DEQ's Stressor ID models

1) Model development

2) Establishing reference expectations

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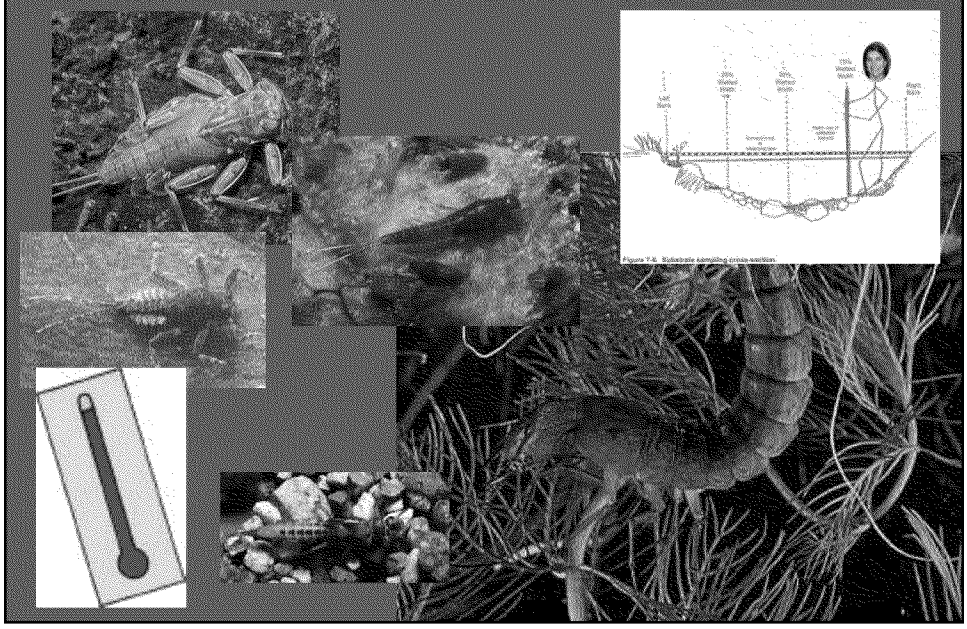
Determining if Sediment is a Stressor

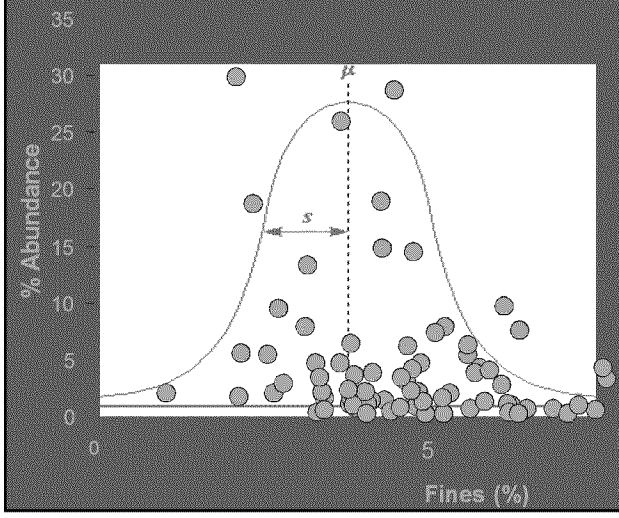
- Follow up to biocriteria
- 1) Identify beneficial use condition
- 2) Identify why a use is impaired

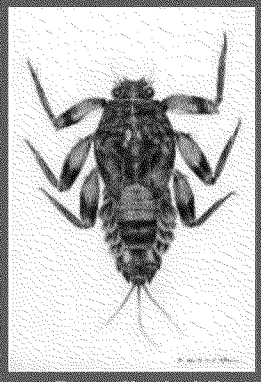
- Backwards from stressor first approach
  - Rely on biological condition to determine if fines are a stressor
  - Are sediment tolerant bugs more prevalent than at reference sites

Part 1: Model Development



Calculating Fine Sediment Optima & Tolerances





Drunella doddsi

Calculate Fines Optima for a Taxon

Taxon A.	Relative Abundance	Site % Fines	Product
Site #1	0.08	5	0.4
Site #2	0.12	14	1.7
Site #3	0.1	21	2.1
Site #4	0.07	3	0.2
Site #5	0.25	10	2.5
Site #6	0.33	15	5
Site #7	0.05	33	1.7
Site #8	05	5	0
		∑ (RA * % Fines) =	**14 % Fines**

- Weight Relative Abundance by % Fines
- Sum the weighted abundances of all sites where the taxon was collected

Calculate Fine Sediment Score

Taxon	Relative Abundance	Optima (% Fines)	Product
Arctopsyche	0.08	2	0.16
Drunella doddsi	0.12	3	0.36
Rhithrogena	0.1	5	0.5
Cinygmula	0.07	6	0.42
Optioservus	0.25	12	3
Juga	0.33	15	4.95
Cheumatopsyche	0.05	20	1
Ceonagrionidae	02	5	0
		∑ (RA * Optima) =	**10**

Inferred % fines score at test site = 10

- data from all observed taxa in a sample
- "Score" vs. Measured value

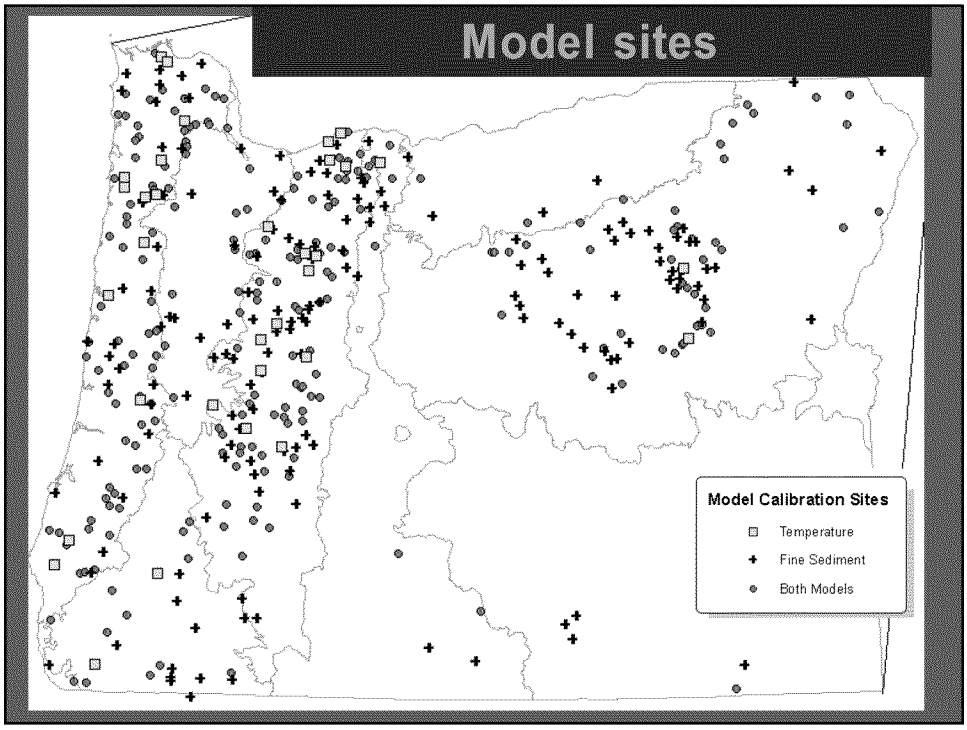
ODEQ's Stressor ID models

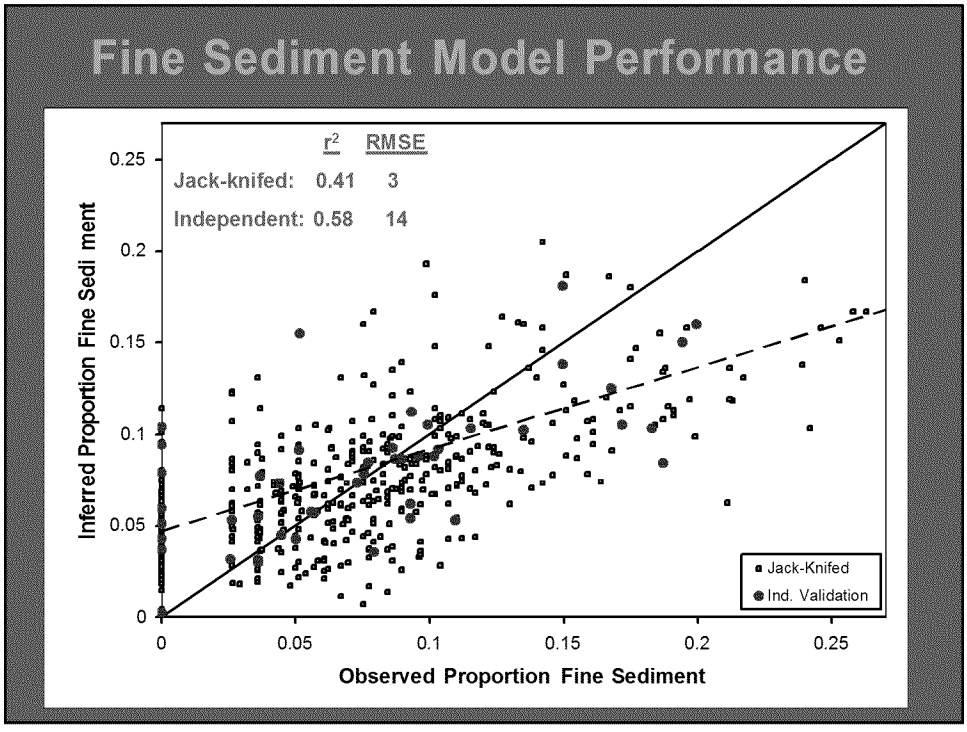
- **Macroinvertebrate data**
  - Riffle habitat
  - D-frame kicknet
  - Area = 8 ft^2
  - 80% of taxa at genus/species

Environmental Data		
	Temperature	**Sediment**
Sample size	269	320
Method	VEMCO data logger	Modified Wolman pebble count
Metric	7-day seasonal max	% Fines

Model Output = *Stressor Scores*

- Not a direct measure
- Diagnostic tool: identify stressor causing impairment
  - At least one of the potential stressors
- Screening tool: prioritize future monitoring
- Effectiveness monitoring
  - Can we show improvement in biology, not just % fines?

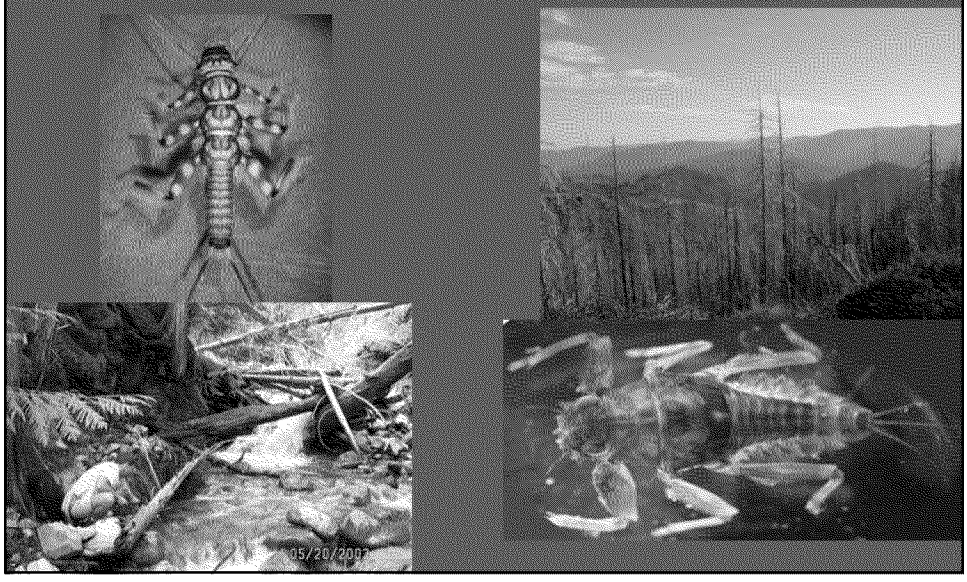

Model sites
Model Calibration Sites
Temperature
Fine Sediment
Both Models


Fine Sediment Model Performance
r2 RMSE
Jack-knifed: 0.41 3
Independent: 0.58 14
Inferred Proportion Fine Sedi ment
Observed Proportion Fine Sediment
0
0.05
0.1
0.15
0.2
0.25
Jack-Knifed
Ind. Validation

End of Part 1

Questions on Model Development?

Part 2: Establishing Reference Expectations



Do these Stressor ID models matter?

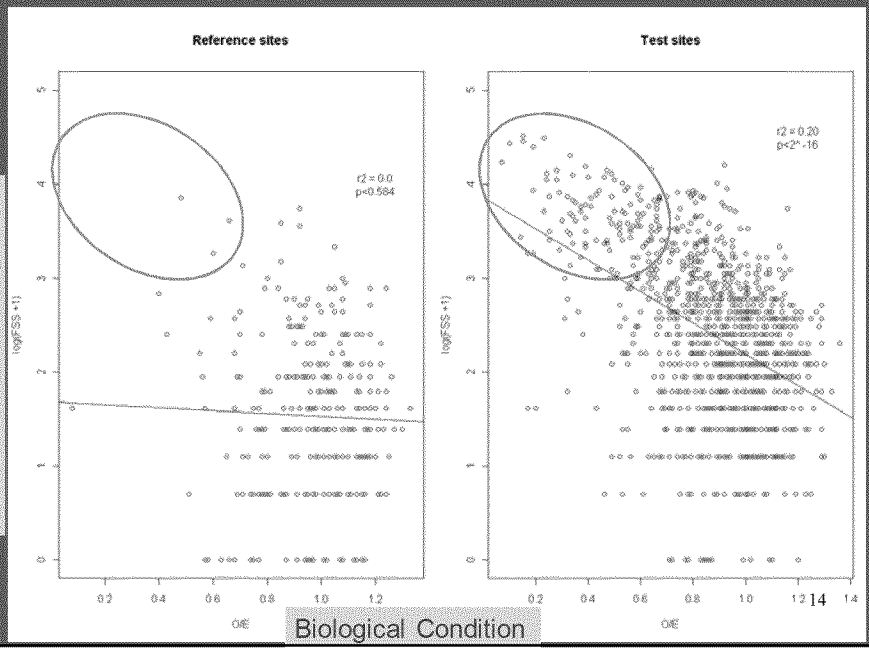
- What is the risk of having a "poor condition" fish community? *

Stressor Measurement		Stressor--Inferred	
Temperature Standard:	9.0	Temperature Score (TS):	9.8
Fine Sediment ^ > 30%:	5.1	Fine Sediment Score (FSS):	8.4

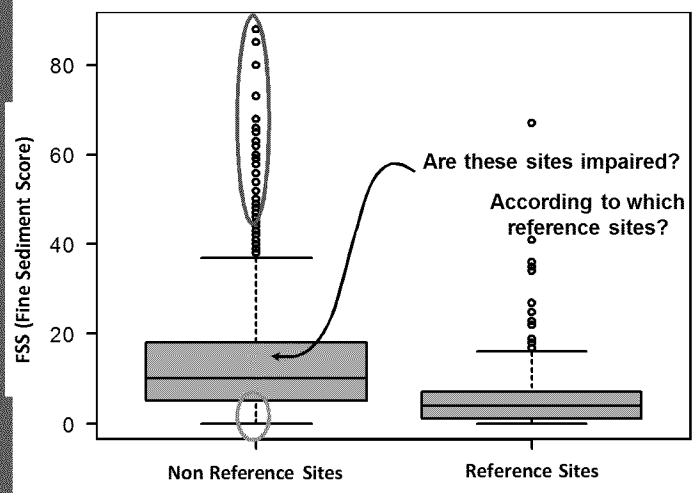
^ Fines + Sand

* Based on data from Coastal Coho ESU assessment (2004)

How does FSS relate to O/E?

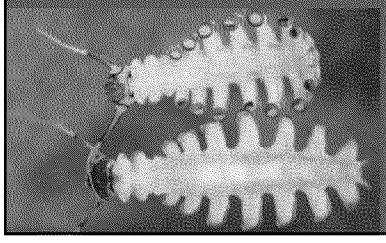


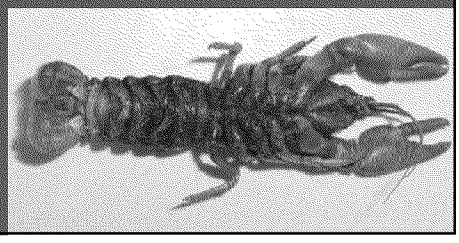
When is a site different from least disturbed reference sites?



Determining the Appropriate Reference Population

- **Modeling**
  - Benchmarks vary depending on a site's natural factors
- **Distribution of reference scores**
  - DEQ's standard approach = 75th and 90th percentiles





Modeling FSS

- Reference sites only
- Adjust FSS for natural gradients (predictors)
  - latitude, longitude, elevation
  - Air temperature, Precipitation
  - Watershed area, Flow, Gradient, Stream Power
  - Lithology (% erodible)
  - Categorical:
    - Ecoregion 3, Eco4, Basins, Lithology groups, Lithology (site)

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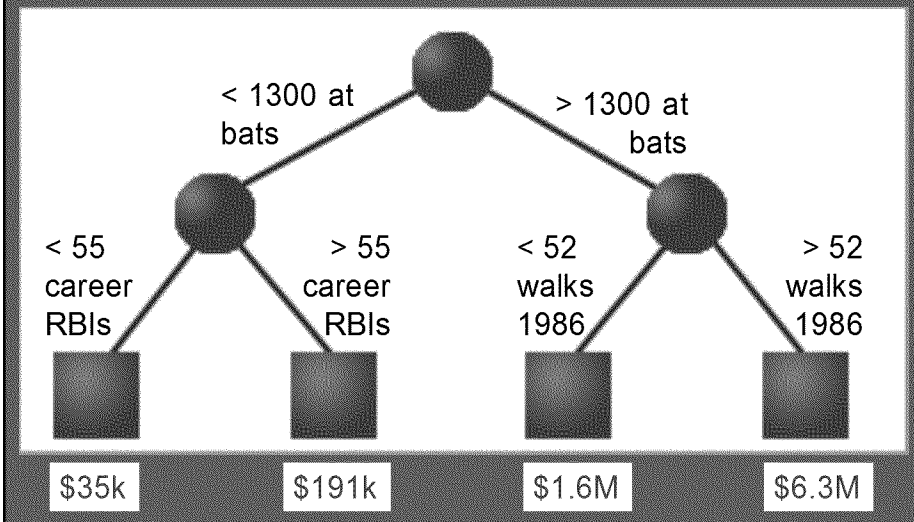
Controlling for Environmental Factors

- CART(Classification And Regression Trees)
- Allows for predicting values of interest (FSS), given:
  - continuous predictors
  - categorical factors

Example: CART model for predicting 1987 baseball salary*



* Source: Wei-Yin Loh (2002)

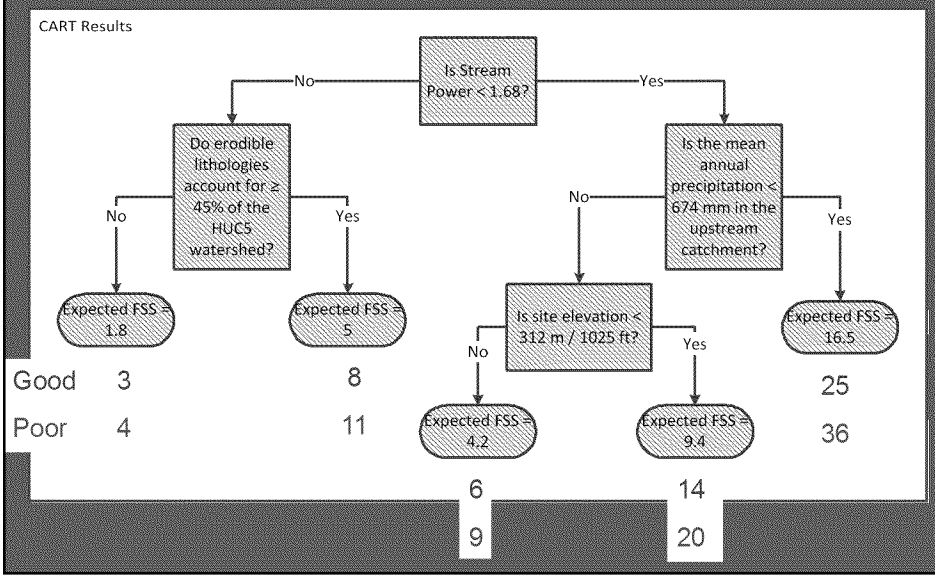
Modeling Results

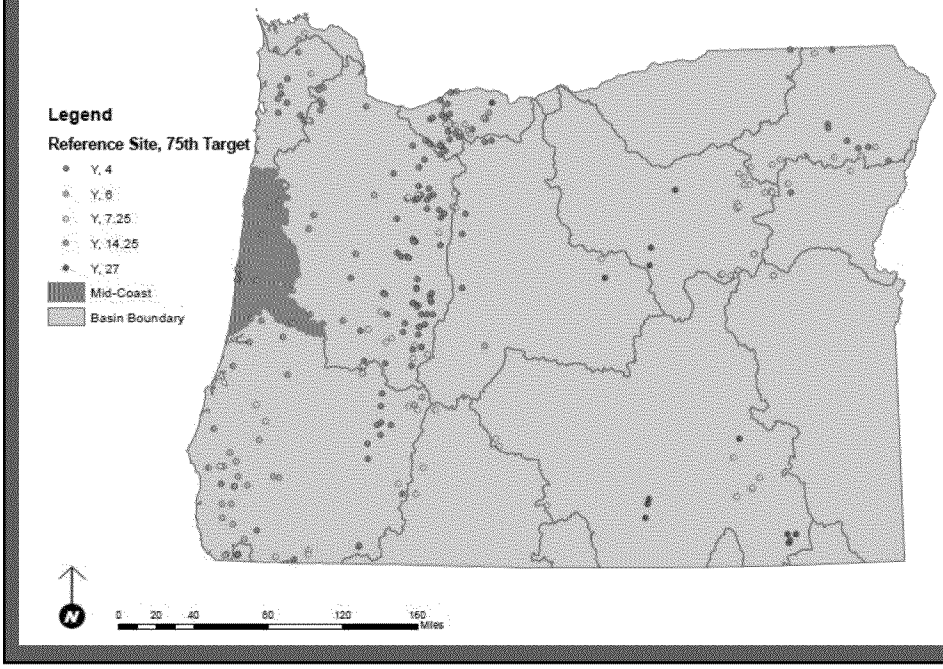
- **4 predictors of reference condition FSS**
  - -Precipitation
  - -Stream Power
  - -Elevation
  - -% Erodible
- **Expectations for FSS dependent on natural factors**
- **Reference benchmarks**
  - 75th and 90th percentiles

How much greater is FSS_{obs} than FSS_{exp}?

Not Impaired ≤ 75th	Potential Concern	Impaired ≥ 90th
≤ 1.5x	1.5x – 2.2x	≥ 2.2x

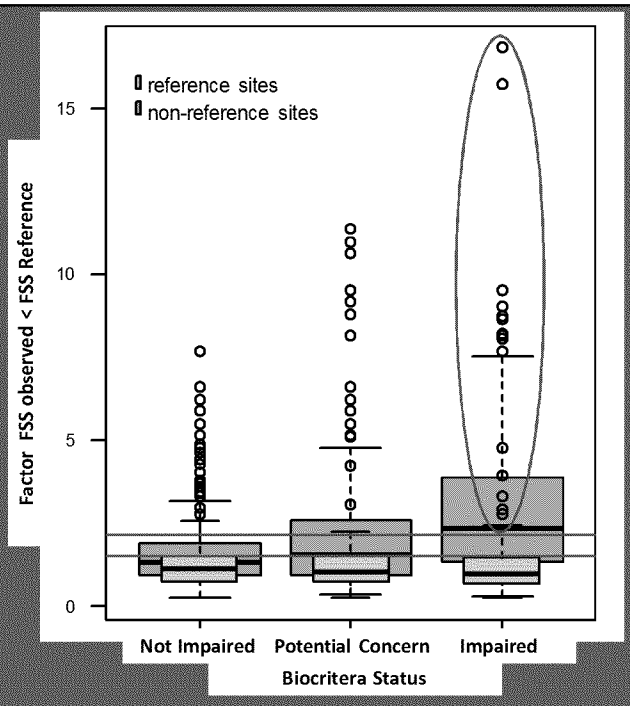
Final Model: Variable FSS targets





Sediment Impairment Requirements

PREDATOR Region	Biological Impairment	Biological Fine Sediment Score
Marine Western Coastal Forest (Mid-Coast)	≥ 15% taxa loss	Observed > Reference x 2.2
	OE Score ≤ 0.85	

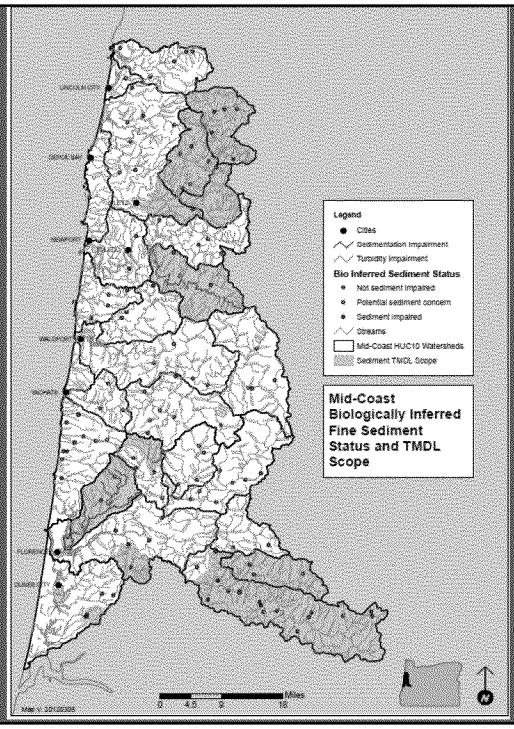


Summary

- We developed variable benchmarks for the biological sediment index (FSS),
  - Reference expectations adjusted for natural gradients
- O/E approach
  - Is the observed >> expected?
- Sediment Impairments require failure of two biological indexes
  - Biocriteria (PREDATOR)
    - ≥ 15% taxa loss
  - Biological sediment index (FSS)
    - Observed ≥ 2.2 * Expected

Example sites from Siuslaw

Site	Watershed	O/E	303d category	FSS (obs)	FSS (exp)	75th	90th	FSS condition	Sediment Status
Wolf Cr	Wolf Creek	0¾	Attaining	18	9	14	20	Fair	Not sediment impaired
Siuslaw River at RM 60.1	Upper Siuslaw	1.08	Attaining	24	9	14	20	Poor	Not sediment impaired
Haight Creek at RM 1.20	Upper Siuslaw	1.1	Attaining	10	9	14	20	Good	Not sediment impaired
Raleigh Cr at RM 0.14	Deadwood Creek	0.91	Potential Concern	11	9	14	20	Good	Not sediment impaired
Buck Creek	Deadwood Creek	1.25	Potential Concern	8	9	14	20	Good	Not sediment impaired
Panther Cr	Wolf Creek	0.88	Potential Concern	26	9	14	20	Poor	Potential sediment concern
Potato Patch Cr at RM 0.97	Wildcat Creek	0.81	Impaired	13	9	14	20	Good	Not sediment impaired
Indian Cr	Indian Cr./Lake Cr.	0.78	Impaired	20	9	14	20	Fair	Potential sediment concern
Siuslaw River	Upper Siuslaw	0.53	Impaired	40	5	8	11	Poor	Sediment impaired
Esmond Cr. Trib A	Upper Siuslaw	0.65	Impaired	22	9	14	20	Poor	Sediment impaired
Siuslaw River at RM 76.2	Upper Siuslaw	0.79	Impaired	23	9	14	20	Poor	Sediment impaired



Acknowledgements

John Van Sickle (USEPA, ORD)

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End of Part 2

Questions on

Establishing Reference Expectations?