



Coeur d'Alene, Idaho
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Maine's Tiered Aquatic Life Standards and Biological Criteria

Presented by

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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

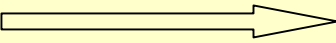
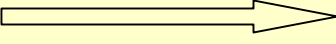
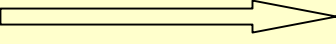


Definitions: Clarify biological attributes

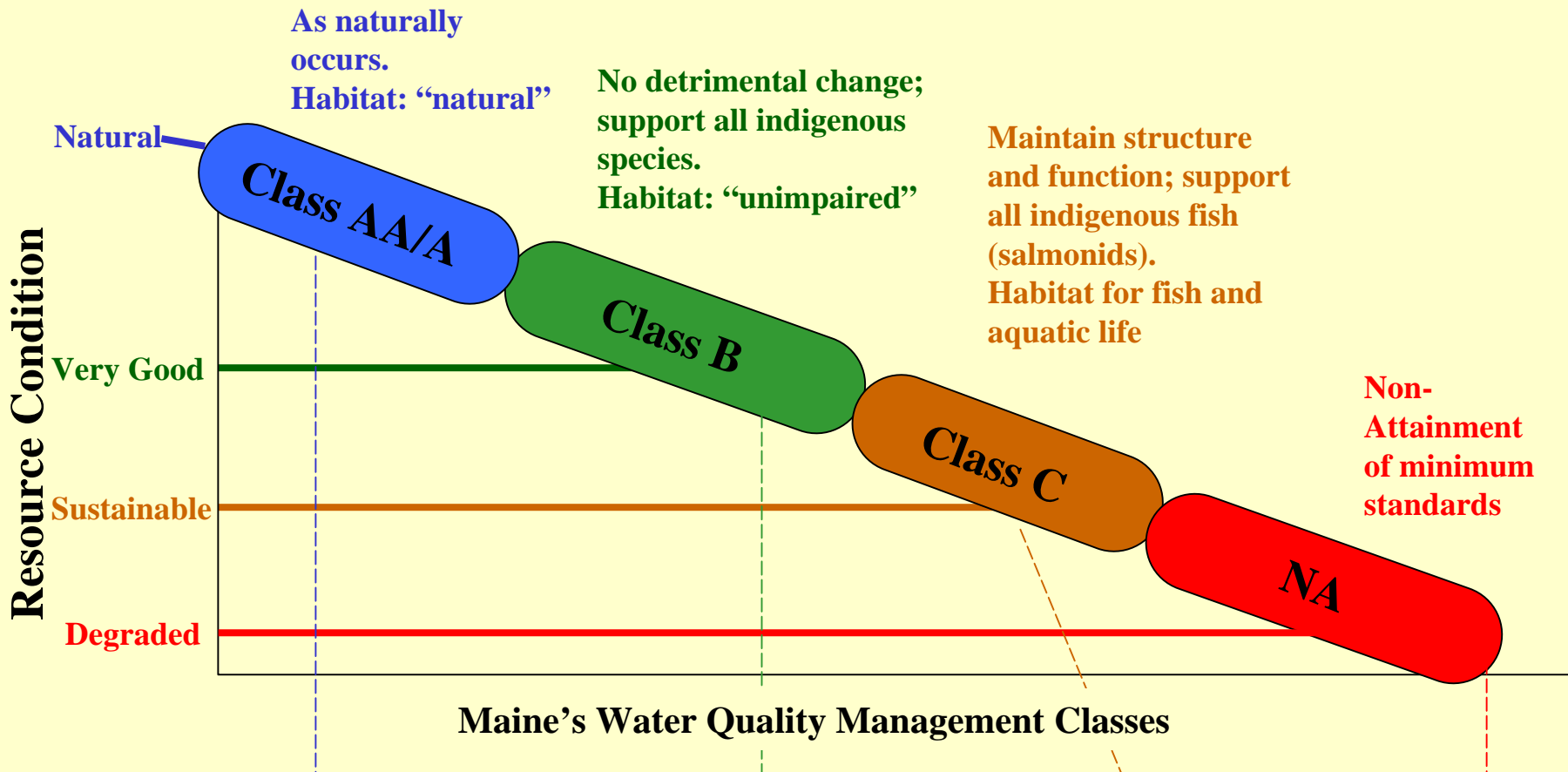


Rule: Specify methods to determine
attainment of water quality class

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

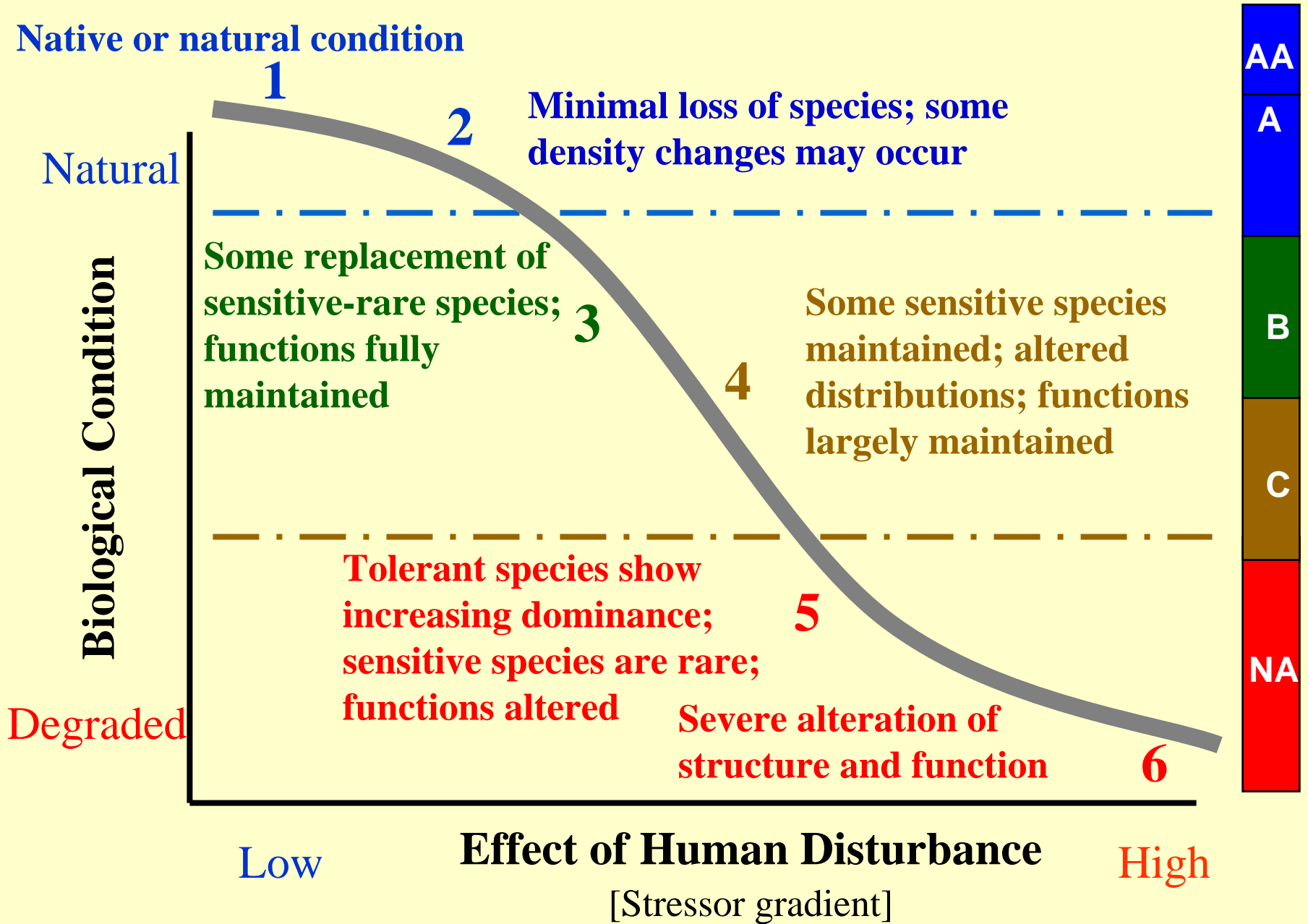
CLASS B

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”

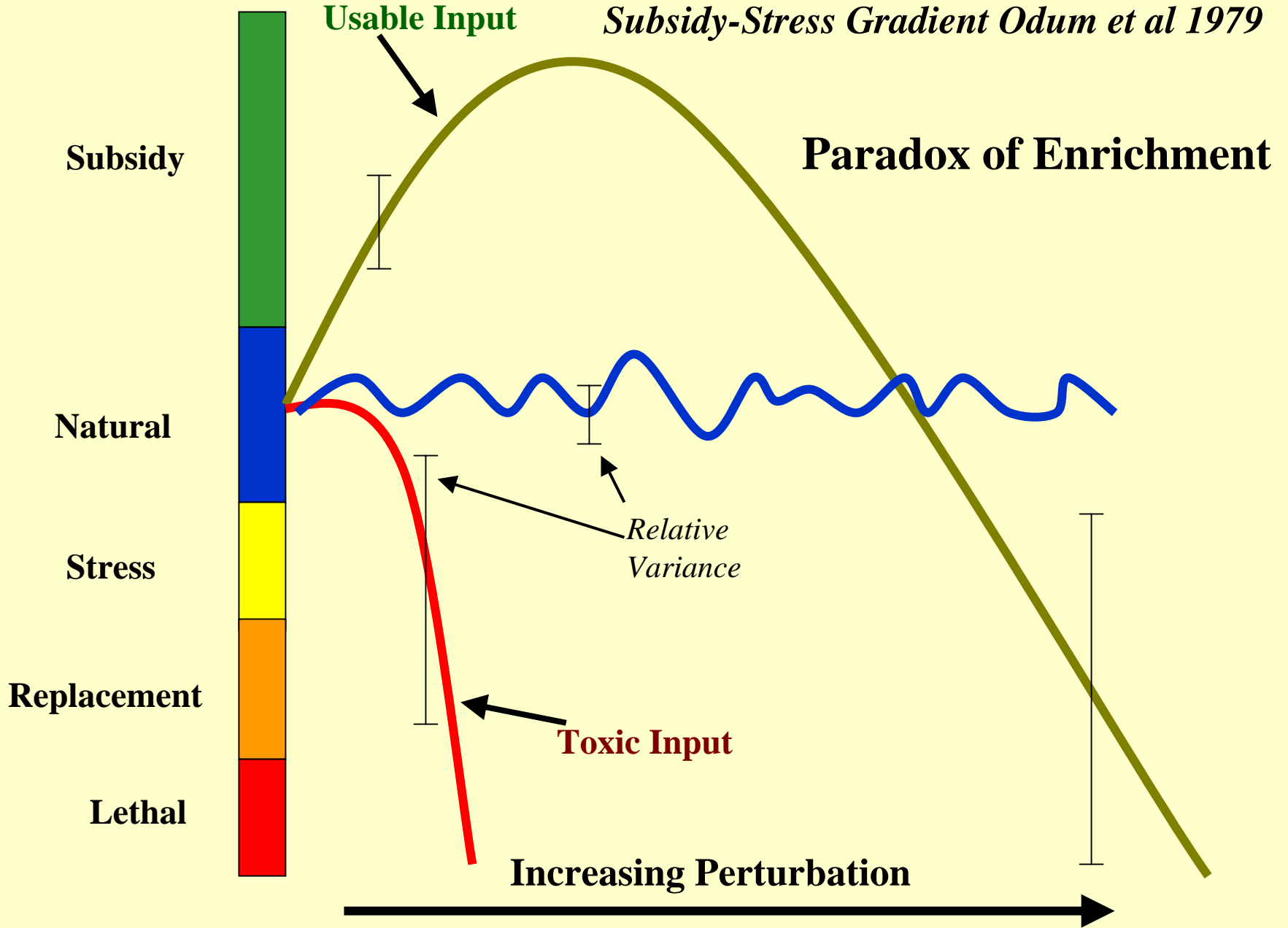
“...mechanisms of uptake, storage and transfer of life-sustaining materials available to a biological community which determine the efficiency of use and the amount of export of the materials from the community”

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 standards have been applied in aquaculture permitting

Technical Basis

Subsidy-Stress Gradient Odum et al 1979

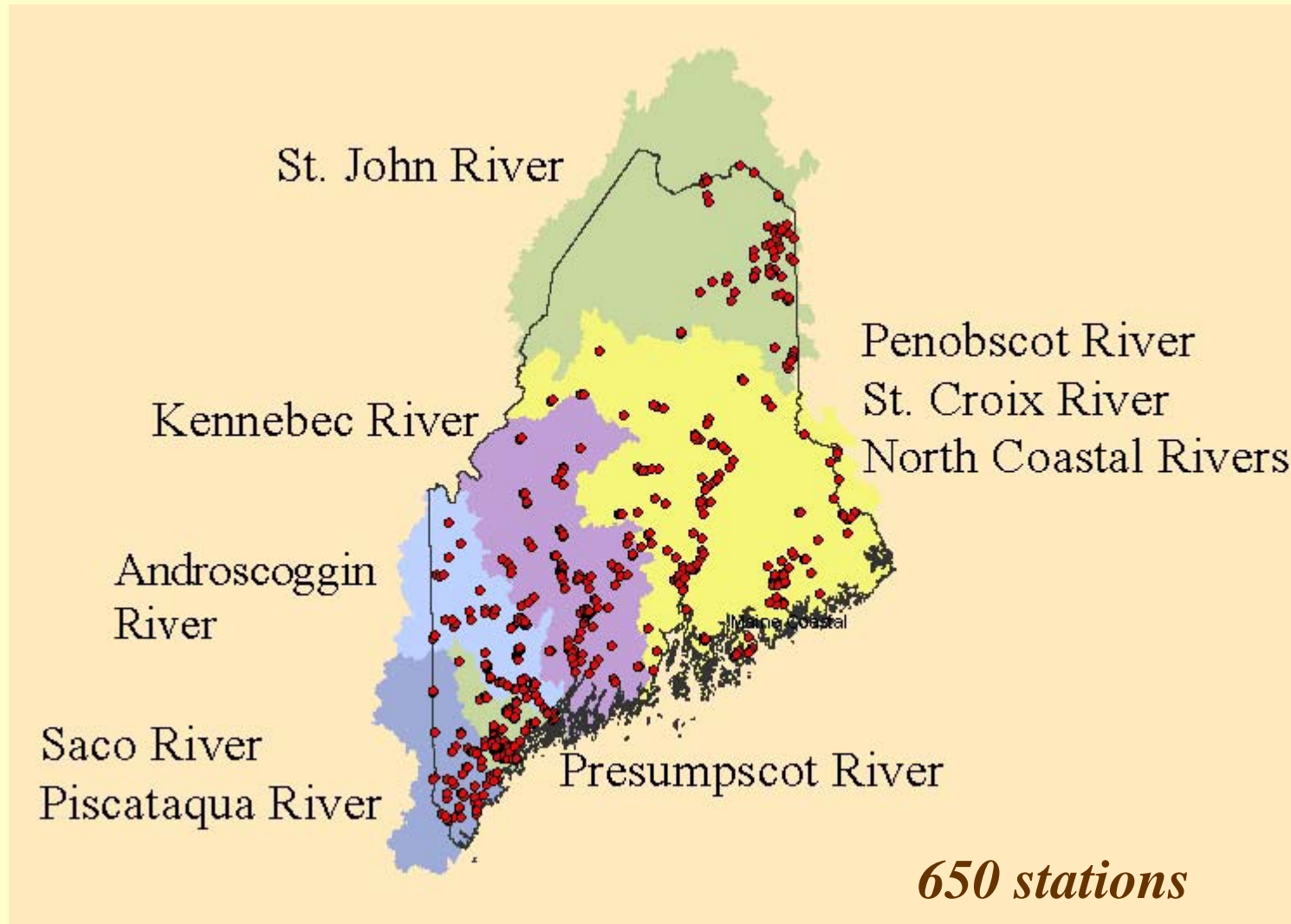


Macroinvertebrate Sampling Methods

- 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

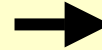
Biological Value

Quantifiable Measures

CLASS A
natural

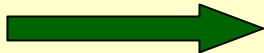


Taxonomic and Numeric
Equality ; Presence of
Indicator Taxa

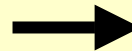


Similarity, Richness,
Abundance, Diversity; EPT,
Indicator Taxa, Biotic Index

CLASS B
*unimpaired, maintain
indigenous taxa*

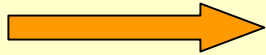


Retention of taxa and
numbers; Absence of
hyperdominance;
Presence of sensitive taxa

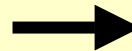


Community loss; Richness;
Abundance; diversity; equitability;
evenness; EPT; Indicator Taxa,
Biotic Index

CLASS C
*maintain structure
and function*



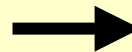
Resistance, Redundancy;
Resilience; Balanced
Distribution



Richness; Diversity;
Equitability; Evenness



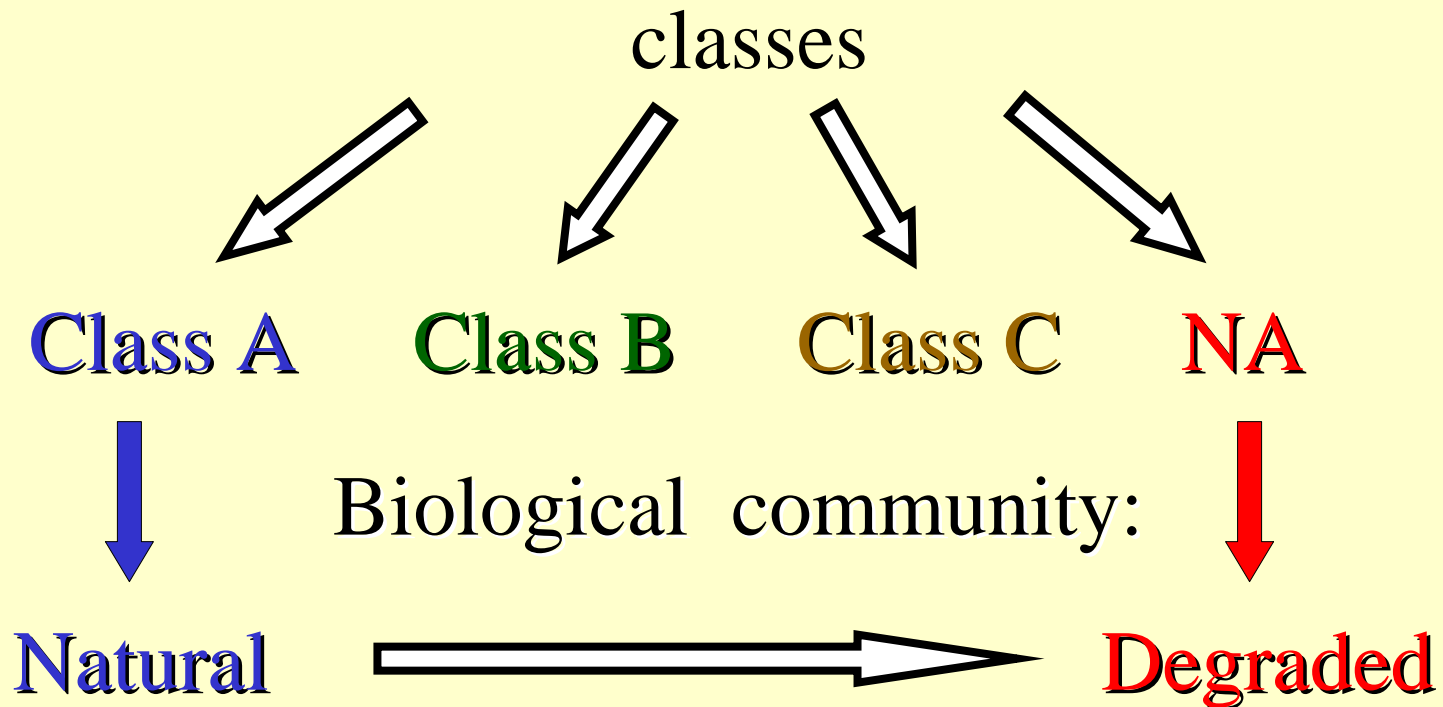
Energy Transfer; Resource
assimilation; Reproduction



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

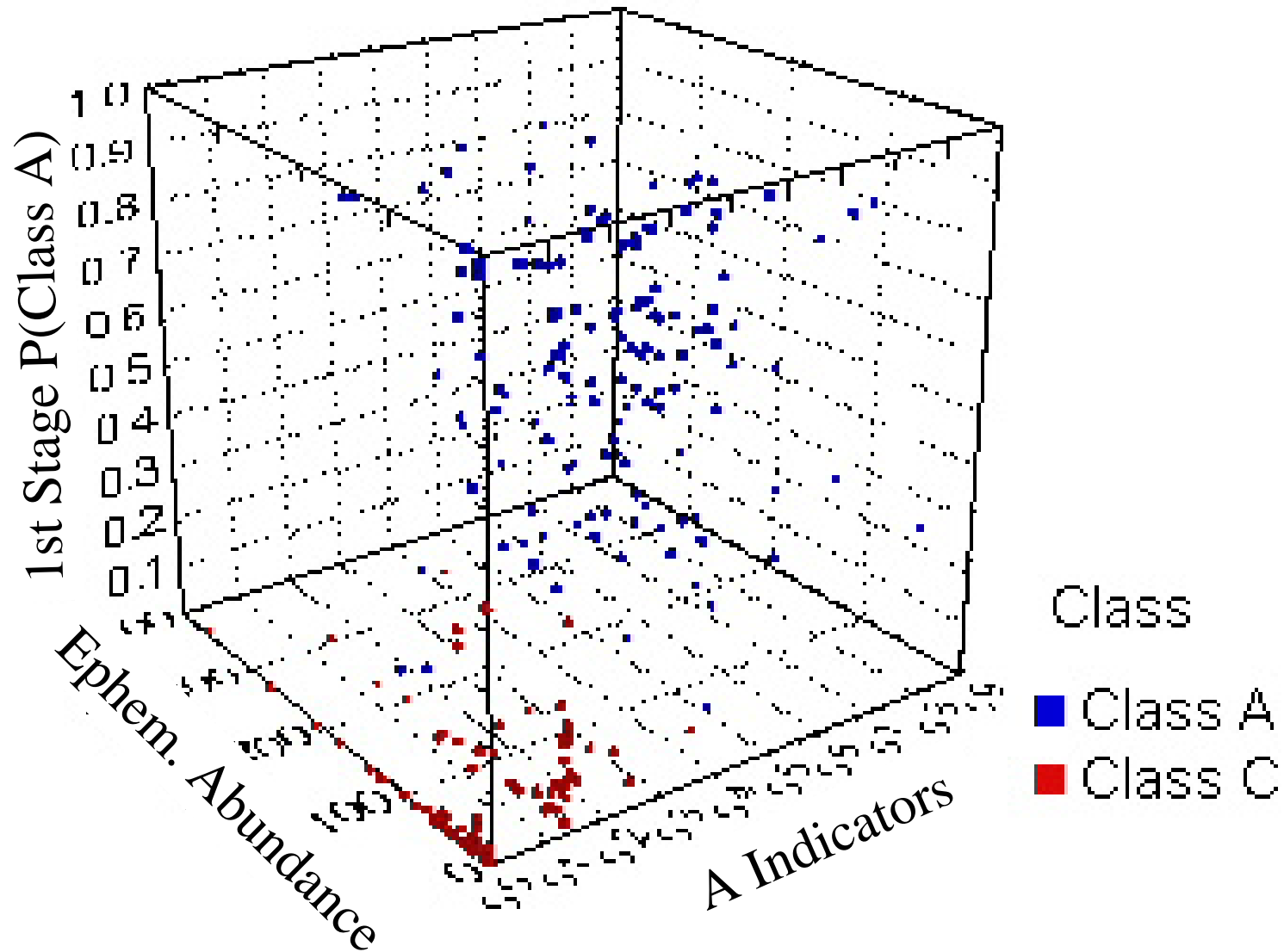


What is the Precision of the Model?

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	B,C,NA	A,B	C,NA	A,B,C	NA
A priori							
A	A	89.4%	8.2%	96.4%	5.5%	97%	2.9%
B,C,NA	B,C,NA	8.6%	91.4%	6.7%	92.3%	12.2%	86.7%

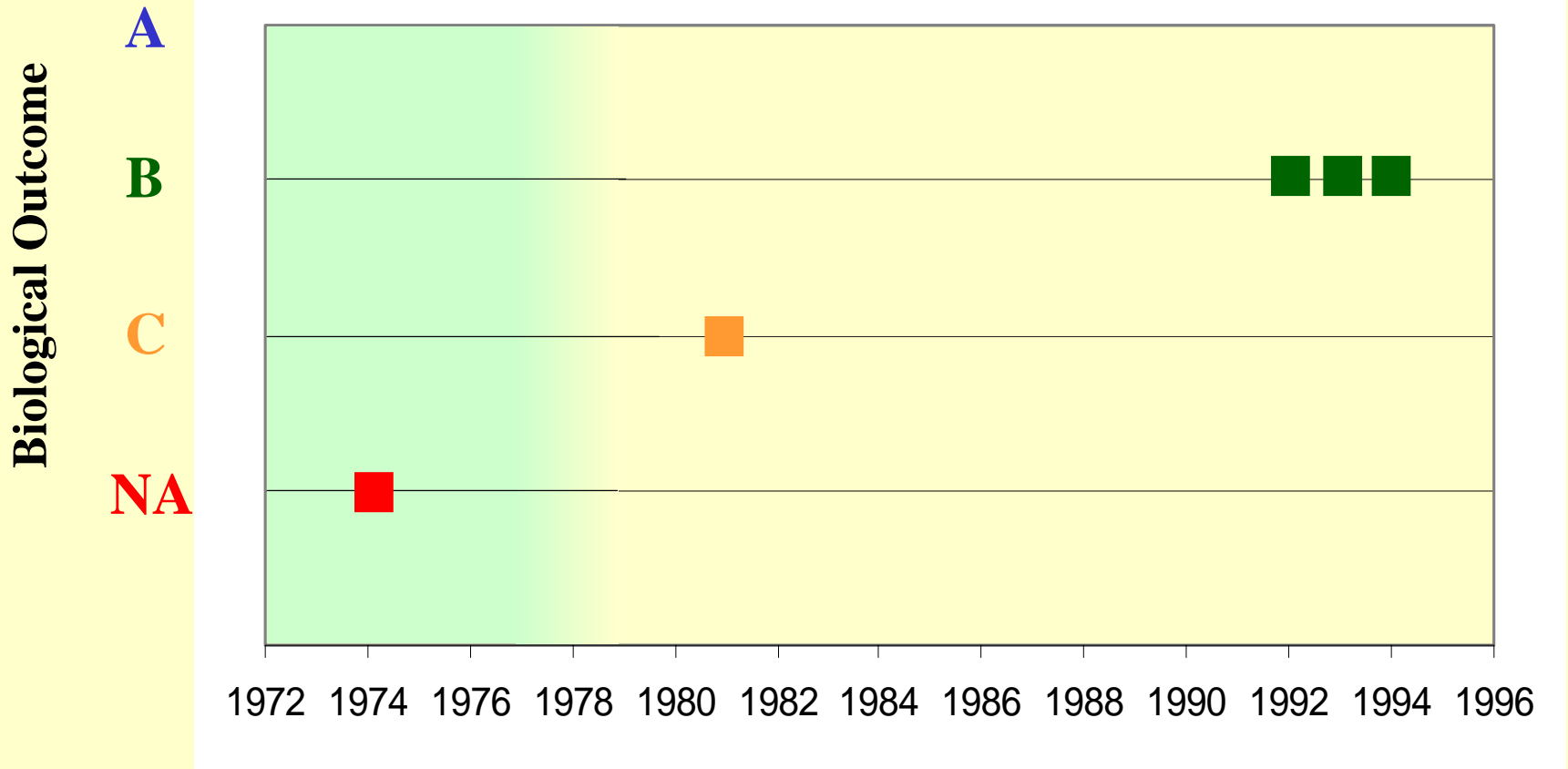
3 Variable Separation of “Natural” from “Borderline Attaining”



RESULTS:

Case Studies

Reducing Discharges from Lincoln Pulp and Paper Company into Penobscot River

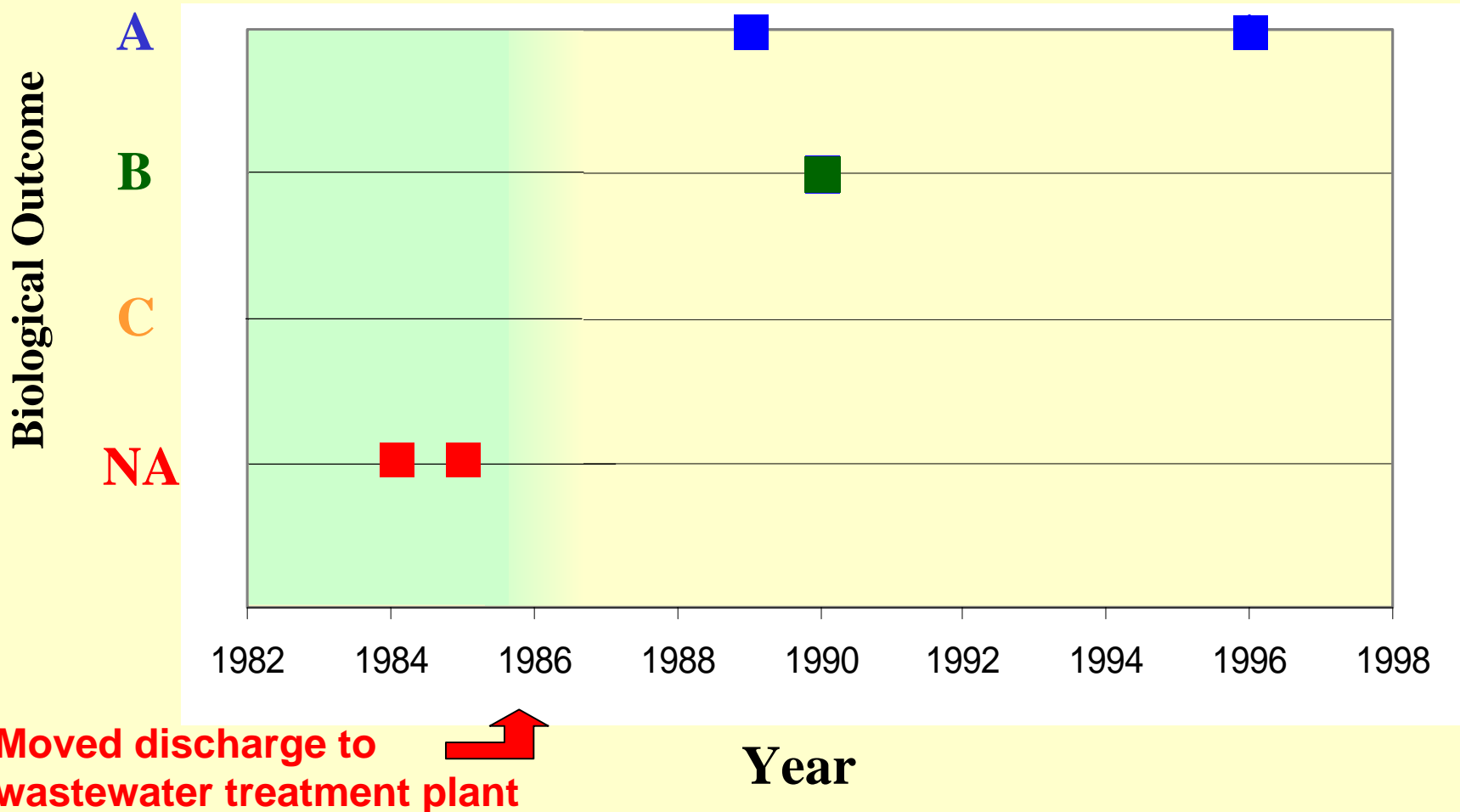


Secondary wastewater
treatment in place

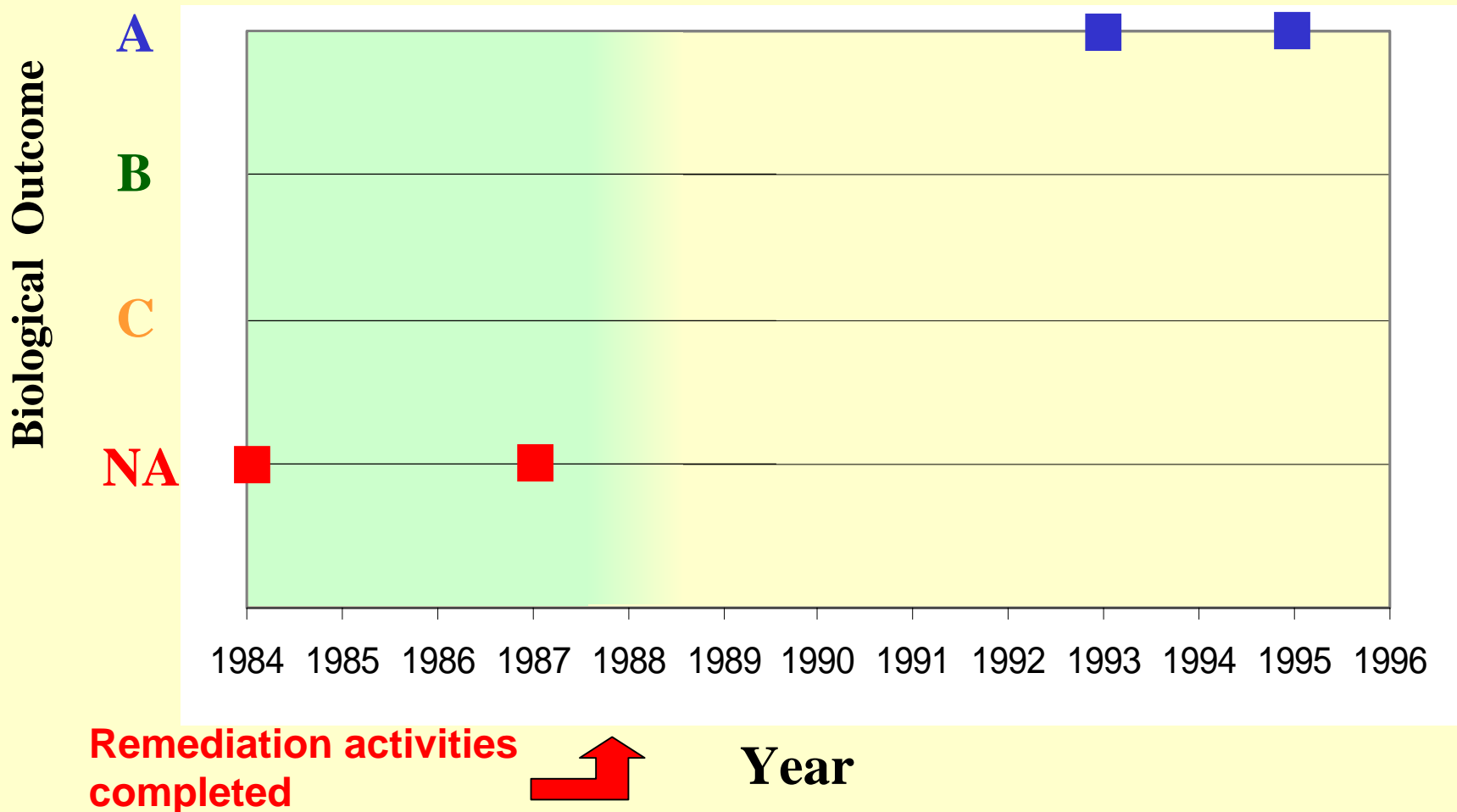


Year

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**

Reasons?

- 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

- 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)

State of Maine

Water Classification 2000

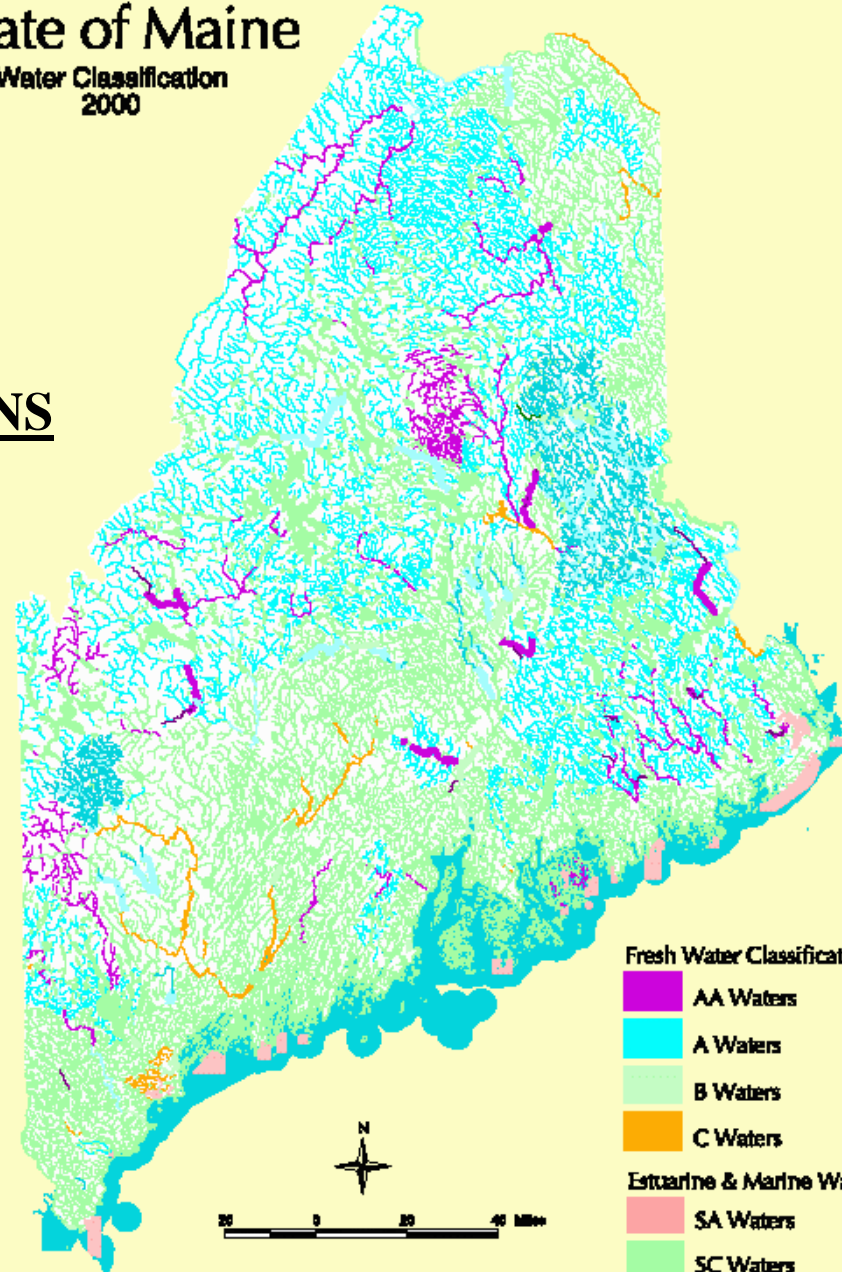
% OF LINEAR MILES OF STATUTORY CLASSIFICATIONS

Class AA = 6%

Class A = 45%

Class B = 47%

Class C = 2%



What Does it Take?

GREAT PEOPLE



Resource Requirements

- **Current: +/- \$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
- **Start-up 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/biohomp.html>

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)