

Hydraulic Connectivity

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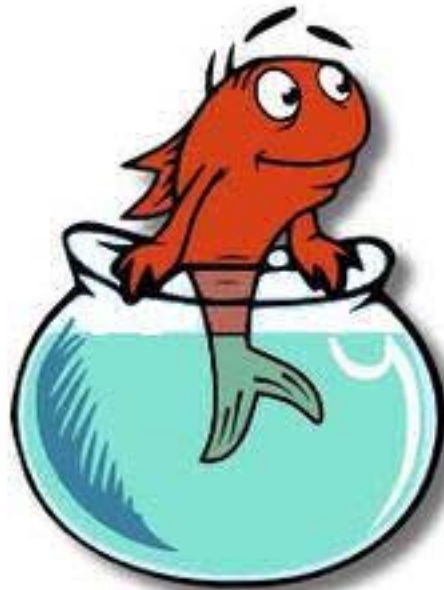
Connectivity – why do we care?

Example: Centrarchid fish in winter

I can't breath!!!



Low connectivity



"Just-right" connectivity

I'm too cold!!!



High connectivity

Connectivity

From Lubinski et.al.:

Lateral connectivity

- Habitat connectivity
- **Flood pulse connectivity**
- **Lateral non-flood connectivity**
- Main stem/tributary connectivity
- **Sub-surface connectivity**

Longitudinal connectivity

Backwater connectivity – types

Isolated backwater lakes

Water exchange a function of:

- Connectivity is primarily a function of frequency of connection (binary)
- Ground water exchange important in some cases

inundation tool developed by Tim Fox
HREPs could alter with levee building or breaching

Unlikely HREPs could alter – but consider when evaluating projects

There's been few HREPs that have altered connectivity of isolated backwaters.

Potential for more of these, especially in the lower river. - RECONNECTION

Backwater connectivity - types

Contiguous backwater lakes

Two ways to consider connection:

- **Connection at low to moderate discharge (non-flood)**
- Connection when natural levees over-topped (flood pulse)

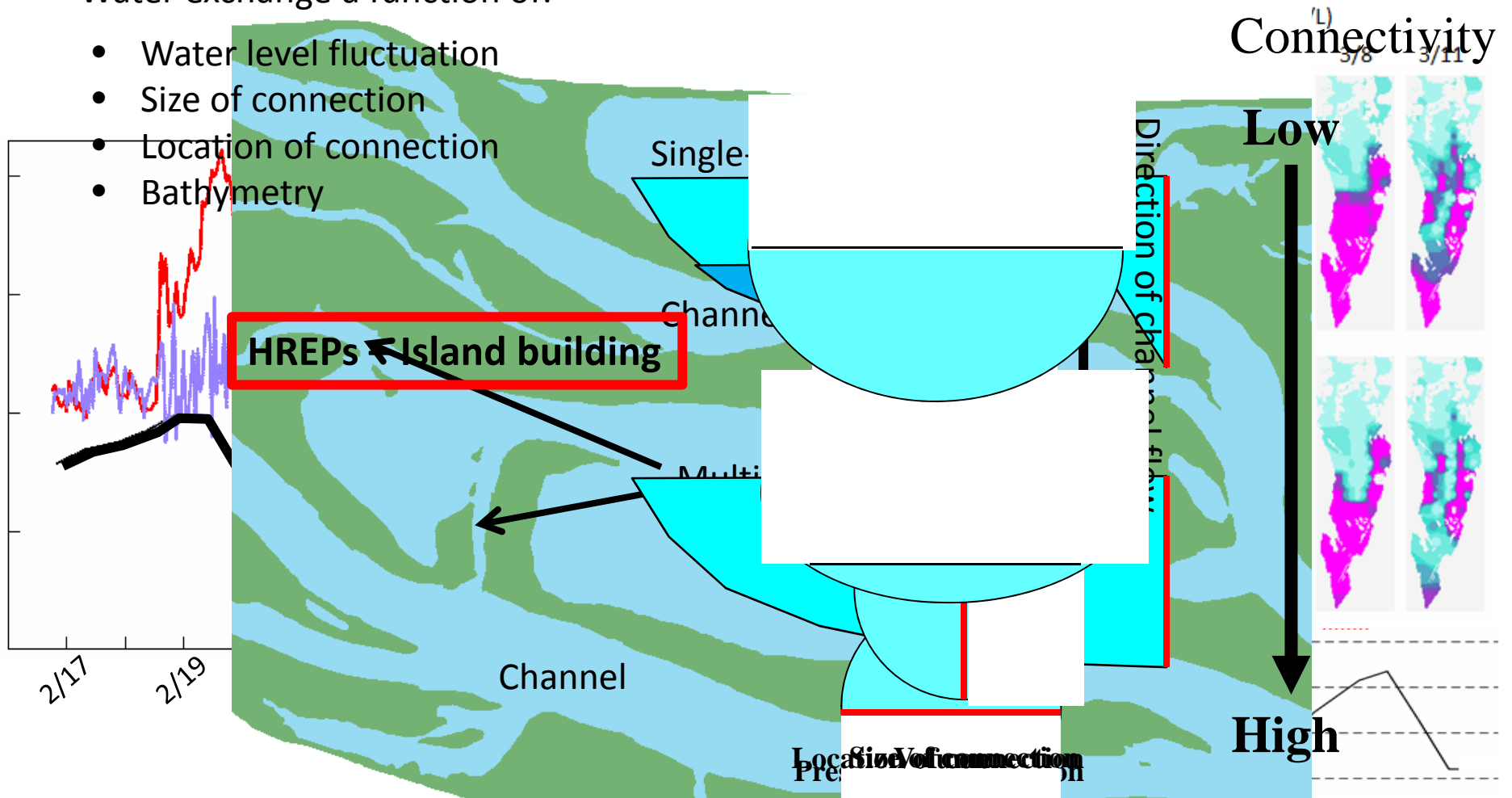
Note: water exchange can vary within lakes.

Backwater connectivity - types

Single-connection backwater lakes

Water exchange a function of:

- Water level fluctuation
- Size of connection
- Location of connection
- Bathymetry

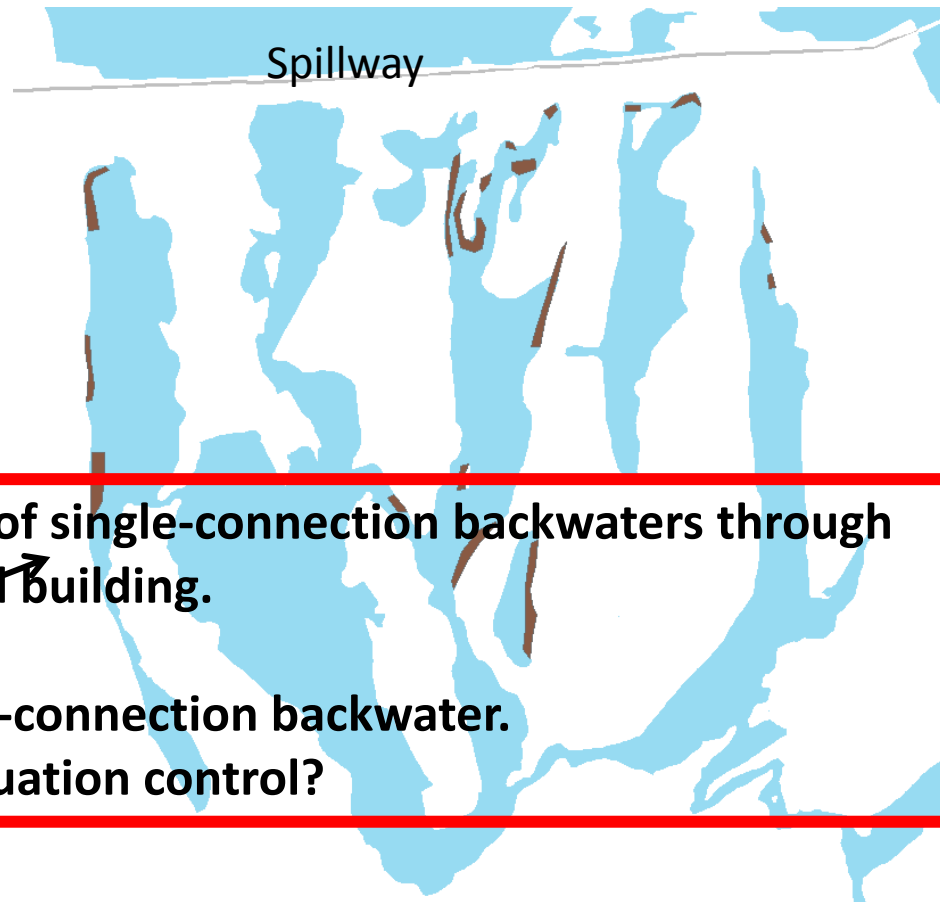


Backwater connectivity - types

Single-connection backwater lakes

Water exchange a function of:

- Water level fluctuation
- Size of connection
- Location of connection
- Bathymetry
- Ground water exchange



HREPs have altered connectivity of single-connection backwaters through dredging (bathymetry) and island building.

Open water in winter indicating

Could alter to change to multiple-connection backwater.

Opportunity for water level fluctuation control?

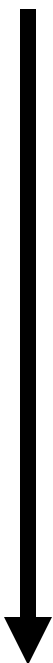
Backwater connectivity - types

Multiple-connection backwater lakes

Water exchange a function of:

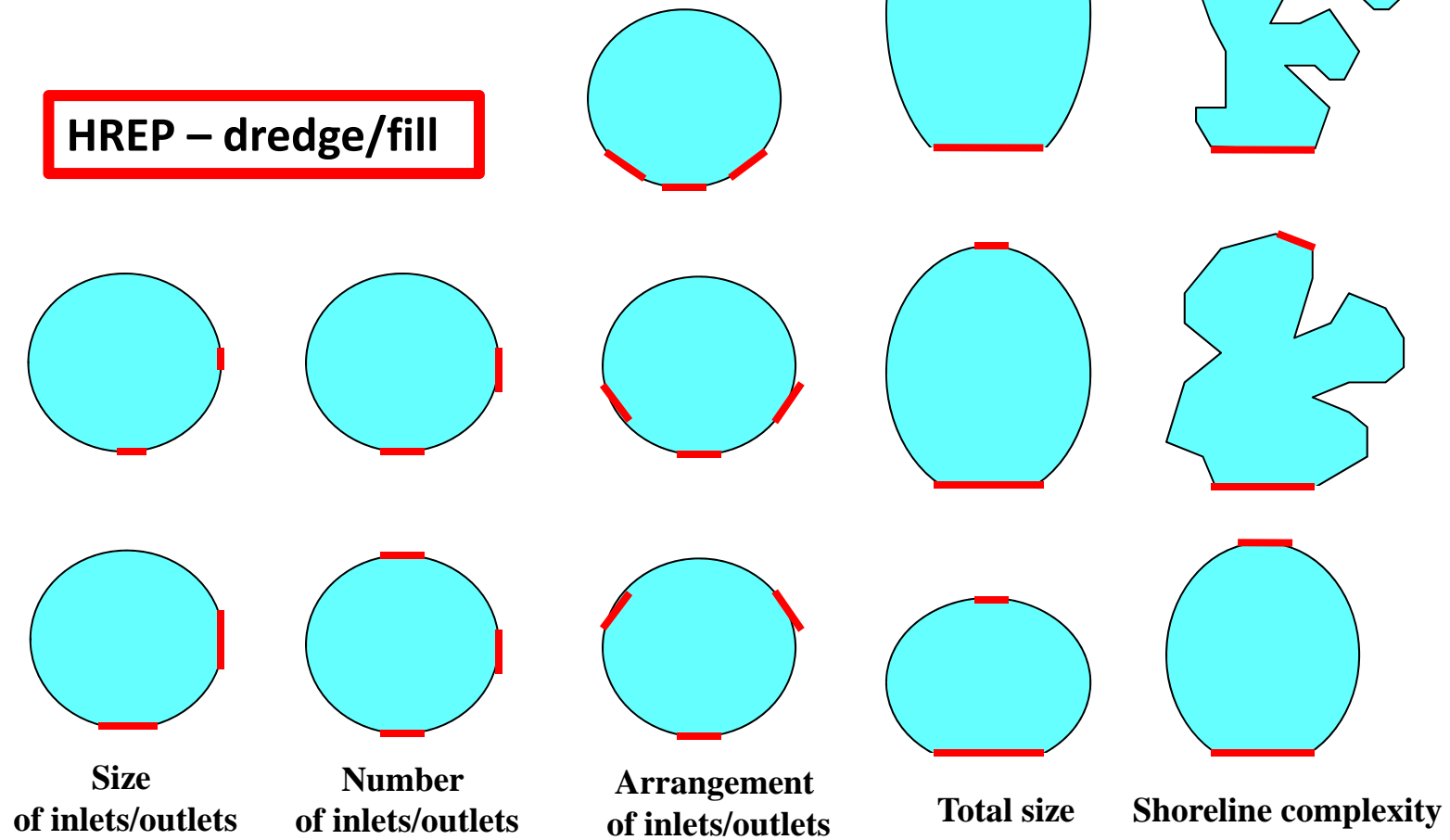
Connectivity – planform surrogate metrics

Low



High

HREP – dredge/fill

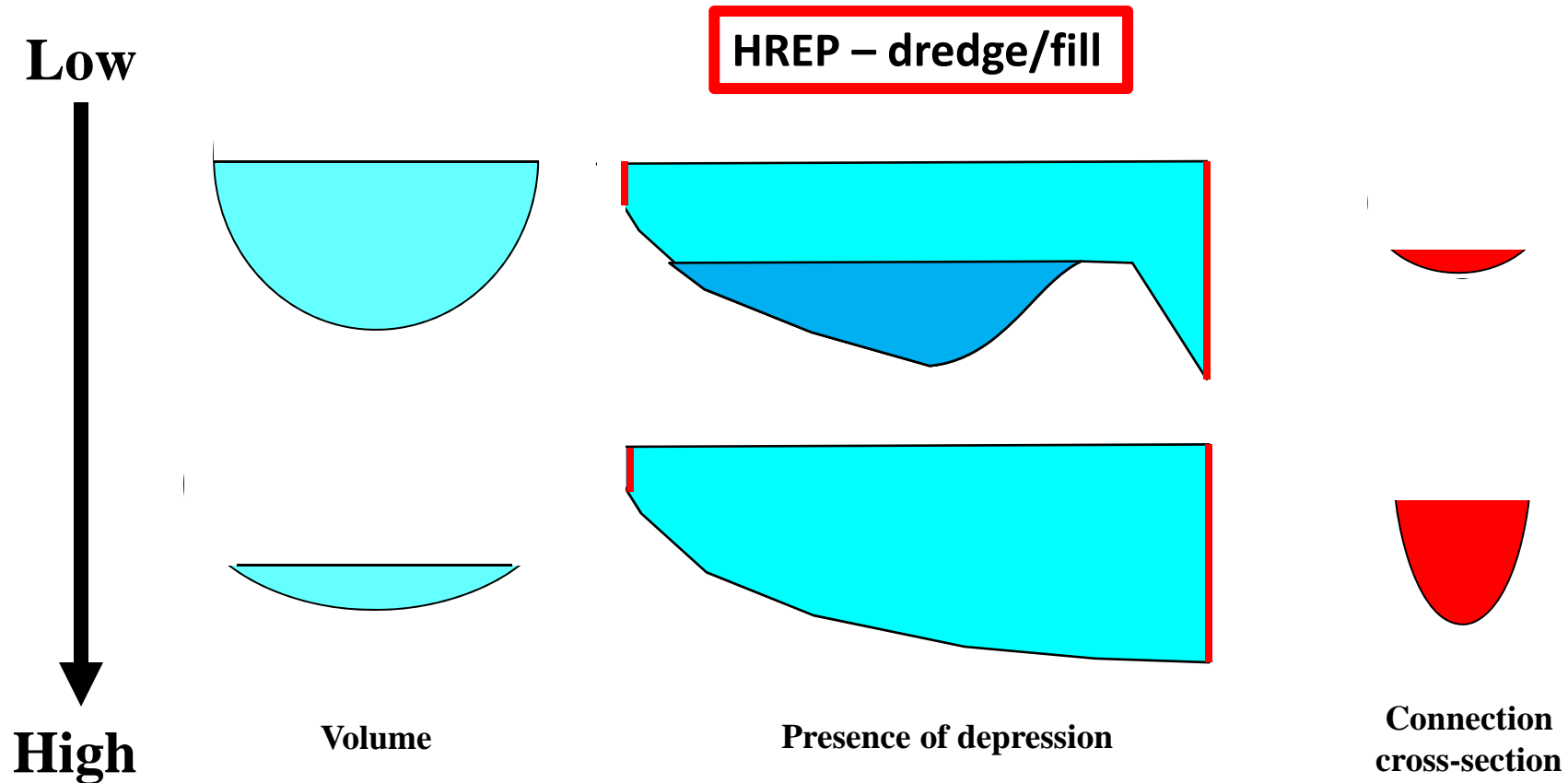


Backwater connectivity - types

Multiple-connection backwater lakes

Water exchange a function of:

Connectivity – bathymetric surrogate metrics



Backwater connectivity

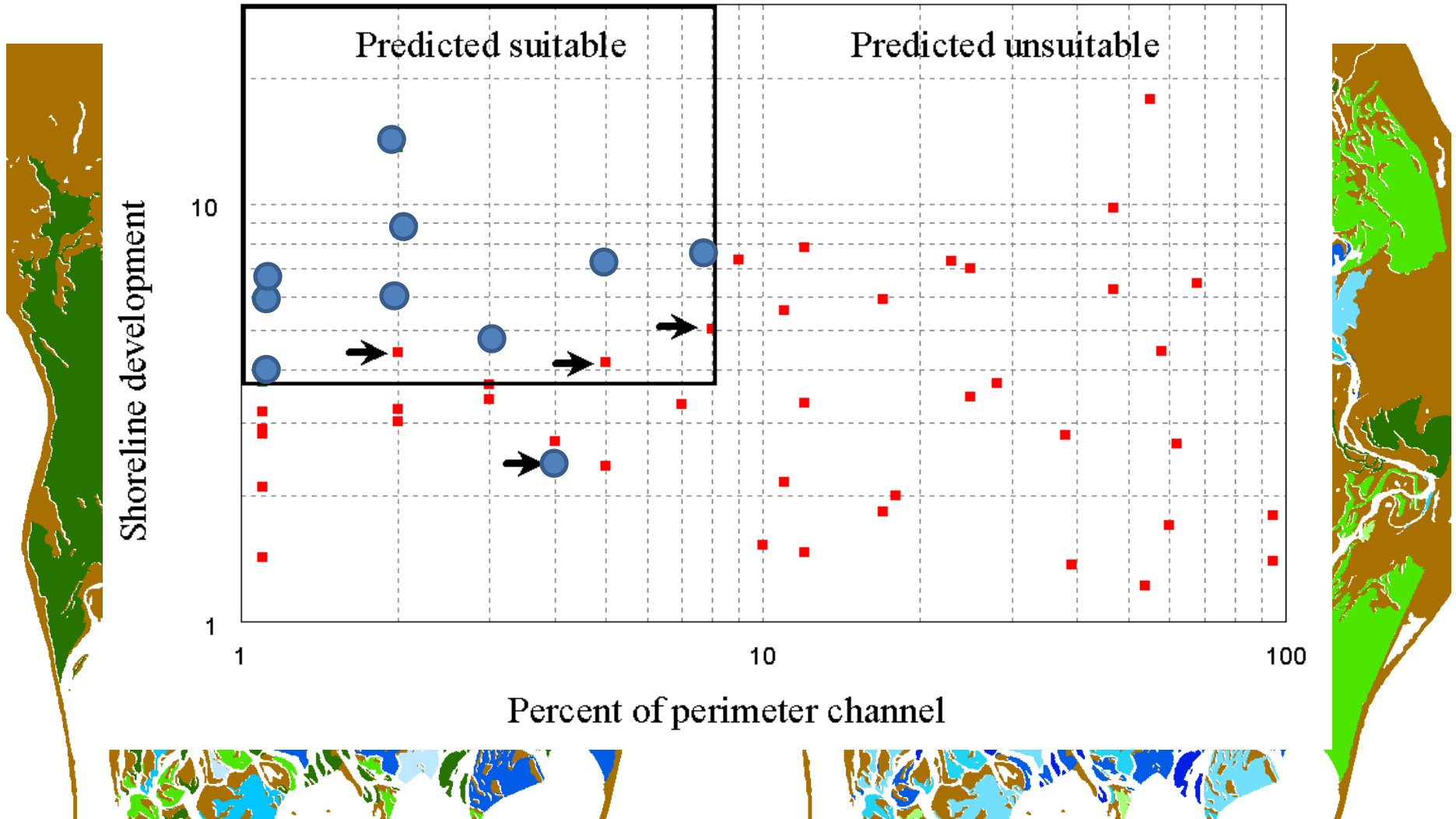
Water exchange predicted by surrogates:



Winter habitat suitability for centrarchic fishes

Percent of perimeter that is channel

Number of connections to channels



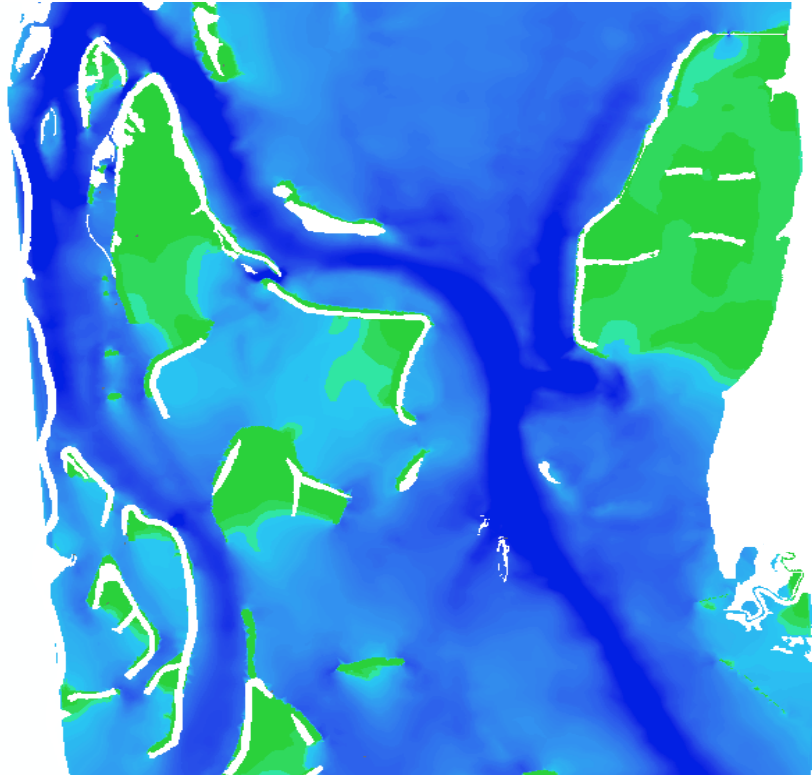
Backwater connectivity – HNA II

HREPs selected to address existing and future needs derived from HNA II

HNA II will include enhanced aquatic area classes that include connectivity metrics derived from planform metrics

Backwater connectivity

Water exchange measured as velocity (modeled):



HREP island construction results in areas of reduced connectivity

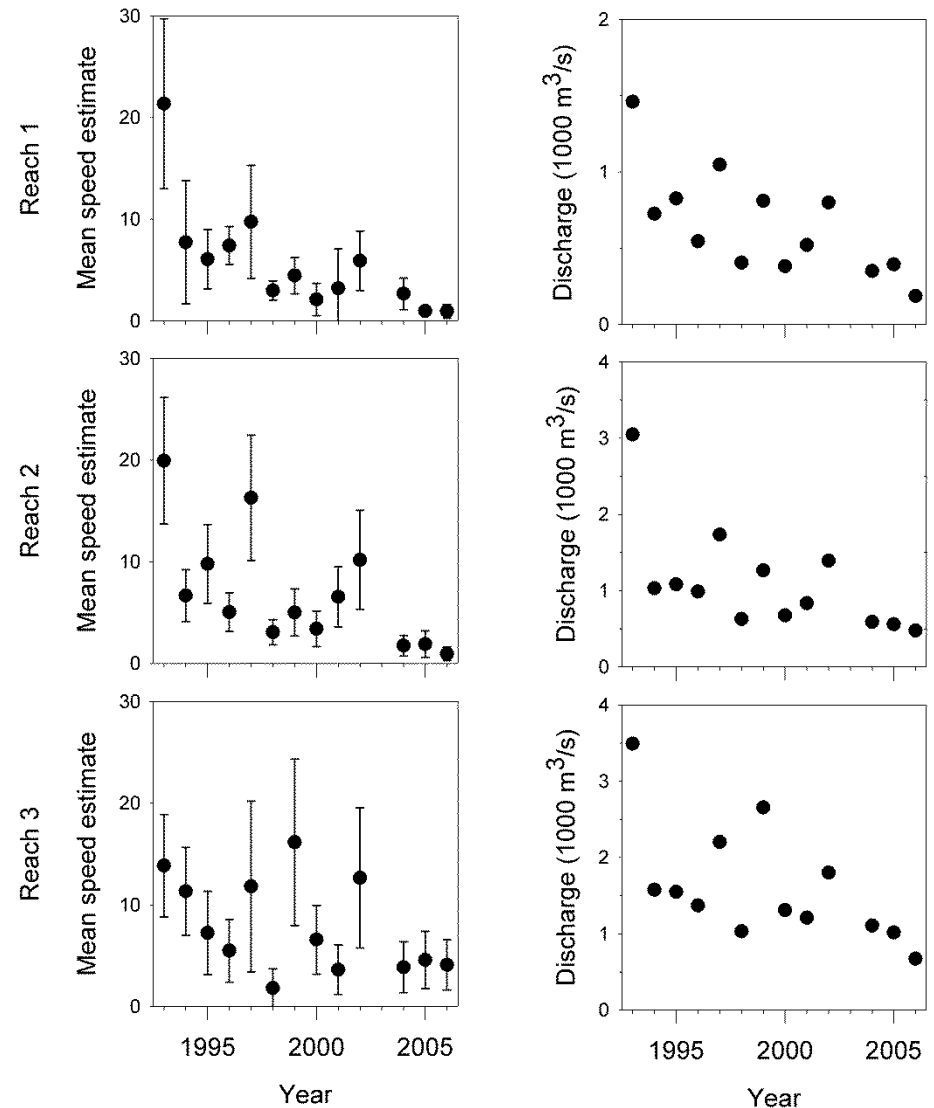
2-D hydraulic models are often part of project planning and evaluation

Backwater connectivity

Water exchange directly measured as velocity:

Trends in velocity using SRS data

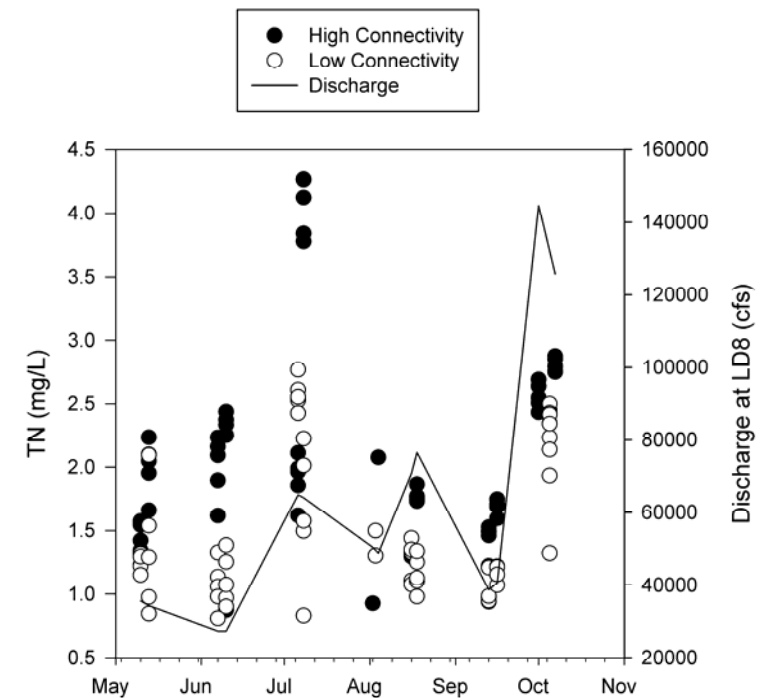
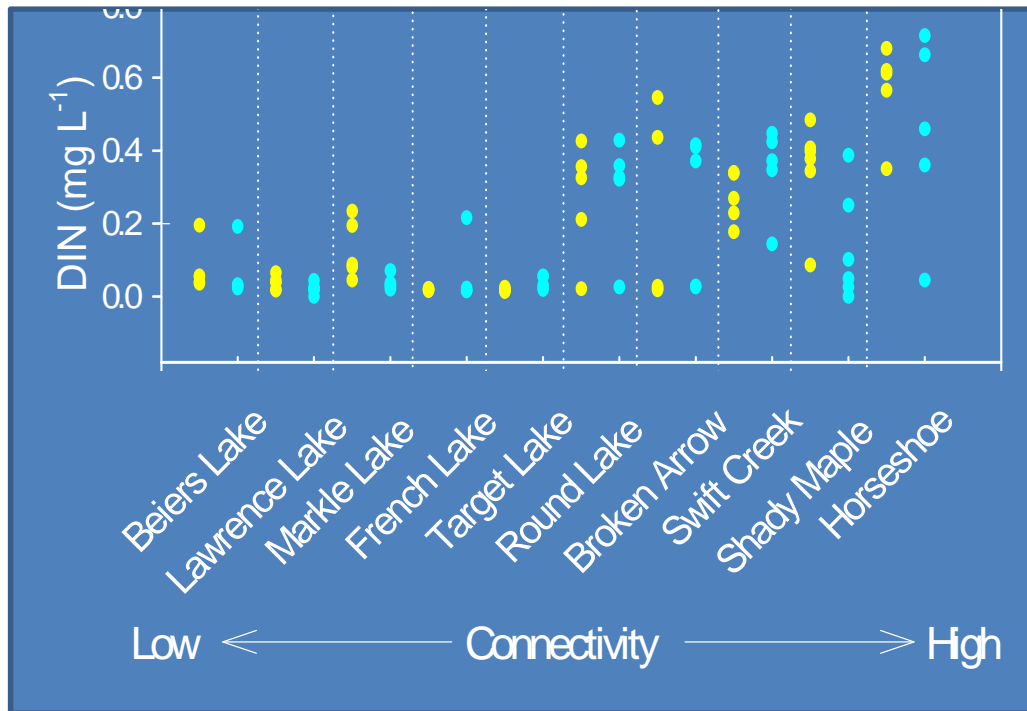
- Mean water speed decreased over the study period
- However, after adjusting for discharge, no detectable trend.



Backwater connectivity - associations

Nutrient associations with connectivity

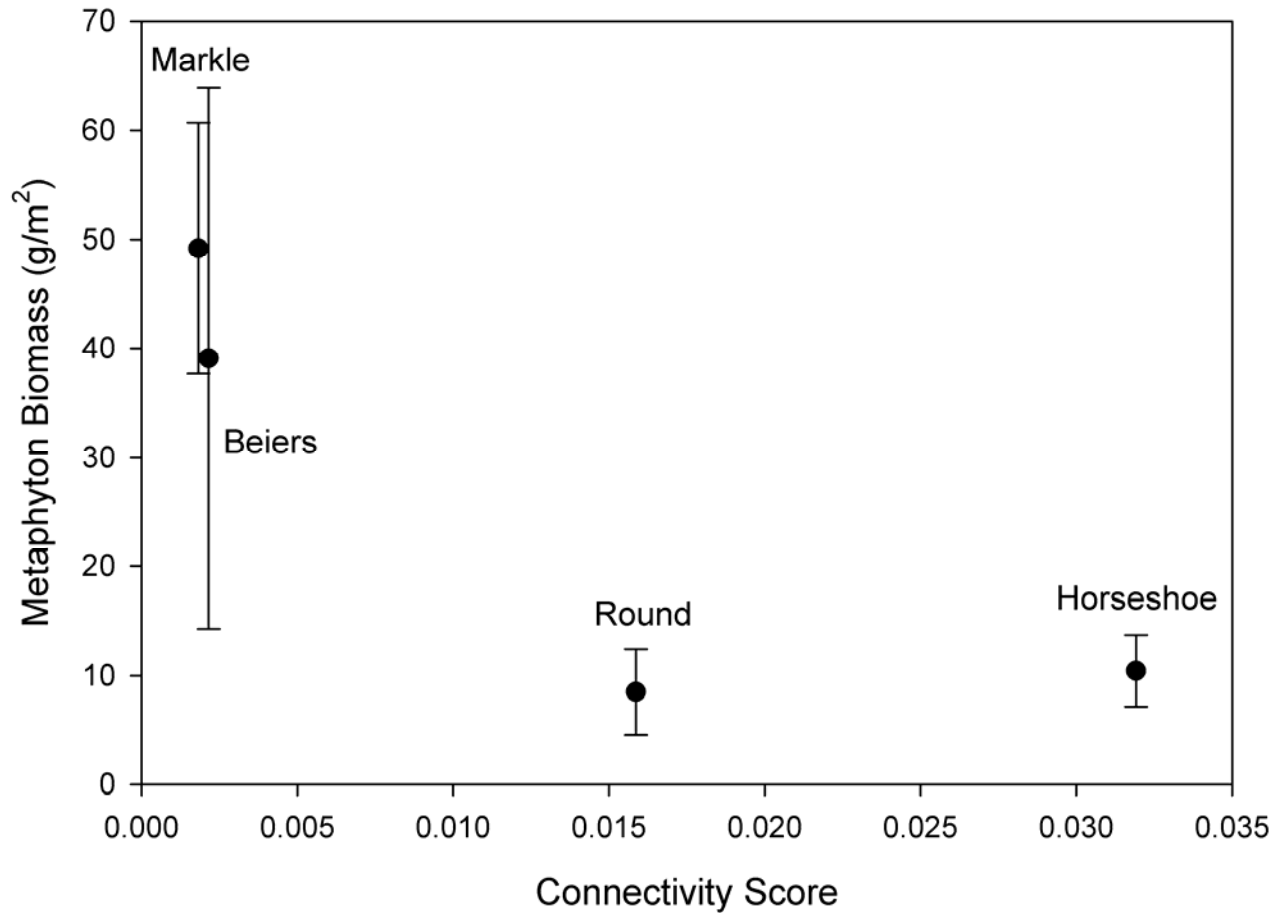
Nitrogen associated with connectivity



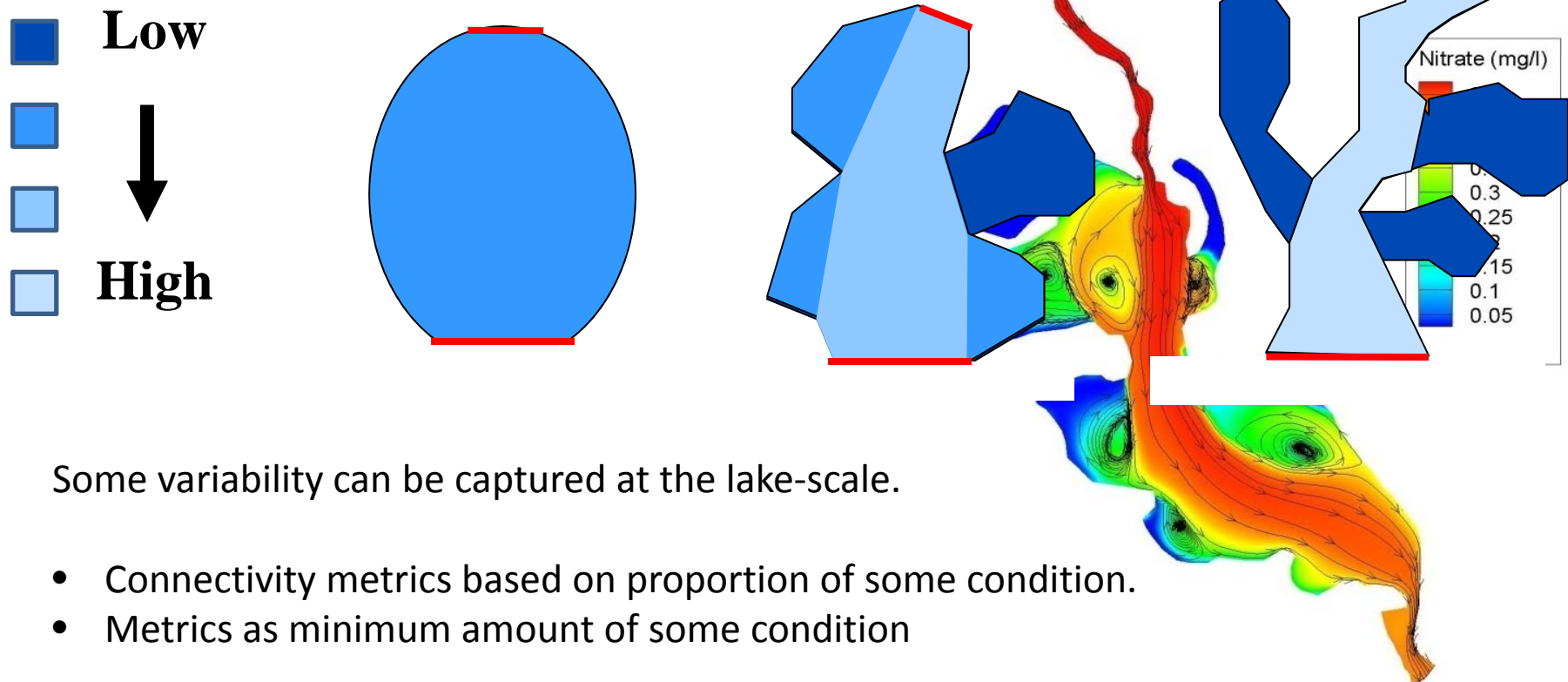
Backwater connectivity - associations

Biological associations with connectivity

Metaphyton associated with connectivity



Backwater connectivity – within lake considerations



Some variability can be captured at the lake-scale.

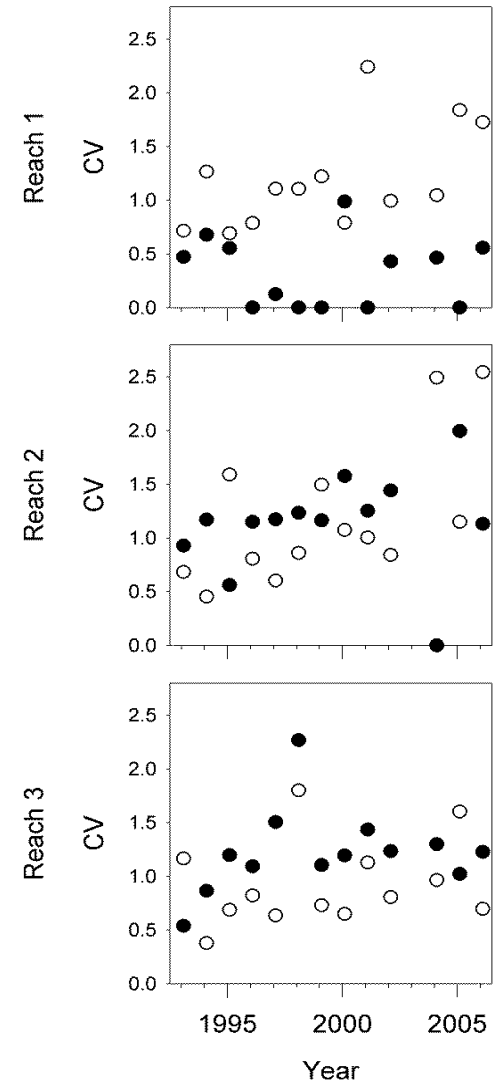
- Connectivity metrics based on proportion of some condition.
- Metrics as minimum amount of some condition

Backwater connectivity – within lake considerations

Trends in velocity using SRS data

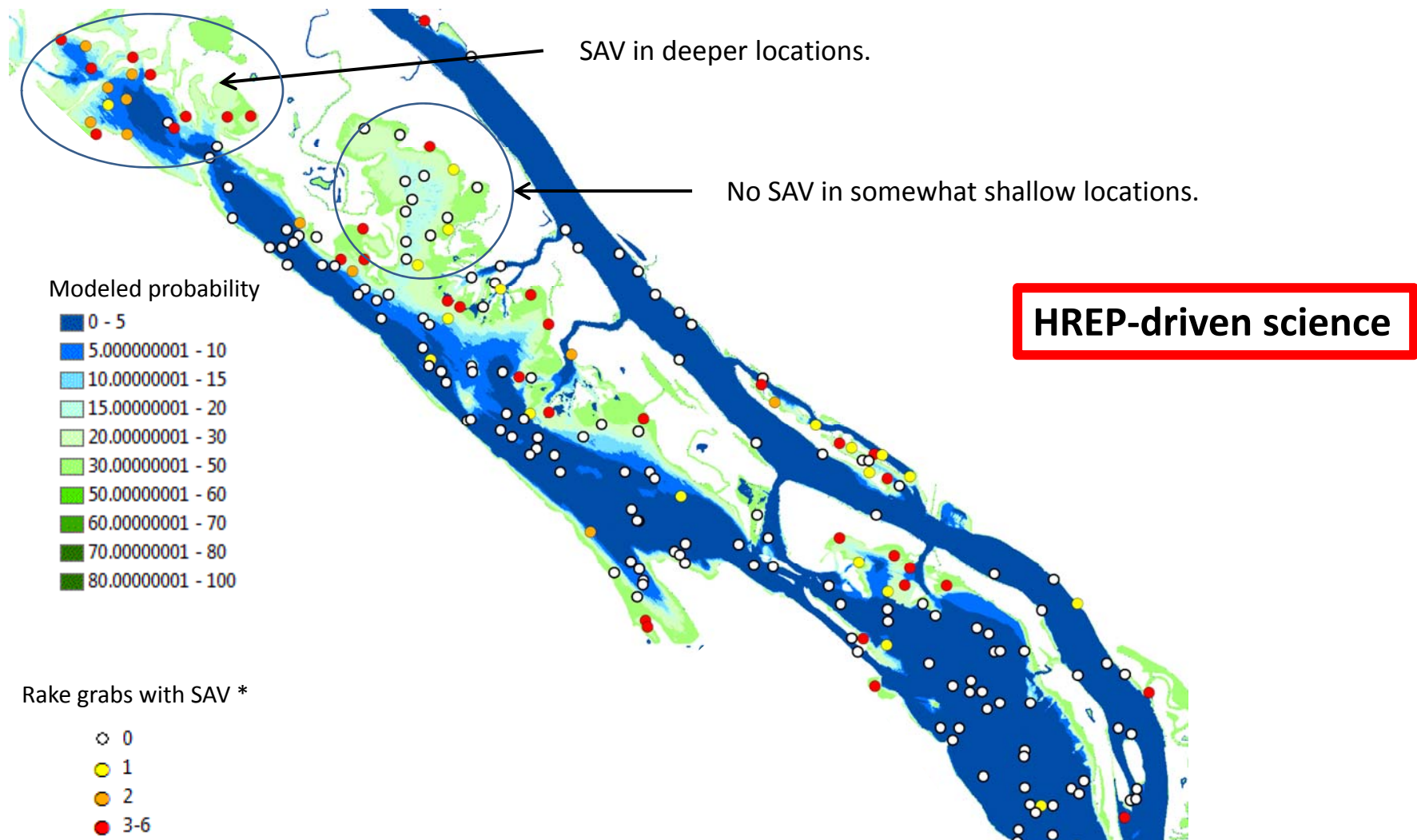
- Slight positive trend found for within-lake variation.
- The occurrence of BDL values (< 2 cm/sec) was found to be increasing.
- These changes might be best explained by recent increases in vegetation.

○ within ● among



Backwater connectivity – within lake considerations

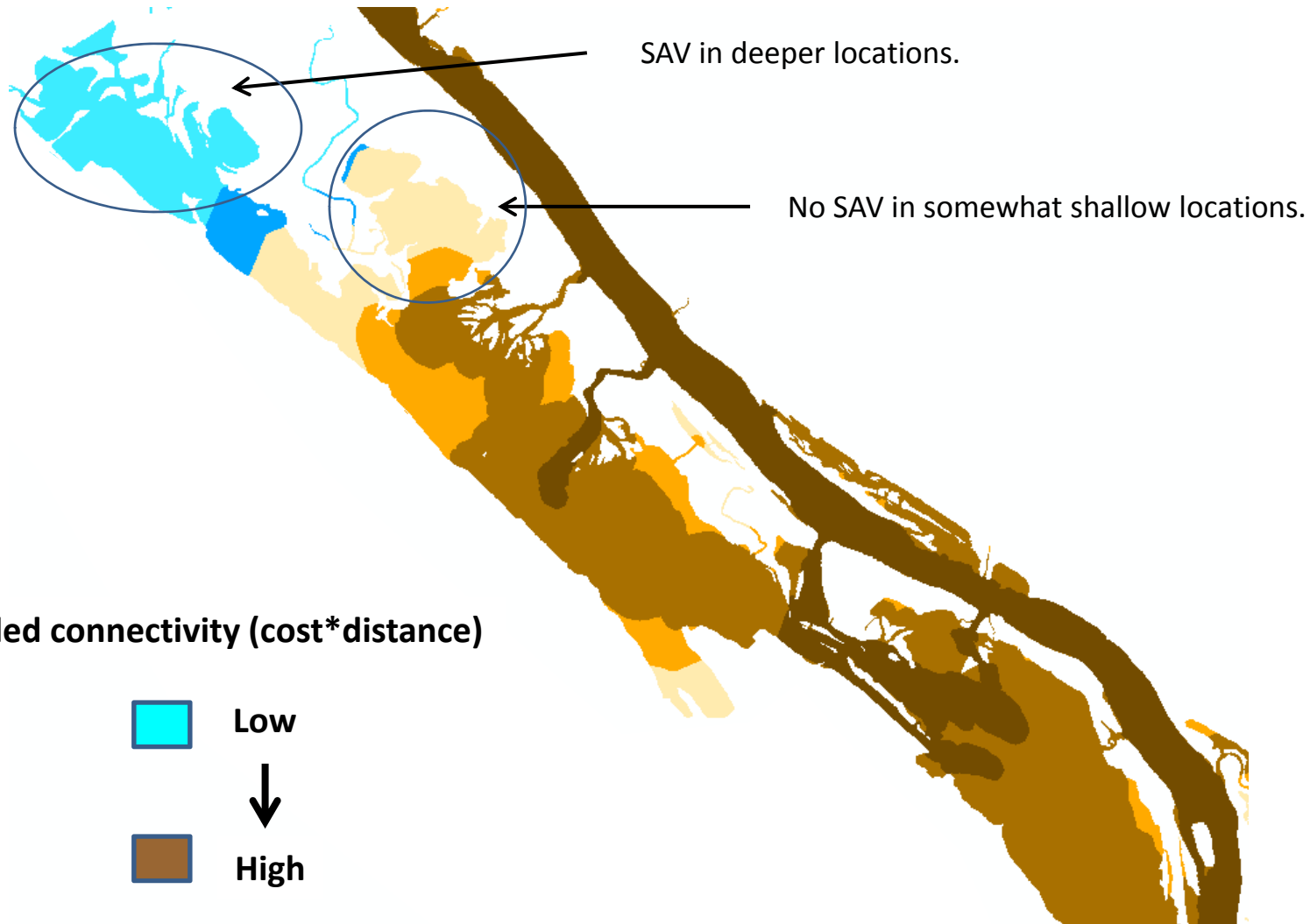
Overlay of 2008 SAV sampling and 2008 modeled probability of SAV



Backwater connectivity – within lake considerations

A simple sediment transport model

Estimating water exchange using cost*distance



Connectivity – how do we use it to manage?

Example: Centrarchid fish in winter

