



[PugetSoundStreamBenthos.org](http://PugetSoundStreamBenthos.org)

An inter-agency resource for managing  
benthic macroinvertebrate monitoring  
data in the Puget Sound region

# Problem

- Data “managed” in Excel files provided by private labs
  - Excel can’t enforce business rules
  - Versioning
- Data analysis is difficult
  - Different jurisdictions use different templates
  - Very hard to QC lab metrics
  - Across years / jurisdictions – not done

# Solution

- Collaborate w/ others
- Focus on needs
- Participants:
  - King County WLRD
  - King County Roads
  - Pierce County
  - Snohomish County
  - City of Seattle

# Development Process

- Initiated in Spring of 2007
- Team of IT staff and SMEs
- COTS Review
- Develop initial requirements
- Agile development
- Launched site in August 2008

# COTS Review

- Researched existing solutions:
  - EDAS (EPA)
  - EIM (Ecology)
  - EcoAnalysts, Inc.
- Custom solution determined to be best
  - Less effort overall
  - More suited to specific needs
  - Easier to maintain & upgrade

# System Architecture

- Database (MS SQL Server 2005)
  - Maintain integrity
  - Perform analysis
- Web Interface (.net 2.0)
  - Viewing data
  - Managing / uploading data
- Desktop tool (Access 2003)
  - Lab entry / upload

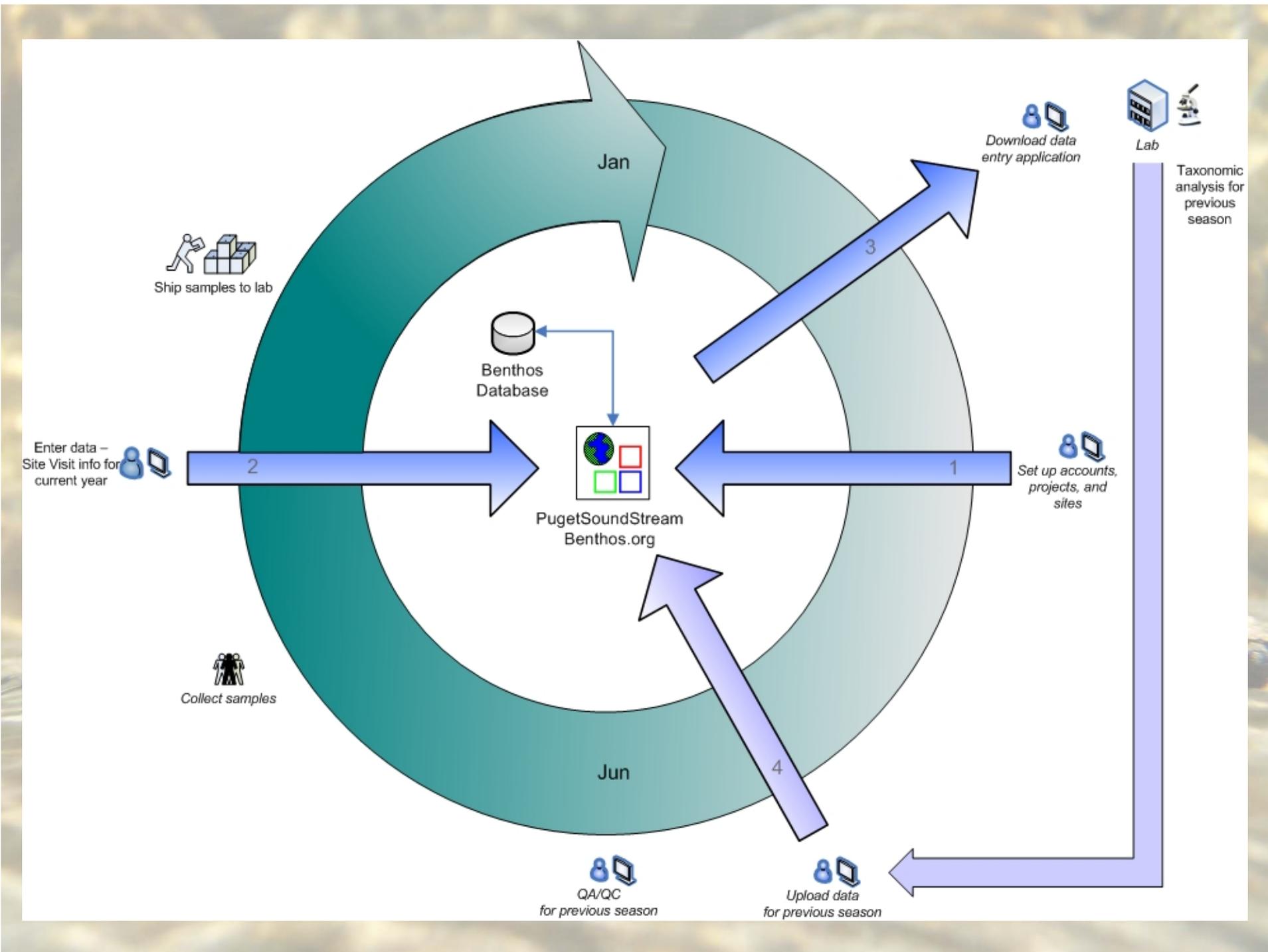
# Business Rules

- Jurisdictions control their own data
- ITIS taxonomic names
  - Exceptions for Groups
  - Duplicate issues
  - Shorten list
- BIBI Analysis
  - Wisseman 1998 attributes (initially)
  - Clingers from SalmonWeb

# Implementation

- King County WLRD Developers
- Hosted offsite (independent)
- Neutral domain name
  - <http://pugetsoundstreambenthos.org/>







# Data Loading

- King County staff for historical data
  - 2006 loaded

<b>Jurisdiction</b>	<b># of Samples</b>
King County WLRD	160
King County Roads	81
Pierce County	54 (18)
Snohomish County	31
Seattle	33 (11)

- 2007 loaded for Seattle (17 sites)
- 2008 in process

# Data Loading (cont'd)

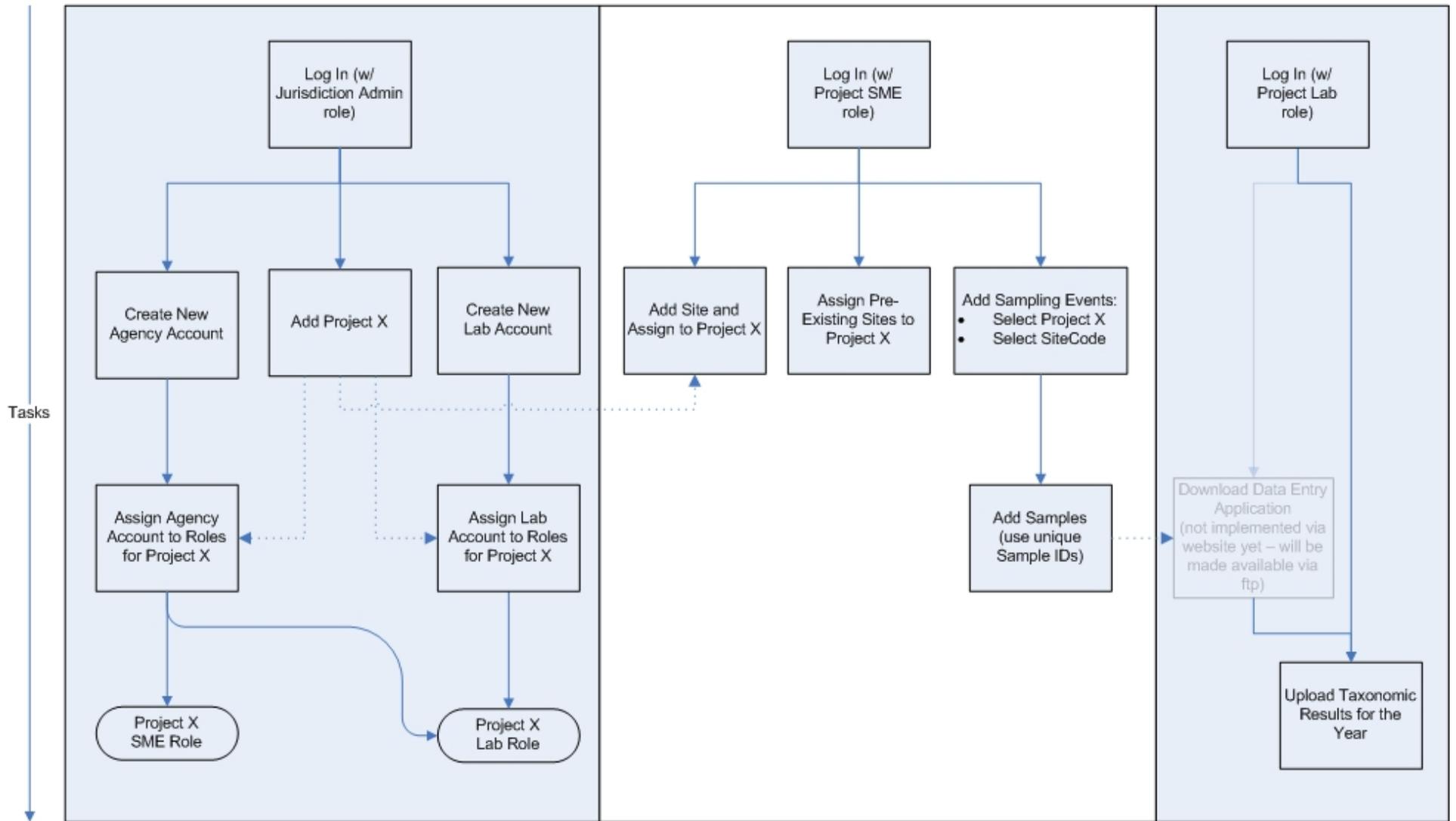
- Historical metadata difficult to obtain
- Labs can upload new data
- Business Rules enforced for future data

# Expand Geographic Scope

- Ecology Contract
  - Survey & gap analysis
    - 106 jurisdictions/organizations
    - 25 have macroinvertebrate data
  - Obtain and load data
    - ~18 to be included
- Technical Services Agreements
  - Long-term O&M

# Puget Sound Stream Benthos

## Data Upload Process



Dependency Order

# Demo

<http://pugetsoundstreambenthos.org/>



# Analysis Page Features

- Geographic filter
- Project filter
- Date filter
- More options
  - Spatial Aggregation
  - BIBI type
  - Metric
  - Replicate handling
  - # of organisms filter

# Features (cont'd)

- Integrated tooltips
- Zoom control
- Plot scores vs. Show scores
- Show samples
- Download
- Administrative interface
- Lab interface

# Puget Sound Stream Benthos

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## Analysis: [Benthic Index of Biotic Integrity](#)

Area All Streams, Subbasins, Basins, WRAs	Projects All Projects	Year From Any To Any
Aggregate Don't Aggregate	BIBI Type Use lab's method (recommended)	Metric to Plot Overall Score
Replicate Handling Average replicates' overall BIBI scores (recommended)	Number of Organisms Minimum: 350 Maximum:	

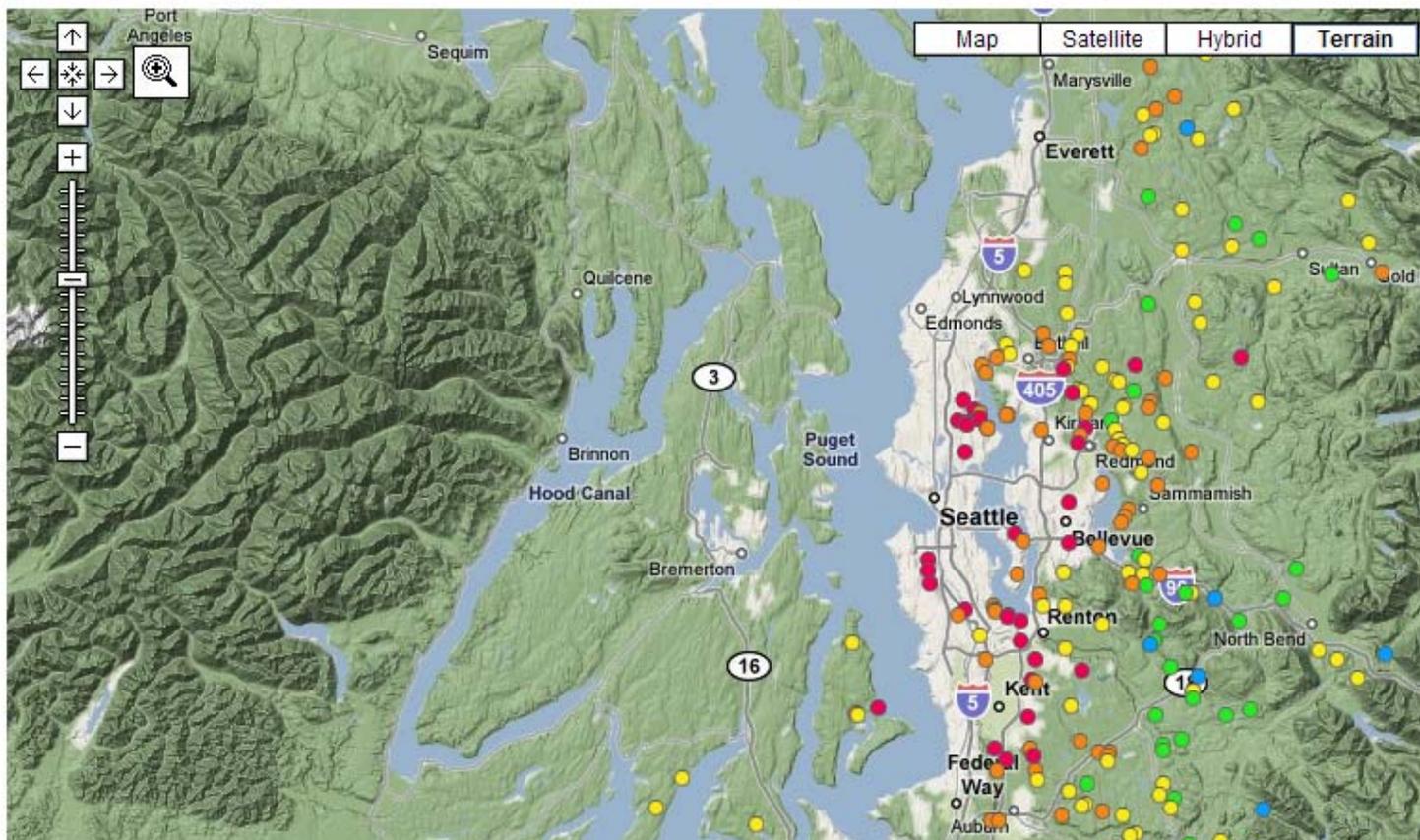
Fewer Options

Plot Scores

Show Scores

Show Samples

Download



Organisms Counted: 540 QC: 552

**BIBI Score Details**

**Taxonomic Composition**

### Analysis: Benthic Index of Biotic Integrity

BIBI Type

Use lab's method (recommended)



Recalculate Score

Metric	Sample 08EVA4249/06 Quantities	Score
Taxa Richness	24	3 ●
Ephemeroptera Richness	4	1 ●
Plecoptera Richness	2	1 ●
Trichoptera Richness	5	3 ●
Clinger Richness	13	3 ●
Long-Lived Richness	4	3 ●
Intolerant Richness	1	1 ●
Percent Dominant	77.2%	3 ●
Predator Percent	18.0%	3 ●
Tolerant Percent	11.7%	5 ●
Number of Organisms	540	n/a
<b>Overall BIBI Score</b>		26 ● <b>Fair/Poor</b>

### QC Replicate

Metric	Sample 08EVA4249/06-R Quantities	Score
Taxa Richness	20	5 ●

Sampling Agency: [Pierce County](#)

Project: [NPDES Monitoring](#)

Analyzed By: Rhithron Associates, Inc.

Chironomid Resolution: Family

Samples Taken: 3

Organisms Counted: 315+504+515 = 1334

Sampling Date: Monday, October 02, 2006

Location: 47.3173°, -122.7685°

Dutchers Creek  
Key Peninsula (Subbasin)  
Peninsula (Basin)  
WRIA 15 - Kitsap

[BIBI Score Details](#) [Taxonomic Composition](#)

### Analysis: [Benthic Index of Biotic Integrity](#)

BIBI Type Replicate Handling

Metric	Sample Dutchers Rep #1-06		Sample Dutchers Rep #2-06		Sample Dutchers Rep #3-06		Averages	Scores based on quantity averages
	Quantities	Scores	Quantities	Scores	Quantities	Scores		
Number of Organisms	315	n/a	504	n/a	515	n/a	444.0	n/a
Number of Taxa	24	3	30	5	32	5	28.0	4.3 ●
Ephemeroptera (Mayfly) Taxa	4	1	4	1	4	1	4.0	1.0 ●
Plecoptera (Stonefly) Taxa	5	3	7	3	8	5	6.0	3.7 ●
Tricoptera (Caddisfly) Taxa	5	3	4	1	6	3	5.0	2.3 ●
Clinger Taxa	11	3	10	3	12	3	11.0	3.0 ●
Long-Lived Taxa	3	3	3	3	3	3	3.0	3.0 ●
Pollution Intolerant Taxa	0	1	1	1	1	1	0.0	1.0 ●
Pollution Tolerant Organisms	0.3%	5	3.4%	5	1.1%	5	1.6%	5.0 ●
Predatory Organisms	20.3%	5	8.3%	1	6.2%	1	11.6%	2.3 ●
Dominance: Organisms in Top 3 Taxa	51.1%	5	52.8%	5	59.4%	5	54.4%	5.0 ●
<b>Overall BIBI Score</b>		32		28		32		30.7 ● Fair

# Future Work

- Load more historical data
- Future releases:
  - Extend attribute options
  - Support different BIBI analyses
  - Data entry application upgrade
  - Subsampling
  - Spatial aggregation display
  - Trends
  - Animation
  - Associated habitat data?
  - Predictive modeling?