

Assessing the biological quality of the Nation's streams with an indicator of taxonomic completeness

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What is "Taxonomic Completeness" and Why Use it for the WSA?

- Taxonomic completeness is the proportion of expected taxa observed at a site (O/E), where O is derived from a sample and E is estimated from a model.
- It has several useful properties:
 - It has a clear biological interpretation: biodiversity loss.
 - O/E is site specific but means the same thing everywhere: standardized.
 - E is not calibrated against stressed sites.
 - It is quantitative.

O/E as a measure of the taxonomic completeness of the biological assemblage observed at a site



E = 8 taxa



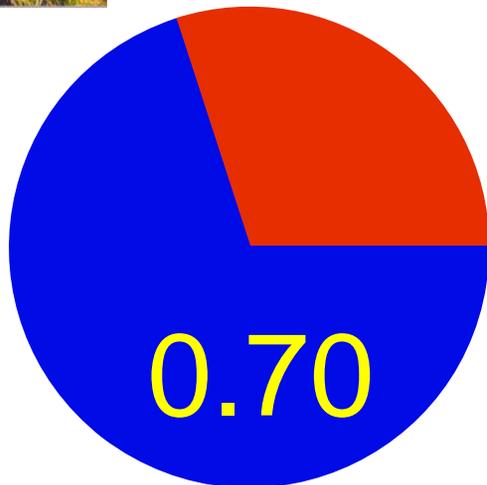
O = 3 taxa

$$\frac{O}{E}$$
$$0.38$$

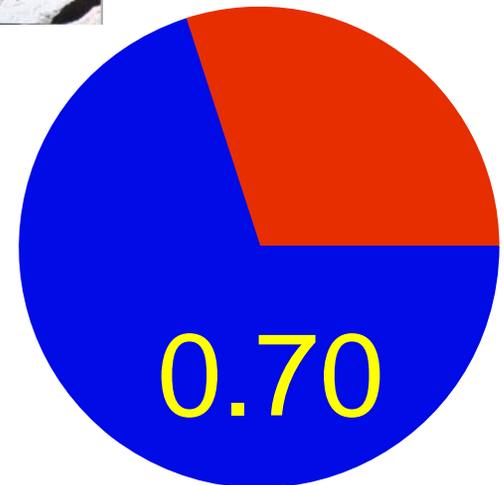
O/E is a Site-Specific, Standardized Measure of Biodiversity Status Relative to Reference Conditions



$O = 7$
 $E = 10$



$O = 21$
 $E = 30$



Modeling E is the biggest technical challenge in making O/E assessments

- Details covered in Friday's shortcourse (or www.cnr.usu.edu/wmc), but...
- Classes of sites defined on biological similarity.
- Develop model from reference site data to predict probabilities of capture (PC) of all taxa as a function of natural environmental setting (stream size, geology, temperature, etc.).
- $E = \sum PC.$

How O/E is
Calculated:

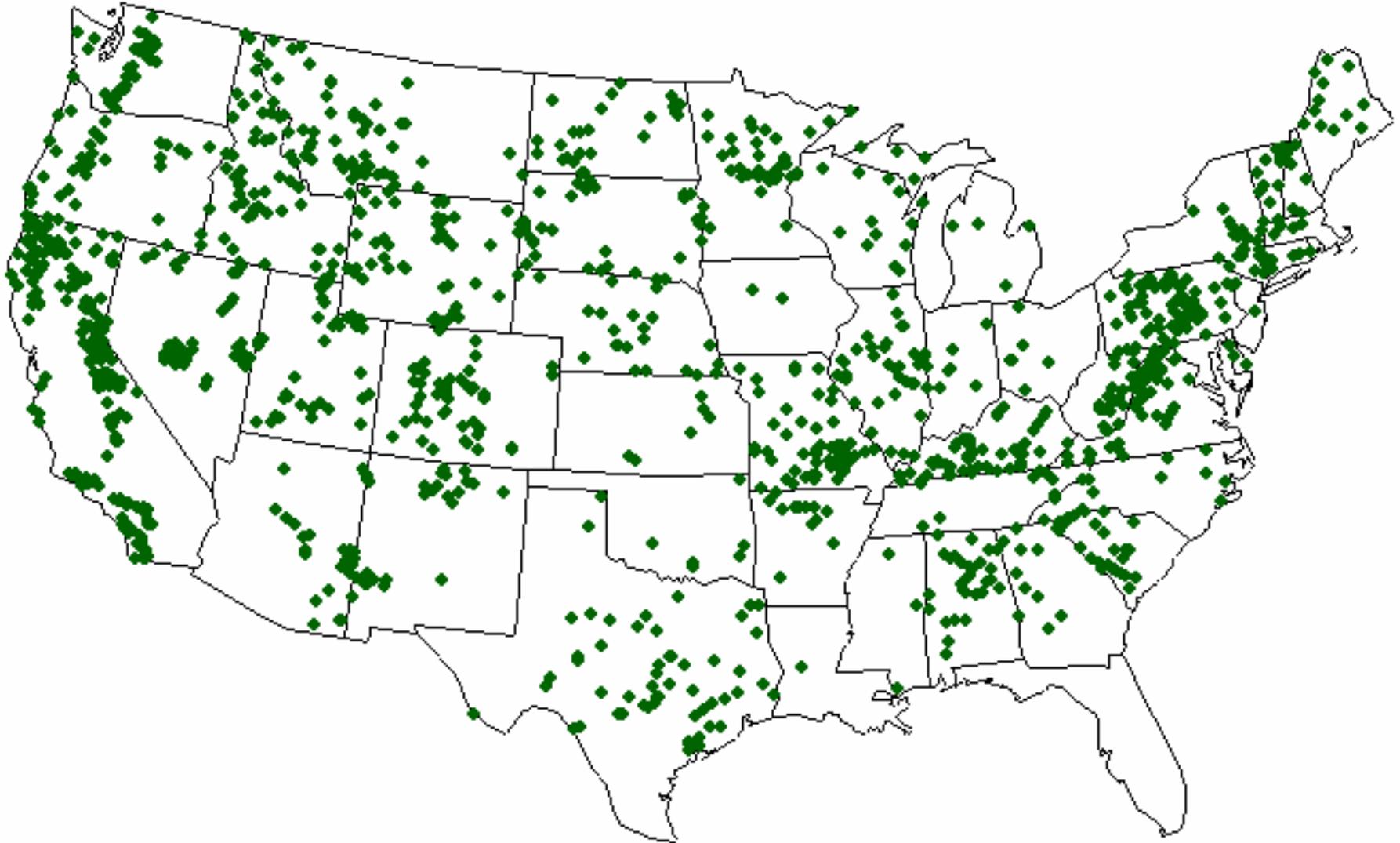
Sum of taxa
pc's estimates
the number of
taxa (E) that
should be
observed given
standard
sampling.



Taxon	pc	O	O ₂	O ₃
<i>Atherix</i>	0.92	●	●	
<i>Baetis</i>	0.86	●		●
<i>Caenis</i>	0.70		●	●
<i>Drunella</i>	0.63		●	●
<i>Epeorus</i>	0.51	●		
<i>Farula</i>	0.32			
<i>Gyrinus</i>	0.07			
<i>Hyalella</i>	0.00		●	
E	4.01	3	3	3

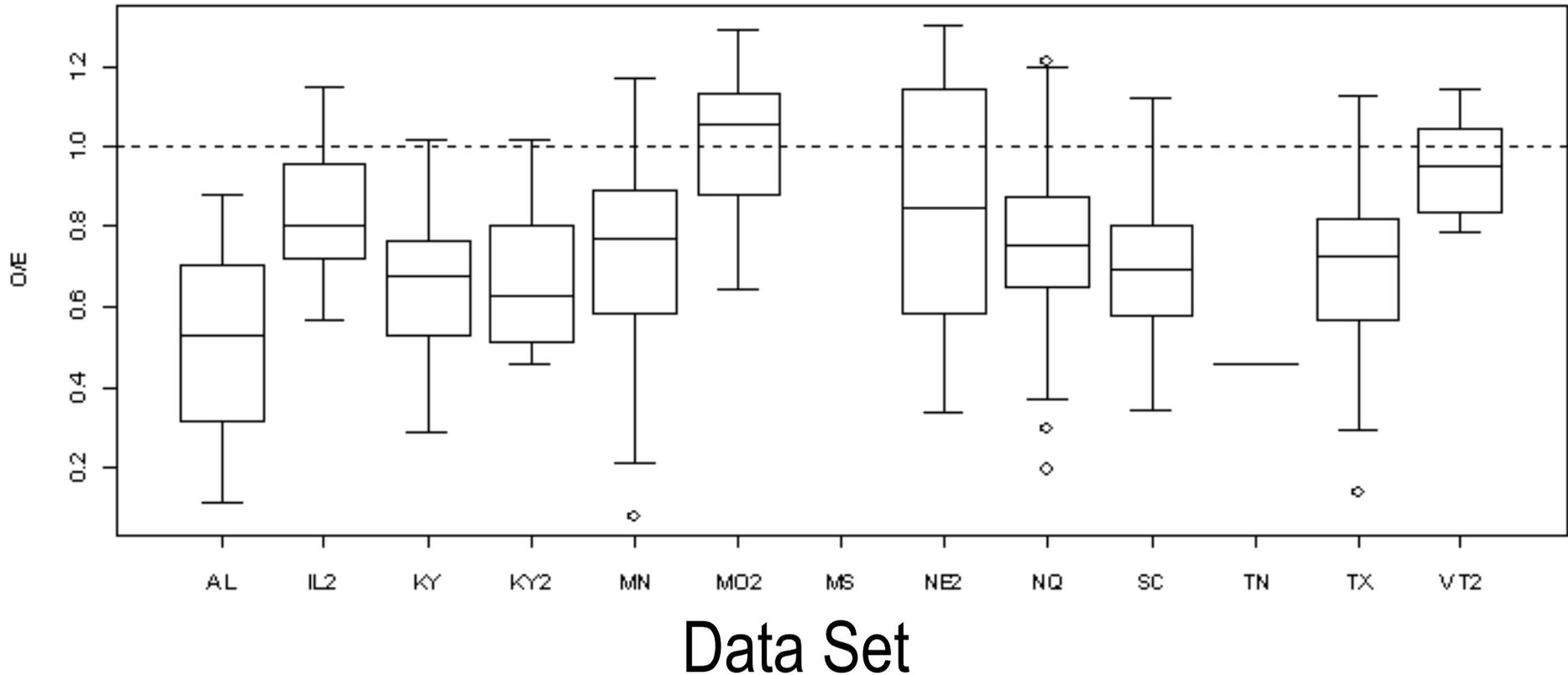
$$O/E = 3 / 4.01 = 0.75$$

1,625 Initial Reference Sites: EMAP + WSA + STAR + NAWQA + States



State Reference Site Samples Tended to Have Low O/E Values Because of Differences in Sampling Method/Effort.

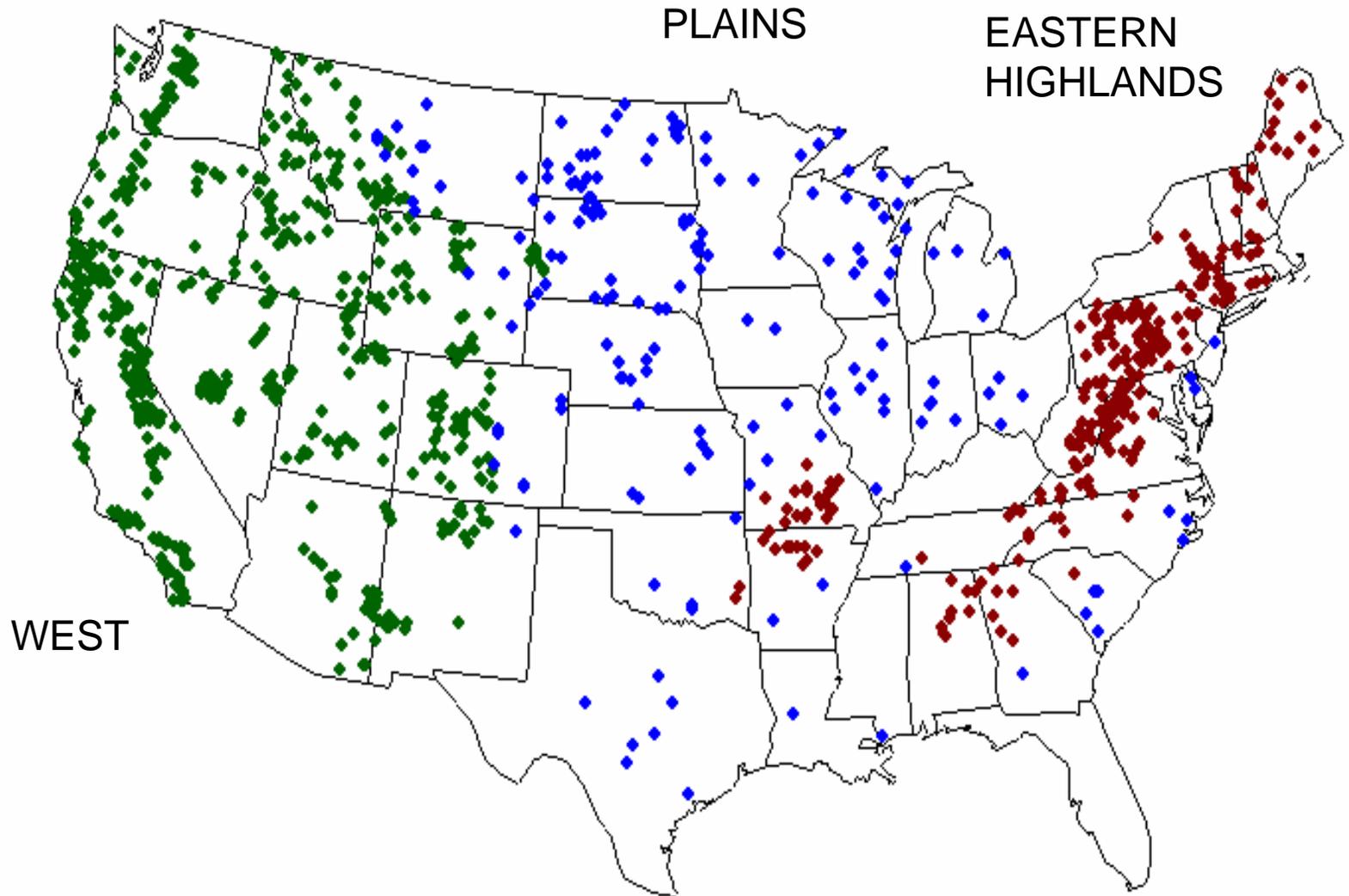
Dropped State Data From Model Building



WSA Models

- Initially built one nation-wide model.
- Performance surprisingly good considering its geographic scope, but desired better accuracy and precision.
- For the WSA, settled on 3 “regional” models, defined on the basis of aggregated ecoregions.

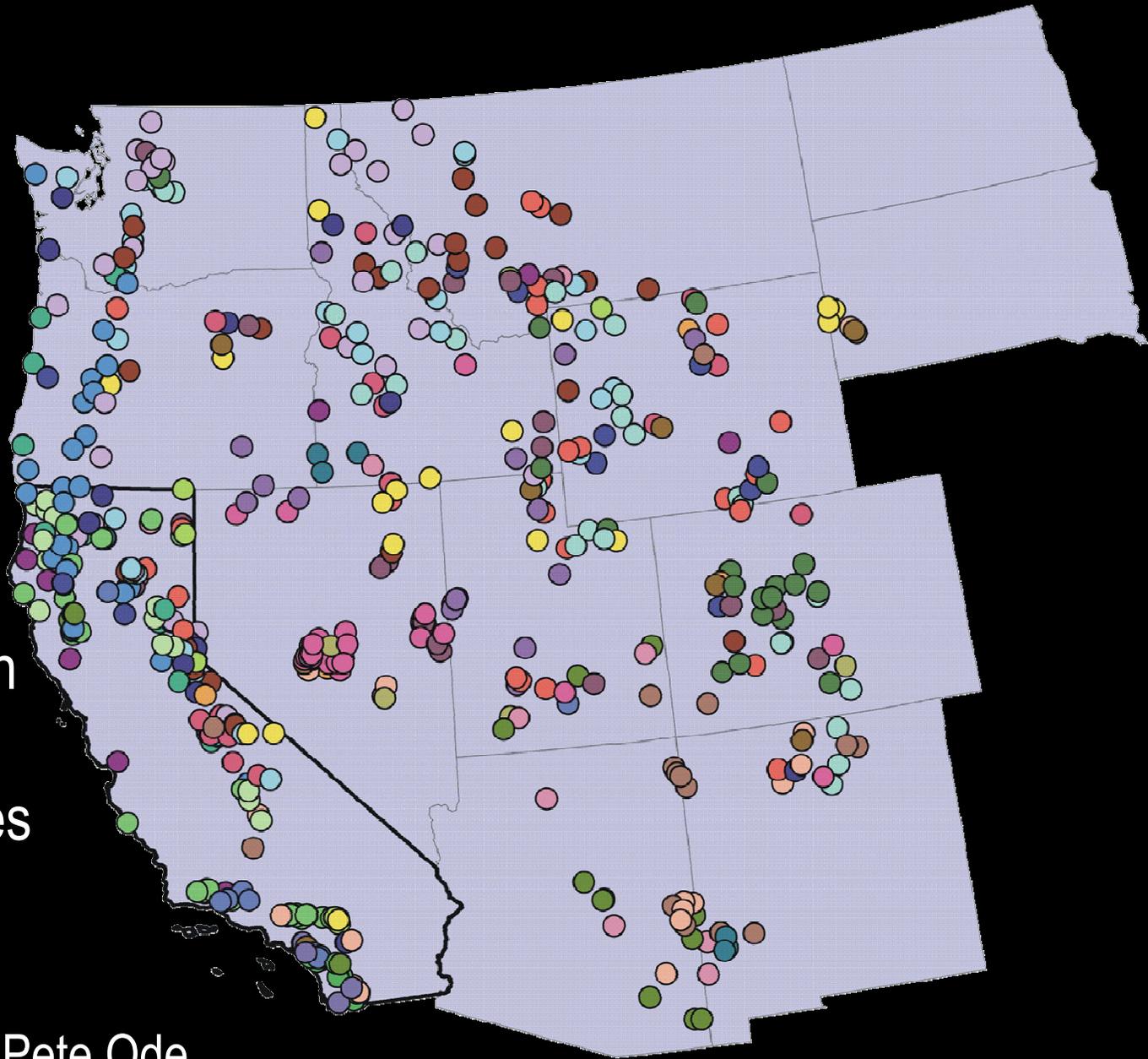
1097 Reference Sites in 3 Super-Ecoregions



Sample Sizes

	WEST	PLAINS	EAST
Calibration	527	140	217
Validation	125	40	48

Western Model
used 30 classes
of streams for
modeling



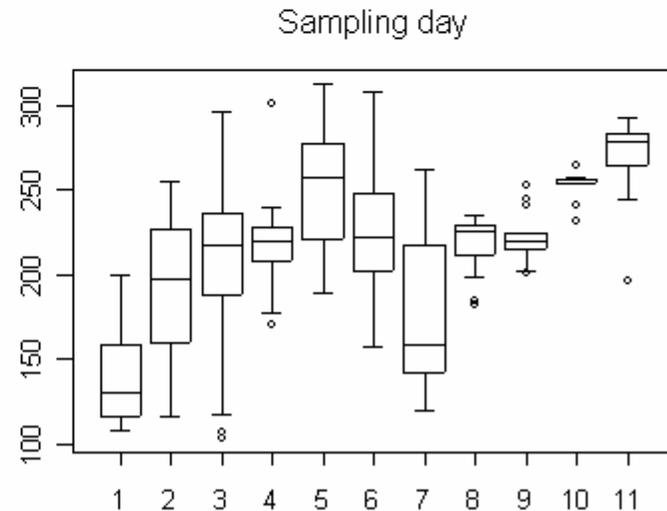
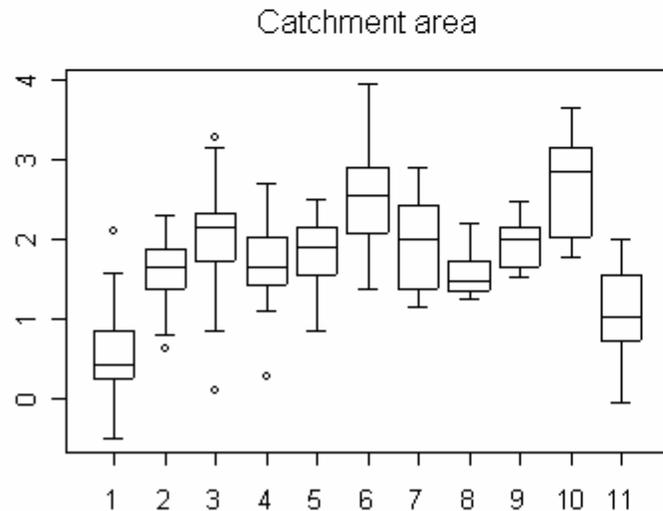
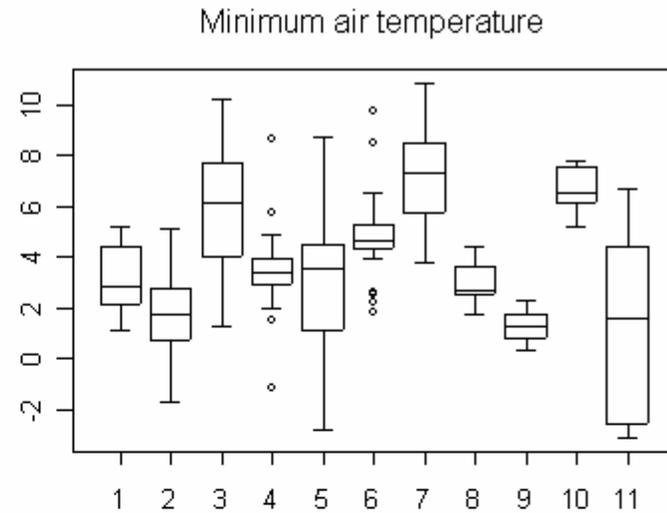
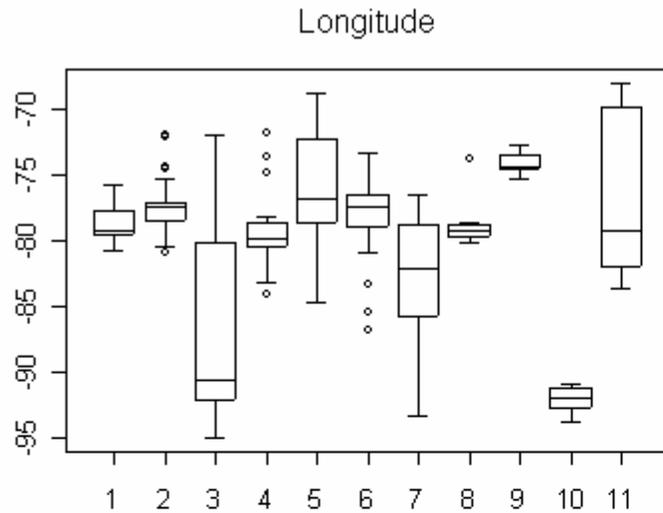
Great variability in
geographic
distribution of sites
within classes.

Graphic courtesy of Pete Ode.

Predictor Variables

West	Plains	E. Highlands
Longitude	---	Longitude
Elevation	Elevation	---
Air Temperature	Freeze-Free Days	Air Temperature
Day of Year	Day of Year	Day of Year
Basin Area	Basin Area	Basin Area
Stream Slope	Stream Slope	---
Log Precipitation	Log Precipitation	Wet Days

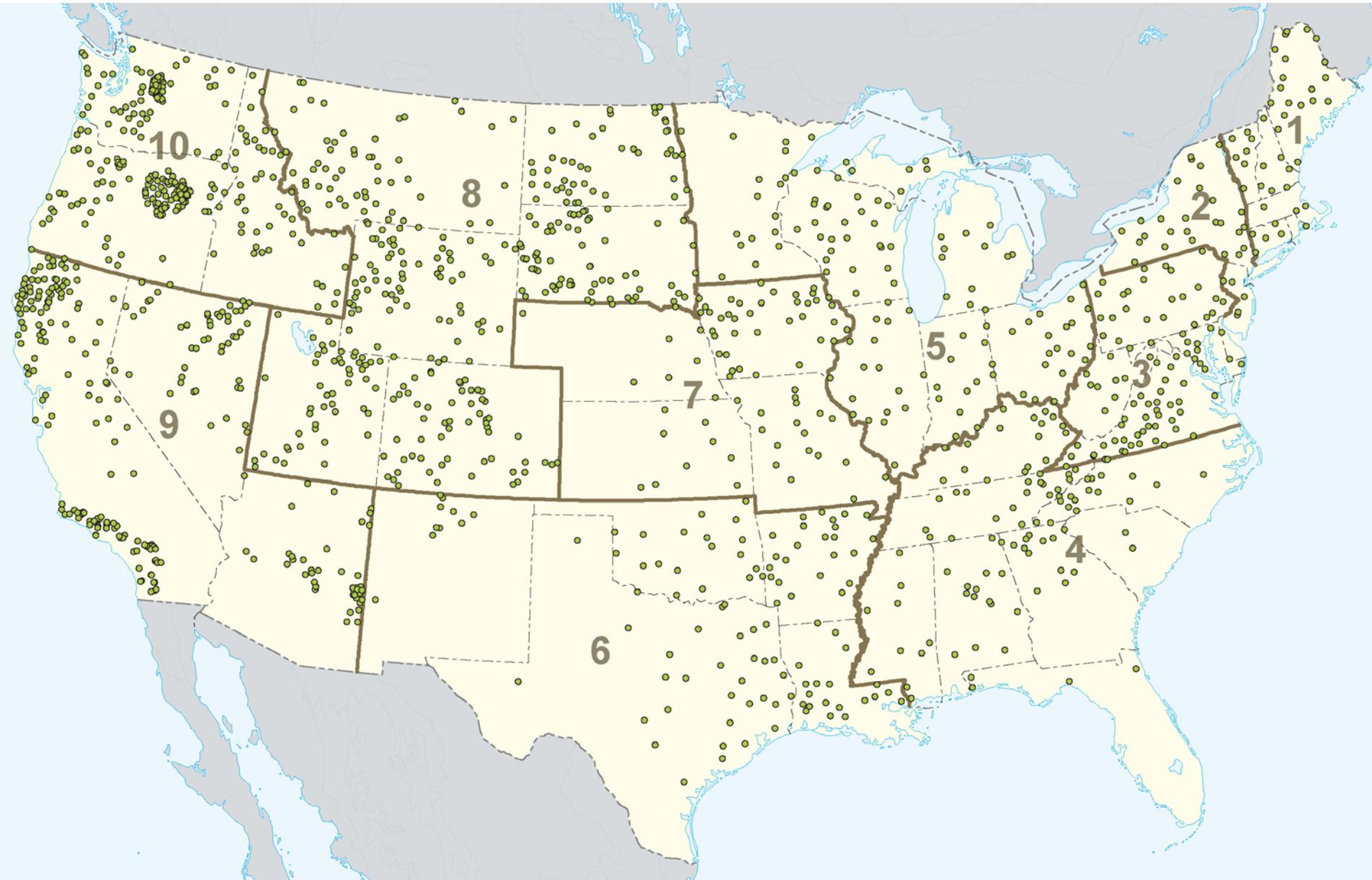
Variation in Predictor Variable Values Within and Among the Eastern Highland Reference Site Classes



Model Performance

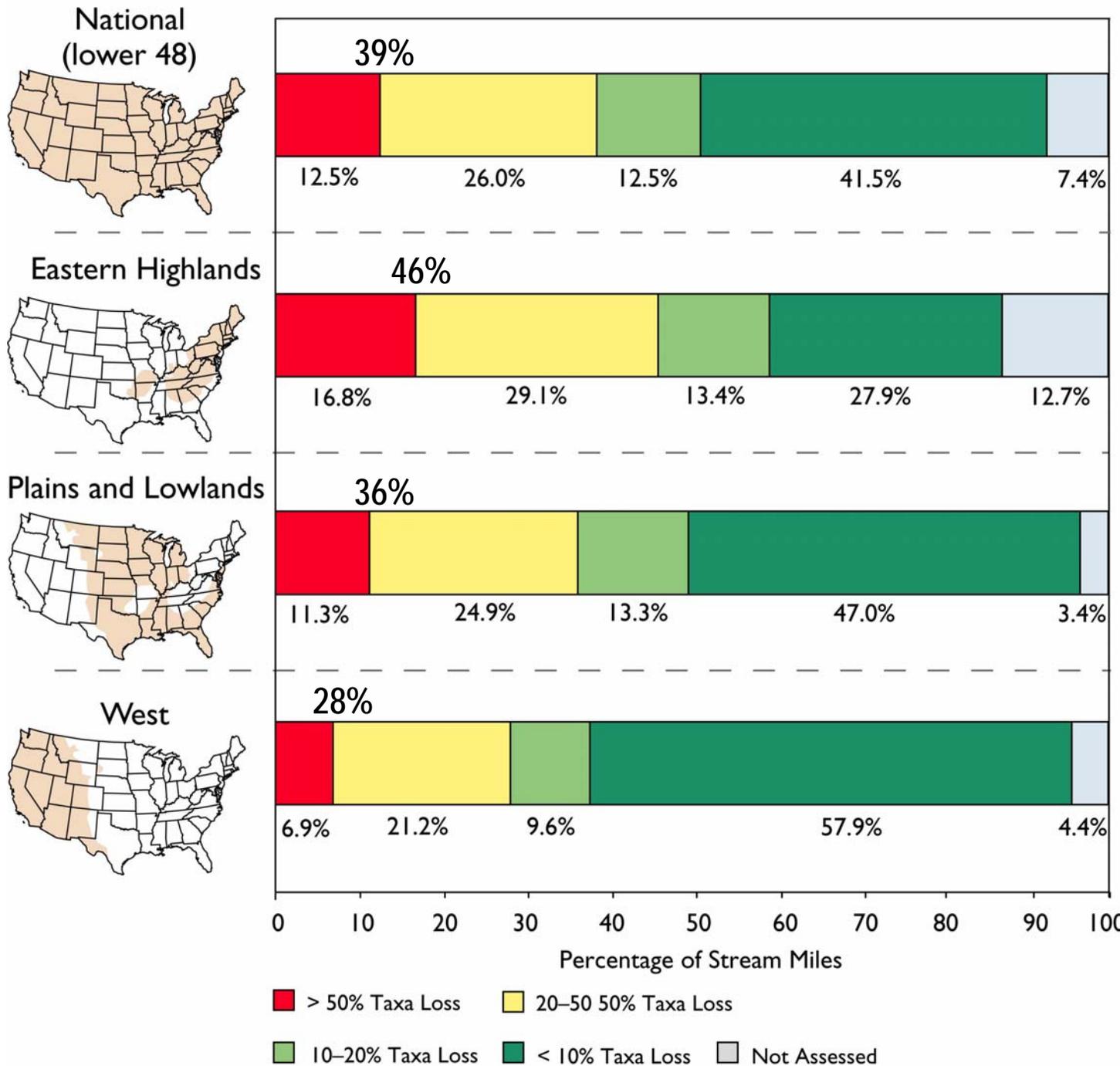
<u><i>Validation</i></u>	West	Plains	East Highlands
Mean	0.99	0.95	0.99
SD (model)	0.20	0.24	0.18
SD (null)	0.26	0.30	0.22
<u><i>Test Sites</i></u>			
Mean	0.84	0.86	0.81

1382 Probabilistic Sample Sites for the Wadeable Streams Assessment.



Biodiversity status of the Nation's streams as measured by O/E:

Data summarized as % of stream miles in each of 4 O/E classes.



Concluding Remarks

- Interpretation of O/E assessments must be tempered by variation in reference site quality across regions.
- Assessments are also almost certainly conservative because of:
 - Coarseness of taxonomy used to ensure consistency across the Nation, and
 - Tendency for models to ‘over-predict’ (see next talk by Ode et al.).
- O/E is one piece of the WSA that should better inform water resources protection and restoration.