National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

Coeur d'Alene, Idaho
31 March – 4 April, 2003

WQS 101

KEYS TO GETTING BIOCRITERIA INTO WATER QUALITY STANDARDS

Course Presenters and Contributors
William Swietlik, Thomas Gardner, Rick Hafele, Chuck Potts, Susan Davies, Rich Eskin

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Introduction

Presented by

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Take Home Concepts

- **What are and are not water quality standards?**
- **Different ways biological assessments and criteria can be used to enhance water quality standards**
- **Trials and tribulations of other States**

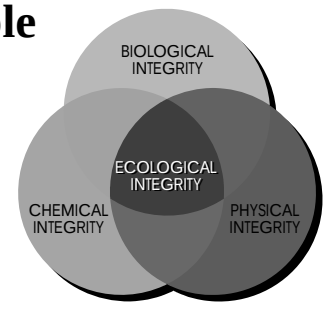
Outline

1. **Basics of Water Quality Standards**
2. **Case Presentations**
   - **Oregon**
   - **Oklahoma**
   - **Maine**

Basics of Water Quality Standards

Clean Water Act

- **Objective: "restore and maintain the chemical, physical and biological integrity of the Nation's waters"**
- **Interim goal: "water quality which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water", wherever attainable**



What are Laws?

- **Passed by Congress, signed by the President**
- **Published in the United States Code (U.S.C.) (www.access.gpo.gov/congress/cong013.html)**
- **Clean Water Act is 33 U.S.C. 1251 - 1587**

What are Regulations?

- **"Substantive Rules" or "Legislative Rules"**
- **Have the force and effect of law**
- **A "must"**
- **Involve "notice and comment" rulemaking**
- **Water Quality Standards regulations are at 40 CFR 131**
- **http://www.regulations.gov/**
- **Basis for EPA disapproval of State/Tribal water quality standards**

What is Guidance or Policy?

- **"General Statements of Policy"**
- **A "should"**
- **Notice and comment not required**
- **Not binding on Agency or Public**
- **Not a basis for disapproval**
- **Governed by section 553 of the Administrative Procedure Act: http://www.nara.gov/fedreg/legal/apa/553.html**

Water Quality Standards

- **Designated Uses**
- **Criteria to protect those uses**
  - **narrative or numeric**

- **Antidegradation Policy**

Uses: Statute and Regulation

- **CWA 101(a): requires, where attainable, water quality providing for the protection and propagation of fish, shellfish and wildlife, and recreation in and on the water**
- **CWA 303 (c)(2)(a): consider the use and value for public water supplies, propagation of fish and wildlife, recreational, agricultural, industrial and other purposes**
- **40 CFR 131.3, 131.10**

Uses: Terminology (1)

- ***Designated Uses*: those uses specified in State or Tribal water quality standards regulations for each waterbody or segment, whether or not they are being attained.**
  - **"goals" for a waterbody**

Uses: Terminology (2)

- ***Existing Uses*: those uses actually attained in a waterbody on or after November 28, 1975, whether or not they are included in the water quality standards**
  - **Cannot be removed**
- **Determined on a case-by-case basis, considering:**
  - **Historical and current water quality**
  - **Historical and current biological condition**
  - **Pattern and frequency of human activities**

Uses: Terminology (3)

- ***Use Attainability Analysis*: a structured, scientific assessment of the factors affecting the attainment of the use which may include physical, chemical, biological and economic factors**
  - **Based on natural, human-caused, social or economic conditions**

Designated Uses (40 CFR 131.10)

- **Protection and propagation of fish, shellfish and wildlife**
- **Recreation in and on the water**
- **Public water supply**
- **Agriculture**
- **Industry**
- **Navigation**
- **Others**

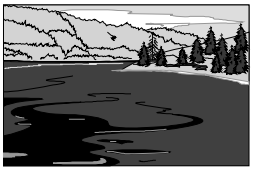
Designated Use "Musts" (1)

- **Specify appropriate water uses to be achieved and protected**
- **Protect uses that can be achieved by the imposition of:**
  - **1) Technology based effluent limits on point sources and**
  - **2) Cost effective and reasonable best management practices on nonpoint sources**

Designated Use "Musts" (2)

- **Provide for the attainment and maintenance of the water quality standards of downstream waters**
- **States/Tribes must have provided an opportunity for a public hearing when adding or removing uses, or establishing sub-categories**

Designated Use "Must NOTs":



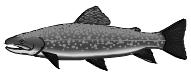
- **Provide for waste transport or assimilation**
- **Remove an existing use (unless adding a use with a more stringent criteria)**
- **Be less than those specified by CWA 101 (a) (unless justified by a UAA)**
- **Adopt sub-categories of such a use with less stringent criteria, without a UAA**

Designated Use "Mays"

- **Protect uses higher than those currently being achieved**
- **Adopt sub-categories of a use**
- **Adopt seasonal uses**
- **Be removed (with appropriate justification)**
- **Consider economic and social impacts**

Sub-Categories of Uses: CWA 101(a)

- **Protection and propagation of fish, shellfish and wildlife**



  - **Protection of Aquatic Life**
    - **Coldwater fishery**
    - **Warmwater fishery**

  - **Recreation in and on the water**
    - **Primary Contact Recreation**
    - **Secondary Contact Recreation**
    - **Seasonal Primary Contact Recreation**

Refining More Specific Sub-categories

- **Refining use descriptions for specific types of waters, based on biology, geomorphology or frequency or timing of human activity:**
  - **Exceptional Habitat Quality Aquatic Life Use**
  - **Minimally Impacted Aquatic Life Use**
  - **High Gradient Trout Stream**
  - **Low Frequency Swimming Area**
- **Refining use descriptions for specific human caused conditions or degrees of degradation**
  - **Urban Spillway**
- **Advantage: tailored criteria for more specific levels of protection**

Removing Designated Uses

1. **Naturally occurring pollutant concentrations,**
2. **Low flow conditions or water levels,**
3. **Human caused conditions or pollutant sources,**
4. **Dams or other hydrologic modifications,**
5. **Natural physical conditions for aquatic life,**
6. **Substantial and widespread economic and social impact.**

"Criteria": 1 Word, 2 Meanings:

- **Scientifically defensible guidance developed by EPA**
  - **Section 304(a)**
    - **Guidance to States/Tribes adopting criteria to protect uses**
    - **basis for promulgation of criteria when necessary**
- **Part of State/Tribal Water Quality Standard**
  - **Section 303(c)**

Water Quality Criteria: Definition

- **Concentration, level or statement in water quality standards**
- **Intended to protect and support a designated use**

Forms of Criteria

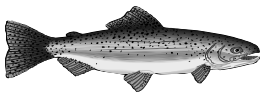
- **States Should Adopt (1) Numerical Criteria Based on:**
  - **304(a) Guidance, or**
  - **304(a) Guidance Modified to Reflect Site-Specific Conditions, or**
  - **Other Scientifically Defensible Methods**
- **And (2) Narrative Criteria or Criteria Based on Biological Monitoring and Assessment Methods to Supplement Numerical Criteria**

Water Quality Criteria (40 CFR 131.11)

- **Narrative or Numeric**
- **Include:**
  - **Aquatic Life Criteria**
  - **Human Health Criteria**
  - **Biological Criteria**
  - **Nutrient Criteria**

Terminology

- **Biocriteria– (scientific)** ***quantified values representing the biological condition of a waterbody, as measured by structure and function of the aquatic communities typically at reference condition.***
- **Biocriteria– (regulatory)** ***narrative descriptions or numerical values of the structure and function of aquatic communities in a waterbody necessary to protect the designated aquatic life use, implemented in, or through water quality standards.***



State/Tribal Antidegradation Policies (40 CFR 131.12)

- **Existing uses and the level of water quality to protect them**
- **Higher Quality Waters where a public determination must be made that it is necessary to lower existing water quality to accommodate important economic and social development**
- **Outstanding Natural Resource Waters: No degradation in State/Tribal designated waters of exceptional significance**

Protecting Water Quality for Existing Uses

- **Existing uses and the level of water quality necessary to protect existing uses shall be maintained and protected.**

Protecting High Quality Waters

- **Maintain and protect the quality of high quality waters unless-**
  - **The State/Tribe determines that it is necessary to lower water quality to accommodate important economic and social development;**
  - **Public and intergovernmental participation in the decision making process;**
  - **The most stringent statutory and regulatory requirements for point sources and cost-effective and reasonable BMPs are implemented, and;**
  - **Existing uses are protected.**

Protecting Outstanding Natural Resource Waters (ONRWs)

- **...waters of exceptional recreational, environmental or ecological significance...**
- **No degradation is allowed in an ONRW (only short-term/temporary).**
- **Regulations require provision to allow for ONRWs in antidegradation. No requirement for which waters or how waters classified as ONRWs.**
- **Instead of ONRWs, many states adopt an Outstanding State Resource Water or Exceptional Water category. More flexibility available than for ONRWs.**

General Policies 40 CFR 131.13

- **States and Authorized Tribes may include in their standards policies affecting application and implementation, such as:**
  - **Mixing zones**
  - **Low flows**
  - **Variances**
- **Subject to EPA review and approval**

Submittal and Approval of WQS

- **States and Authorized Tribes must:**
  - **Review adopted Water Quality Standards once every 3 years**
  - **Provide an opportunity for a public hearing**
  - **Submit the results to the EPA Regional Administrator**

Review Time Schedule

- **60 days after submittal for EPA Region to approve**
- **90 days after submittal for EPA Region to notify State/Tribe of disapproval**
- **90 days after notification - State or Tribe must revise standards to meet requirements**
- **EPA Administrator to promulgate standards promptly**

Biological Information Can Be Used in Water Quality Standards to:

- **Describe existing uses (131.3(e))**
- **Assign appropriate designated uses (131.10)**
- **Refine and subcategorize designated uses (131.10(c))**
- **Develop biological criteria to protect uses (131.11)**
- **Help make attainment decisions (130.23)**

Application into Water Quality Standards

Where can States/Tribes start?

Depends on where a State/Tribe currently stands, what their current standards are like and how much change can be made!

Application into Water Quality Standards

Key Questions:

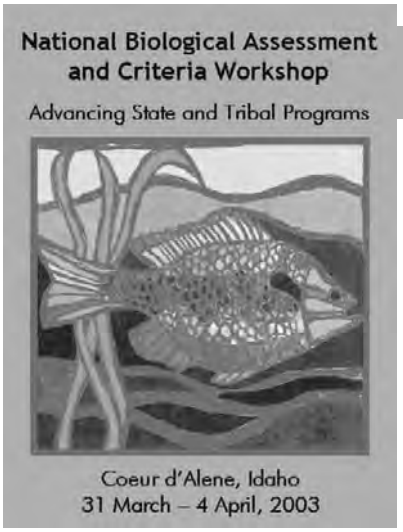
1. **How developed is the bioassessment program?**
2. **Do current designated aquatic life uses reflect/protect existing ecological resources and biological integrity?**
3. **Is there a general aquatic life narrative standard that needs to be interpreted?**
4. **Is there a narrative biocriterion that needs translation?**
5. **Is there only one overarching aquatic life use?**
6. **Do existing aquatic life uses need better interpretation?**
7. **Are current aquatic life uses bioassessment-based?**
8. **Do you want to revise existing standards or leave standards as they are?**
9. **How much effort can be afforded?**
10. **Is there institutional support?**

Application into Water Quality Standards

- **Ways States and Tribes have been using biological assessments and criteria in standards:**
  1. **Interpret or translate narrative standards or criteria.**
  2. **Interpret attainment of one or all designated aquatic life uses.**
  3. **Revise one or all designated aquatic life uses to be bioassessment-based.**
  4. **Sub-categorize one or all aquatic life uses to be bioassessment-based.**
  5. **Adopt numeric biocriteria that define the biological condition for each designated aquatic life use.**
  6. **Completely revise designated aquatic life uses and criteria using bioassessments and biocriteria.**
  7. **Combinations of the above, sequences of the above.**

State Program Examples

Oregon
Oklahoma
Maine



WQS 101

The Path to Biocriteria in Oregon

Presented by

Rick Hafele
Oregon Department of Environmental Quality

Path to Biocriteria in Oregon


A Brief History of Time

- **1970's – 1980's:**
  - Bioassessments at point sources
  - Upstream/downstream studies
- **Late 80's and early 90's**
  - Begin to evaluate non-point source problems
  - Start using and refining EPA's RBP methods

A Brief History of Time cont.

- 1991 DEQ adopts narrative biocriteria:
  - Improve point source protection of beneficial uses
  - Clarify standards for aquatic life protection
    - No toxics in toxic amounts
    - No detrimental changes outside mixing zone
    - Push bioassessment work forward by formally adopting a narrative standard

Oregon's Narrative Standard

Waters of the State shall be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.

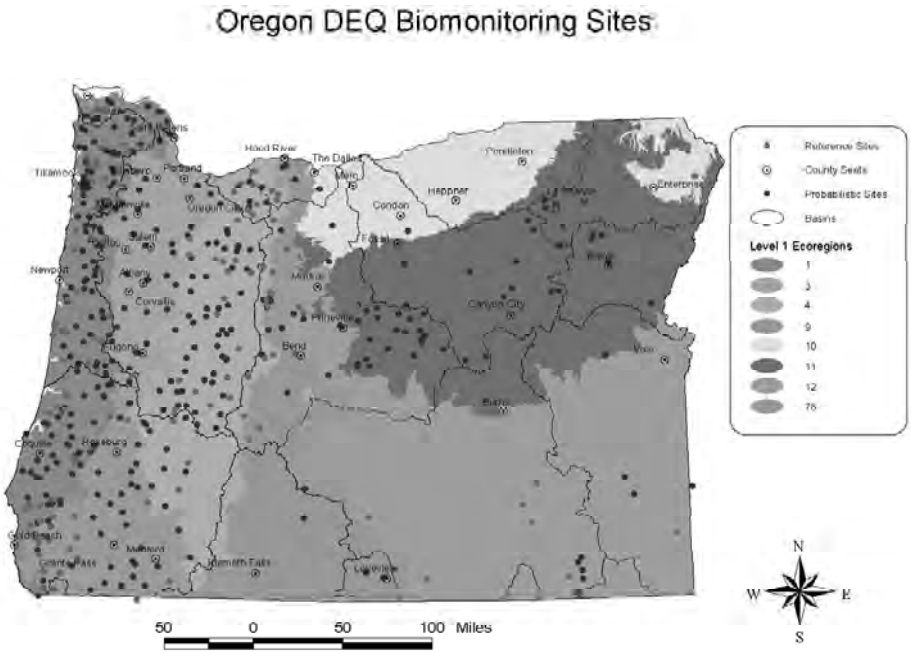
Without detrimental changes in the resident biological community *means no loss of ecological integrity when compared to natural conditions at an appropriate reference site or region.*

Ecological integrity *means the summation of chemical, physical, and biological integrity capable of supporting and maintaining a balanced, integrated adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat in the region.*

A Brief History of Time cont.

- **Late 1990's to Present:**
  - Regional probabilistic monitoring studies
  - Reference site selection and sampling
  - Sampling and analysis method refinement
  - Currently in middle of triennial standards review process for numeric biocriteria

Biological Data in Oregon

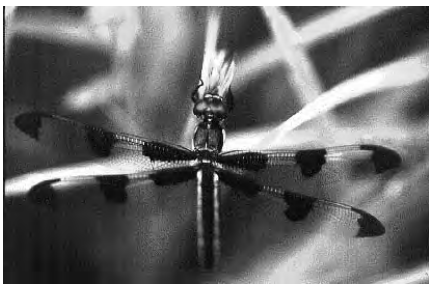


Are Numeric Biocriteria Necessary?

- Oregon DEQ isn't forced to develop **numeric** biocriteria. We could continue to apply the narrative standard. However, to apply the narrative standard one must develop evaluation methods that rely on consistent, accurate and appropriate assessment and analysis techniques - i.e. numeric criteria.

- We decided to pursue numeric biocriteria through the triennial standards review process to allow technical input and review, and public comment.

Technical Issues



- Field Sampling Methods
- Data Analysis Methods
- Site Assessment Methods
- Implementation Issues
  - What waters of the state?
  - Reference site selection and use
  - Beneficial Use categories

Implementation Issues

- Numeric criteria will first be implemented for wadeable streams. Narrative criteria will continue to apply to other waters - ex. large rivers, lakes, estuaries.
- Numeric criteria will be developed first for Western Oregon streams and then implemented in other regions of the state as sufficient data becomes available.
- Process for establishing numeric criteria (data requirements, analysis and assessment techniques) in other regions will be described in the new rule.

Data Analysis and Site Assessment Methods

Metric and Multivariate Models

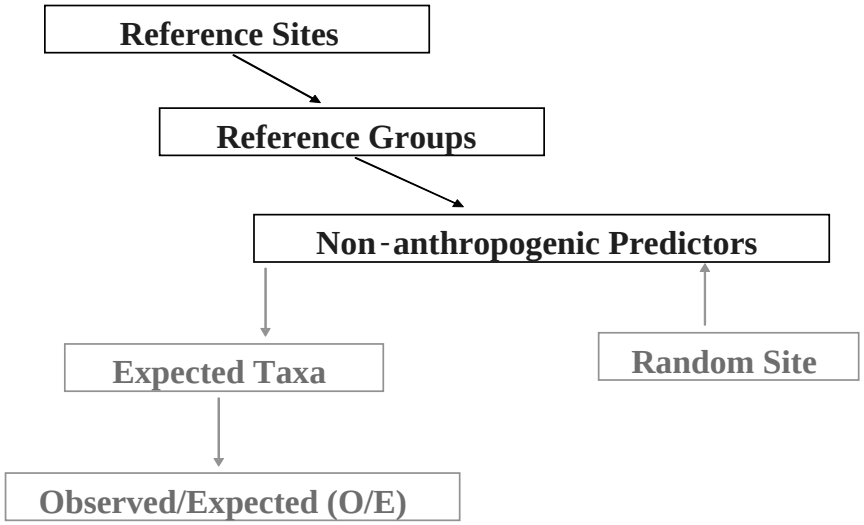
Genus/species level metrics and scoring criteria.

Metric	Raw Value	Scoring Criteria 5	3	1	Score (Circle)
Taxa Richness		>35	19-35	<19	5 3 1
Mayfly Richness		>8	4-8	<4	5 3 1
Stonefly Richness		>5	3-5	3	5 3 1
Caddisfly Richness		>8	4-8	<2	5 3 1
Sensitive Taxa		>4	2-4	<2	5 3 1
Sediment sens. Taxa		>2	1	0	5 3 1
Modified HBI		<4.0	4-5	>5.0	5 3 1
% Tolerant Taxa		<15	15-45	>45	5 3 1
% Sed Tol Taxa		<10	10-25	>25	5 3 1
% Dominant (single taxa)		<20	20-40	>40	5 3 1

Score Range	Stream Condition
>39	**No Impairment**: passes level 3 assessment. Indicates good diversity of invertebrates and stream conditions with little or no disturbance.
30-39	**Slight Impairment**: evidence of some impairment exists.
20-29	**Moderate Impairment**. clear evidence of disturbance exists.
<20	**Severe Impairment**. conditions indicate a high level of disturbance.

Data Analysis and Site Assessment Methods

River InVertebrate Prediction And Classification System "RIVPACS"



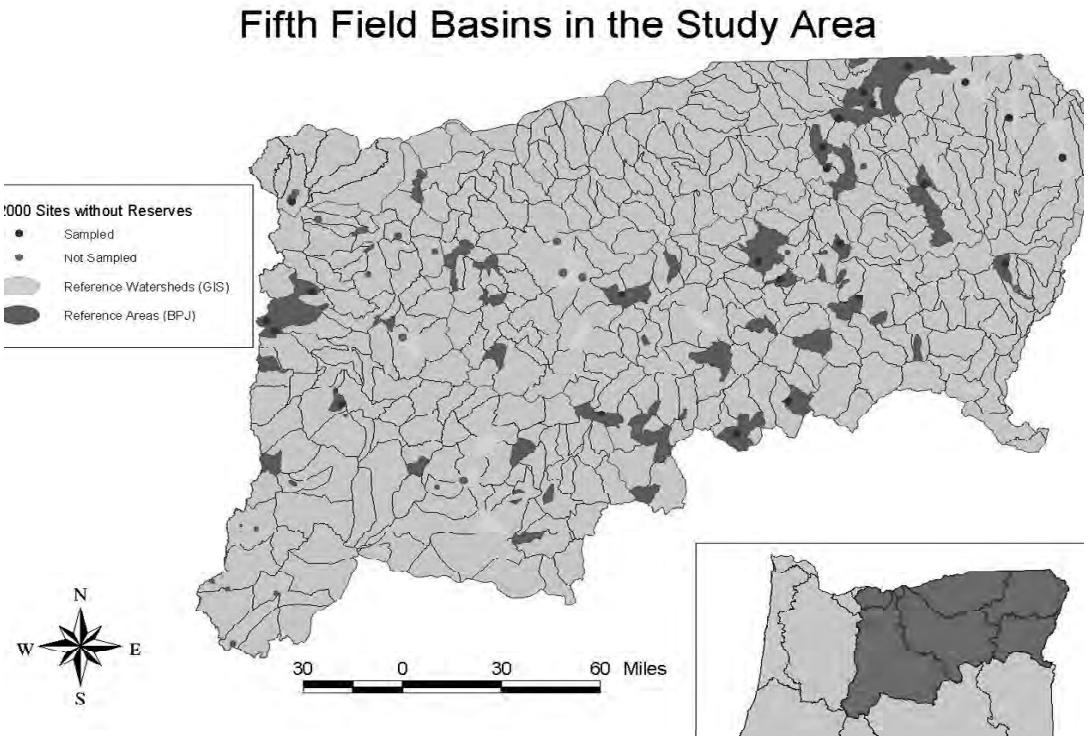
Reference Site Selection & Use

Reference Sites - Sites with no or minimal human disturbance that represent the habitat, water quality, and biological community conditions attainable within the region, basin or water body.

Northeast Oregon Reference Site Project

- NE Oregon basins broken into 5th field watersheds, Strata: 2nd-4th order, 3 elevation classes
- Examined 10 GIS coverages
- BPJ survey of resource managers
- GIS & BPJ folded together, EPA selected random sites

Reference Site Selection & Use cont.



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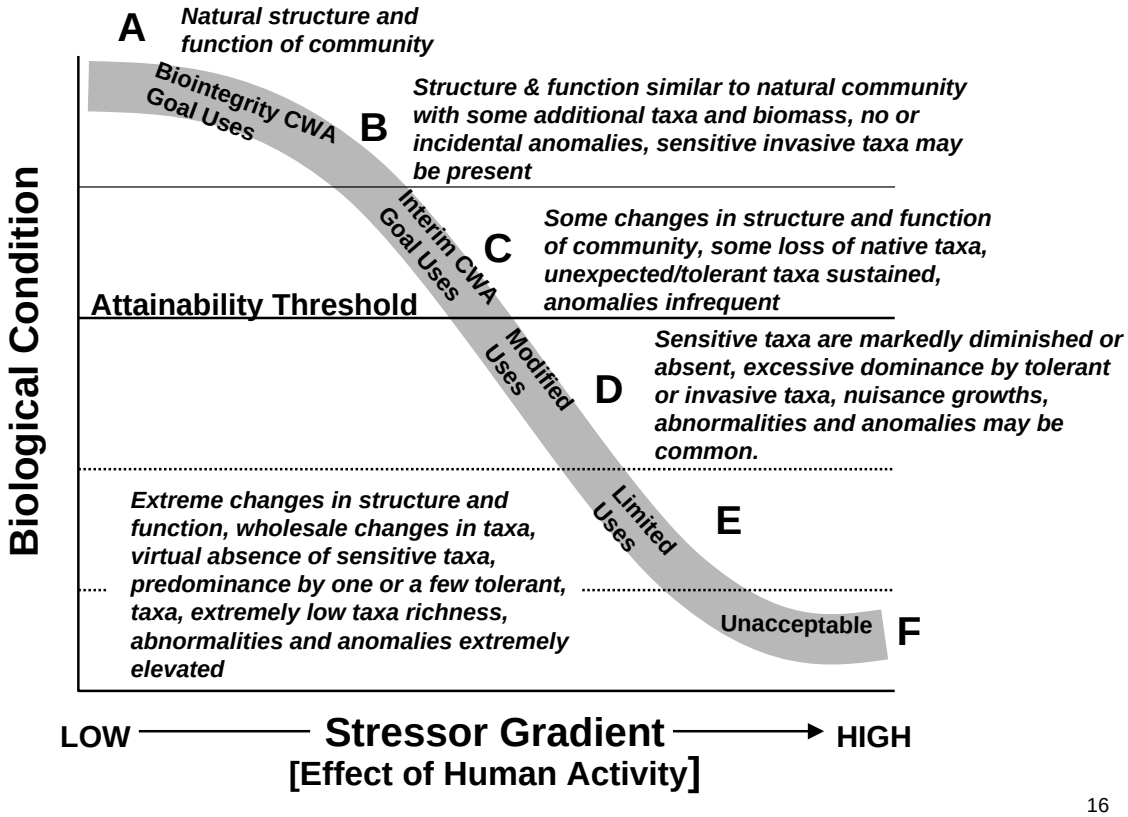
Reference Site Categories

A - Ideal watershed and stream condition, a watershed with virtually no human disturbance.

B - Good watershed and stream condition, some limited human disturbance and/or BMPs are well implemented.

C - Marginal watershed and stream condition. Human disturbance present. Best available. Replace if better quality reference sites are located.



Beneficial Use Categories

Oregon's beneficial uses for aquatic life:

- Salmonid passage
- Salmonid spawning
- Salmonid rearing
- Protection of fish and aquatic life

Beneficial Uses and Biocriteria

Biocriteria: Beneficial Uses and Tiered Aquatic Life Uses

CWA Goals	Bio Integrity		Interim Goal	Unacceptable---------->	
Tiered Use Categories	**A**	**B**	**C**	**D**	**E**
	Natural Conditions	Minimal Changes	Conspicuous Changes	Major Changes	Severe Changes
Beneficial Uses	Salmonid Fish Spawning Salmonid Fish Rearing Anadromous Fish Passage Resident Fish & Aquatic Life		Anadromous Fish Passage Resident Fish & Aquatic Life	Anadromous Fish Passage	
Biology	**All expected** Taxa present will appropriate community relationships	**Expected taxa** present withminor but measurable changes in community	**Most** expected taxa present, measureable changes in community	**Some to few** expected taxa present; major changes in community	**Few to no** expected taxa present; severe changes in community
Chemistry	Low Temperature Dissolved Oxygen at Sat. pH 6.0 to 8.5 Low Nutrients Low Turbidity Low BOD No Toxins				
Physical Habitat	Good Shade Low Sediment Good Habitat Complexity Good LWD Good Bank/Chan. Stability Good Riparian Good Substrate/Cover				
Landscape	**None** of Landscape altered by Humans	**Minimal** Proportion **(<10%)**of Watershed Landscape altered by Humans	**Conspicuous** Proportion **(10-30%)** of Watershed Landscape altered by Humans	**Major** Proportion **(30-50%)** of Watershed Landscape altered by Humans	**Severe** Proportion **(50-70%)** of Watershed Landscape altered by Humans

Uses of Biocriteria

- NPDES Permits
- 401 Permit Certifications
- 303d List
- 305b Reports
- Oregon Benchmarks
- Oregon Plan Stream Assessment
  - Status & Trends
  - Restoration Effectiveness
  - TMDL Effectiveness

Lessons Learned

- Develop sufficient data base to adequately evaluate sampling and analysis techniques.
- Reference site selection methods and criteria critical to developing defensible biocriteria.
- Need to integrate biological data and assessments into other water quality programs – TMDLs, permits, 401 etc.
- Reporting and data management often not adequately budgeted.

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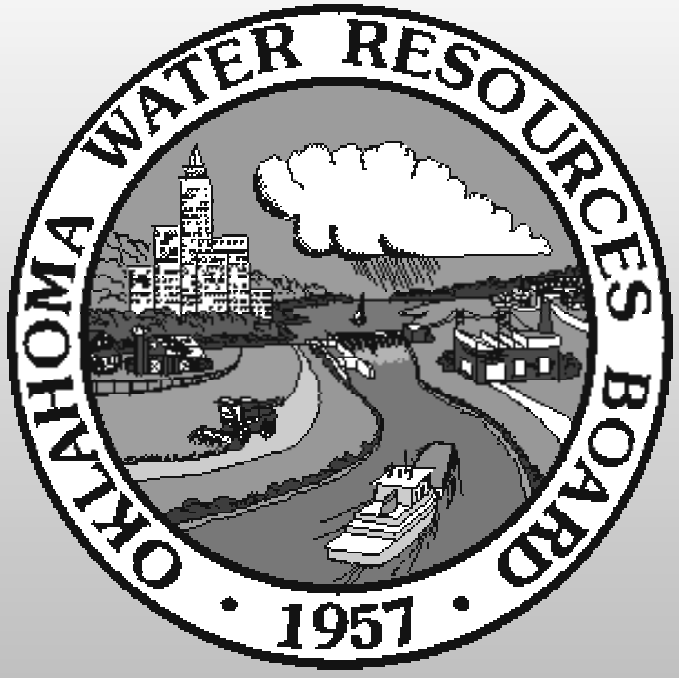
Oklahoma Water Quality Standards

Presented by

Chuck Potts
Oklahoma Water Resources Board



OKLAHOMA WATER QUALITY STANDARDS

OAC 785:45	WATER QUALITY STANDARDS
OAC 785:46	IMPLEMENTATION OF WATER QUALITY STANDARDS

OKLAHOMA WATER QUALITY STANDARDS

OAC 785:45-5-12 Fish and Wildlife Propagation

(5) Biological Criteria.

(A) Aquatic life in all waterbodies designated Fish and Wildlife Propagation (excluding waters designated "Trout, put-and-take") shall not exhibit degraded conditions as indicated by one or both of the following:

(i) comparative regional reference data from a station of reasonably similar watershed size or flow, habitat type and Fish and Wildlife beneficial use subcategory designation or

(ii) by comparison with historical data from the waterbody being evaluated.

(B) Compliance with the requirements of (this section) shall be based upon measures including, but not limited to, diversity, similarity, community structure, species tolerance, trophic structure, dominant species, indices of biotic integrity (IBI's), indices of well being (IWB's), or other measures.

Public/Private Water Supplies

Agriculture

Body Contact Recreation

Hydropower

Agriculture

Fish and Wildlife Propagation

- **Habitat Limited A.C.**
- **Warm Water A.C.**
- **Cool Water A.C.**
- **Trout – put and take**

Aesthetics

Navigation

Industrial / Municipal Cooling Water

HOW CAN YOU TELL IF THIS IS A FISH COLLECTION FROM A HEALTHY STREAM?

DETAILED PLANNING

- WHAT DO YOU WANT BIOCRITERIA TO DO FOR YOUR PROGRAM?
- WHAT DO YOU HAVE ?
- WHAT DO YOU NEED ?
- IDENTIFY YOUR DEFENSIBLE ASSUMPTIONS

ULTIMATE GOAL FOR BIOLOGICAL ASSESSMENT

- to be able to examine a standardized biological collection and determine if the stream is supporting the fish community it is capable of supporting and determine at what level the **appropriate** "Fish and Wildlife Propagation" Beneficial Use is being supported

USE SUPPORT ASSESSMENT PROTOCOLS

The ability to consistently determine

- if the Beneficial Use is being supported
- the level at which the Beneficial Use is being supported (fully, partially, threatened, etc)

Benefits:

- "blind to source"
- can be used by any agency
- acceptable level of precision and accuracy
- focused toward 303(d) list and reporting compliance

USE SUPPORT ASSESSMENT PROTOCOLS

OAC 785:46-15-5. Assessment of Fish and Wildlife Propagation Support

(e) **Biological criteria.**

(1) If data demonstrate that an assemblage of fish or macro invertebrates from a waterbody is significantly degraded, according to 785:45-5-12(f)(5), from that expected for the subcategory of Fish and Wildlife Propagation designated in OAC 785:45 for that waterbody, then that subcategory may be deemed by the appropriate state environmental agency to be not supported.

GENERAL PROCESS

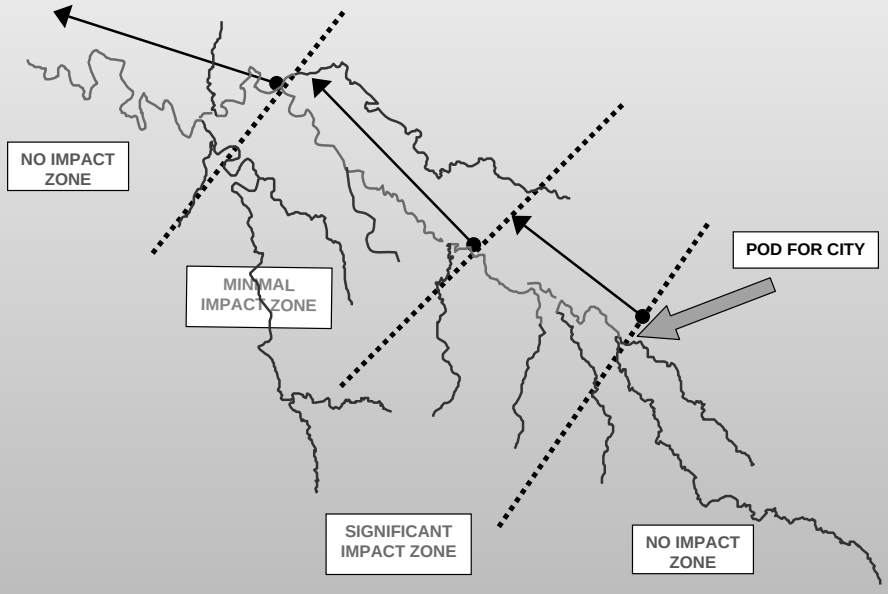
ASSEMBLE ASSESSMENT DATA FROM DIFFERENT BENEFICIAL USE SUB-CATEGORIES AND ECOREGIONAL REFERENCE STREAMS

ASSIGN IMPACT LEVEL TO ALL TEST SITES BASED UPON LOCATION OF ASSESSMENT SITE

TEST IBI PARAMETERS FOR EFFICIENCY IN DETECTING CHANGES IN STREAM QUALITY AND APPLY TO STREAM DATA

CREATE TEXT TO REFLECT IBI RESULTS

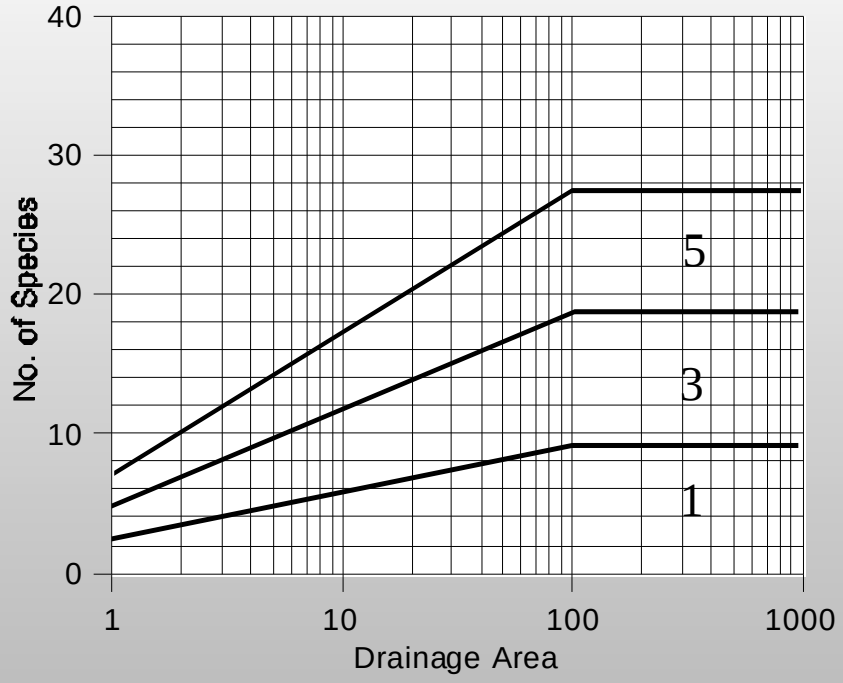
ASSIGNMENT OF IMPACT LEVELS



IBI FOR OK WQS

		5	3	1	
Sample Composition	# Total Sp.	see figure			
	Shannon's diversity* based upon numbers	>2.50	2.49-1.50	<1.50	
	# sunfish sp.	>4	3-4	<3	
	# species comprising 75% of sample	>5	4-3	<3	
	# intolerant sp. <100mi² area	>6	4-6	<4	
	>100mi² area	see figure			
	% tolerant sp.	see figure			
Fish Condition	% lithophils	>36	18-36	<18	
	% DELT anomalies**	<0.1	0.1-1.3	>1.3	
	Fish numbers (total individuals)	>200	200-75	<75	

"number of sp."

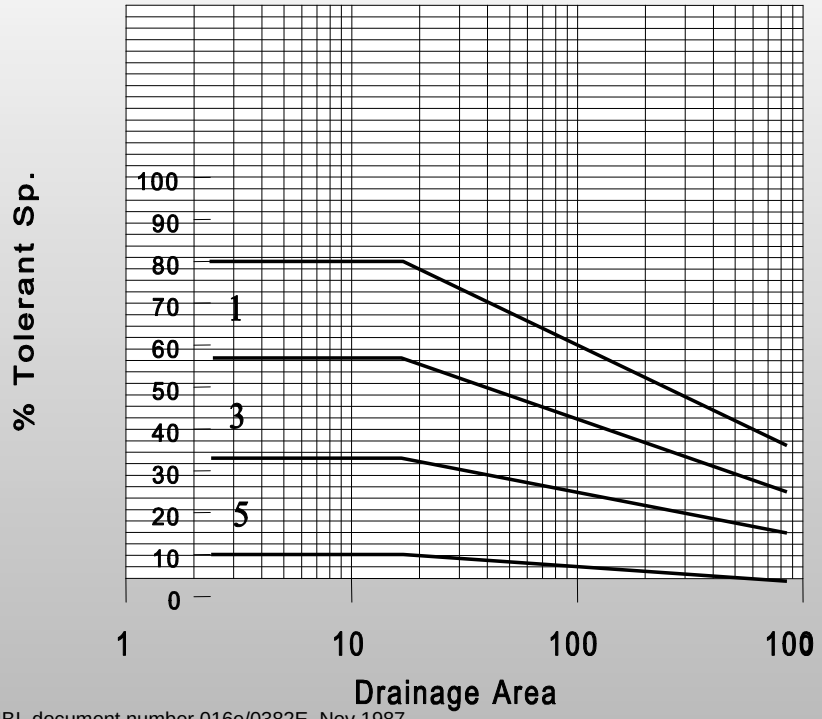


Ohio IBI, document number 016e/0382E, Nov 1987

"number of intolerant sp."

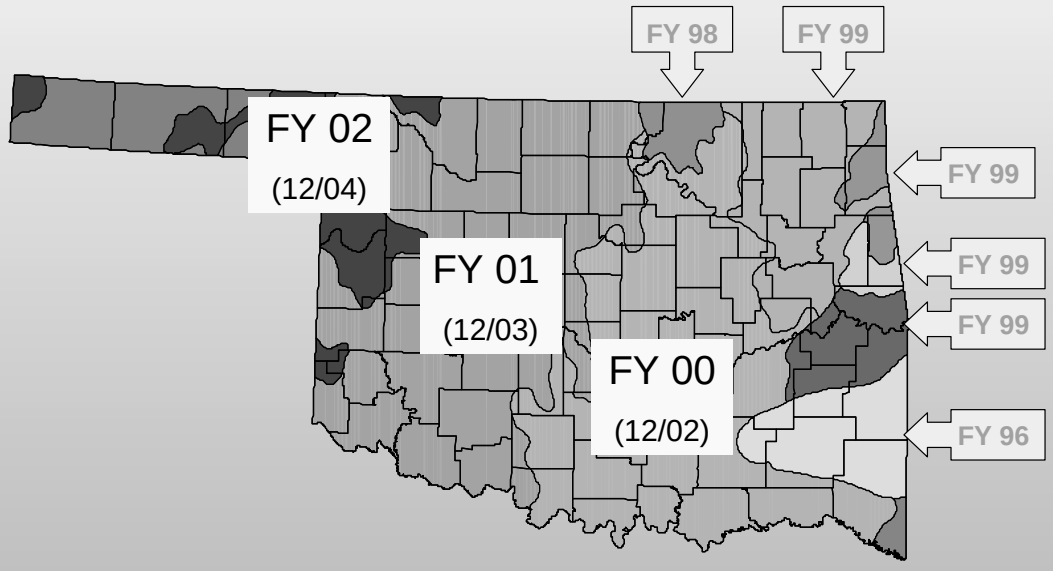
Ohio IBI, document number 016e/0382E, Nov 1987

"percent tolerant sp."



Ohio IBI, document number 016e/0382E, Nov 1987

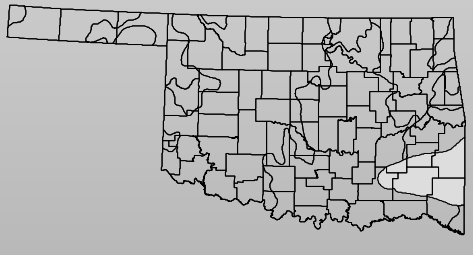
OMERNICK ECOREGIONS



USE SUPPORT ASSESSMENT PROTOCOLS

OAC 785:46-15-5. Assessment of Fish and Wildlife Propagation support (cont.)

(g) **Special provisions for Ouachita Mountains wadable streams**. The determination of whether the use of Fish and Wildlife Propagation is supported for wadable streams located in the Ouachita Mountains ecoregion shall be made according to the application of Appendix C of this Chapter, together with this subsection, as follows:



USE SUPPORT ASSESSMENT PROTOCOLS

OAC 785:46-15-5 (g). Assessment of Fish and Wildlife Propagation support (cont.)

(1) Where designated, the subcategory of Warm Water Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 35 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 24 or less. If a score is 25 to 34 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.

(2) Where designated, the subcategory of Habitat Limited Aquatic Community shall be deemed fully supported if the application of Appendix C produces a score of 27 or more. Such subcategory shall be deemed not supported if the application of Appendix C produces a score of 18 or less. If a score is 19 to 26 inclusive, the issue of whether this subcategory is supported shall be deemed undetermined.

LESSONS LEARNED

- **HAVE A COMPREHENSIVE PLAN**
- **SHARE THE PLAN WITH STAKEHOLDERS**
- **BUILD ON THE RESULTS OF OTHERS**
- **RESULTS MUST BE DEFENSIBLE**
- **MORE DATA IS BETTER**
- **GET THE RESULTS INTO RULE**

QUESTIONS

National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

Coeur d'Alene, Idaho
31 March – 4 April, 2003

WQS 101

Maine's Tiered Aquatic Life Standards and Biological Criteria

Presented by

Susan P. Davies
Maine Department of Environmental Protection
Biological Monitoring Program

Tiered Aquatic Life Standards and Biological Criteria

Maine Department of Environmental Protection Biological Monitoring Program

Susan P. Davies

The Policy Context

Maine DEP
Biological Monitoring Program

- In existence since 1983
- Authorizing legislation passed in 1986
- Monitoring activities
  - Streams and rivers statewide; about 650 stations and >1000 sampling events to date (stream insects)
  - Stream periphyton, wetlands and lakes are also monitored
- River and stream classification (classes A, B, C; NA) based on biological criteria

The Clean Water Act (CWA) and Its Implementation

Federal Law: Protect chemical, physical and biological integrity

⇩

State Law: Specify biological condition goals - establish tiered classification system

⇩

Definitions: Clarify biological attributes

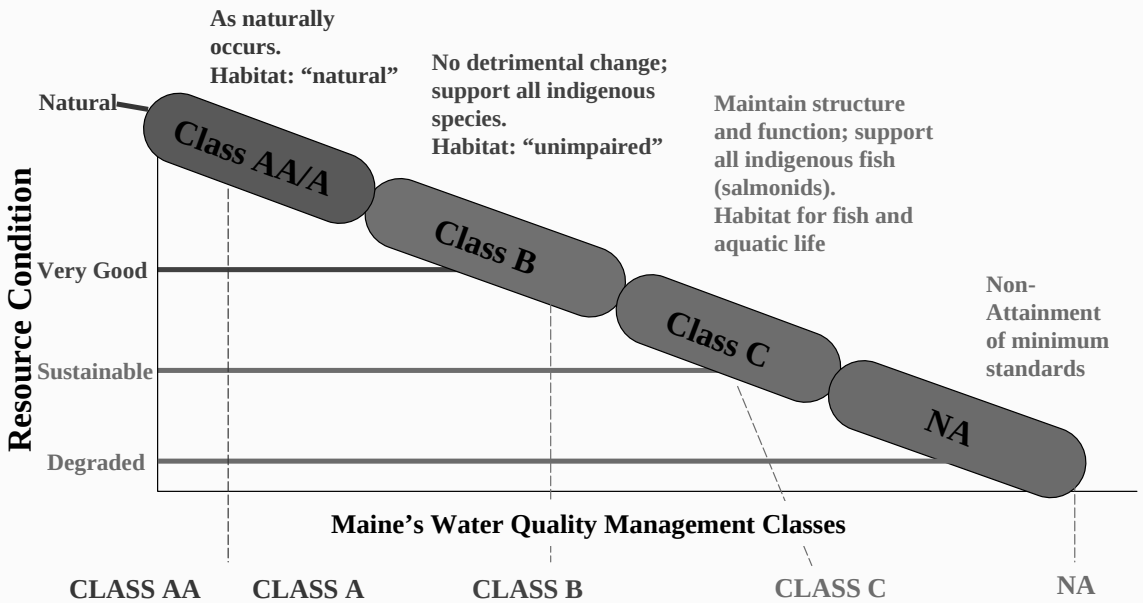
⇩

Rule: Specify methods to determine attainment of water quality class

Maine Statutory Aquatic Life Standards

- **Class A/AA** ⟹ ***"as naturally occurs"***
- **Class B** ⟹ ***"support all indigenous species"; "no detrimental change"***
- **Class C** ⟹ ***"support indigenous fish (salmonids); maintain structure and function"***

Maine's Aquatic Life Management Classes



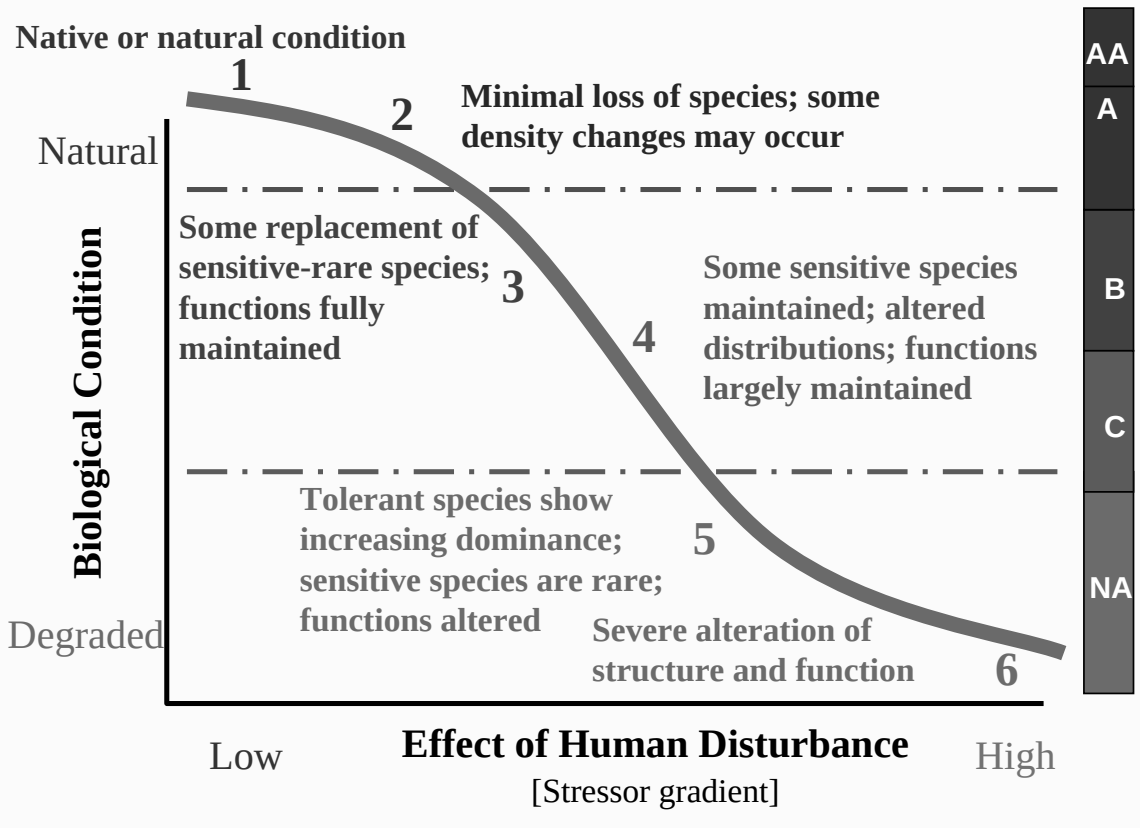
CLASS AA
Zero discharge; No hydrologic alteration; DO and bacteria as natural

CLASS A
No alternatives; D/C Equal to or better; hydro allowed; DO: 7ppm/ 75% saturation; bacteria as natural

CLASS B
D/C with ample dilution; DO: 7ppm/75% saturation; 9ppm for salmonid spawning; Bacteria: 64/100 mil- in the summer

CLASS C
DO: 5ppm/60% saturation; Water quality sufficient to ensure salmonid spawning/survival; Bacteria:142/100 mil

NA



Statutory Definition: "as naturally occurs"

"with essentially the same physical, chemical and biological characteristics as found in situations with similar habitats, free of measurable effects of human activity"

"without detrimental changes in the resident biological community"

"…no significant loss of species or excessive dominance by any species or group of species attributable to human activity"

"community structure"

"…the organization of a biological community based on numbers of individuals within different taxonomic groups and the proportion each group represents of the total community"

"community function"

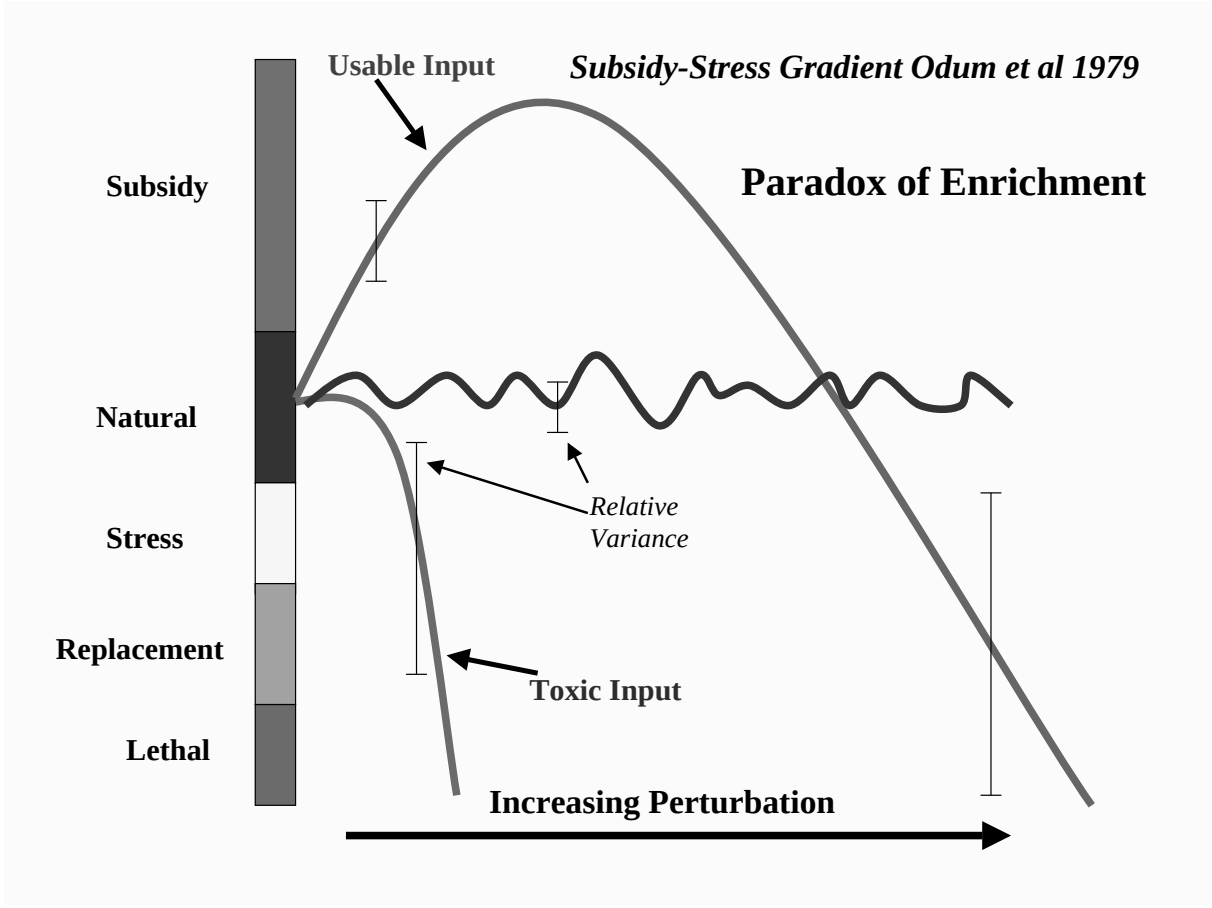
"…mechanisms of uptake, storage and transfer of life-sustaining materials available to a biological community which determine the efficiency of use and the amount of export of the materials from the community"

Tiered Standards for Other Waterbody Types

- **Wetlands-** AG consult to clarify *"waters of the state"* and applicability of existing standards; active bioassessment program; moving towards numeric biocriteria

- **Marine-** same as riverine aquatic life standards; marine standrads have been applied in aquaculture permitting

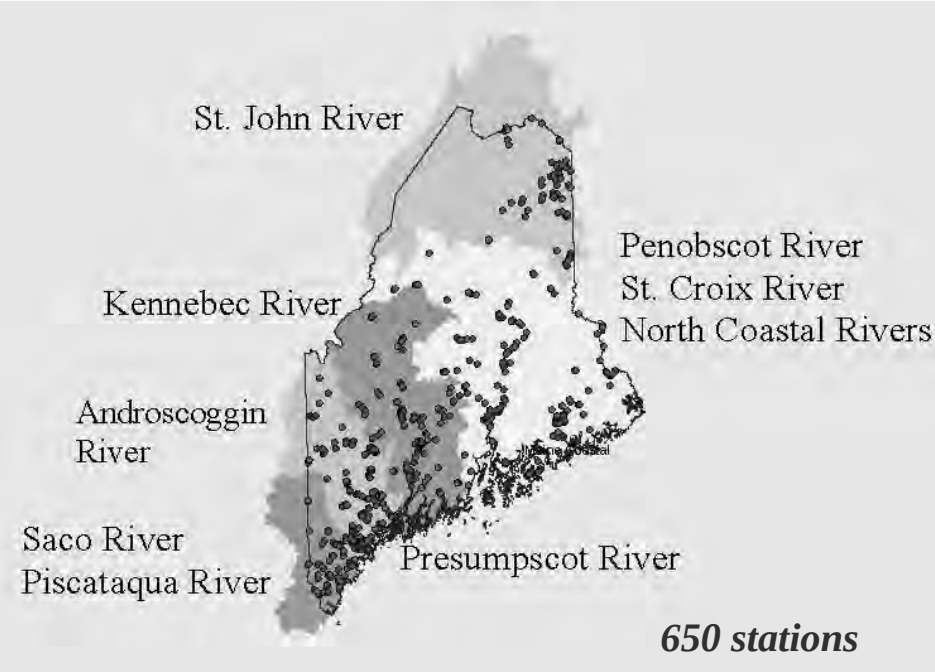
Technical Basis



Macroinvertebrate Sampling Methods

- Rock bags/baskets/cones with standard weight of stream cobble
- Three bags or baskets placed in riffle or run of wadeable stream, or three cones in river
- Left in place for 4 weeks

River and Stream Monitoring Stations

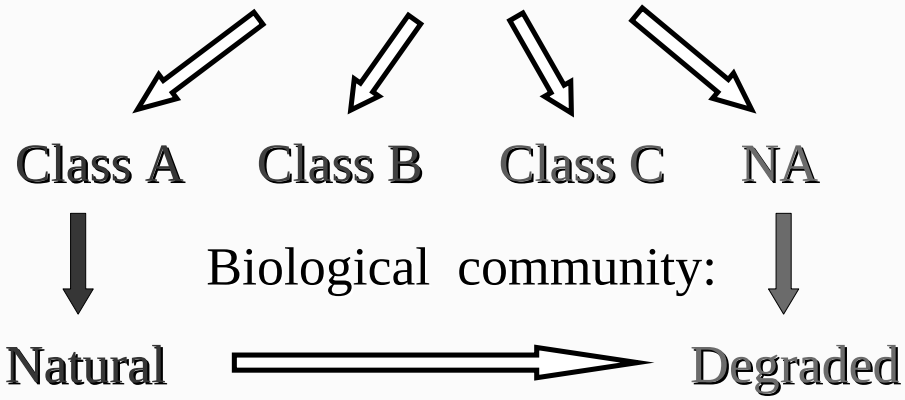


Maine Tiered Uses Based on Measurable Ecological Values

Narrative Standard	Biological Value	Quantifiable Measures
CLASS A ***natural***	Taxonomic and Numeric Equality ; Presence of Indicator Taxa	Similarity, Richness, Abundance, Diversity; EPT, Indicator Taxa, Biotic Index
CLASS B ***unimpaired, maintain indigenous taxa***	Retention of taxa and numbers; Absence of hyperdominance; Presence of sensitive taxa	Community loss; Richness; Abundance; diversity; equitability; evenness; EPT; Indicator Taxa, Biotic Index
CLASS C ***maintain structure***	Resistance, Redundancy; Resilience; Balanced Distribution	Richness; Diversity; Equitability; Evenness
and function	Energy Transfer; Resource assimilation; Reproduction	Trophic groups; Richness; abundance; community loss; fecundity; colonization rate

Data Analysis And Classification

- Biological data put into statistical model (30 *variable linear discriminant model*)
  - Model output is an estimation of strength of association of a sample to four water quality classes

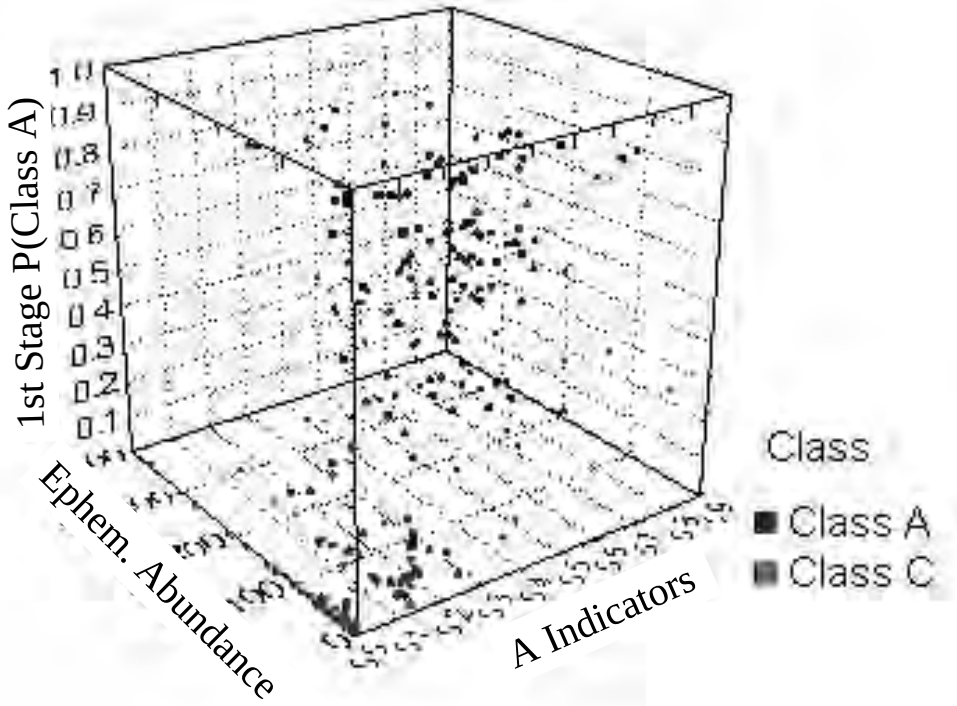


What is the Precision of the Model?

Predictive success in jackknife test of combined four-way and two-way models (373 sample dataset)

	Class A Model			B or Better Model			C or Better Model		
	Model Prediction			Model Prediction			Model Prediction		
A priori	**A**	B,C,NA		**A,B**	C,NA		**A,B,C**	NA	
A	**89.4%**	8.2%		**A,B**	**96.4%**	5.5%	**A,B,C**	**97%**	2.9%
B,C,NA	8.6%	91.4%		C,NA	6.7%	92.3%	NA	12.2%	86.7%

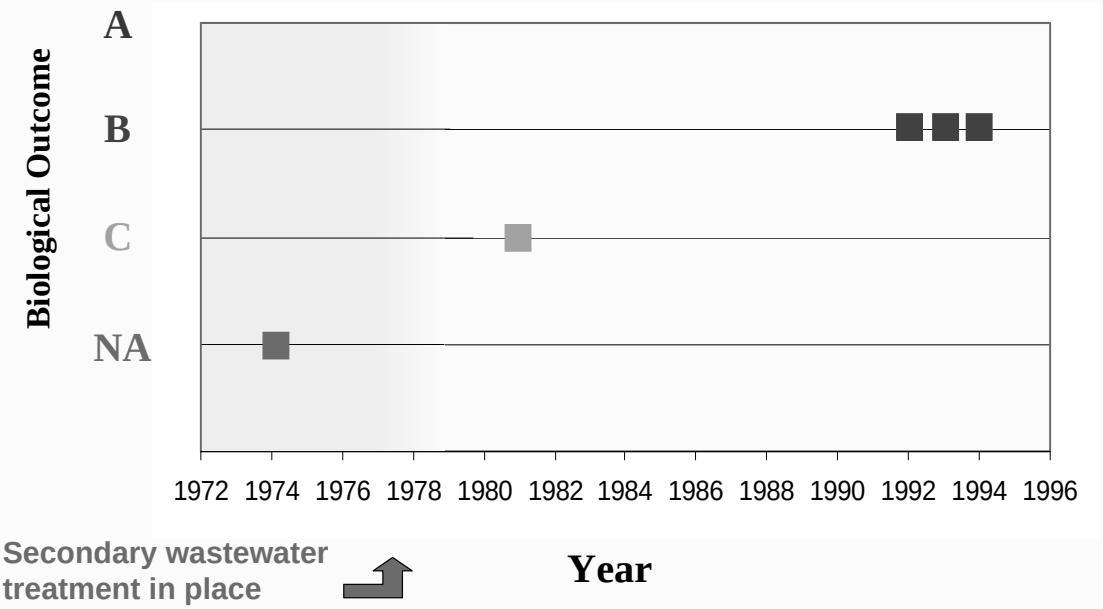
3 Variable Separation of "Natural" from "Borderline Attaining"



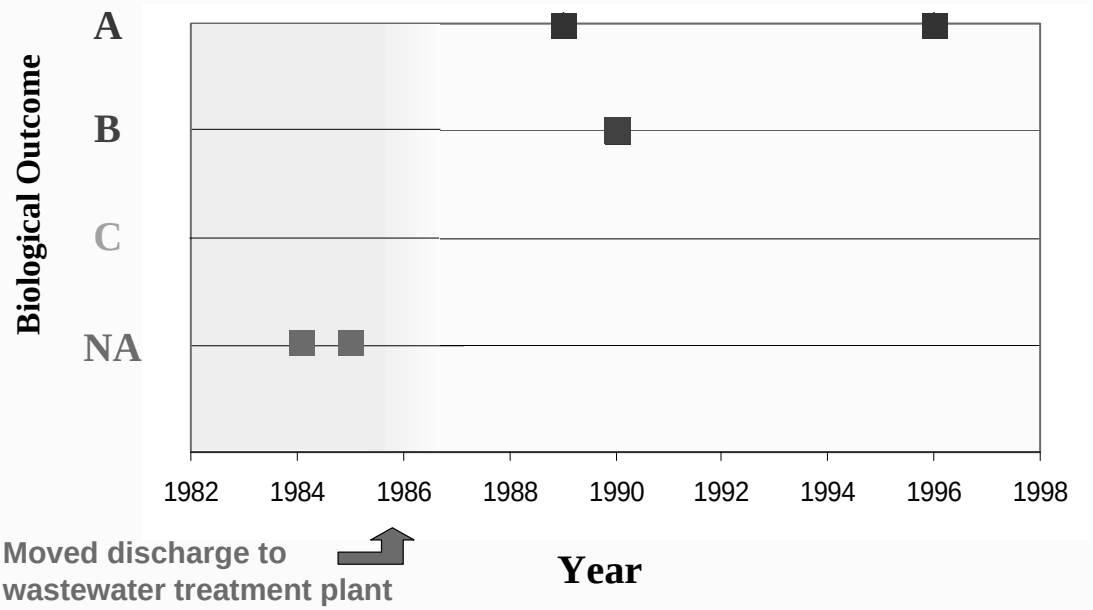
RESULTS:

Case Studies

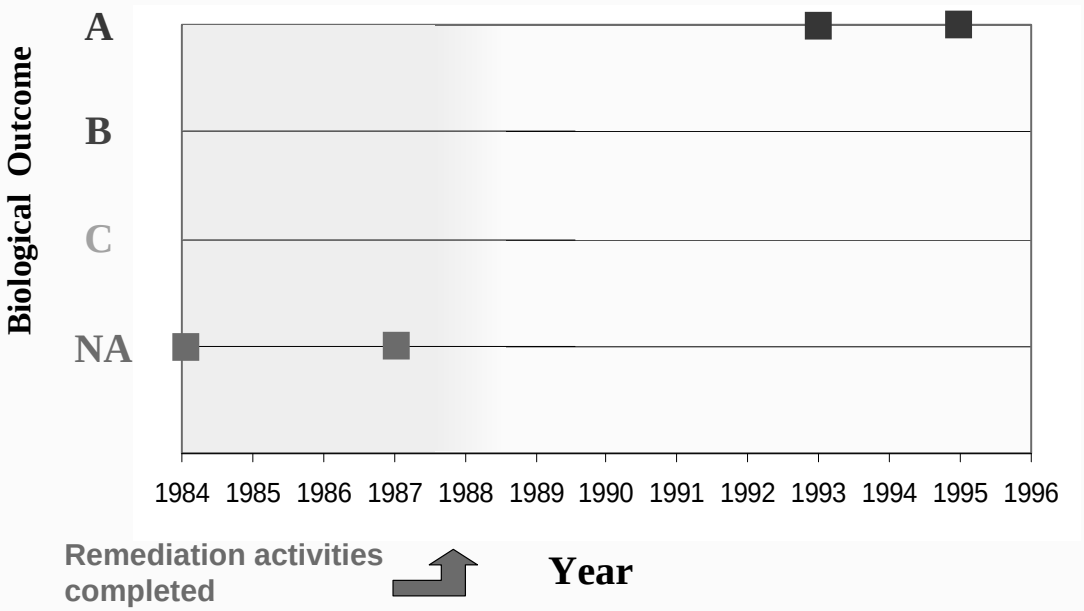
Reducing Discharges from Lincoln Pulp and Paper Company into Penobscot River



Reducing Discharges from Guilford Industries into Piscataquis River



Cleaning Up Groundwater Contamination in Cooks Brook, Waterboro, Maine



Uses and Applications of Biological Monitoring Results

- **Purpose and Uses**
  - Set Goals
  - Document Status
  - Identify/Prioritize
  - Report on Status
  - Force Action
  - Measure Progress
- **Programmatic Context**
  - Standards and Criteria
  - 305b; State legislature
  - 303d; Work Planning
  - 305b; SWAT; public
  - Standards and Criteria; Enforcement
  - Monitoring; Adaptive Management

MAINE Water Quality Re-Classification History

- **1990-2003 UPGRADES = 1,441 miles**
  - Class C to Class B= 68 miles
  - Class B to Class A= 798 miles
  - Class B to Class AA= 59 miles
  - Class A to Class AA= 346 miles

Reasons?

- **trout & Atlantic salmon protection**
- **tribal petitions**
- **point-source improvement; dam removal**

- **1998-2003 DOWNGRADES = 5 miles**
  - Class B to Class C (UAA due to impoundment + point sources)

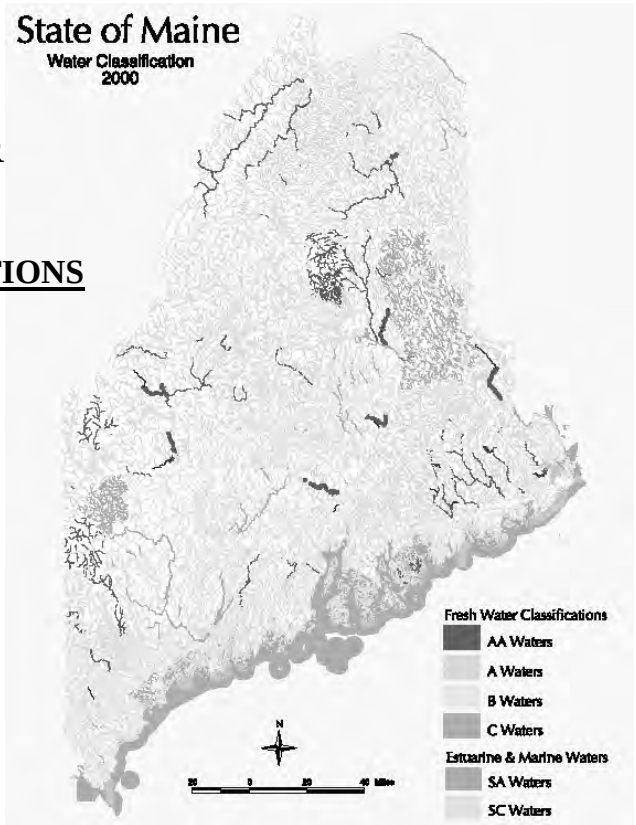
% OF LINEAR MILES OF STATUTORY CLASSIFICATIONS

Class AA = 6%

Class A = 45%

Class B = 47%

Class C = 2%



What Does it Take?

GREAT PEOPLE

Resource Requirements

- **<u>Current</u>: +/- $280,000 per year**
  - about 2% of total state water management budget
  - 4 FTE biologists; 2 field season interns
  - rivers, streams, wetlands
  - macroinvertebrates, periphyton, physical/chemical
- **<u>Start-up</u> research and development: $600,000 spent over about seven years**

Lessons Learned

Good Management Tool

- Provides answers needed by management
- Addresses management goals
- Able to trigger management intervention
- Provides management flexibility
  (a range of management classes)
- Transparent and reproducible decision process

Sound Science

- Ecologically accurate:
  i.e. positive findings reveal **actual loss** of ecological integrity and negative findings indicate **actual maintenance** of ecological integrity
- Free from unsupported assumptions
- Known probability of error

Practical to Use

- **Feasible (not *easy*)** level of effort
  - to develop
  - to apply
- Robust to operator error
- Provides unambiguous results
- Easily communicated

The Human Element

- **How to advocate**
- **How to navigate**
- **How to integrate**

How to advocate

Communication

- Authenticity- “Why do I care so much?”
- Credibility- “What makes me so sure?”
- Respectful inquiry- “Where do we differ?”

How to navigate

- **What is the legal bedrock?**
  - **Granite or quicksand?**
- **What is the political reality?**
  - **Industrial capitalism? Deep ecology?**
- **Who are your allies? your detractors?**
  - **Citizen advocacy groups**
  - **Stakeholder-based technical review committees**

How to integrate

What are the goals? (*standards*)

Does it attain? (*numeric criteria*)

What needs to change? *(intervention)*

(*S.I., permits, TMDLs, BMPs*)

Who needs to know? *(reporting)*

(303d, 305b, NPS prioritization lists, etc)

Slowly but surely beats a TRAIN WRECK every time

- **Aquatic life standards passed in 1986**
  - **2 years after the first sample was collected!**
- **Aggressive use since 1990 based on the strength of the statutory aquatic life standards**
- **Numeric criteria rules approved in 2003**
  - **20 years after the first samples were collected !**

Information

Web site:

http://www.state.me.us/dep/blwq/biohompg.htm

Report:

Biomonitoring Retrospective: *Fifteen Year Summary for Maine Rivers and Streams*

Staff:

David Courtemanch, Susan Davies, Leon Tsomides, Jeanne DiFranco, Tom Danielson, Frank Drummond (statistician)