Housekeeping Items

- Non-substantive rule changes
  - Any comments or questions?
- Substantive changes excluding Antidegradation and Narrative Standards
  - Any comments or questions?

Wetlands

- What are the issues with current criteria?
- What are the short- and long-term solutions?
- How we will ensure protection of the uses with the changes?

Programmatic Issues Surrounding these Wetlands

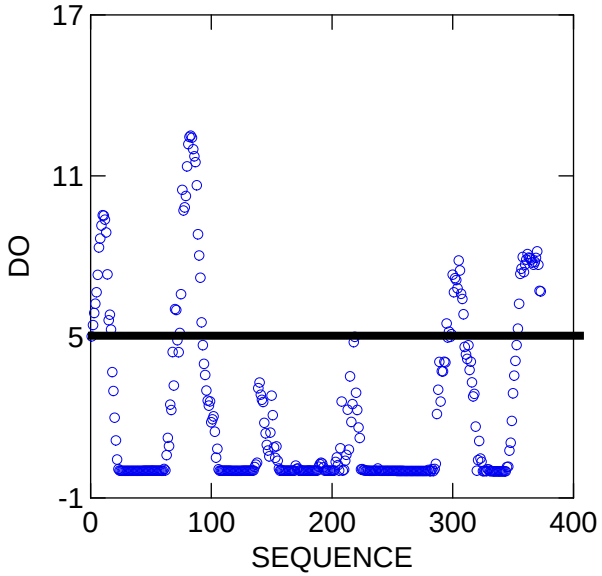
Historically, Great Salt Lake Wildlife Management Areas (WMAs) have had 3B and 3D aquatic life use designations with associated numeric standards.

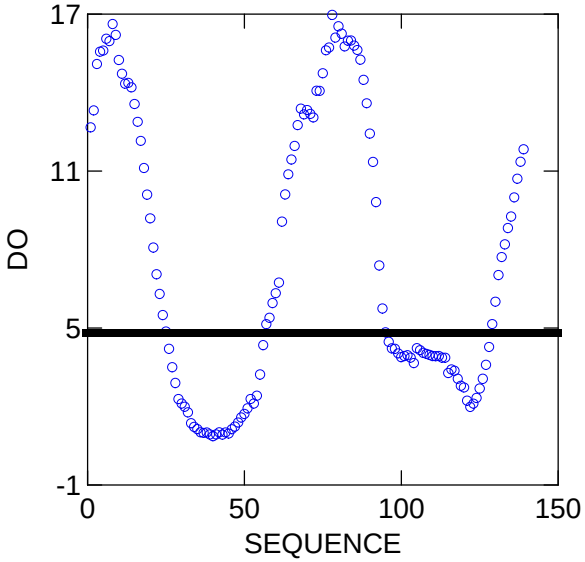
<u>This presents at least three problems</u>

1) The **boundaries are political, not ecological**, and different species use different wetland classes, which alters interpretation of biological uses.
2) **Not all of the wetlands around the Great Salt Lake are expressly protected** and many of these water are important to our stakeholders.
3) **Some numeric criteria**, currently universally applied to all waters in WMAs **may not be appropriate**. In particular, the current DO and pH criteria are not appropriate for impounded wetlands.

Our last changes to water quality standards attempted to address the boundaries to some degree by creating a wetland class for the sloped wetlands, however broader changes to our standards are needed.

Water Quality Concerns in GSL Impounded Wetlands





Problems Associated with Existing DO & pH Criteria

- All impounded wetlands show WQS violations
- High temporal variation (daily, seasonally)
- Patterns are ecologically relevant, yet these data are difficult to obtain
- Diurnal patterns are altered by weather

An alternative approach is needed that provides data that are more reflective of designated use support..

Standards Discussion Excel Table

Biological Assessments: The Regulatory Basis

EPA considers both DO and pH criteria to be "basic" to all State standards, however narrative statements are possible provided that it can be demonstrated that the use remains protected.

"**Regardless of whether changes or modifications in uses are made, criteria protective of the use must be adopted**."

One way to ensure protection of aquatic life designated uses is to devised methods that allow the relative biological health of biological assessments to be directly quantified.

These "biological assessments" are referenced numerous times in the CWQ and associated regulation, and are an integral part of water quality programs nationwide.

Proposed Short- and Long-term Changes to our WQSs

Ultimately…

Create Additional Use Classes for all Wetlands & appropriate changes to numeric criteria, which requires:

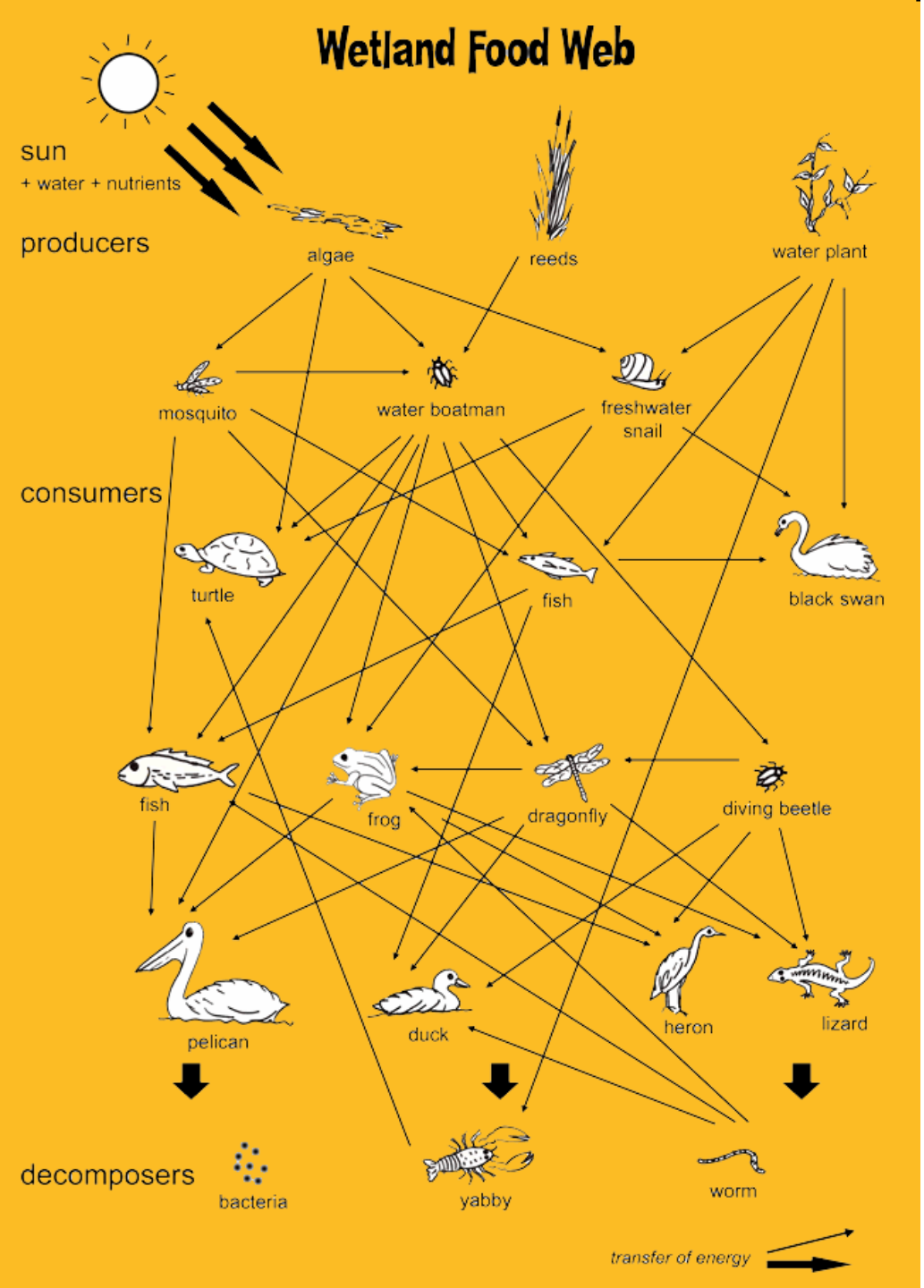
- A Use Attainability Analyses (UAA) to justify the change in use;
- Clear and concise definitions of key wetland classes and maps;
- documentation and evidence that new standards will protect the uses.

We are making progress on all of these steps, but work remains for each product.

Short-term Fix…

Fix the most urgent issues, which are the DO and pH criteria in WMA impounded wetlands with a footnote to standards.

A biological assessment framework will need to accompany the standards package for any of these changes to show that the uses will remain protected.



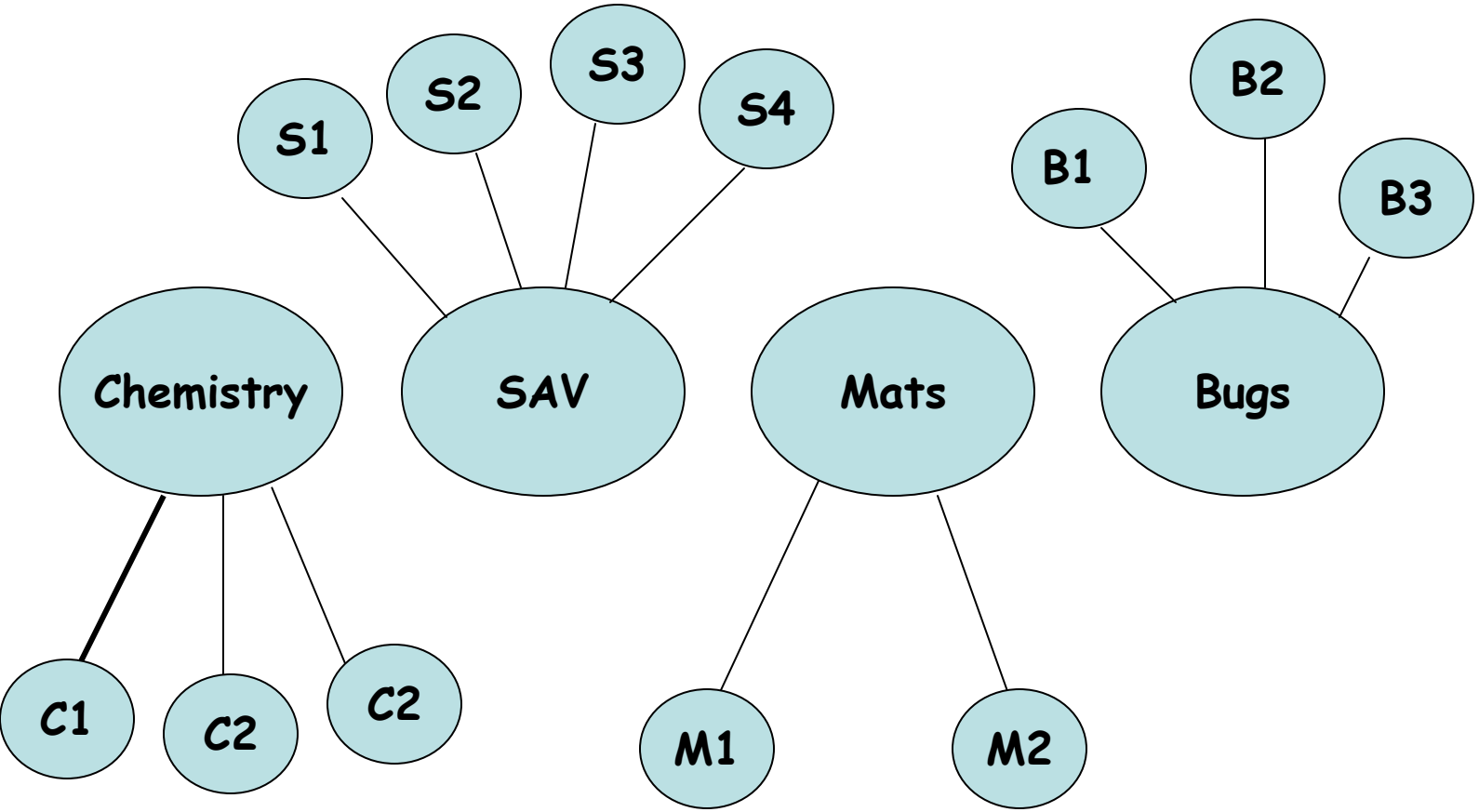
What to Measure?

Standards to support aquatic life uses should be established that protect the most sensitive organisms.

Numerous methods are employed to measure biological composition, which are generally combined into a single measure of condition.

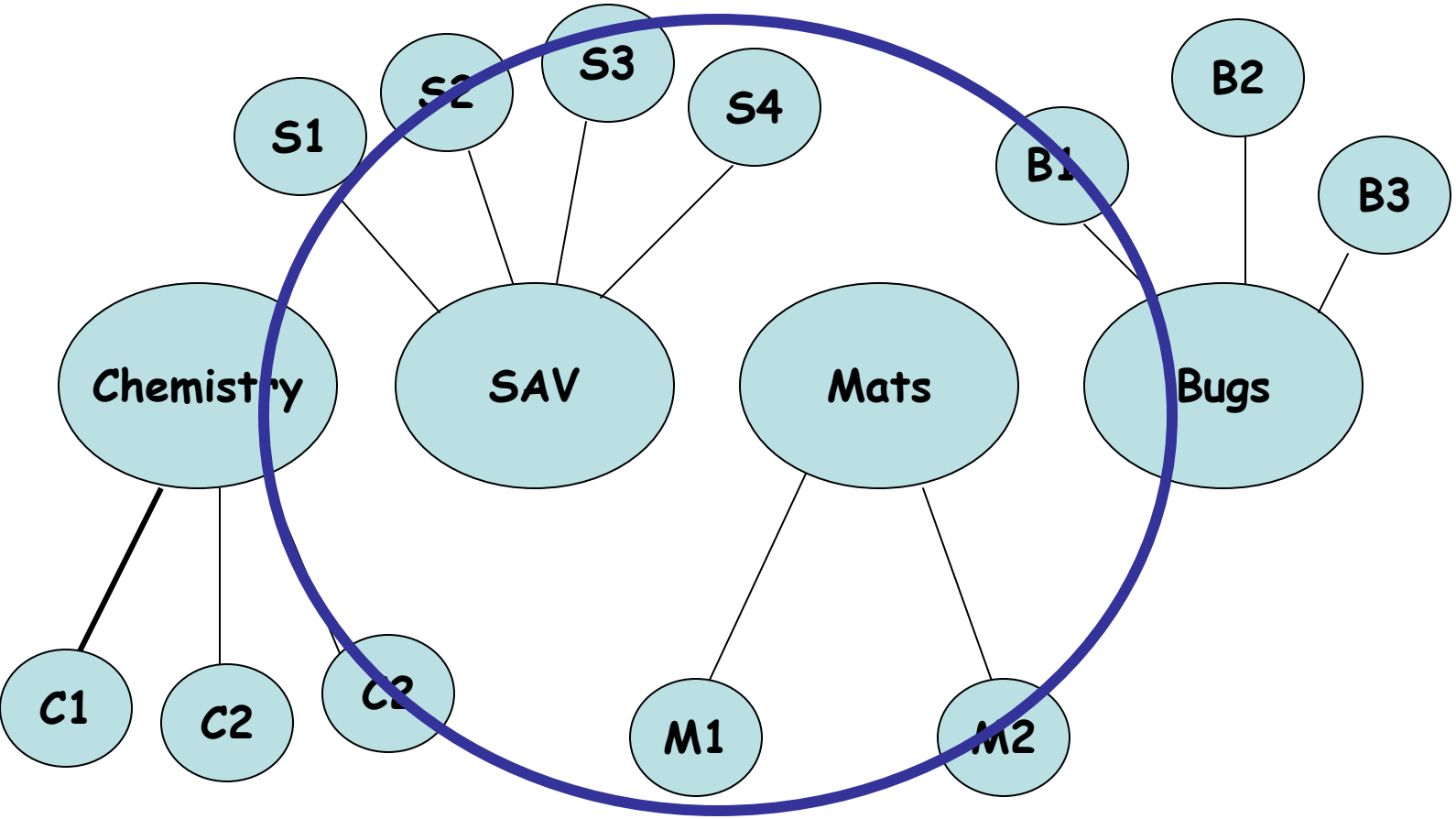
Robust standards and associated assessment methods should identify threatened waterbodies before major problem arise.

Bringing it all Together: Multiple Lines of Evidence to Measure the Condition of Impounded Wetlands



Multiple indicators paint a more complete picture of condition.

An Example of How an Assessment Framework Works



Focus for our conversation on the SAV and Mat lines of evidence.

The Role of the MMI with Regard to the Change to Standards

- The framework will accompany the change to standards to provide a framework that describes how we will ensure protection of the use
- The framework will also include a timeline for refining the MMI over the next two years

The Surface Mat Story

- Extensive surface mats of algae and/or duckweed occur at some, but not all ponds.

- Sometimes the mats cover the entire surface of the ponds and can be inches thick!

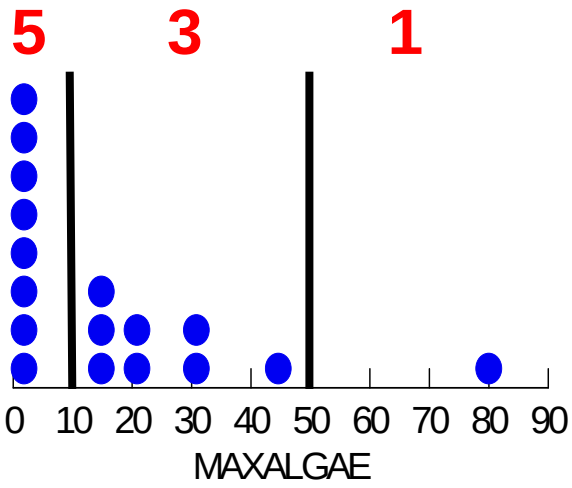
- Field notes indicate that when the mats die, they often create a blanket that literally crushes SAV

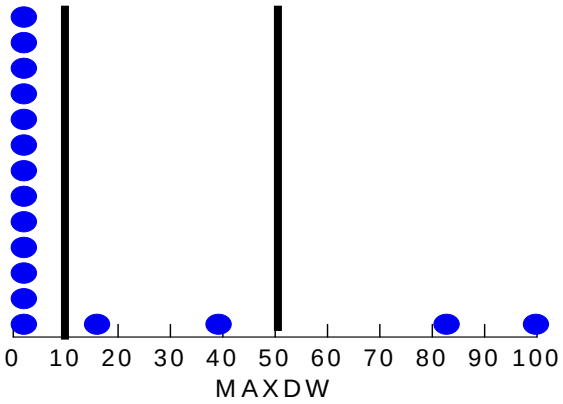
- Especially for thick mats, they block light sometimes below the requirements of SAV.

- These are a big part of the complaints of duck club stakeholders: gross, stinky, difficult to walk or boat through.

- May or may not affect wildlife use.

Surface Mat Measure of Condition



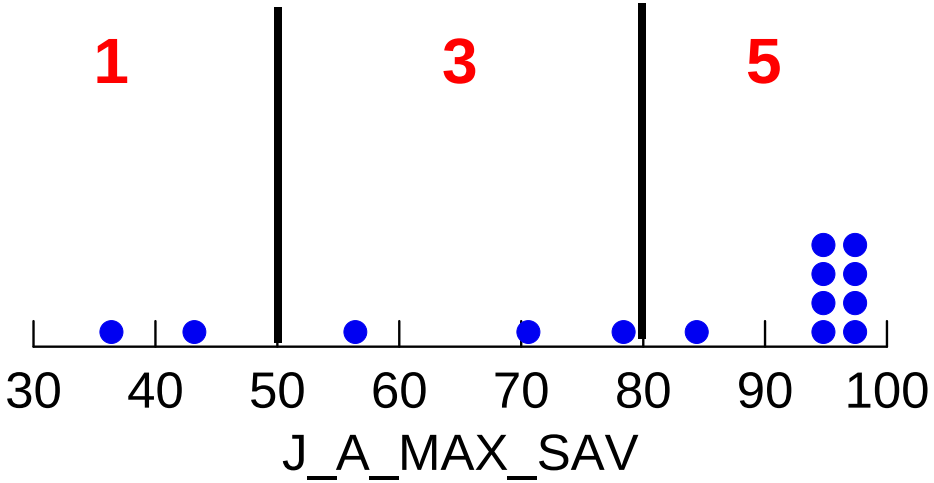


- Ponds can have mats that consist of algae, duckweed, or both.
- Most sites did not indicate problems.
- Scoring schemes are used to allow measures of condition to be combined are easily interpreted.

The Submerged Aquatic Vegetation (SAV) Story

- The ponds are managed for SAV as a source of duck food, especially important during fall migration
- When the duck arrive in the fall, they eat most remaining SAV, which then reached peak abundance in July or August.
- At some ponds SAV has a tendency to "tank" before the ducks arrive.

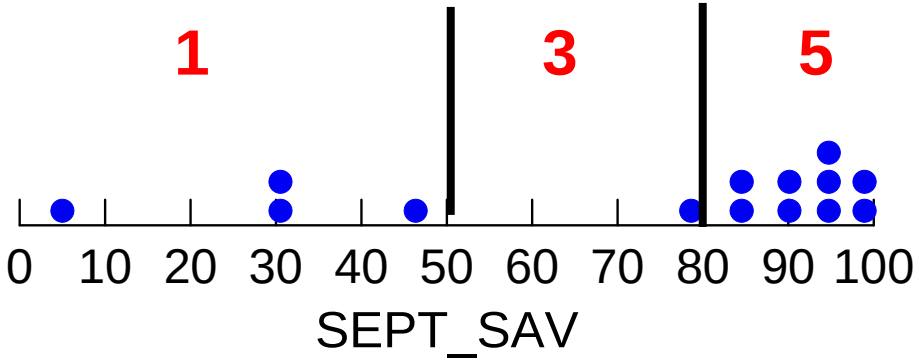
Maximum SAV Cover in July/August



This metric was selected because it represents SAV abundance, independent of the "tank" issue.

Concept: Some sites may have relatively low SAV, yet not tank, so looking at fall cover alone only tells part of the story.

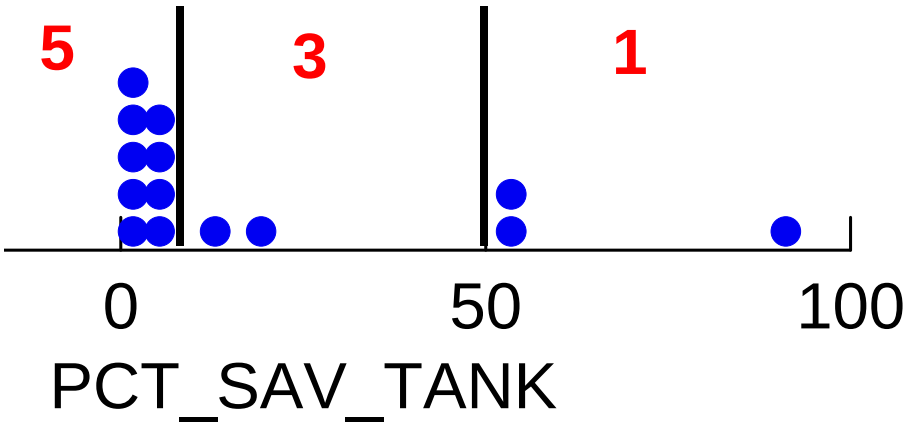
Fall (September) SAV Cover



This metric is essentially a measure of the overall amount of duck food that is available during fall migration.

From a duck centric view of beneficial uses, this is among the most important measure of use support.

Percent Change in SAV



This is our SAV "tank" metric.

Other measures were evaluated, but the percent change was selected because it accounts for initial conditions.

Preliminary Results: It is not all About Chemistry

Good Condition, high nutrients	Poor Condition, high nutrients
Algae Mat = 3	Algae Mat = 3
DW Mat = 5	DW Mat = 1
Maximum SAV = 5	Maximum SAV = 5
Sept SAV = 5	Sept SAV = 1
Percent "Tank" = 5	Percent "Tank" = 1
Total = 23	**Total = 11**
Relative N = 1.4	Relative N = 1.4
Relative P = 3.1	Relative P = 4.0

Preliminary Results: An Example of Extremes

The Best Site

Algae Mat = 5
DW Mat = 5

Maximum SAV = 5
Sept SAV = 5
Percent "Tank" = 5

Total = 25

Relative N = 0.6
Relative P = 0.8

The Worst Site

Algae Mat = 3
DW Mat = 1

Maximum SAV = 1
Sept SAV = 3
Percent "Tank" = 1

Total = 9

Relative N = 2.7
Relative P = 5.5

The Proposed Change to Rule

- DWQ proposed to add the following footnote to the pH and DO criteria:

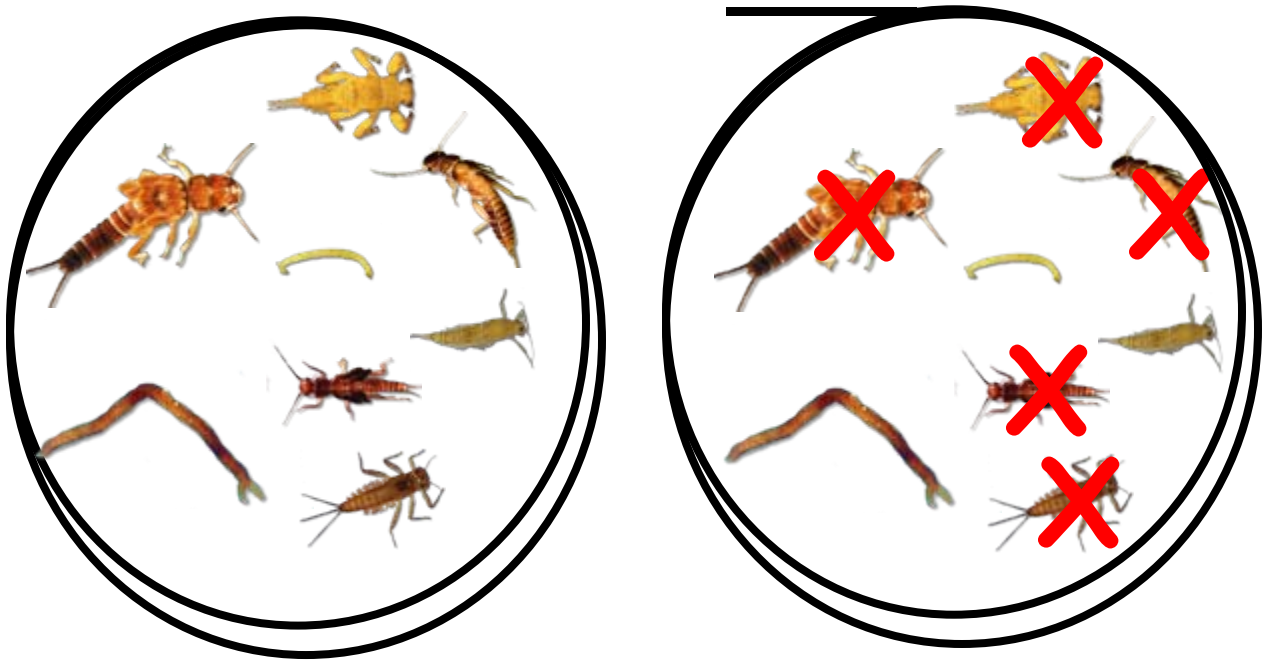
"These limits are not applicable to Class 3D wetlands"

Proposed Changes to Narrative Standards

- DWQ currently uses an empirical model to assess the biological integrity of streams
- Biological assessment approaches are an integral part of our monitoring strategy
- The current assessment methods are made based on a tie to our narrative standards, but we believe that this should be more explicit

What is O/E?

O/E is a measure of the taxonomic completeness of the biological community observed at a site

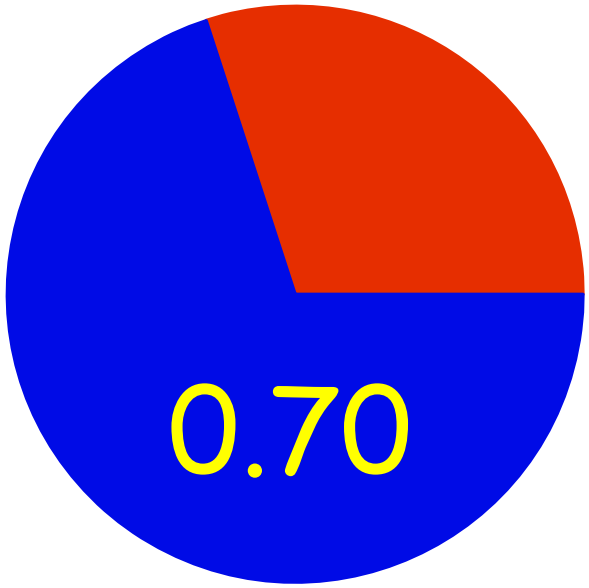


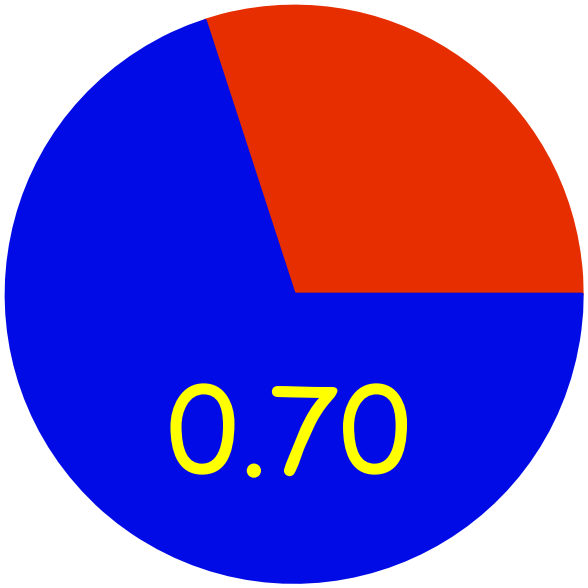
$$\frac{O}{E} = 0.38$$

Expected taxa = 8 **O**bserved taxa = 3

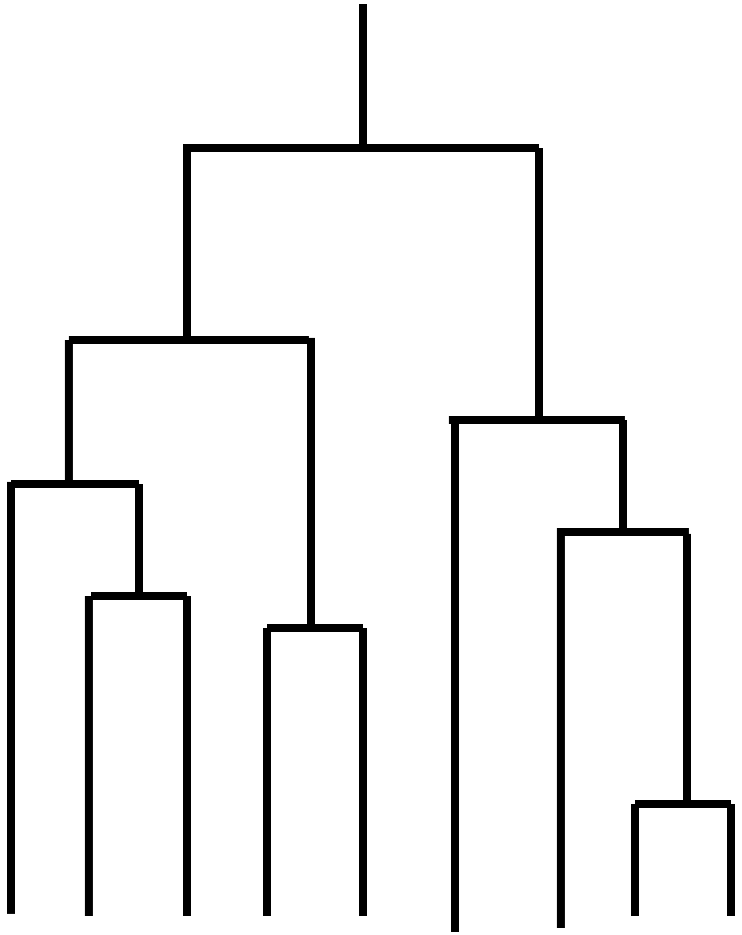
O/E standardizes assessments across sites that differ naturally in the number of expected taxa

Site 1	Site 2
O = 7	O = 21
E = 10	E = 30





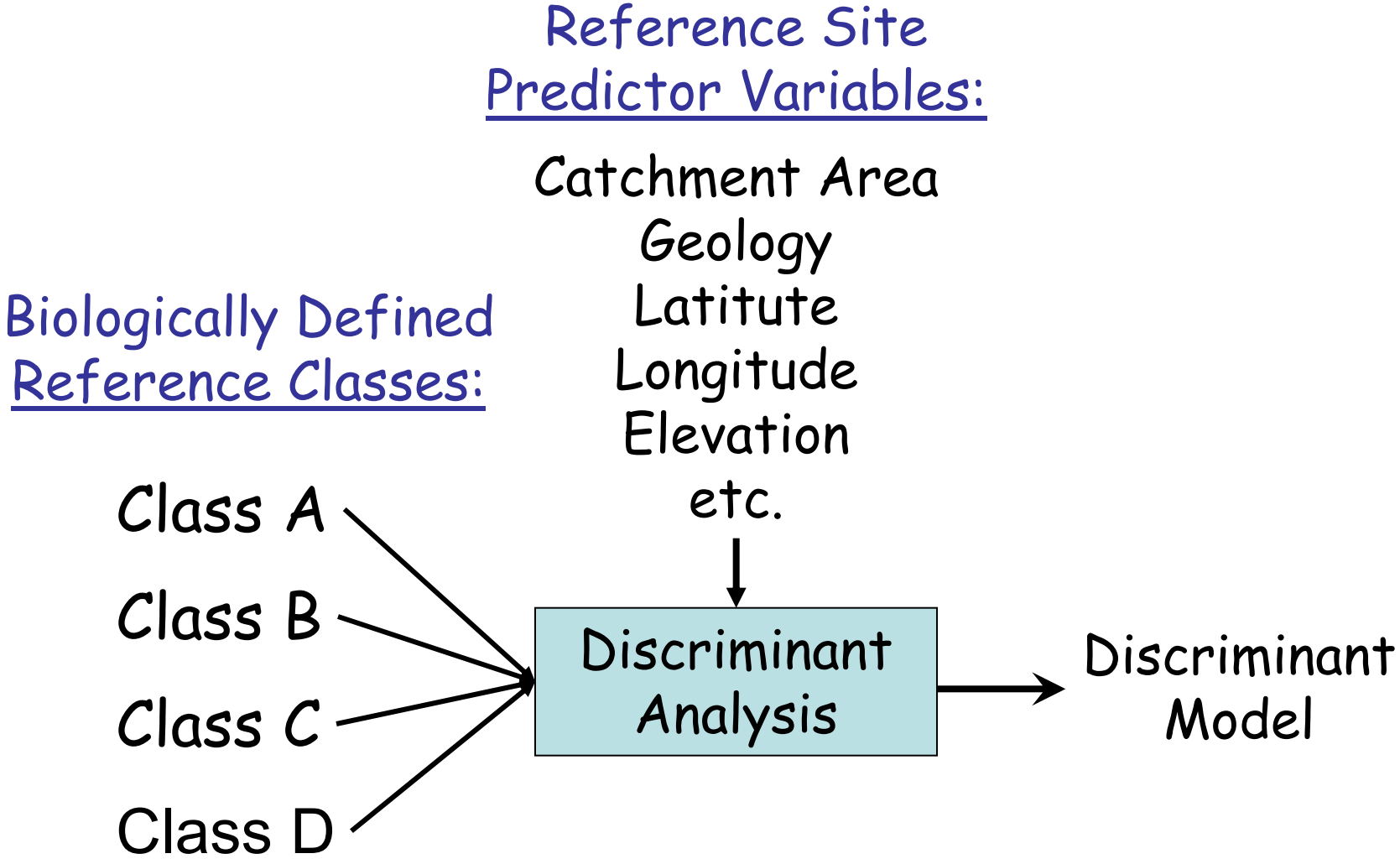
The First Step: Classify Reference Sites by Similar Biological Assemblages



Use cluster analyses (Flexible beta UPGMA)

Point is to let the biota determine similarity among reference sites.

Develop Discriminant Model to Classify New Sites



Use Discriminant Model Output + Frequencies of Occurrence within a Class to Estimate Probabilities of Capture for a Single Taxon, e.g., *Drunella*

Predictor Variables Values

↓

Discriminant Model

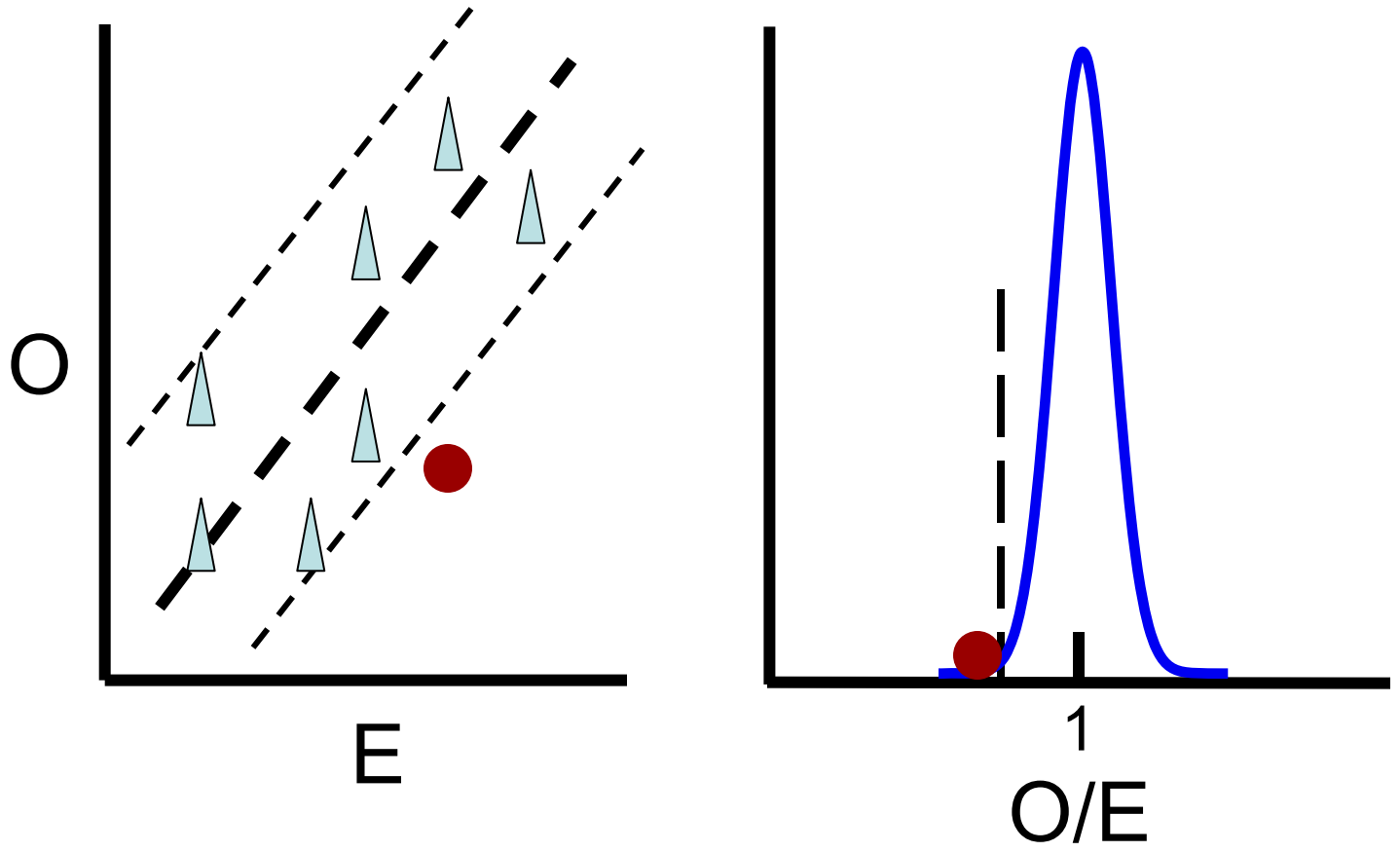
Class	Probability of Class Membership	Frequency of Taxon in Class	Contribution to PC
A	0.5	0.6	0.30
B	0.4	0.2	0.08
C	0.1	0.0	0.00
D	0.0	0.0	0.00
Probability of Being in Sample if Site is in Reference Condition			0.38

Modeling E

- What and how many predictor variables?
- Model performance:
  - SD of reference O/E values
  - Compare with potentially confounding variables
- Used Random Forests and code generated in the program 'R'

Need to Estimate Prediction Error for Individual Site Assessments

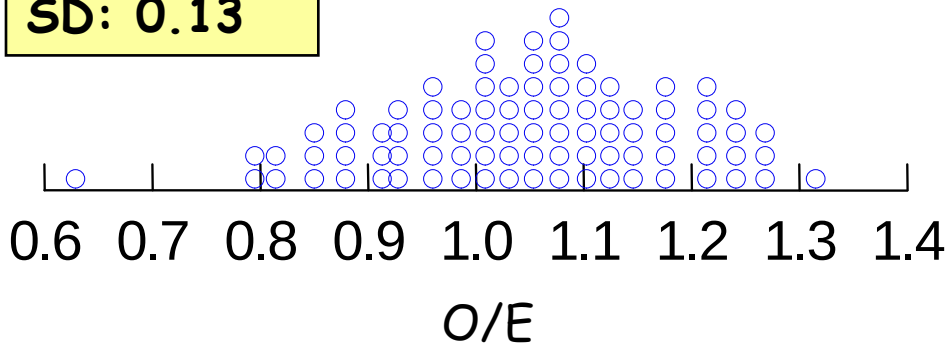
Is a site with O/E = 0.8 based on one sample impaired?



Fall RF Model

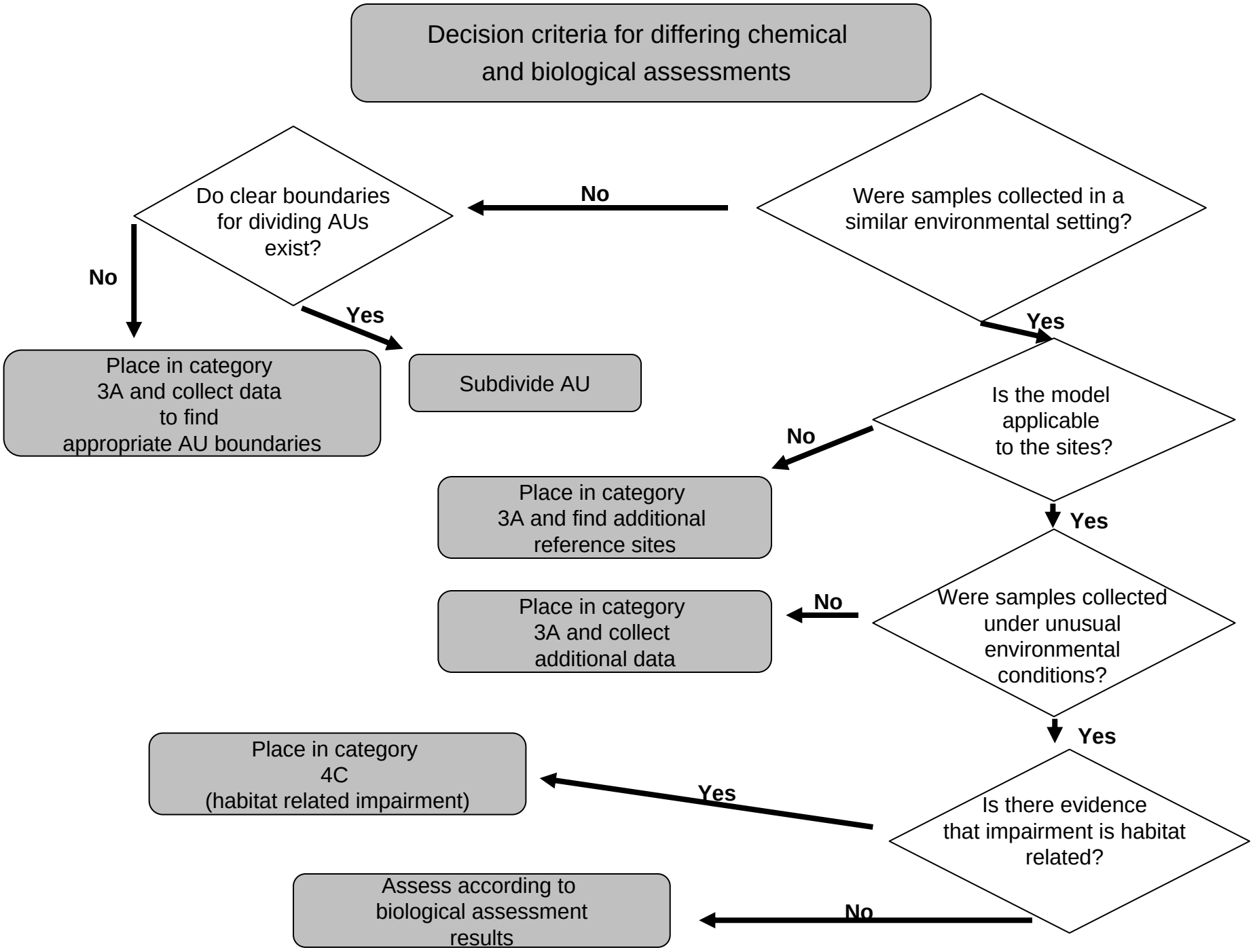
Overall the model performed quite nicely!

Mean: 1.05
SD: 0.13



15 Variables Used

MINWD.WS
BDH.AVE
G.PH.STD
AWCH.AVE
GPT.VOLC
ELEV.MAX
FST32AVE
MEANP.PT
SQ.KM
TMEAN.WS
MINP.PT
ELEV.WS
SLOPE.GIS
LST32AVE
TMEANNET


Decision criteria for differing chemical and biological assessments
Were samples collected in a similar environmental setting?
No
Do clear boundaries for dividing AUs exist?
No
Place in category 3A and collect data to find appropriate AU boundaries
Yes
Subdivide AU
Yes
Is the model applicable to the sites?
No
Place in category 3A and find additional reference sites
Yes
Were samples collected under unusual environmental conditions?
No
Place in category 3A and collect additional data
Yes
Is there evidence that impairment is habitat related?
Yes
Place in category 4C (habitat related impairment)
No
Assess according to biological assessment results

Previous Outreach Efforts

- Many rounds of internal review
- Held two stakeholder discussions
- Presented to the Water Quality Board
- Formal comments through the IR process

Making the Process Formal in our Standards

1.* "Aquatic organism" means any plant or animal which lives at least part of its life cycle in water.

1.* "Biological condition" means the taxonomic composition, richness, and functional organization of an assemblage of aquatic organisms at a site or within a water body.

1.* "Functional organization" means the number of species or abundance of organisms within an assemblage which perform the same or similar ecological functions.

1.* "Metric" means an expression of biological community composition, richness, or function which displays a predictable, measurable change in value along a gradient of pollution or other anthropogenic disturbance.

1.* "Reference sites" are sites that are determined to be representative of sites or waterbodies of similar type (e.g., hydrology and ecoregion) and are least impaired with respect to habitat, water quality, watershed land use, and riparian and biological condition.

1.* "Richness" means the absolute number of taxa in an assemblage at a site or within a water body.

1.* "Taxonomic composition" means the identity and abundance of species or taxonomic groupings within an assemblage at a site or within a water body.

Handout #1

Making the Process Formal in our Standards

The taxonomic composition, richness or functional organization of an assemblage of aquatic organisms shall not differ from comparable measures observed at reference sites. Violations of this criterion will be determined using scientifically defensible and statistically rigorous methods and other information.

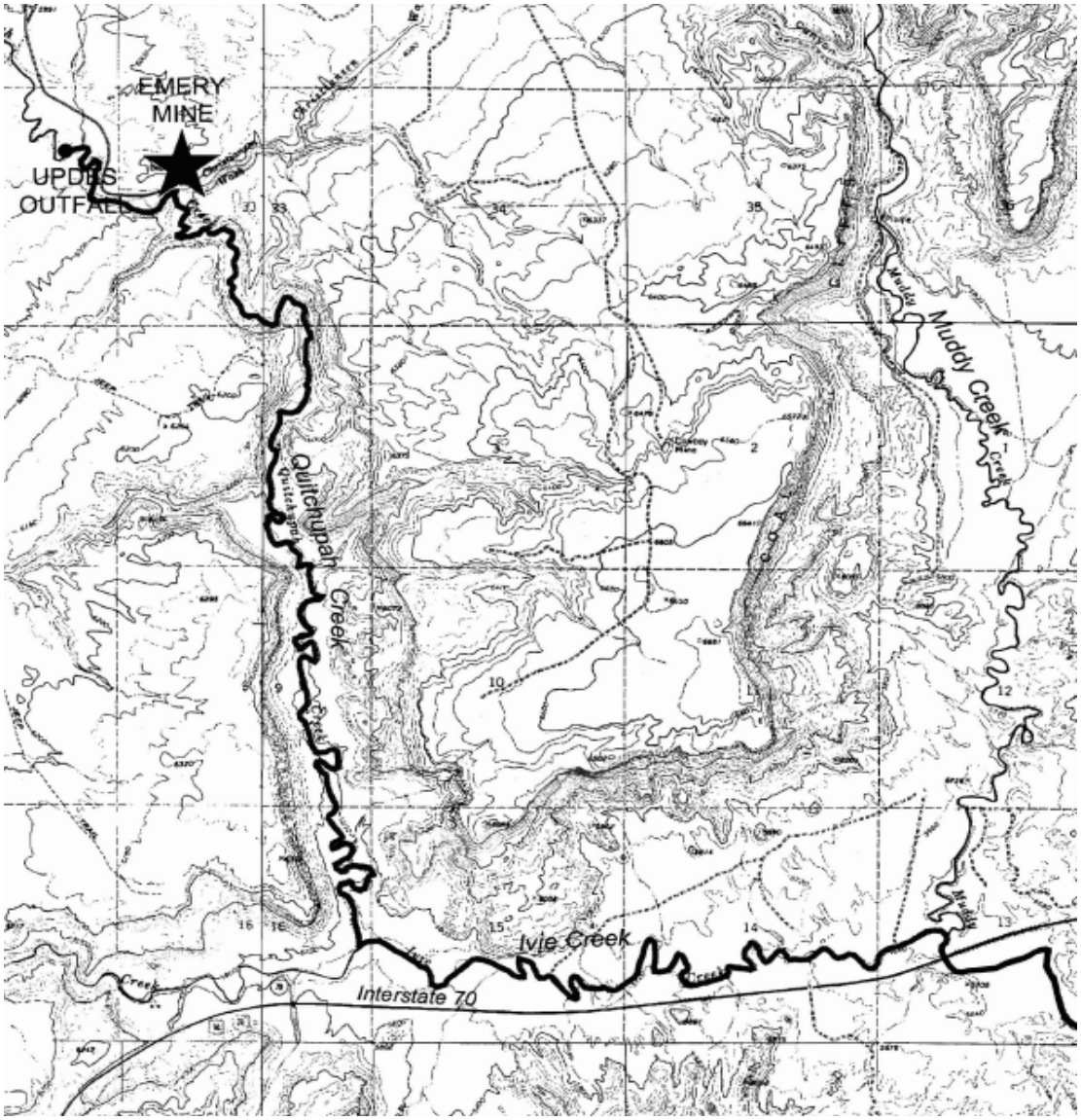
This biological criterion alone shall not be used for regulatory and enforcement actions, such as the development or enforcement of Utah pollution discharge elimination system permits. However, biological assessment methods that have been approved by the Executive Secretary, following consultation and review by the Board and other interested parties, may be used to assess support of biological uses as assigned in R-317-2-6. Biological assessment methods may also be used, in combination with other information, to support the development of site-specific standards, new or refined aquatic life use categories, or to support the need for new permit limits.

Page 12, handout two (mark-up of standards changes)

Site-Specific Standards

- Consolidation Coal Company Emery Mine
  - Permitted discharge of intercepted groundwater
  - Requested a revised site-specific standard of 3,800 mg/L for TDS.
  - Site-specific standard for Quitchupah Creek is 1,700 mg/L

Consolidation Coal Company



Regulatory Requirements for Site-Specific TDS

- A less stringent criterion is appropriate because of natural or un-alterable conditions, or
- a less stringent site-specific criterion is protective of existing and attainable agricultural uses; or
- a more stringent criterion is attainable and necessary for the protection of sensitive crops.

Consol. Coal Emery Mine

- Current use of water is for livestock grazing on BLM land
- No current crop irrigation
  - No current irrigation water rights, stream fully allocated
  - Soils not conducive for growing crops
  - Physical challenges of installing irrigation

Two Issues:

- Is TDS an appropriate measure?
  - Substitute constituent-specific standards
  - Use of SAR for protection of irrigation use
- Should the Agricultural Beneficial Use Class be subdivided?
  - grazing livestock
  - dairy livestock
  - CAFOs, e.g., feedlots
  - crops

TDS

- TDS is a non-specific measure
  - Adverse health effects dependent on actual constituents
- Consol. Coal conducted additional analyses for constituents
  - TDS 4,500 mg/L
  - Sulfate 3,000 mg/L
  - Chloride 150 mg/L
  - Sodium 900 mg/L
  - Calcium and Magnesium 400 mg/L

TDS

- DWQ evaluating constituent-specific standards to replace TDS for Agricultural Beneficial Use
- Consol. Coal
  - Sulfate
    - Most toxic constituent in effluent
    - Excess dietary sulfate can reduce feed and water intake, reduce growth, or be fatal
      - Ruminants (cattle) most sensitive receptor
      - Other livestock (e.g., horses) less sensitive

Source	Sulfate Concentration (mg/L)	Comments
Ellis (undated)	500-1500	Generally safe, trace mineral availability may be reduced, may decrease performance in confined cattle
NDSU (2008)	1000	
SDSU (2004)	1500-2500	Notes that water may be significant source of total sulfur.
Raisbeck (undated)	1000	
NRC (2005)	2500	>40% of diet from forage
USU (1997)	1700	
NMSU (2009)	500-1500	Generally safe, may interfere with trace element nutrition
MSU (undated)	2500-3500	Very laxative; not recommended for pregnant or lactating cows, cattle in confinement, horses, or sheep; Unacceptable for poultry. 4500 mg/L not recommended for use under any circumstances.
Patterson and Johnson, 2003	2000-3000	Generally safe but may reduce performance.
Weeth and Hunter (1971) Weeth and Capps (1972)	2500	Assuming hay diet

Consol. Coal

- DWQ White paper recommends site-specific standard of 2,000 mg/L sulfate
- Site-specific standard protective of existing beneficial use
- Will not adversely affect downstream uses
  - Lower TDS concentrations than background in Muddy Creek (5,800 mg/L)
  - Crops are not expected to be a plausible future agricultural use but review incomplete

What happens if water is used for crops?

- Sodium Absorption Ratio (SAR)
  - Ratio of Na to Ca and Mg
  - Appears to be a better predictor of plant stress than TDS
  - Most toxic metals have existing standards

$$SAR = \frac{[Na^+]}{\sqrt{\frac{1}{2}([Ca^{2+}]+[Mg^{2+}])}}$$

Comments?

- Consol. Coal site-specific sulfate standard
- Subdividing agricultural beneficial use classes
- Use of SAR to evaluate beneficial use for crops

Total Dissolved Solids (TDS)

- TDS is imprecise
- DWQ evaluating constituent-specific standards to replace TDS for Agricultural Beneficial Use
  - Sulfate
    - Most sensitive water use is for ruminants (e.g., cattle)
  - Sodium Absorption Ratio (SAR)
    - Ratio of Na to Ca and Mg
    - Most sensitive water use is for crop irrigation
    - Most

$$SAR = \frac{[Na^+]}{\sqrt{\frac{1}{2}([Ca^{2+}]+[Mg^{2+}])}}$$

TDS

- Other constituents of TDS to be considered?
- Other applicable metrics?