Stream Biological Monitoring

Department of Ecology

Washington Department of Ecology

Stream Biomonitoring Program: History of Development and Critical Elements

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Tetra Tech, Inc.
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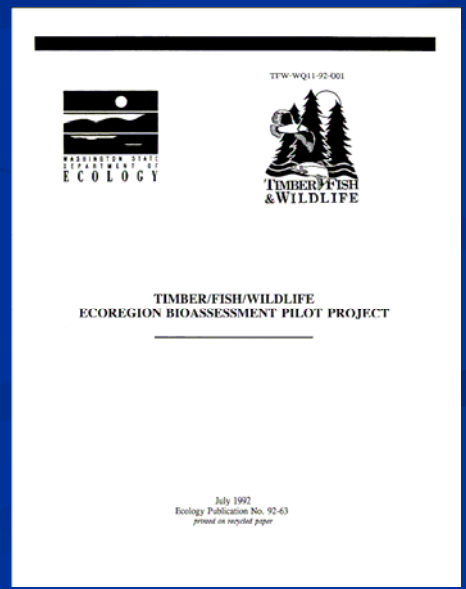
Evaluation of Current Technology:
considerations for building a new program

- Ecoregions of the United States (circa 1986)
- Benthic Collection Protocols
- Seasonal Influences
- Biological Indicators & Distinct Communities
- Indicator Taxa
- Analytical Tools


TFW-WQ11-92-001

ECOLOGY

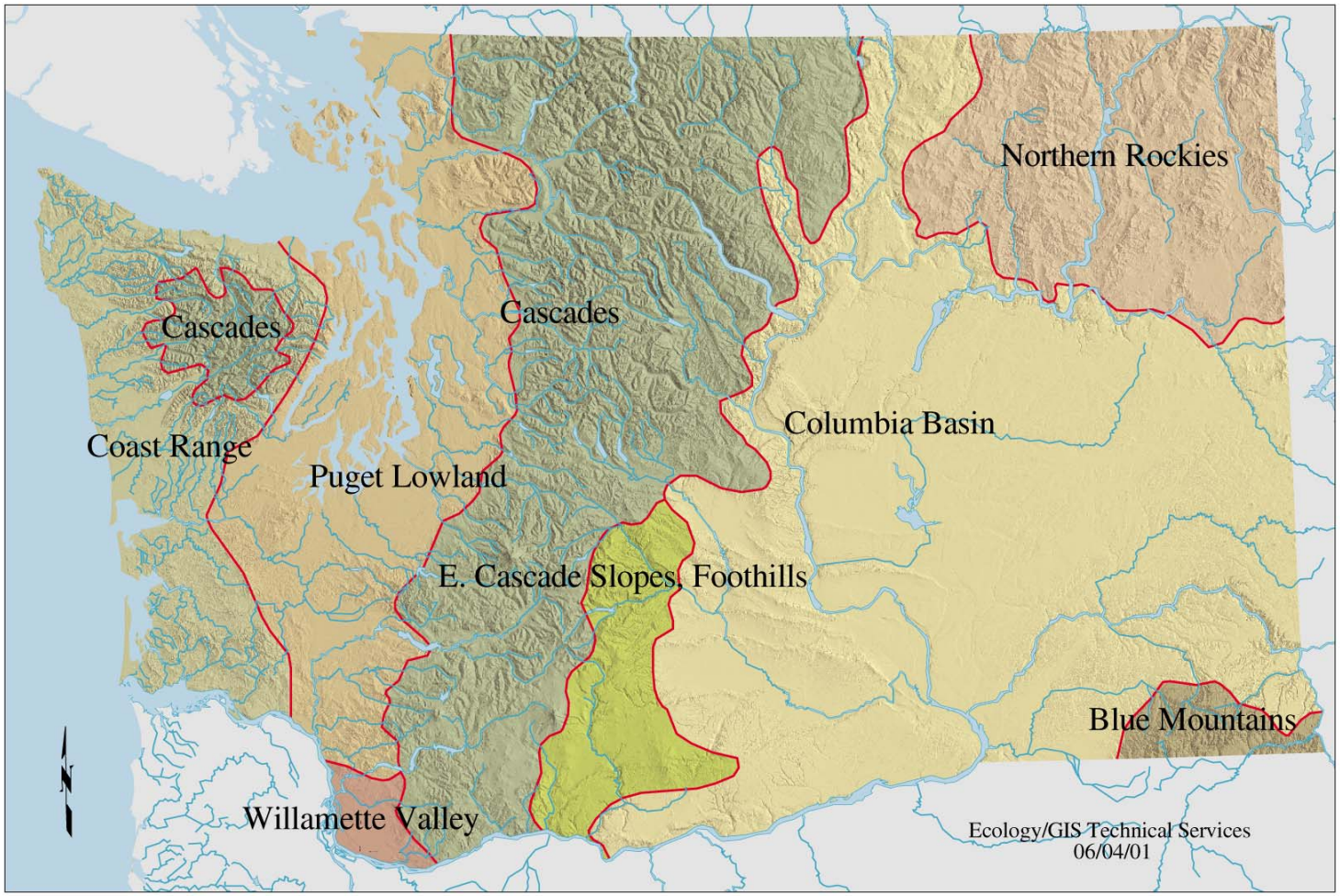
TIMBER/FISH &WILDLIFE

TIMBER/FISH/WILDLIFE
ECOREGION BIOASSESSMENT PILOT PROJECT

July 1992
Ecology Publication No. 92-63
printed on recycled paper

(TFW Ambient Biomonitoring Project)

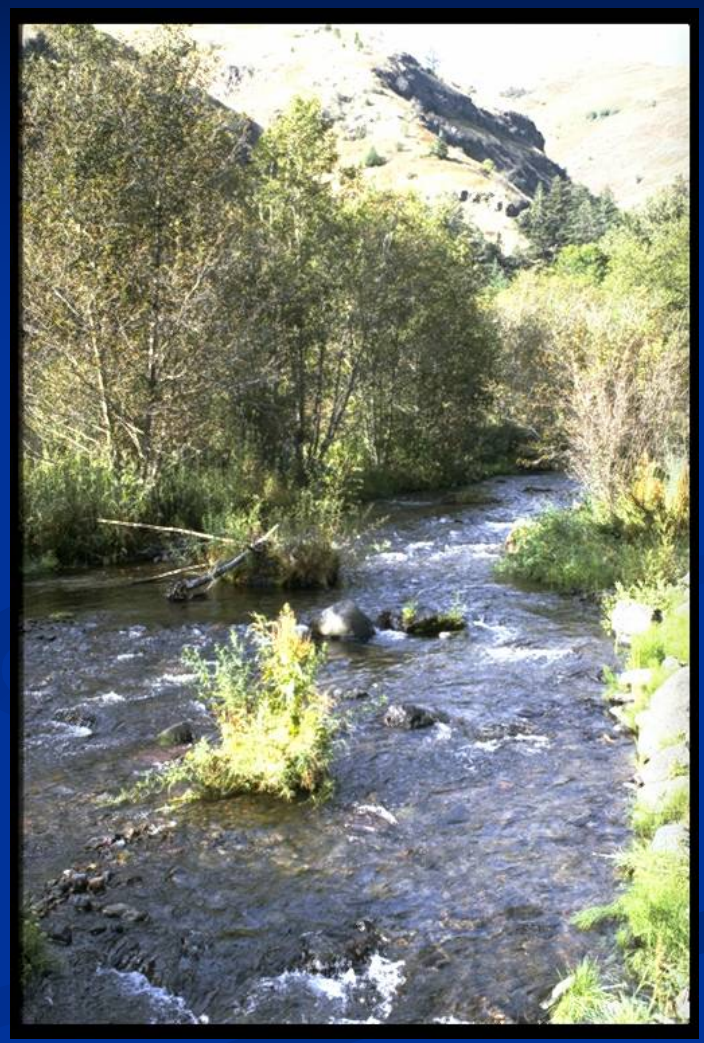
Ecoregions of Washington



Puget Lowland Streams

Cascade Streams

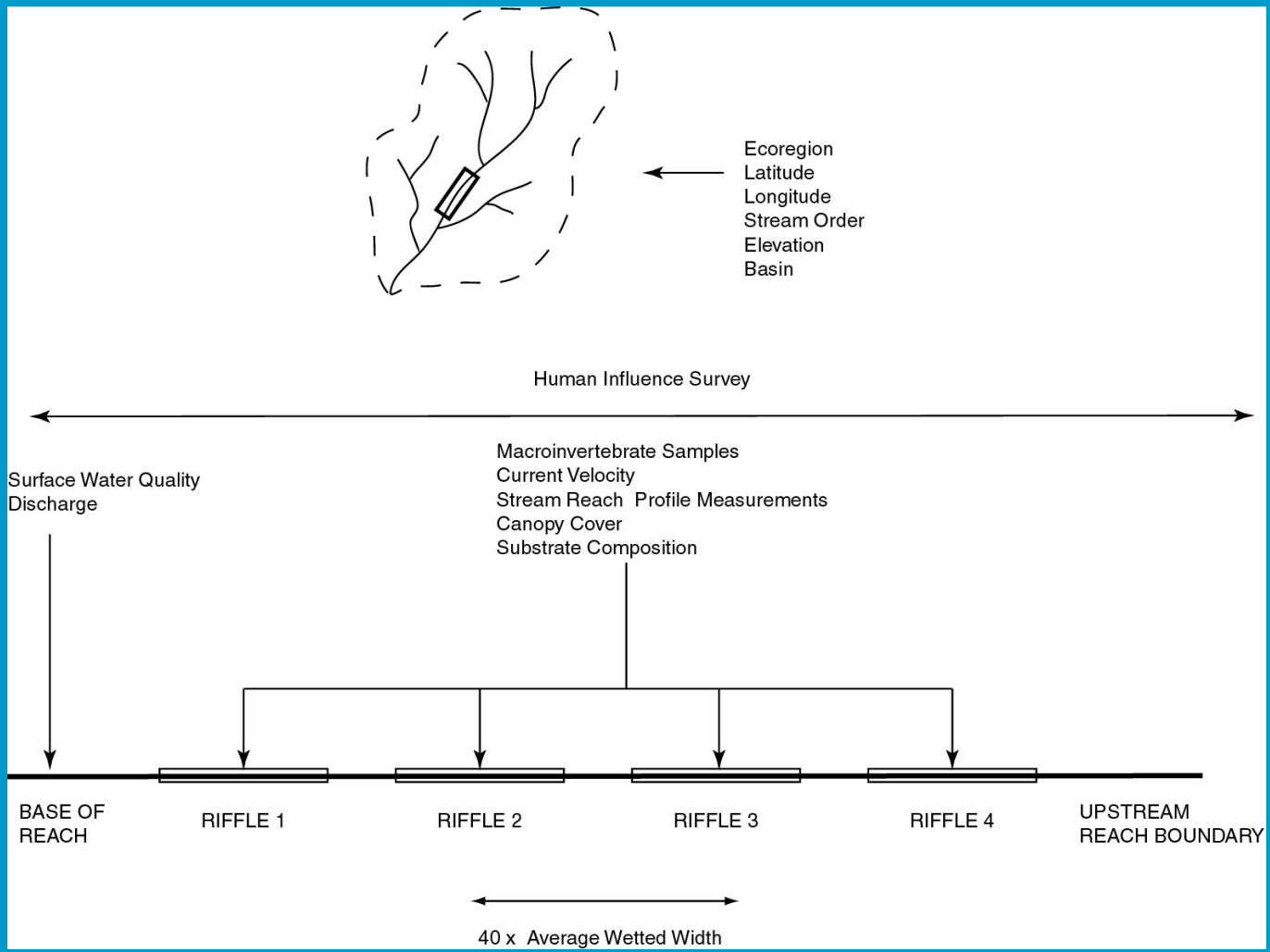
Columbia Basin Streams



Development of a Long-Term Program

- Considerations for inclusion of elements
- Monitoring Program Directives
  - 1990 Common field protocols promoted (EPA Region 10)
  - 1995 Common taxonomic protocols (EPA Region 10)
    - Sample sorting
    - Taxonomic Identification (standardized list)
- Selection of Protocols (Habitat, WQ, Biological)
  - Multiple uses for biological information
  - Correlation between biota and habitat condition (diagnostic)
  - Biological response to environmental gradients
    - (*e.g.*, coarse gravel, cobble, canopy cover)

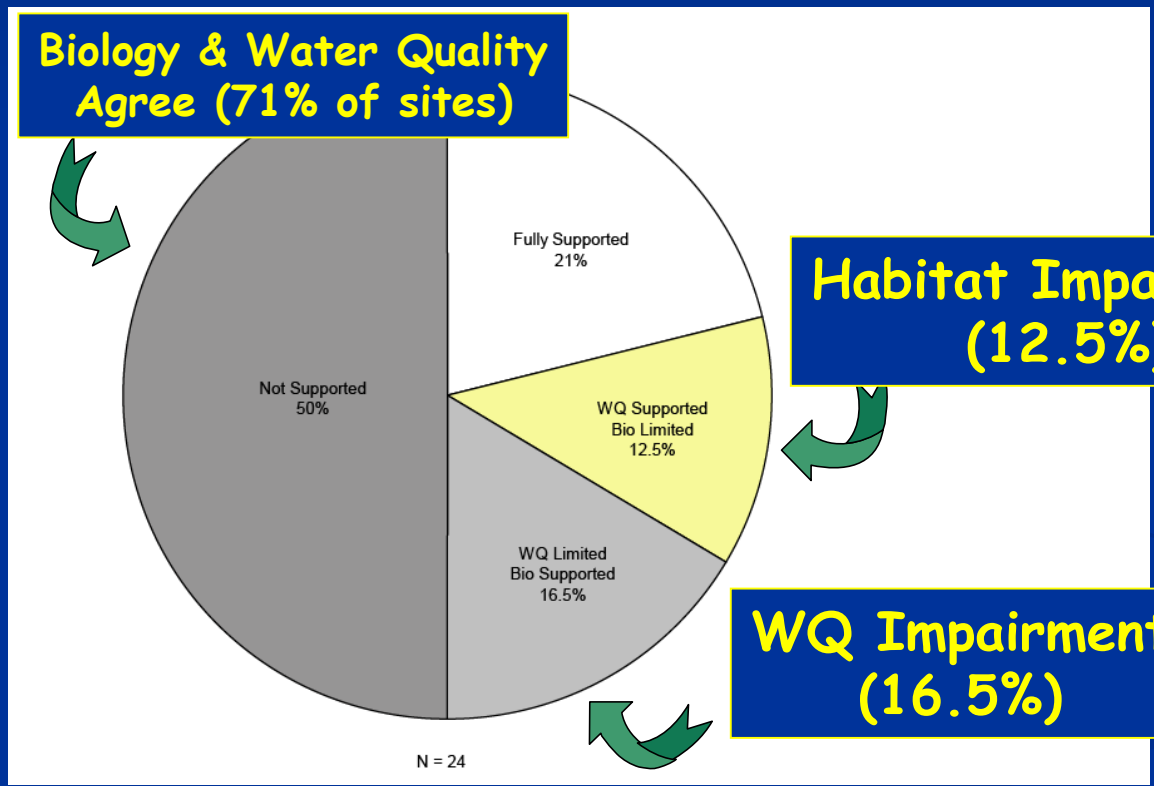
Stream Reach Monitoring Strategy



Exploring Applications of Biology: WA Department of Ecology

- Confirmation of Pollution Problems
  - Complaint-driven pollution observations
  - Beneficial use evaluation
    - (aquatic life & human health)
- Validation of aquatic impairments
  - Chronic/sporadic?
  - Habitat-related or Water Quality-based?

Benefit of Integrated Assessments (Case Study in Washington Streams)

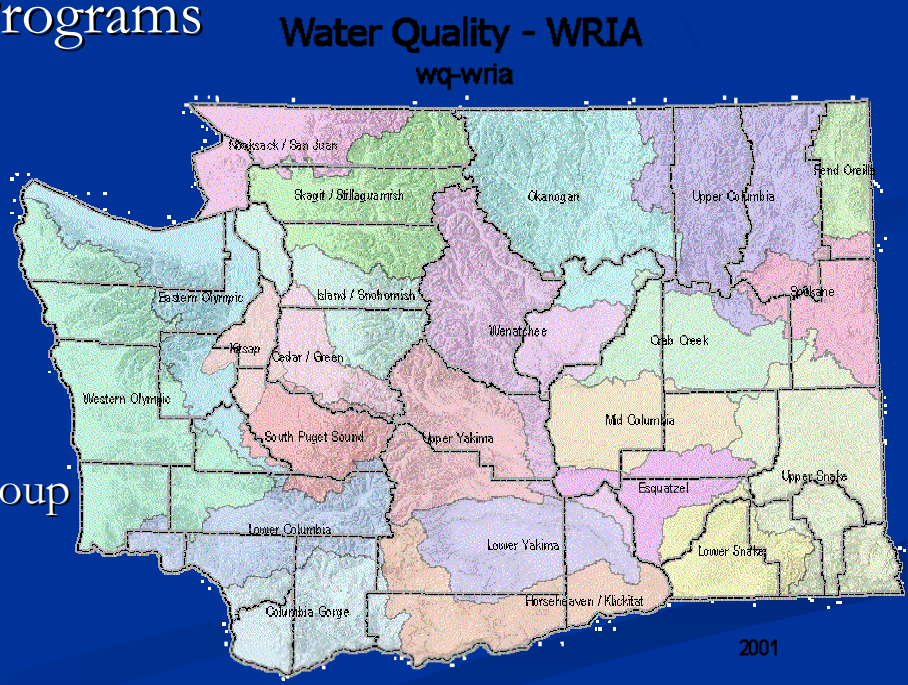


Monitoring Strategy

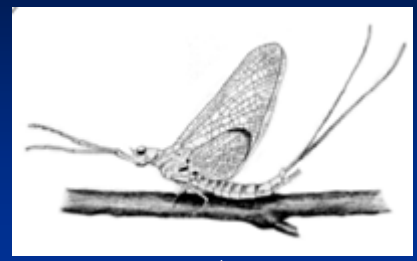
- Identifying Reference Sites & Impaired Sites
- Provide rotation of the biomonitoring service
  - Water Quality Management Areas (WQMA's)
  - Linking biomonitoring service to agency schedule and agendas
- Information for Agency Clients
  - Chemical impairments
  - Habitat impairments
  - Evaluating suitability for salmon enhancement

Biology in Agency Business

- Water Quality Management Areas
  - (WQMA's)
- Local Government Monitoring Programs
  - King County (Seattle)
  - Snohomish County (Everett)
  - City of Bellevue
- Volunteer Monitoring Programs
  - Streamkeepers of Clallam County
    - Research & Technical Advisory Group
    - Planning Advisory Group
    - Technical Services Group



Developing New Analytical Tools

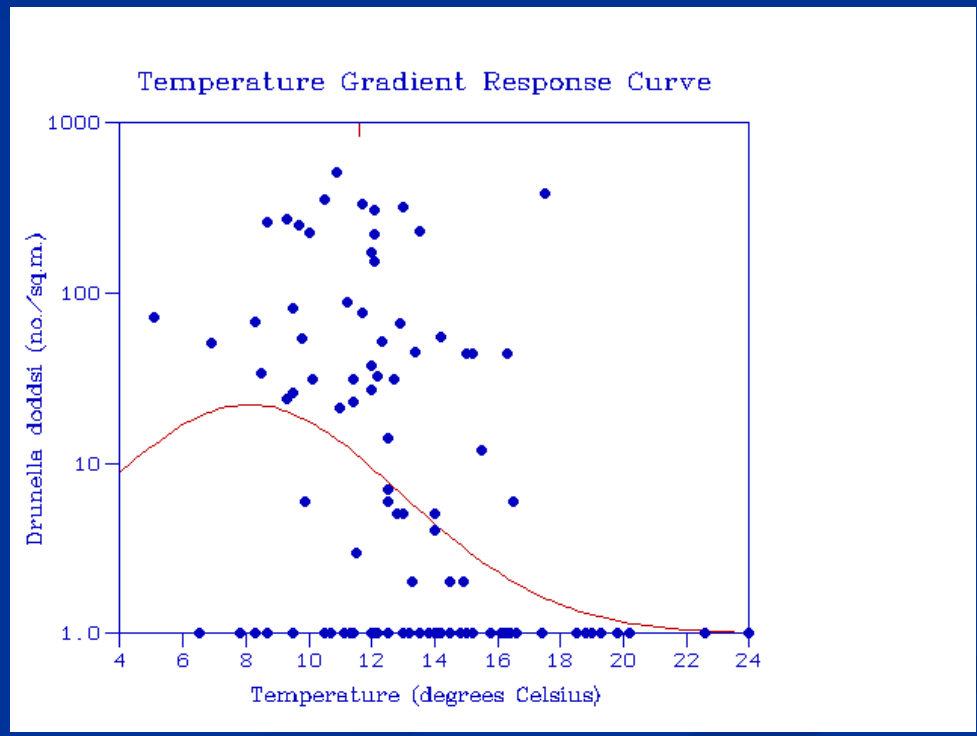


- Ordination applications
- Indicator Species (TWINSPAN & Decorana)
- Correlations between habitat & biological descriptors
- Determining Species Tolerance values along environmental gradients
- Development of Multi-metric Indexes (MMI's)
- Development of RIVPACS (O/E) Models

Species Tolerances to Environmental Gradients

Primary Gradients

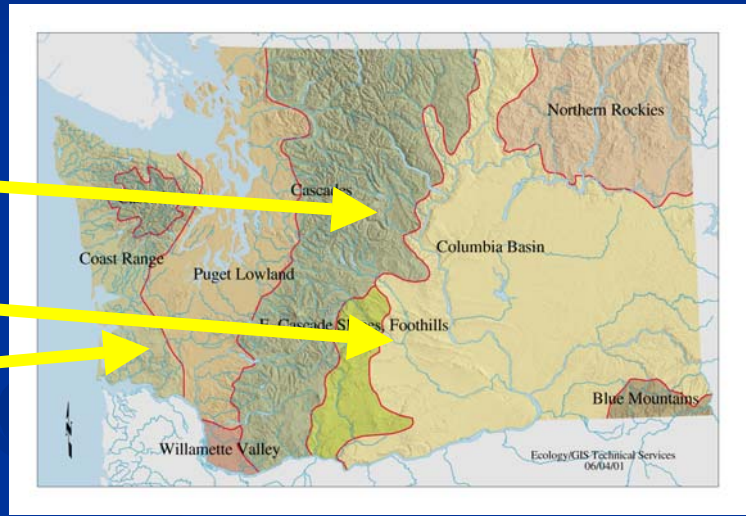
- Temperature
- pH
- % Fine Gravel
- Conductivity



Environmental Monitoring and Assessment Program

EMAP

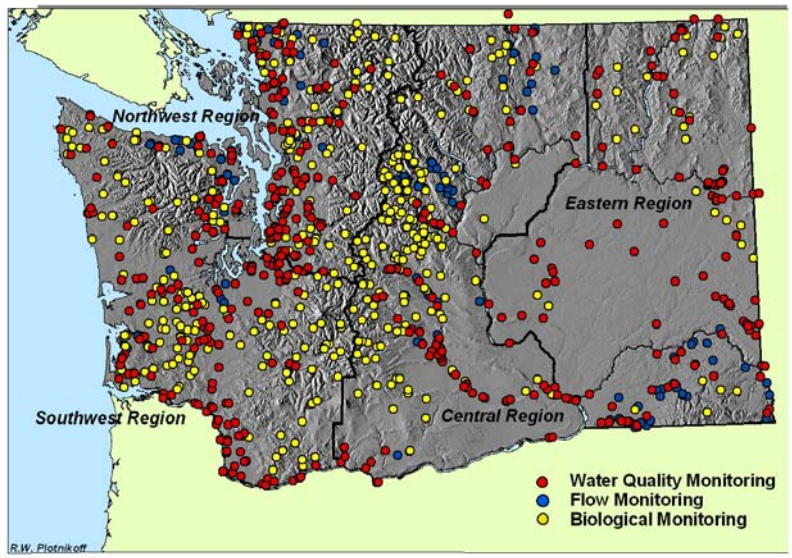
- Landscape-scale Assessment of Streams
- Projects
  - Wenatchee Basin
  - Yakima Basin
  - Upper Chehalis Basin
  - Coast Range
  - Western EMAP
  - South Cascades ESU



Data Management

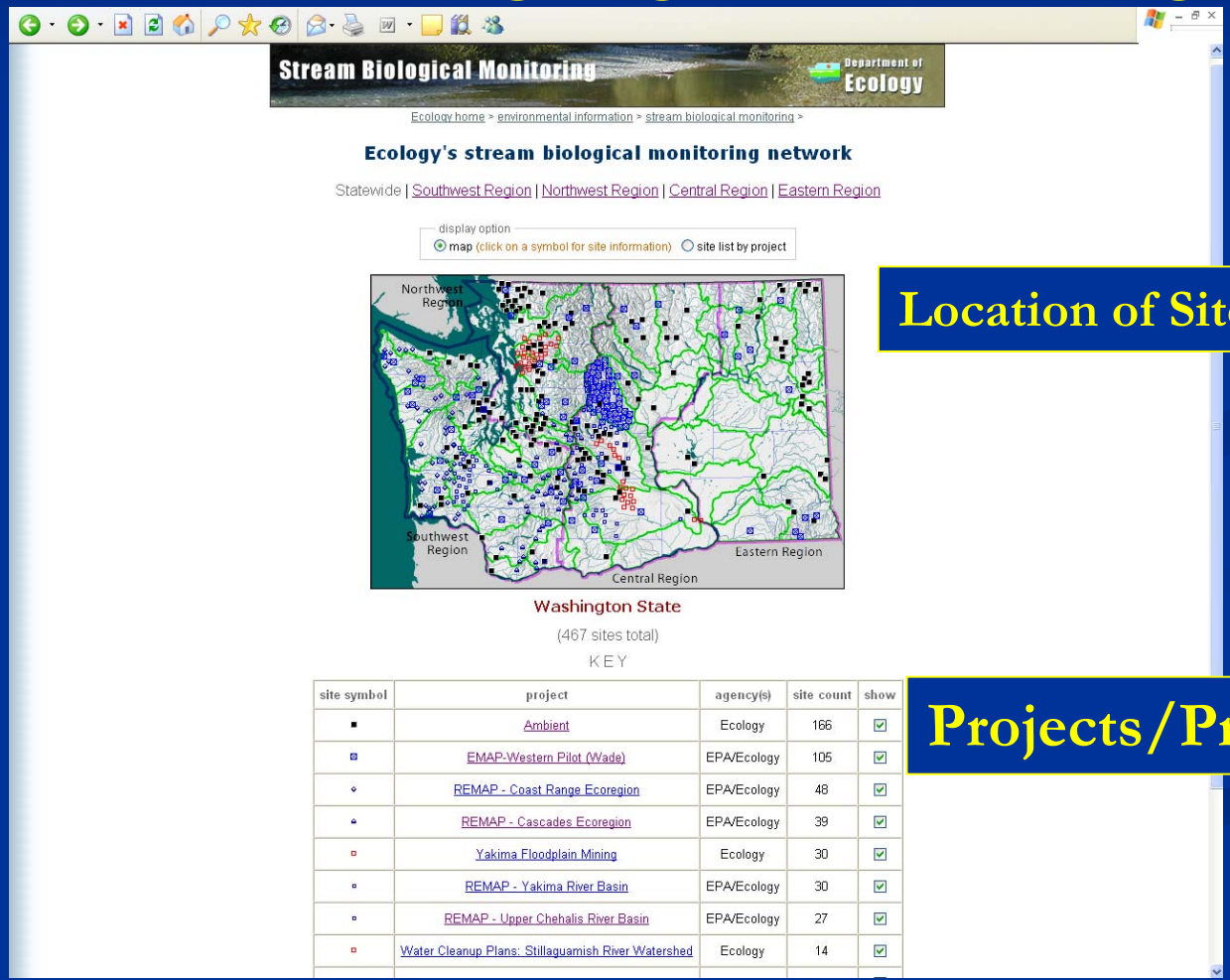
- Design considerations
  - (integrated data management)
- Utilities in the database
  - Biometric (MMI Score) generation
  - Re-sampling tool
    - 100-, 300-, 500-bug count
- Web presence
  - Information display
  - Downloadable data

Database Development: Steve Barrett



Web Site: Main Page

Stream Biomonitoring Program & EMAP Program

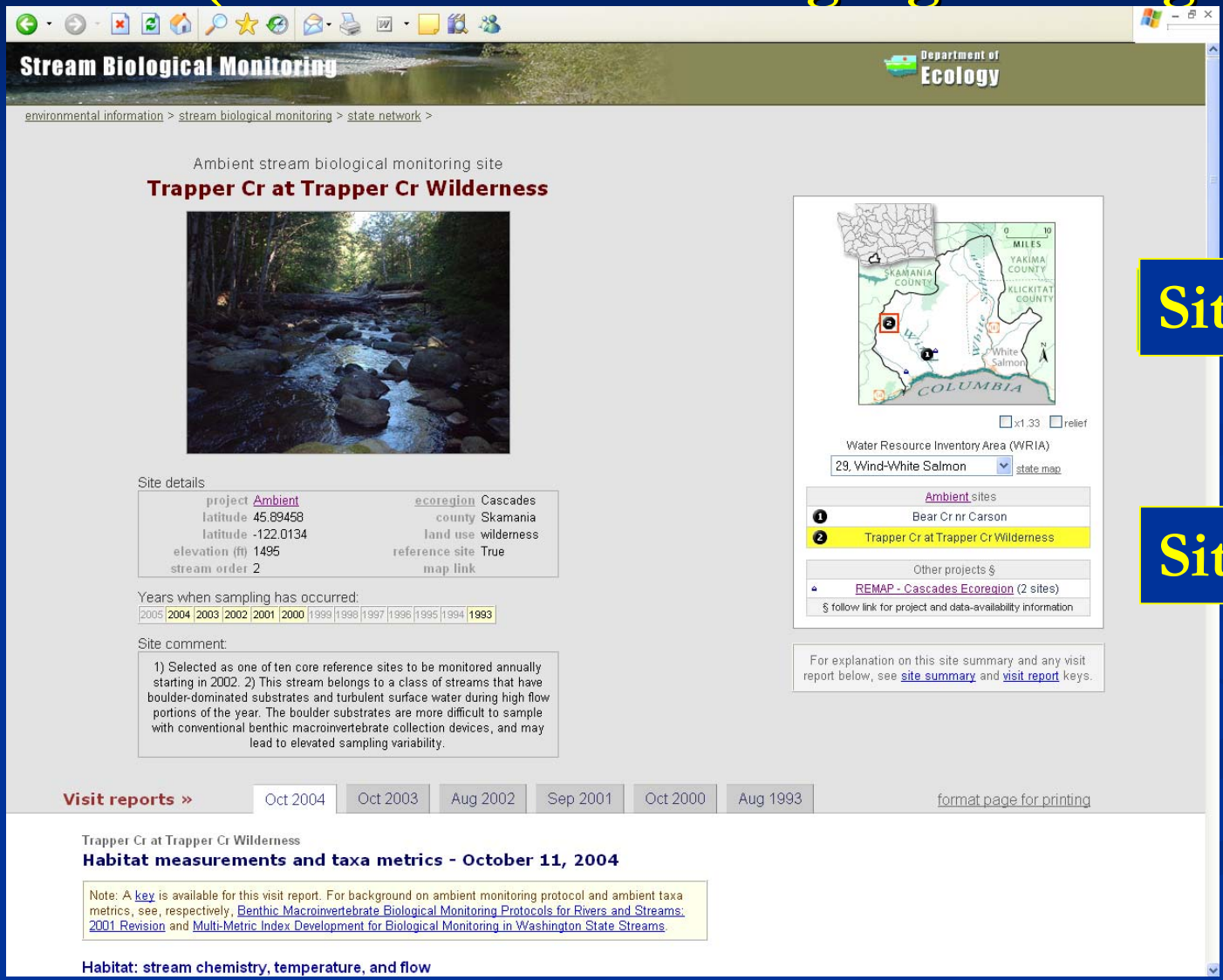


Location of Sites by Project

Projects/Programs

Reference Site Monitoring

(10 sites located among eight ecoregions)



Site Locator

Sites

Data Available On-Line: Habitat

Visit reports » | Oct 2004 | Oct 2003 | Aug 2002 | Sep 2001 | Oct 2000 | Aug 1993 | format page for printing

Trapper Cr at Trapper Cr Wilderness

Habitat measurements and taxa metrics - October 11, 2004

Note: A key is available for this visit report. For background on ambient monitoring protocol and ambient taxa metrics, see, respectively, Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams: 2001 Revision and Multi-Metric Index Development ... Biological Monitoring in Washington State Streams.

Habitat: stream chemistry, temperature, and flow

temperature (deg C)	dis o winkler (mg/L)	stream flow (CFS)	pH (pH)	conductivity (umhos/cm)
9.	10.5	112.4	7.6	54

Habitat: dimensions, gradient, velocity, and canopy

samp type	loc type	loc no	wetted width (m)	stream gradient (%)	sample area (m^2)	RPD (m)	middepth velocity (FS)	max depth (m)	Dp (m)	canopy (%)	bottom velocity (FS)	bankfull width (m)	avg depth (m)
DKICK	riffle	1	25.0	3.00			1.5	0.42		0.41	1.7	49.8	0.12
DKICK	riffle	2	30.1	3.00			1.7	0.30		0.71	0.6	49.5	0.15
DKICK	riffle	3	42.1	3.00			1.5	0.54		0.40	1.0	53.2	0.15
DKICK	riffle	4	37.7	4.00			2.5	0.39		0.35	1.7	46.8	0.12

Habitat: substrate

loc no	other	wood	silt clay	sand	fine gravel	coarse gravel	cobble	boulder	bedrock rough	bedrock smooth
1				6%	20%	30%	44%			
2				2%	2%	24%	66%	6%		
3					6%	44%	30%	20%		
4						10%	70%	20%		

Habitat: pebble counts

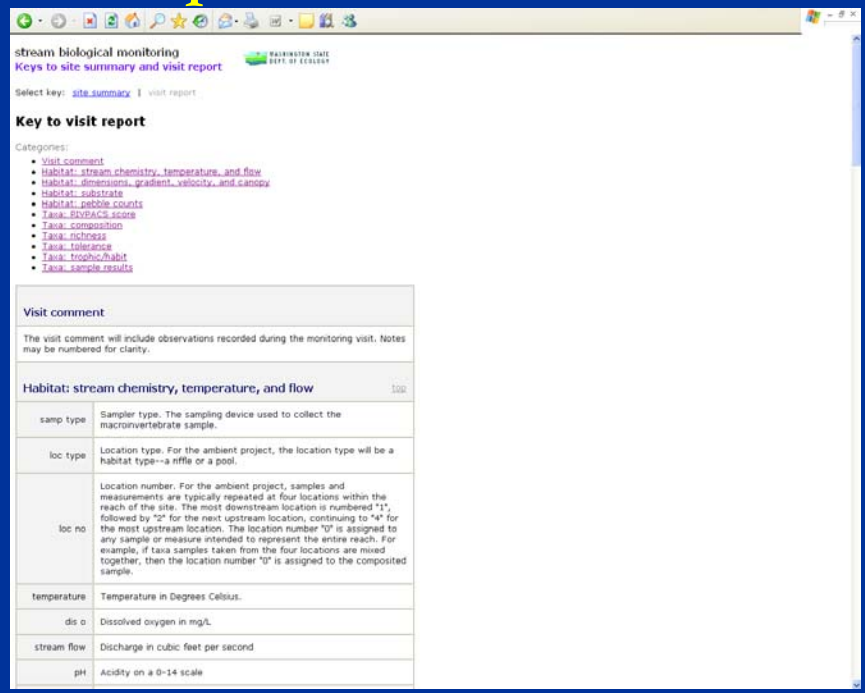
loc no	<2mm	2-4mm	4-6mm	6-8mm	8-11mm	11-16mm	16-22mm	22-32mm	32-45mm	45-64mm	64-90mm	90-128mm	128-180mm	180-256mm	256-512mm	>=512mm
1					2%	4%				6%	9%	17%	22%	19%	22%	
2		3%		2%	2%	2%	2%	3%	3%	7%	7%	3%	21%	13%	33%	
3		8%				2%	3%			5%	5%	10%	12%	19%	36%	
4				2%					2%	8%	11%	6%	19%	11%	42%	

Taxa: RIVPACS score

RIVPACS (River InVertebrate Prediction and Classification System) is a model that predicts probabilities of aquatic invertebrates occurring in streams in Western Washington. The number of observed taxa (O) at a test site is divided by the expected taxa (E), yielding a ratio. A ratio of 1 indicates that all expected taxa are present. As a site becomes more degraded, fewer expected taxa are observed, yielding a smaller ratio. We are 90% confident that a ratio smaller than 0.86 is degraded relative to a reference condition.

RIVPACS score for this visit: **0.97**

Description of Variables



stream biological monitoring
Keys to site summary and visit report

Select key: site summary | visit report

Key to visit report

Categories:

- Visit comment
- Habitat: stream chemistry, temperature, and flow
- Habitat: dimensions, gradient, velocity, and canopy
- Habitat: substrate
- Habitat: pebble counts
- Taxa: RIVPACS score
- Taxa: composition
- Taxa: richness
- Taxa: tolerance
- Taxa: trophic/habit
- Taxa: sample results

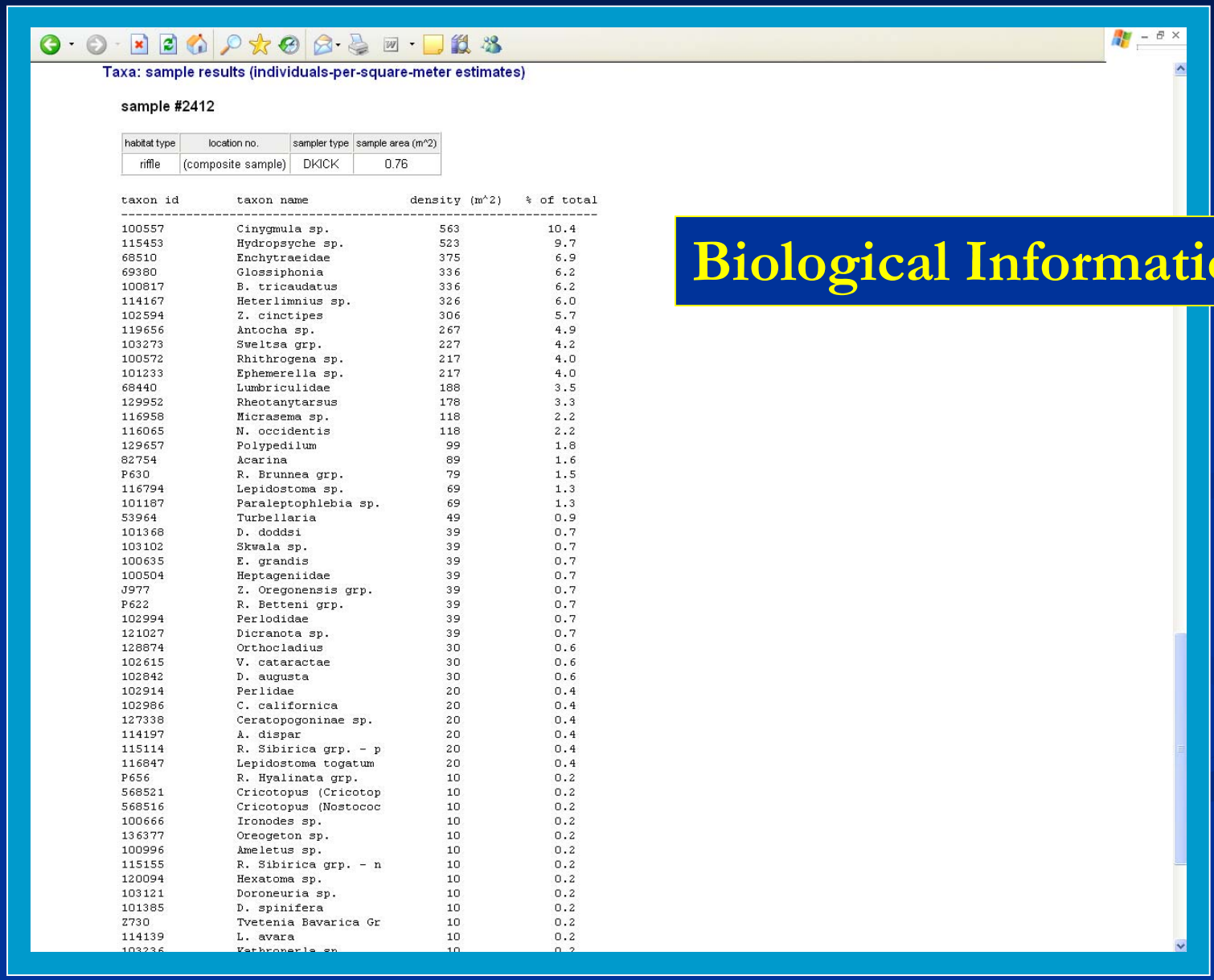
Visit comment

The visit comment will include observations recorded during the monitoring visit. Notes may be numbered for clarity.

Habitat: stream chemistry, temperature, and flow top

samp type	Sampler type. The sampling device used to collect the macroinvertebrate sample.
loc type	Location type. For the ambient project, the location type will be a habitat type--a riffle or a pool.
loc no	Location number. For the ambient project, samples and measurements are typically repeated at four locations within the reach of the site. The most downstream location is numbered "1", followed by "2" for the next upstream location, continuing to "4" for the most upstream location. The location number "0" is assigned to any sample or measure intended to represent the entire reach. For example, if taxa samples taken from the four locations are mixed together, then the location number "0" is assigned to the composited sample.
temperature	Temperature in Degrees Celsius.
dis o	Dissolved oxygen in mg/L
stream flow	Discharge in cubic feet per second
pH	Acidity on a 0-14 scale

Data Available On-Line: Biology



Taxa: sample results (individuals-per-square-meter estimates)

sample #2412

habitat type	location no.	sampler type	sample area (m^2)
riffle	(composite sample)	DKICK	0.76

taxon id	taxon name	density (m^2)	% of total
100557	Cinygmula sp.	563	10.4
115453	Hydropsyche sp.	523	9.7
68510	Enchytraeidae	375	6.9
69380	Glossiphonia	336	6.2
100817	B. tricaudatus	336	6.2
114167	Heterlimnius sp.	326	6.0
102594	Z. cinctipes	306	5.7
119656	Antocha sp.	267	4.9
103273	Sweltsa grp.	227	4.2
100572	Rhithrogena sp.	217	4.0
101233	Ephemerella sp.	217	4.0
68440	Lumbriculidae	188	3.5
129952	Rheotanytarsus	178	3.3
116958	Micrasema sp.	118	2.2
116065	N. occidentis	118	2.2
129657	Polypedilum	99	1.8
82754	Acarina	89	1.6
P630	R. Brunnea grp.	79	1.5
116794	Lepidostoma sp.	69	1.3
101187	Paraleptophlebia sp.	69	1.3
53964	Turbellaria	49	0.9
101368	D. doddsi	39	0.7
103102	Skwala sp.	39	0.7
100635	E. grandis	39	0.7
100504	Heptageniidae	39	0.7
J977	Z. Oregonensis grp.	39	0.7
P622	R. Betteni grp.	39	0.7
102994	Perlodidae	39	0.7
121027	Dicranota sp.	39	0.7
128874	Orthocladius	30	0.6
102615	V. cataractae	30	0.6
102842	D. augusta	30	0.6
102914	Perlidae	20	0.4
102986	C. californica	20	0.4
127338	Ceratopogoninae sp.	20	0.4
114197	A. dispar	20	0.4
115114	R. Sibirica grp. - p	20	0.4
116847	Lepidostoma togatum	20	0.4
P656	R. Hyalinata grp.	10	0.2
568521	Cricotopus (Cricotop	10	0.2
568516	Cricotopus (Nostococ	10	0.2
100666	Ironodes sp.	10	0.2
136377	Oreogeton sp.	10	0.2
100996	Ameletus sp.	10	0.2
115155	R. Sibirica grp. - n	10	0.2
120094	Hexatoma sp.	10	0.2
103121	Doroneuria sp.	10	0.2
101385	D. spinifera	10	0.2
Z730	Tvetenia Bavarica Gr	10	0.2
114139	L. avara	10	0.2
103236	Kathroperla sp.	10	0.2

Biological Information

Publications & Analytical Tools

Available Publications

title	date
Multi-Metric Index Development for Biological Monitoring in Washington State Streams	July 2003
Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams: 2001 Revision	September 2001
The Relationship Between Stream Macroinvertebrates and Salmon in the Quilceda/Allen Drainage	March 1999
Ambient Monitoring Instream Biological Assessment: Progress Report of the 1993 Pilot Survey	June 1995
Taxonomic Laboratory Protocol for Stream Macroinvertebrates Collected by the Washington State Department of Ecology	June 1996
Use of Invertebrates to Assess the Quality of Washington Streams and to Describe Biological Expectations	September 1997
Mid-Sol Duc Watershed Case Study	November 1998
Biological Assessment of Small Streams in the Coast Range Ecoregion and the Yakima River Basin	January 1999
The Relationship Between Stream Macroinvertebrates and Salmon in the Quilceda/Allen Drainage	March 1999

Also see: stream bioassessment publications.

Access to monitoring results

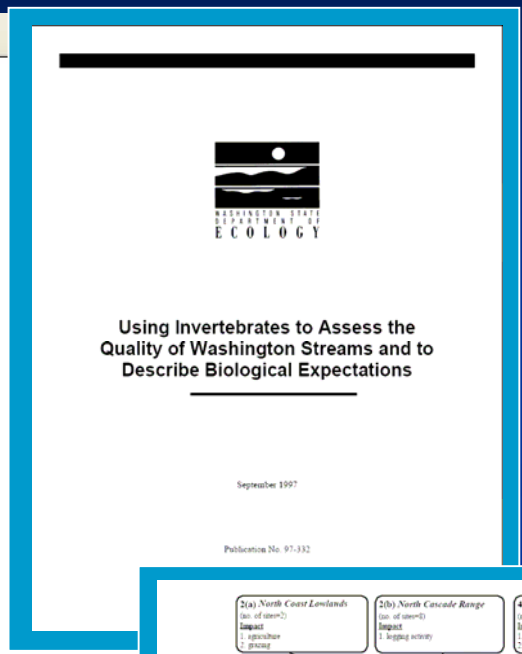
Access to monitoring results varies with project. Site-by-site monitoring reports are available online for ambient project sites. Other projects may provide monitoring results through publications, downloadable files, or by request. Look for *project information* to learn of data availability for non-ambient sites.

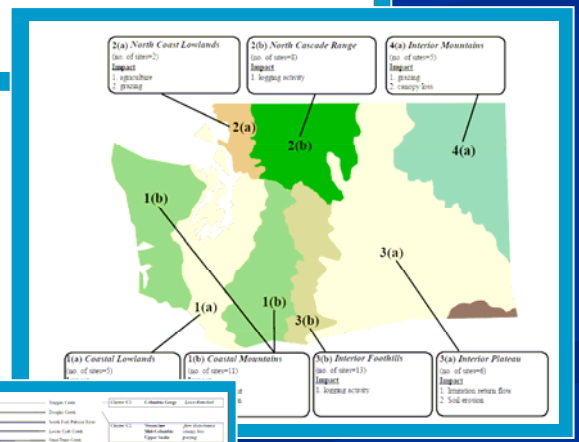
- Map of monitoring sites.
- List of monitoring sites.

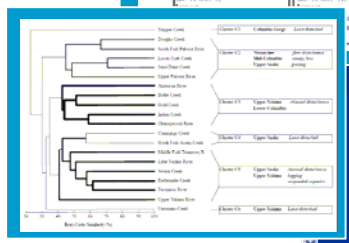
Contacts

For more information on Ecology's ambient stream biological monitoring project, contact George Onwumere, ogeo461@ecy.wa.gov, (360) 407-6730. For more information on EMAP-REMAP projects, contact Glenn Merritt, gmer461@ecy.wa.gov, Ecology's EMAP-REMAP coordinator, (360) 407-6777

Washington State Department of Ecology

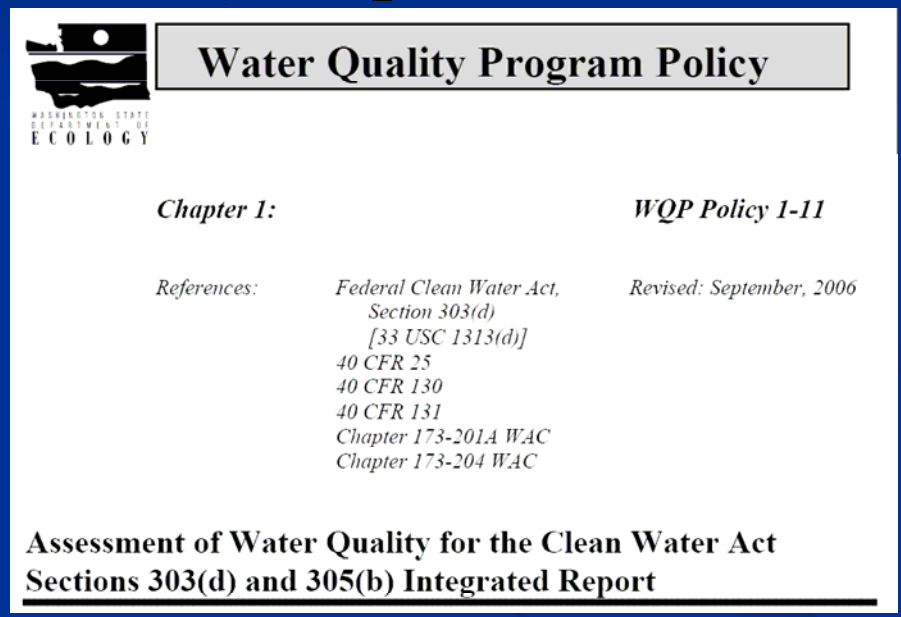






TMDL Connection

- Identification of Water Quality Impairments (303(d) Listing)
  - Category 2
    - Waters of Concern
  - Category 4(c)
    - Waterbodies impaired by a non-pollutant
- Verification of TMDL modeling conclusions



Water Quality Program Policy

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Chapter 1: *WQP Policy 1-11*

References: *Federal Clean Water Act, Section 303(d) [33 USC 1313(d)]*
40 CFR 25
40 CFR 130
40 CFR 131
Chapter 173-201A WAC
Chapter 173-204 WAC

Revised: September, 2006

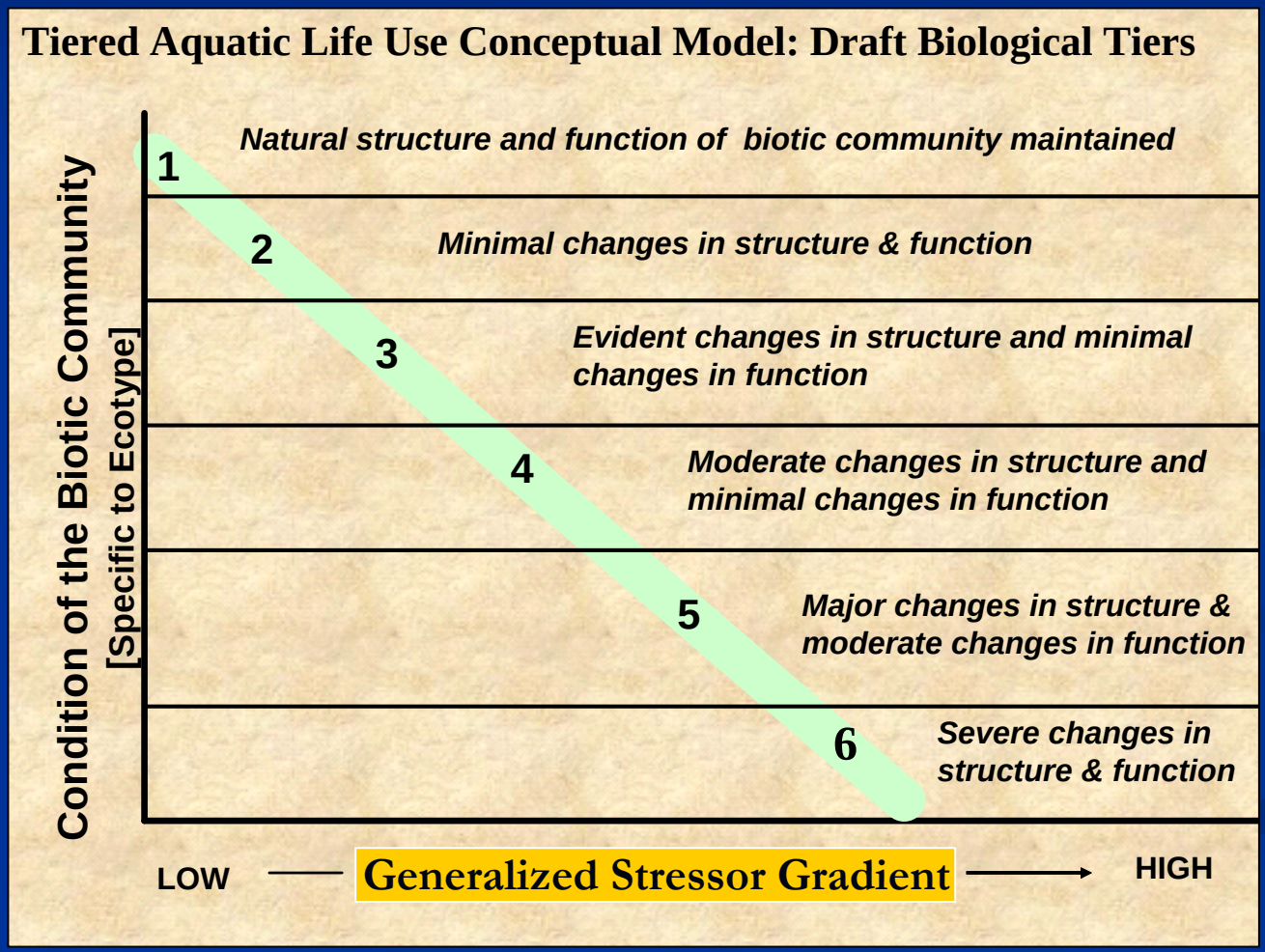
Assessment of Water Quality for the Clean Water Act Sections 303(d) and 305(b) Integrated Report

Advanced Regulatory Products

- Tiered Aquatic Life Use applications (TALU)
  - Facilitates **biocriteria** development
  - Stream **restoration** and **goal-setting**
  - Links to: **UAA**, Criteria **triennial review**, integrating environmental data (wq, habitat, biology)
- CADDIS applications
  - ID specific **stressors** causing biological impairment
  - Application in the **303(d) Listing process**
    - move listing from Category 2 or 4(c) to Category 5

Tiered Aquatic Life Uses (TALU):

Northern Semi-Arid Case Study, Washington State



CADDIS:
Causal Analysis/Diagnosis and Decision Information System

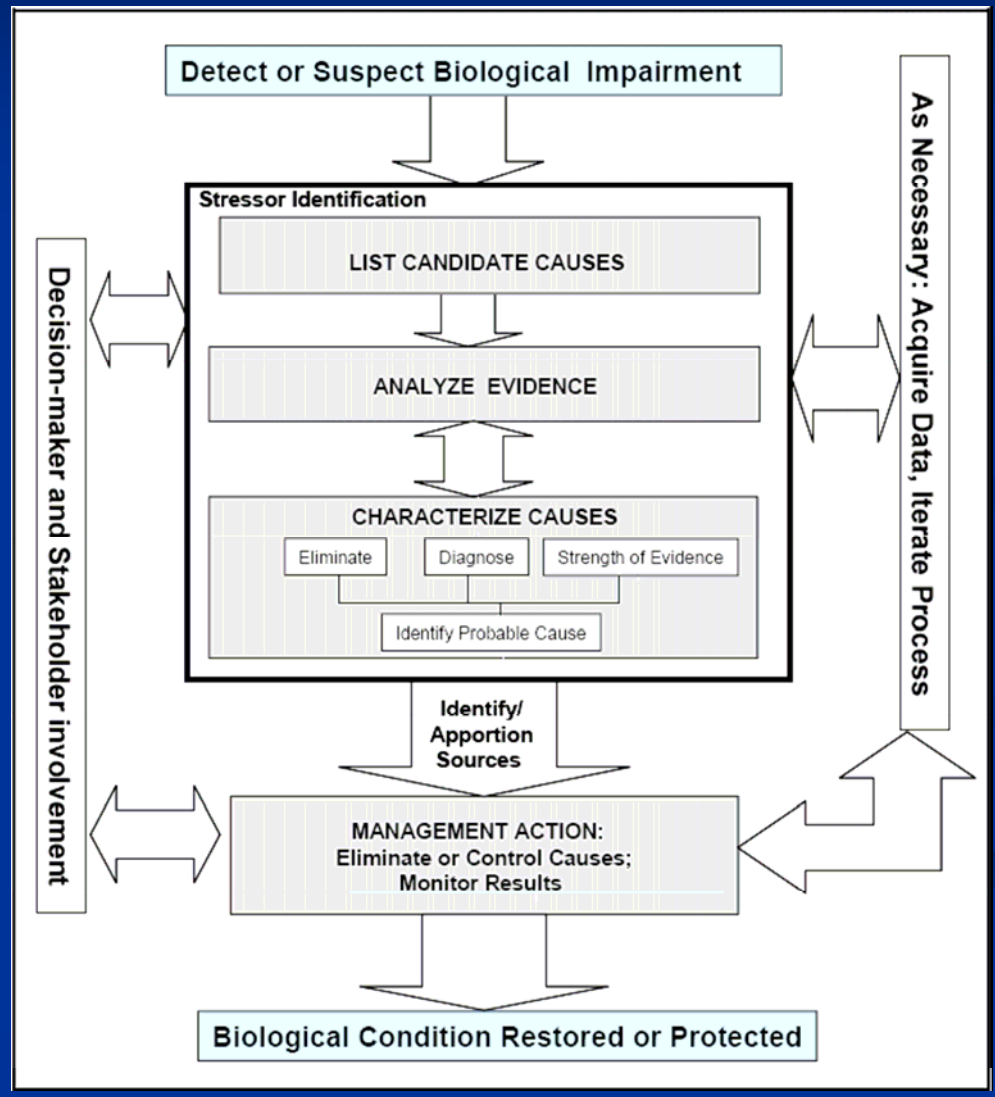
Step 1.

Step 2.

Step 3.

Step 4.

Step 5.



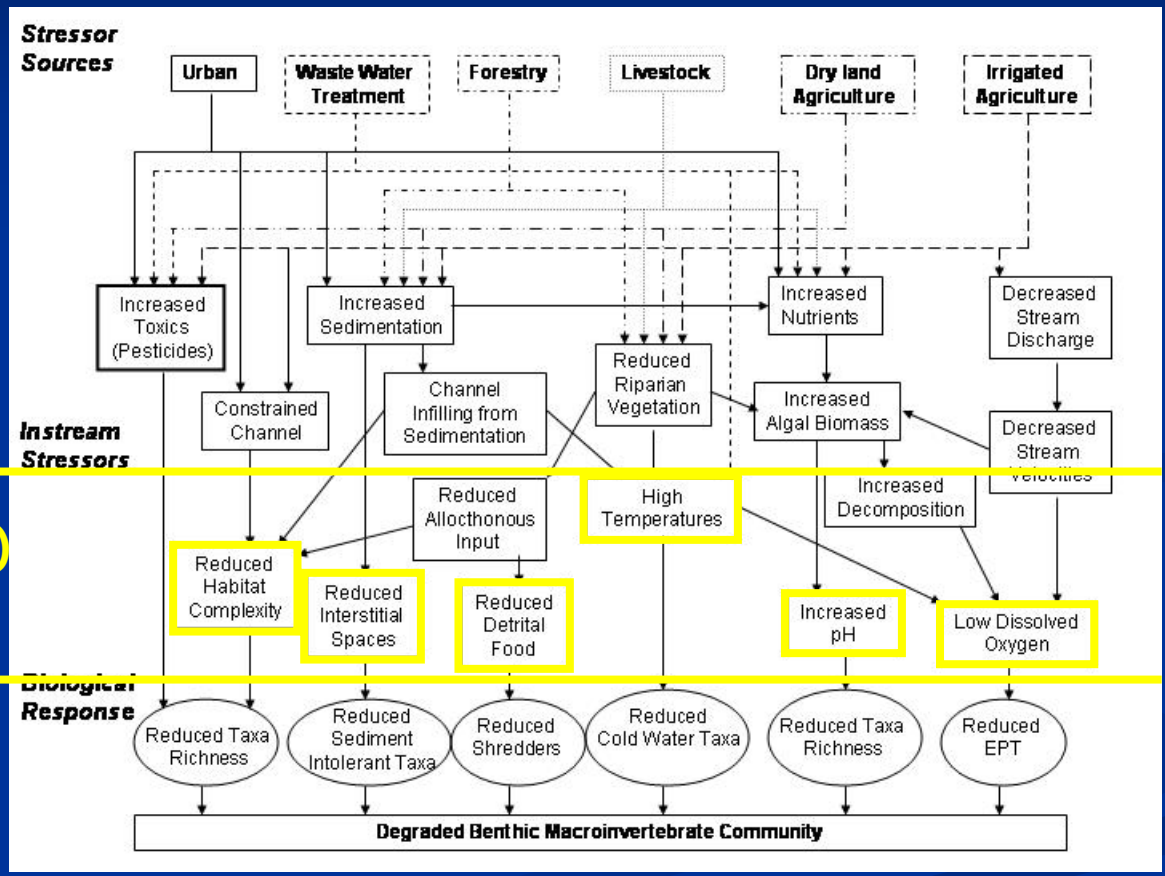
CADDIS: Pathways Analysis

Human Activities

Pollutant Input/ Channel Impact

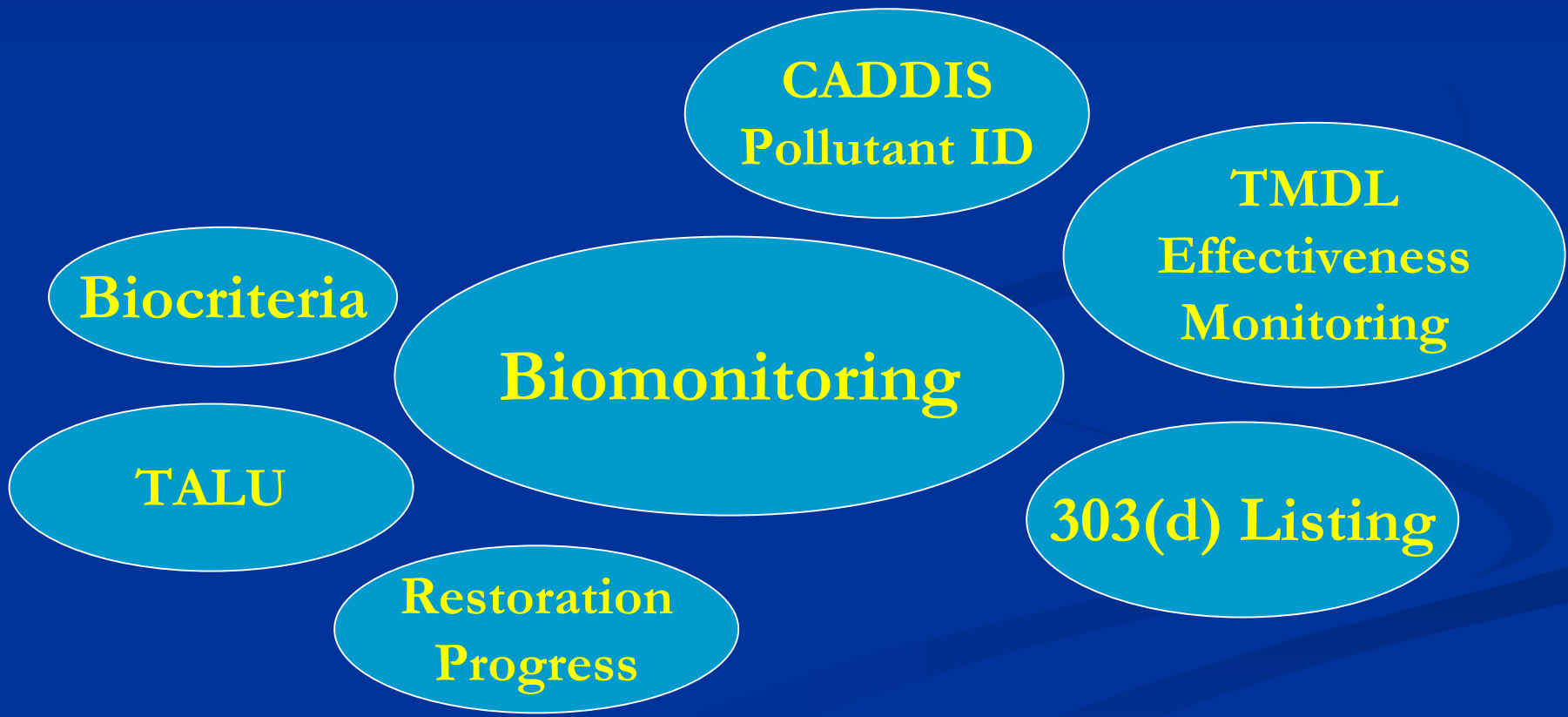
Candidate Cause(s) (WQ/Habitat)

Biological Consequence



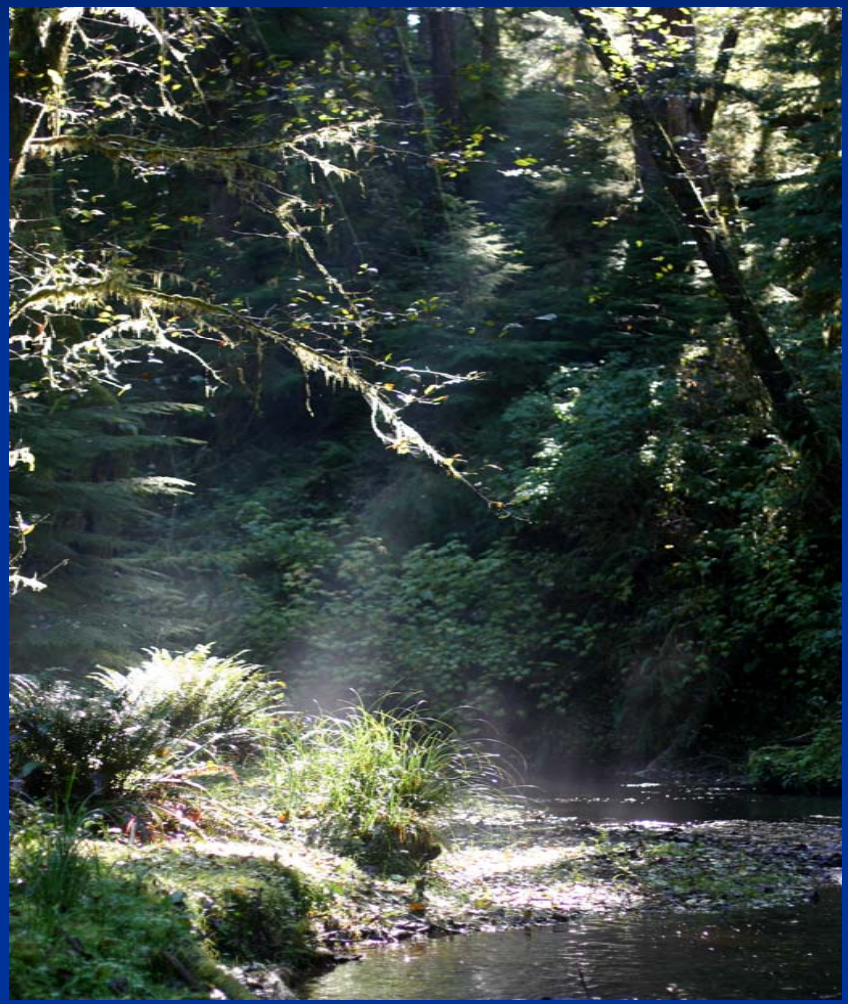
(Touchet River Case Study)

Biomonitoring & Relationship to Regulatory Programs



Themes in Development of the Program

- Assist clients in helping themselves
- Provide direct access to data
- Respond to client needs
  - Department of Ecology, Counties, Cities
- Integrate results with regulatory programs
- Promote a progressive method for assessment



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