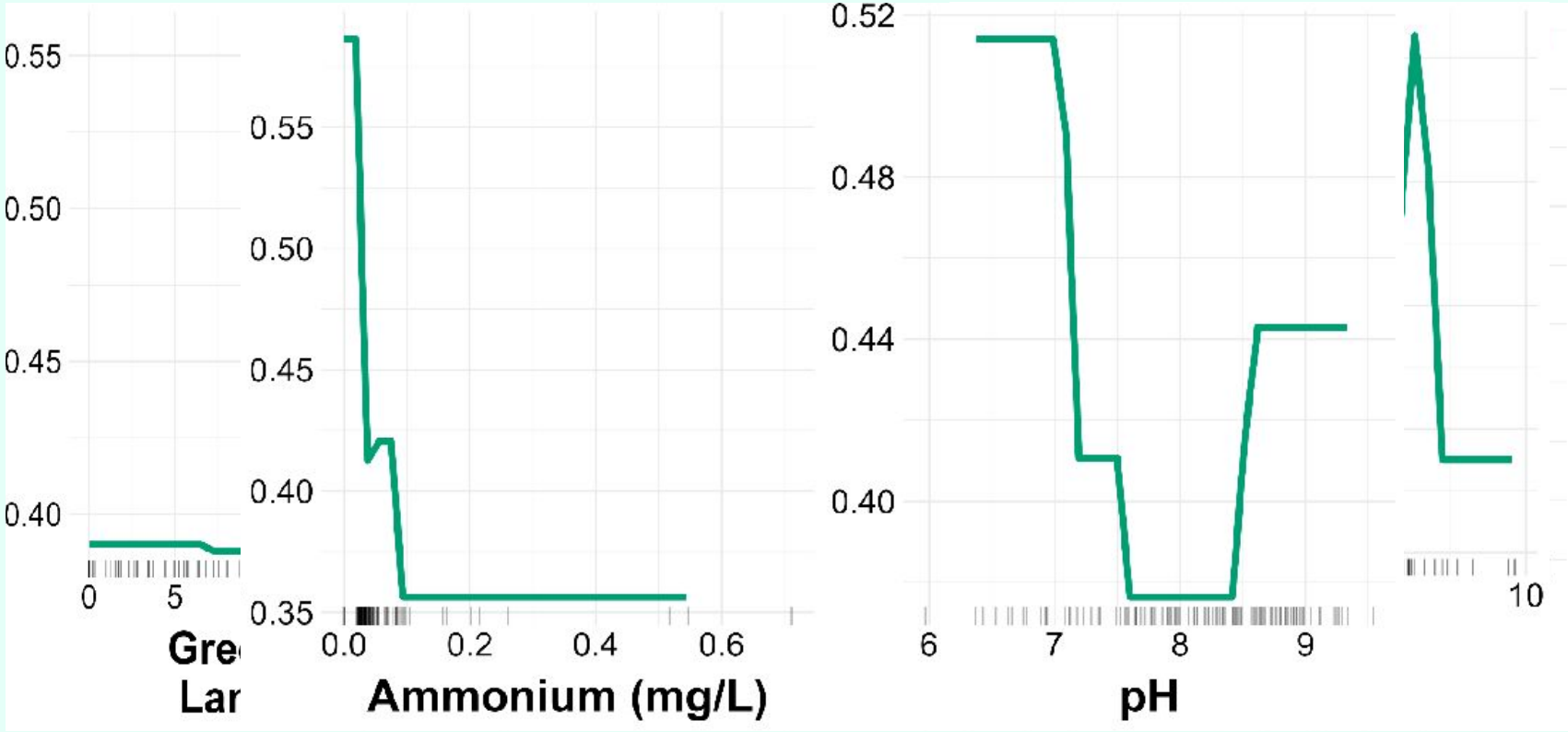
Pond Variables



Landscape Variables

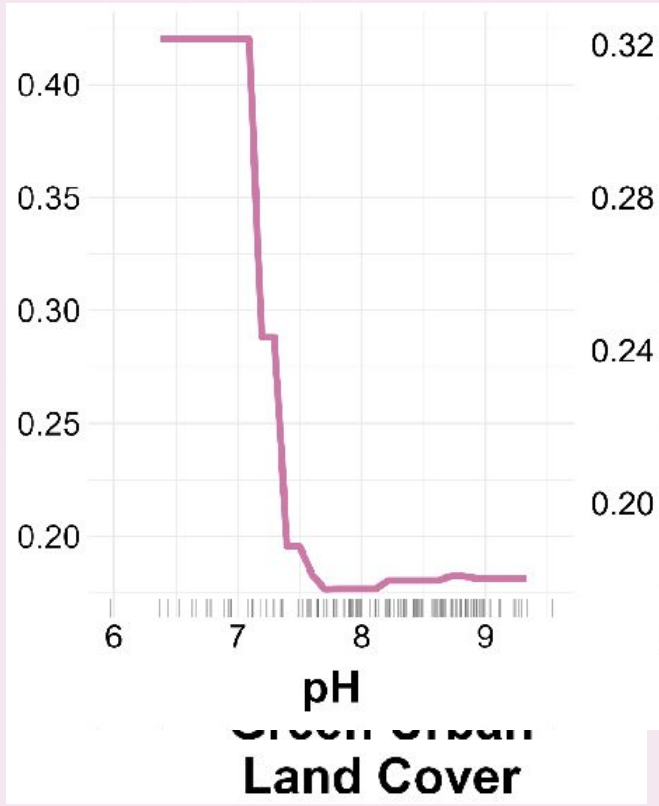
Common Frog

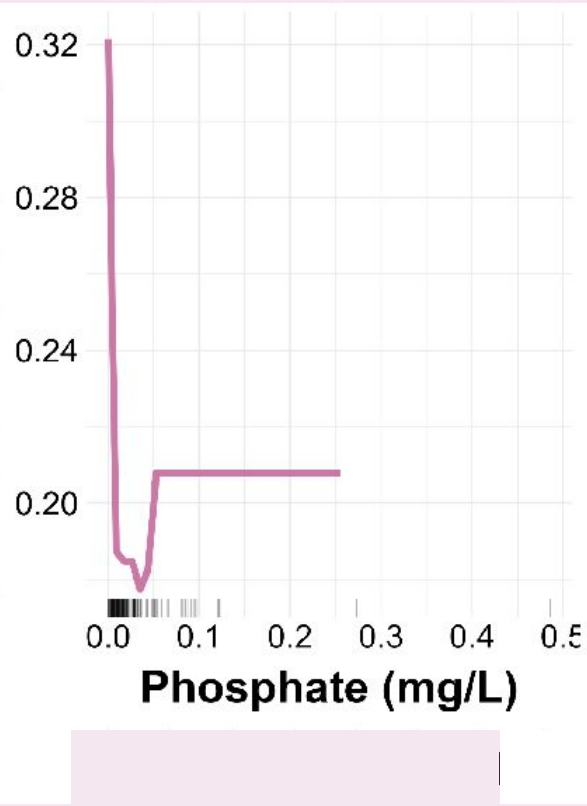
- Green land cover positive influence
- Roads negatively impact
- Ideal ranges of area and vegetation
- Sensitive to water chemistry

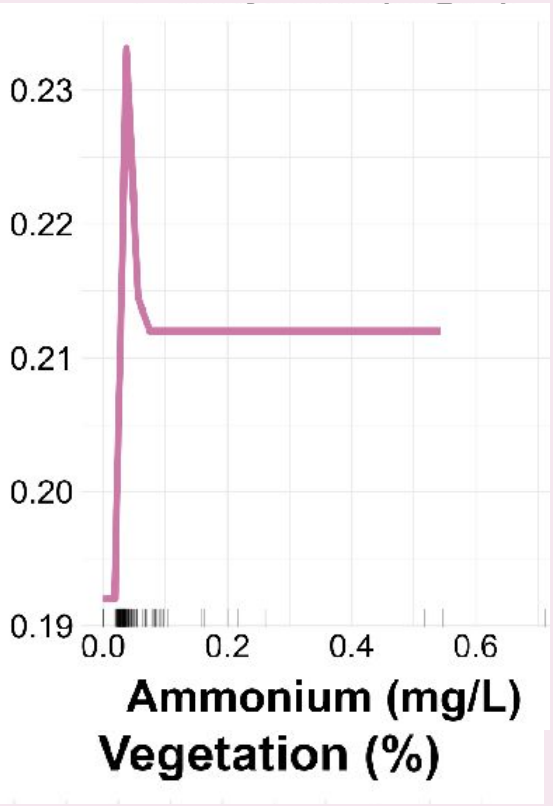


Common Toad

- Philopatric – return annually to breeding ponds
- Positive effect of floating vegetation within the pond
- Sensitivity to water chemistry

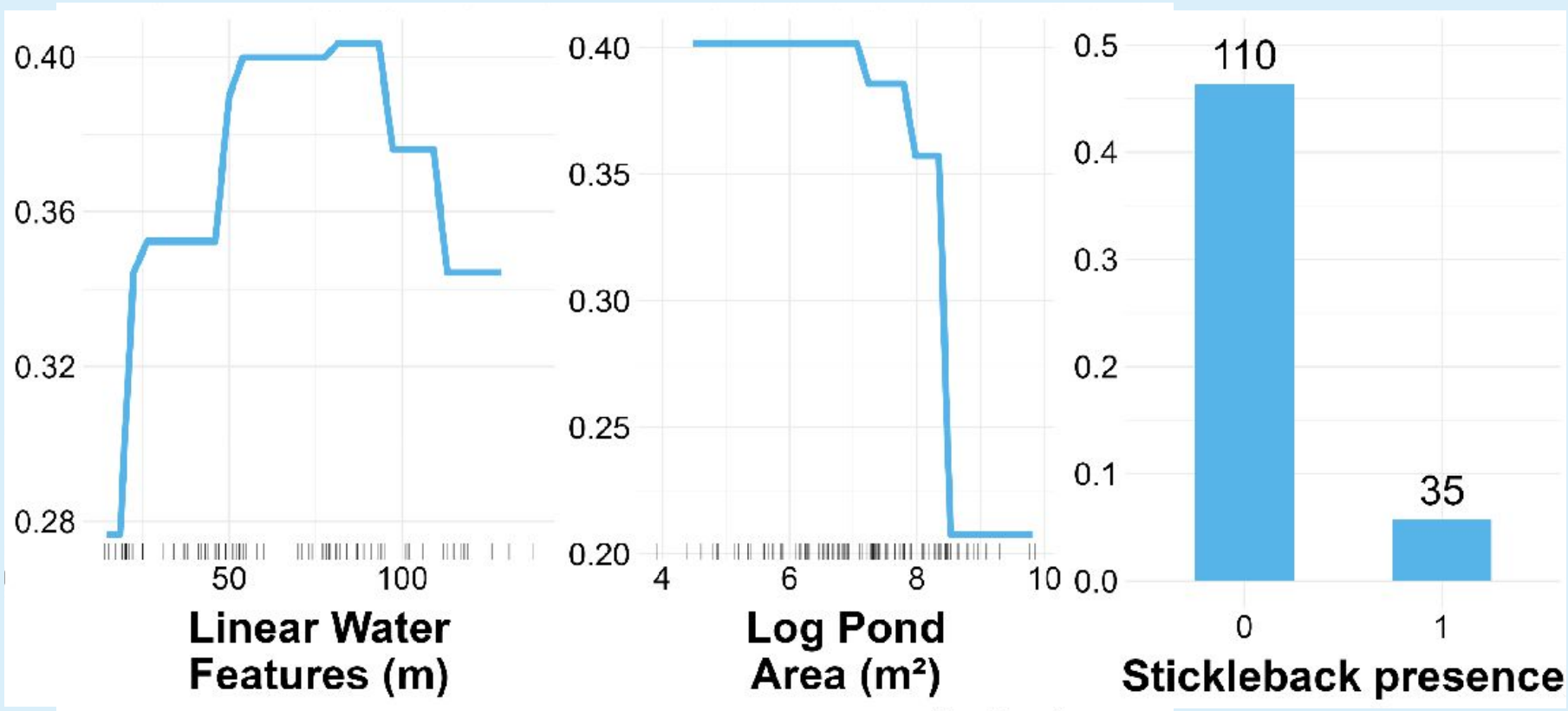






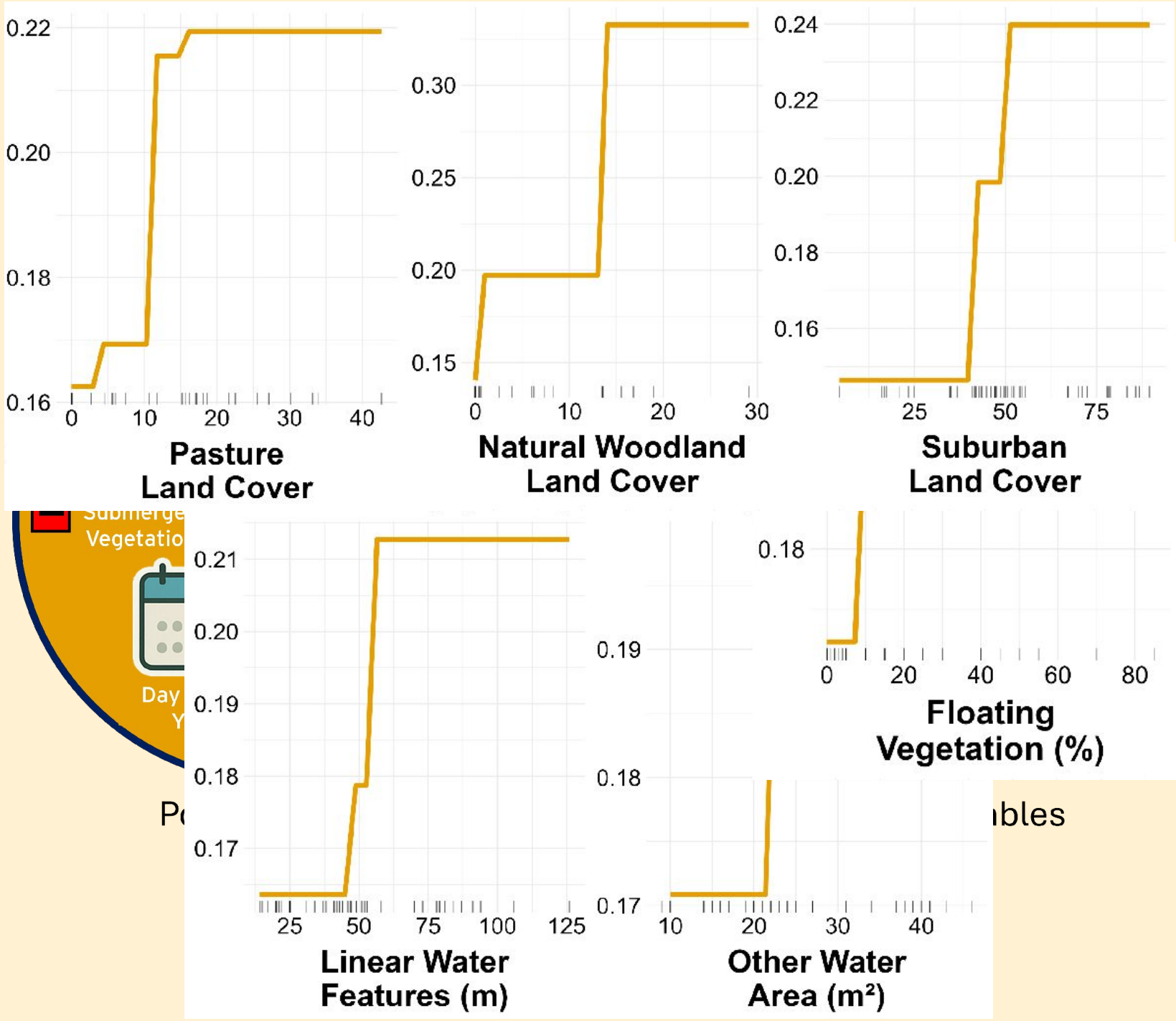
Palmate Newt

- More effect of pond variables than landscape variables
- Major impact of stickleback presence
- Preference for smaller ponds and medium amounts of linear water within the landscape



Smooth Newt

- Generally, more effect of landscape variables over pond variables
- Positive influence of blue and green land cover types
- Positive influence of floating vegetation within the pond

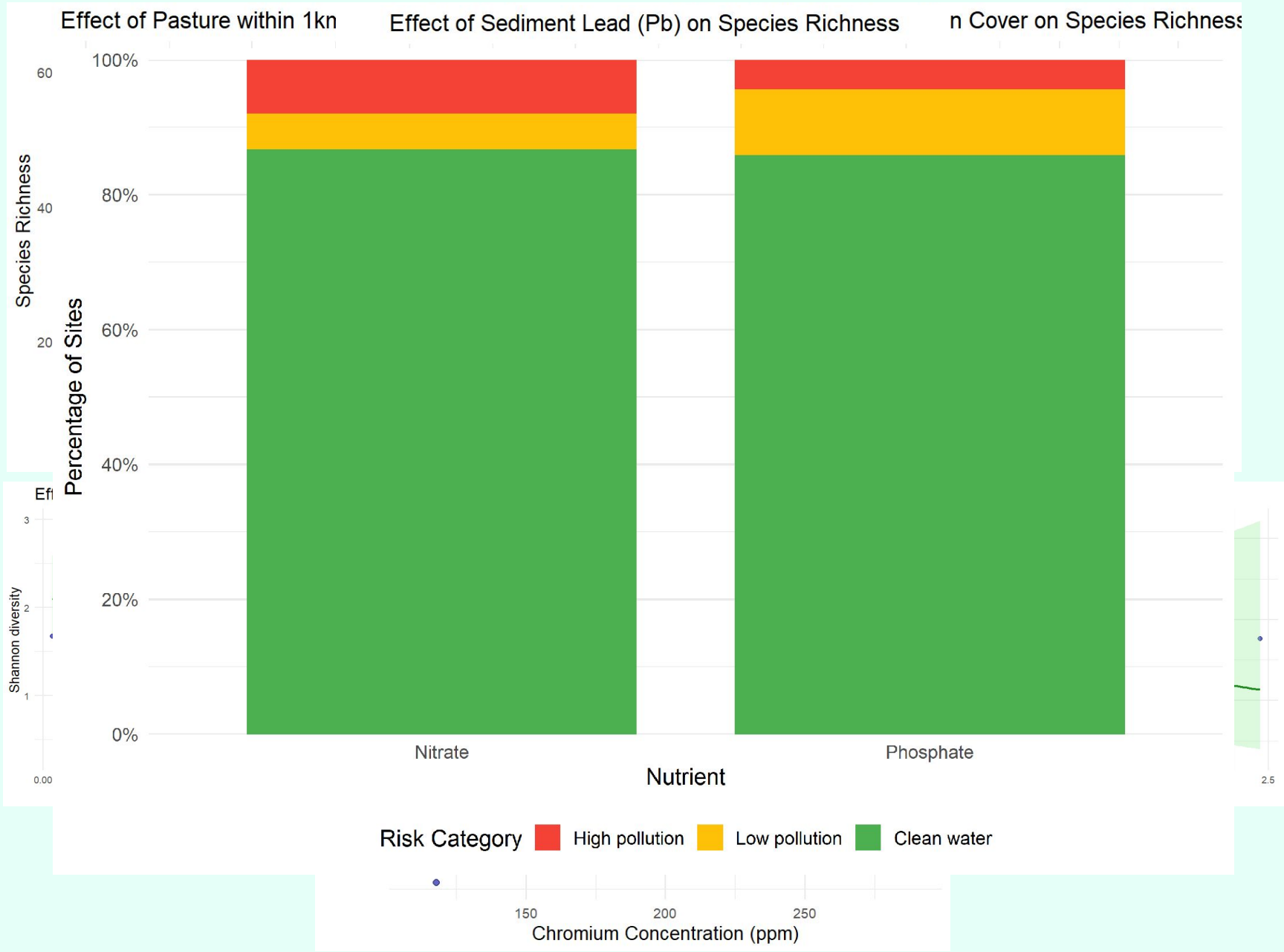


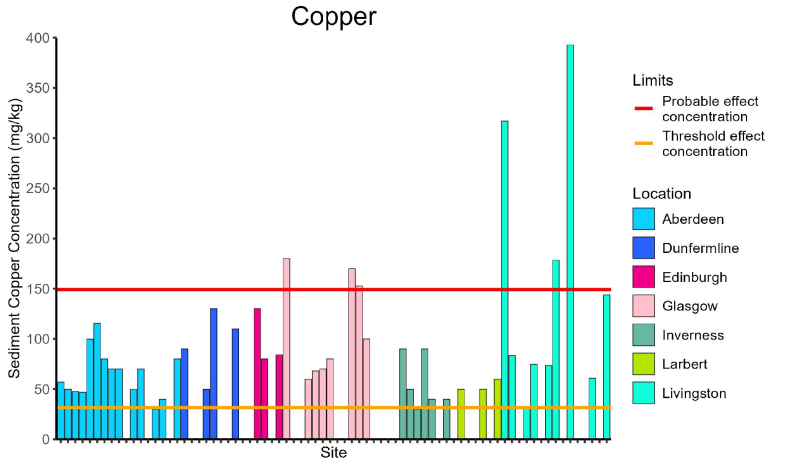
Invertebrate Communities

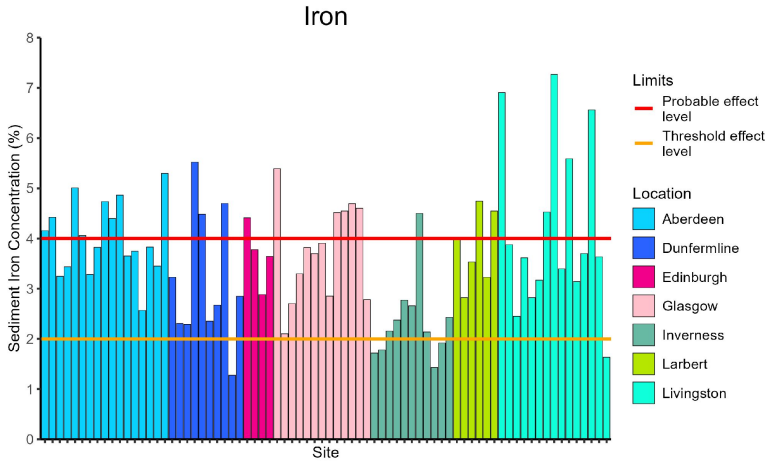
- Underpin pond functioning
- Important indicators of pond health
- Also impacted by urbanization
  - Habitat loss and fragmentation
  - Pollution
  - Increased temperatures
- Preliminary analysis stages

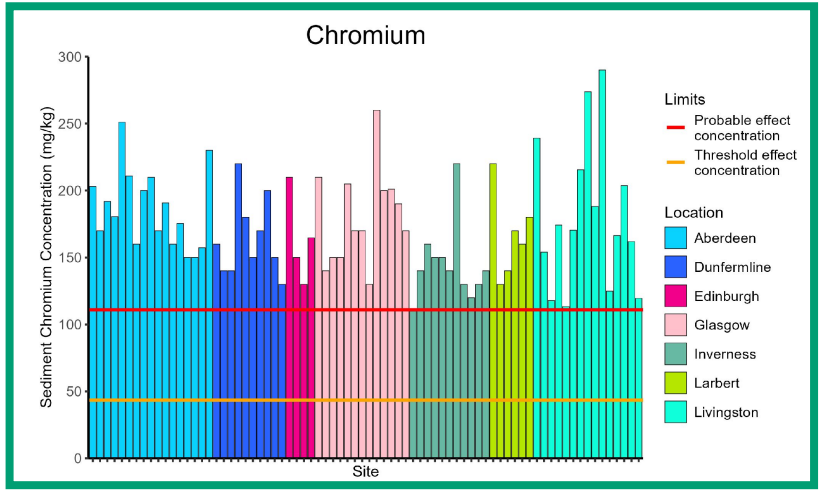
Invertebrates

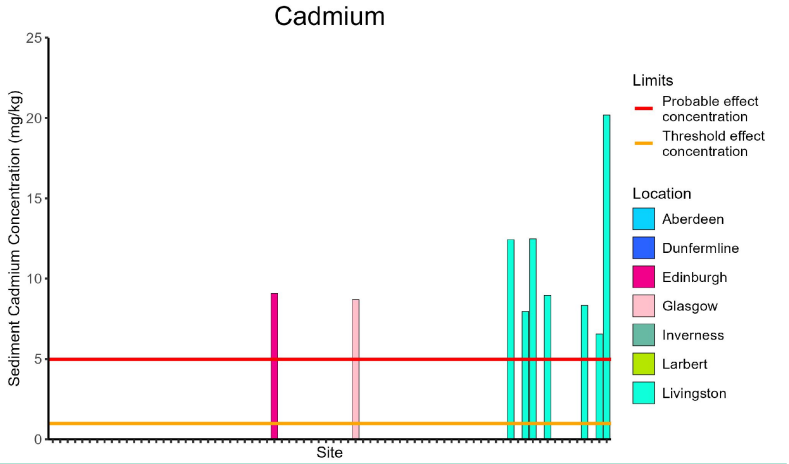
- **PRELIMINARY ANALYSES**
- Negative influence of high **nutrient** content
- Positive effect of **green cover** and **floating vegetation**
- Effect of **lead** and **chromium** in sediment

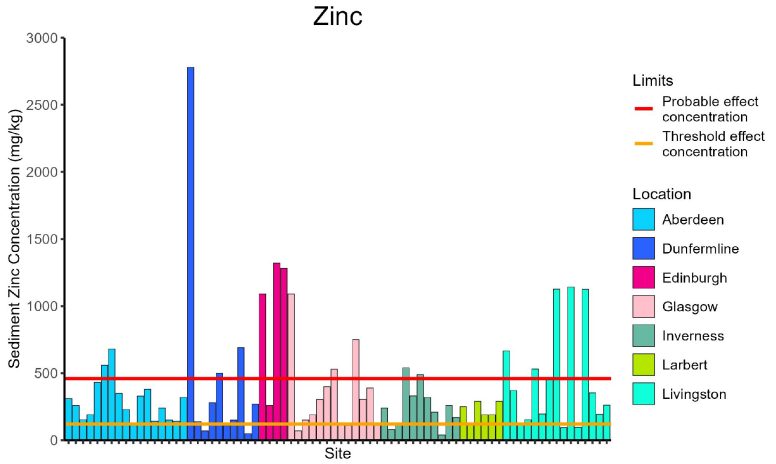


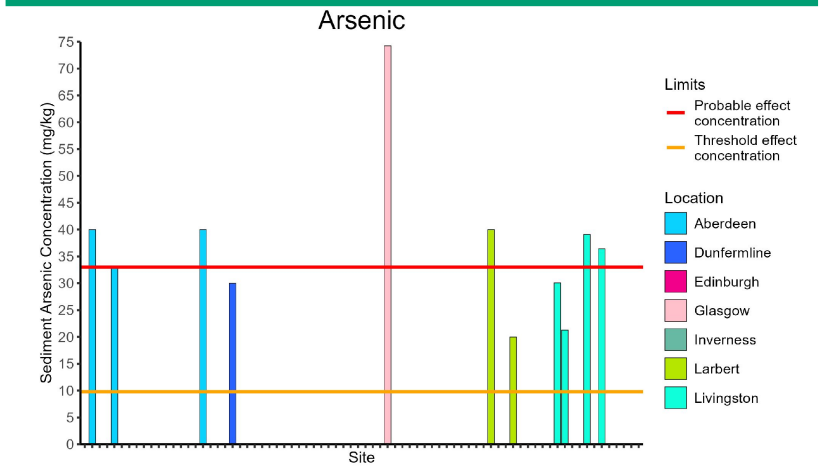


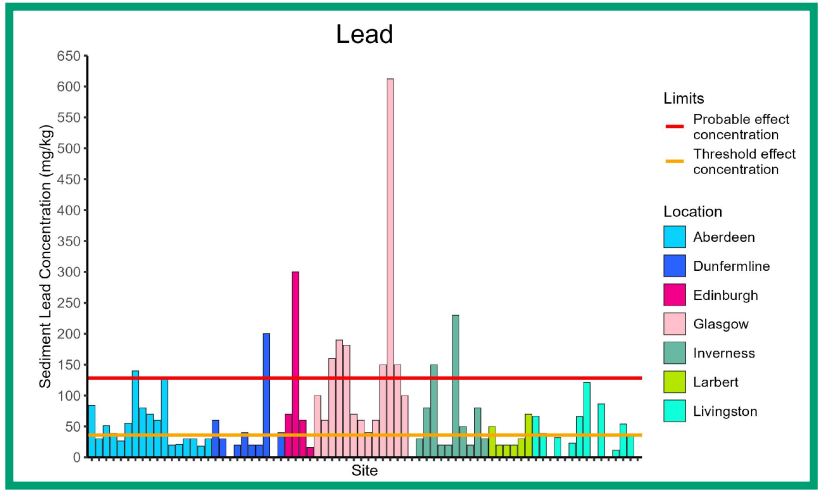








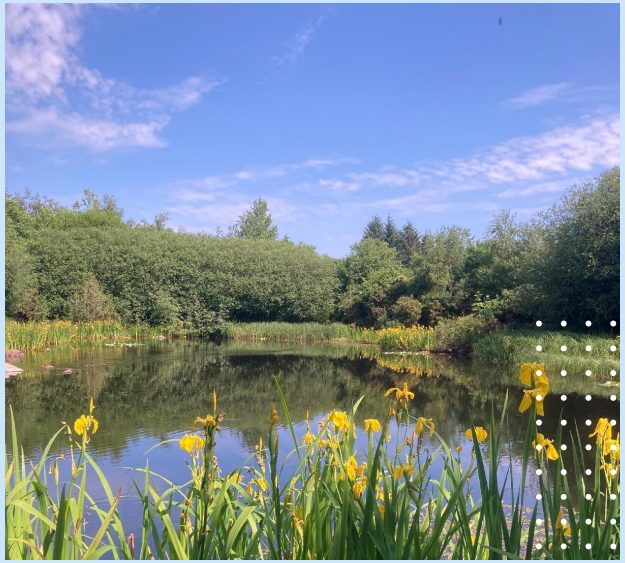




Metal concentrations in sediment measured in mg/kg

- Metal concentrations exceeded the threshold effect concentration in most ponds
- Many of them exceeded the probable effect concentration

Effect concentrations derived from consensus-based sediment quality guidelines developed by MacDonald *et al.* 2000



Design implications

- Each amphibian species has specific preferences but some key features common to all
- **Roads** are detrimental to all amphibians
- Manage **vegetation** for local amphibian populations
- Aim for good **landscape connectivity**
- Ensure proper **treatment train** and maintenance

Thank you for listening!

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