National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

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

APP 101

BIOLOGICAL ASSESSMENTS AND CRITERIA AND THEIR APPLICATION IN WATER PROGRAMS

Course Presenters and Contributors

William Swietlik, Ellen McCarron, Mick Micacchion, Dave Courtemanch, Chris Mebane

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APP 101

Introduction

Presented by

William Swietlik, USEPA
Office of Water, Office of Science & Technology

Take Home Concepts

Upon completion of this course, you will understand a variety of ways biological assessments and criteria can be applied in water programs. Examples from States will illustrate for you what you could potentially do in your own programs.

Purpose of Presentation

1. *INTRODUCTION: Examine possible applications of biological assessments and criteria in water programs*
2. *CASE STUDIES: Look at examples*
3. *Question and answer session*

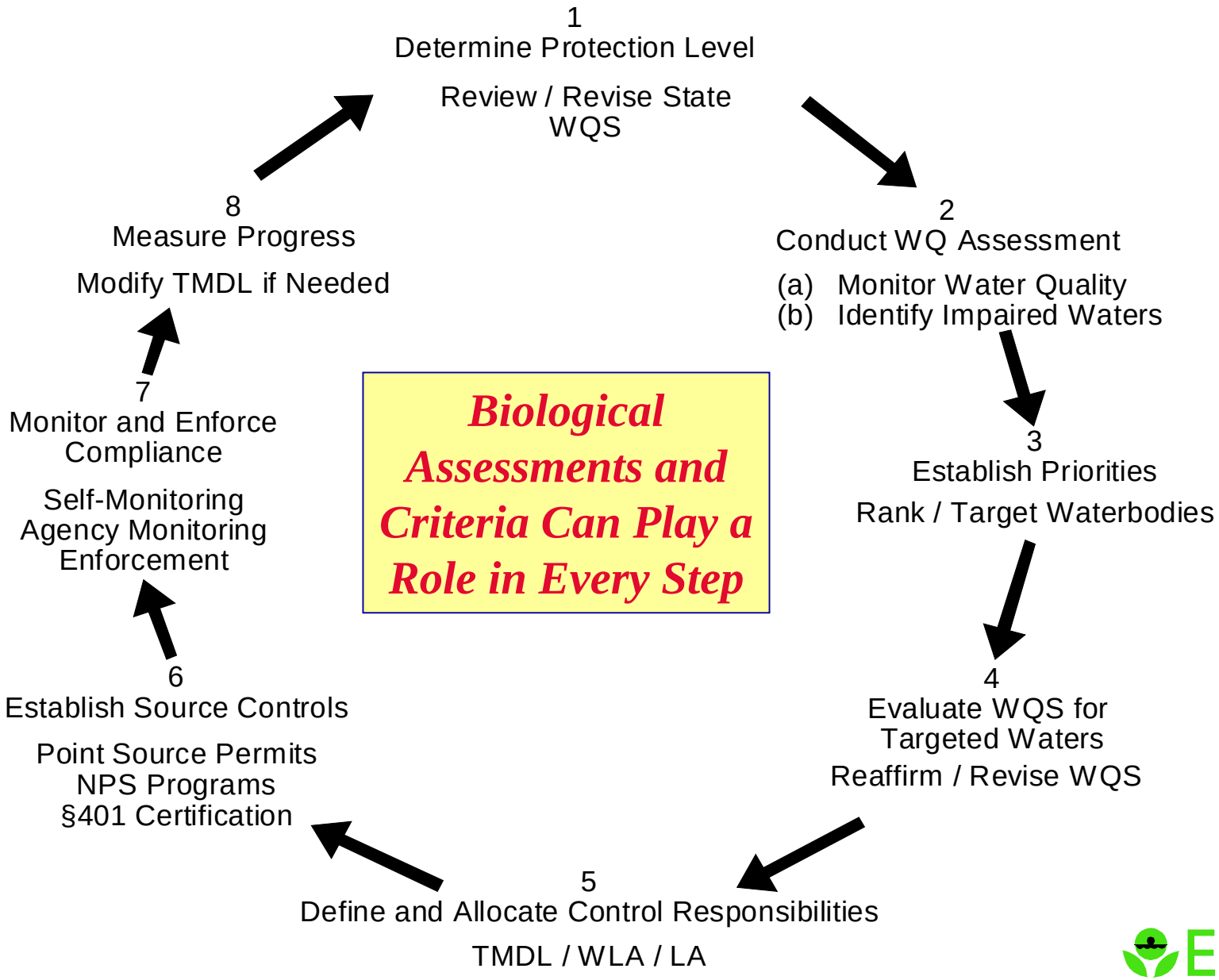
Can Bioassessments/Biocriteria Be Used in Water Programs, including Regulatory Programs?

Sure……….

Terminology

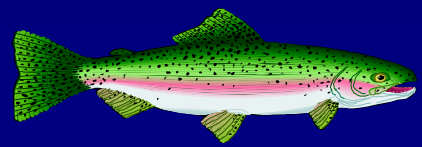
- **Bioassessments**– *an evaluation of the biological condition of a water body using surveys of the structure and function of the community of resident biota of the waterbody.*
- **Biocriteria**– (**scientific**) *quantified values representing the biological condition of aquatic communities in waterbodies.*
- **Biocriteria**– (**regulatory**) *narrative descriptions or numerical values of the biological condition necessary to protect the designated aquatic life use,* **implemented in, or through water quality standards.**

The Water Quality Management Cycle



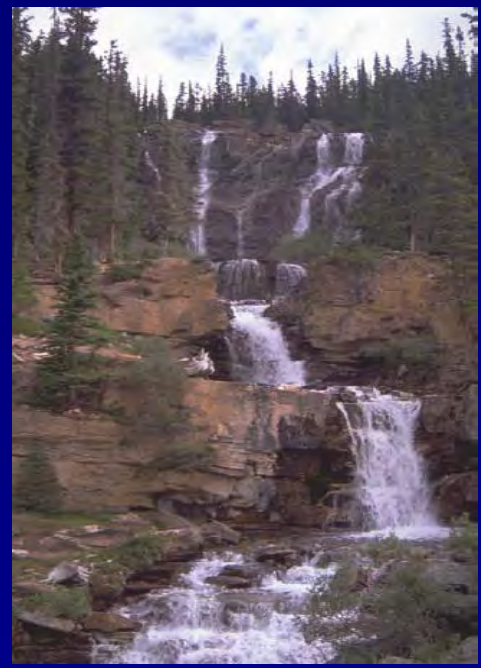
Ways to Use Biological Assessments and Criteria

- **Basic monitoring and assessment tool**
- **Indicator:**
  - **Degradation**
  - **Restoration**
- **Use Attainment:**
  - **305(b) report**
  - **303(d) list**
- **TMDLs:**
  - **TMDL endpoint/indicator of success**



Ways to Use Biological Assessments and Criteria

- **Permitting: (Internal/External)**
  - **NPDES Permitting (402)**
    - **Wastewater**
    - **Stormwater**
      - **Monitoring condition**
      - **Above and below assessments**
      - **Control effectiveness**
      - **Program effectiveness**
      - **Action level or trigger**
      - **Re-issuance impact assessment**
  - **Wetland Permitting (404/401)**



Ways to Use Biological Assessments and Criteria

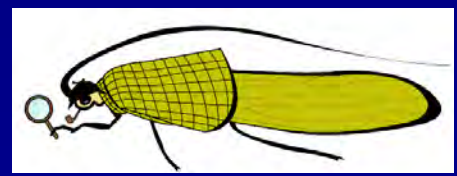
- **Superfund Benchmarks**
- **Enforcement Actions:**
  - **Assessment of damage**
  - **Time of recovery**
  - **Penalty factor**
- **Mitigation target/indicator**
- **Water Quality Standards!**

Caution!!

- ***Biocriteria can be used in a variety of ways in permitting programs, but have not typically been used as effluent limits directly in permits, as are chemical and whole effluent water quality criteria.***

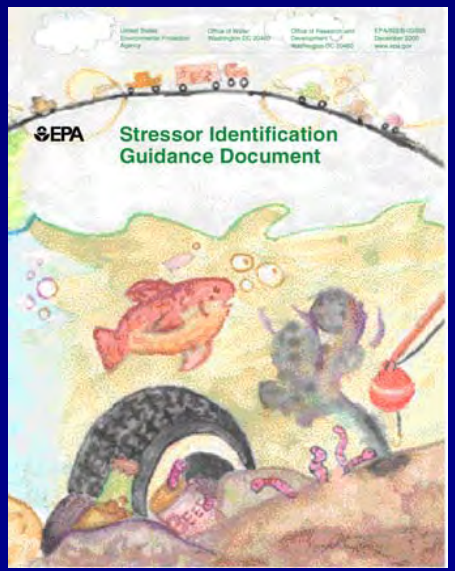
What's the cause??

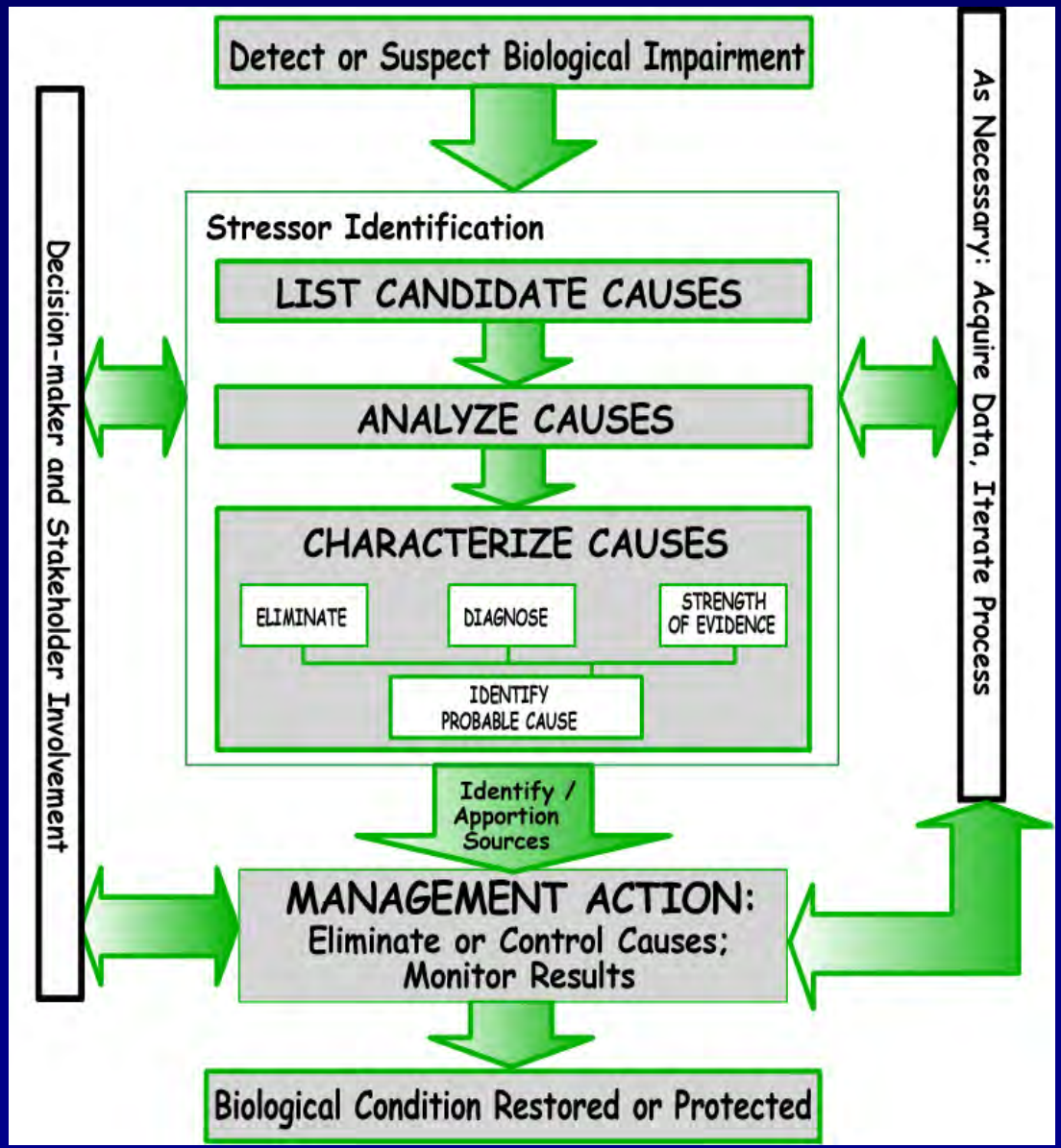
When Biocriteria for a waterbody are exceeded, the stressor(s) causing such should be identified and controlled in the most appropriate manner.



Stressor Identification

Identifying unknown causes of biological impairment





Examples

1. *Florida Program*
2. *Ohio Program*
3. *Maine Program*
4. *Rock Creek Enforcement Case– Washington, DC (Written report and summary in handouts --See Poster)*

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Florida's Bioassessment Program Applications

Ellen McCarron
Russ Frydenborg
Florida Department of Environmental Protection

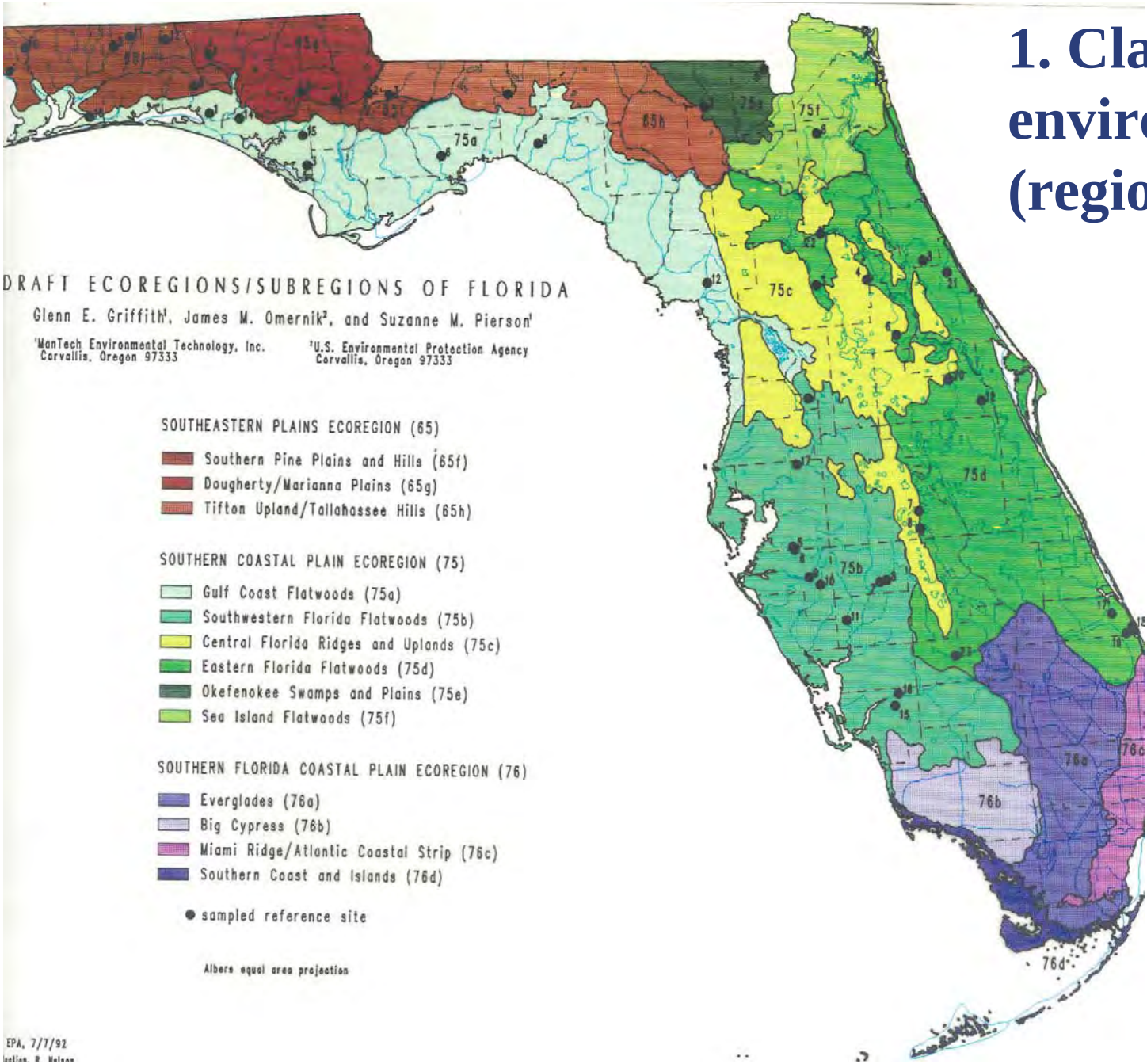
Mission Statement

- Provide cost-effective and accurate ecological information to enable legally defensible environmental decisions

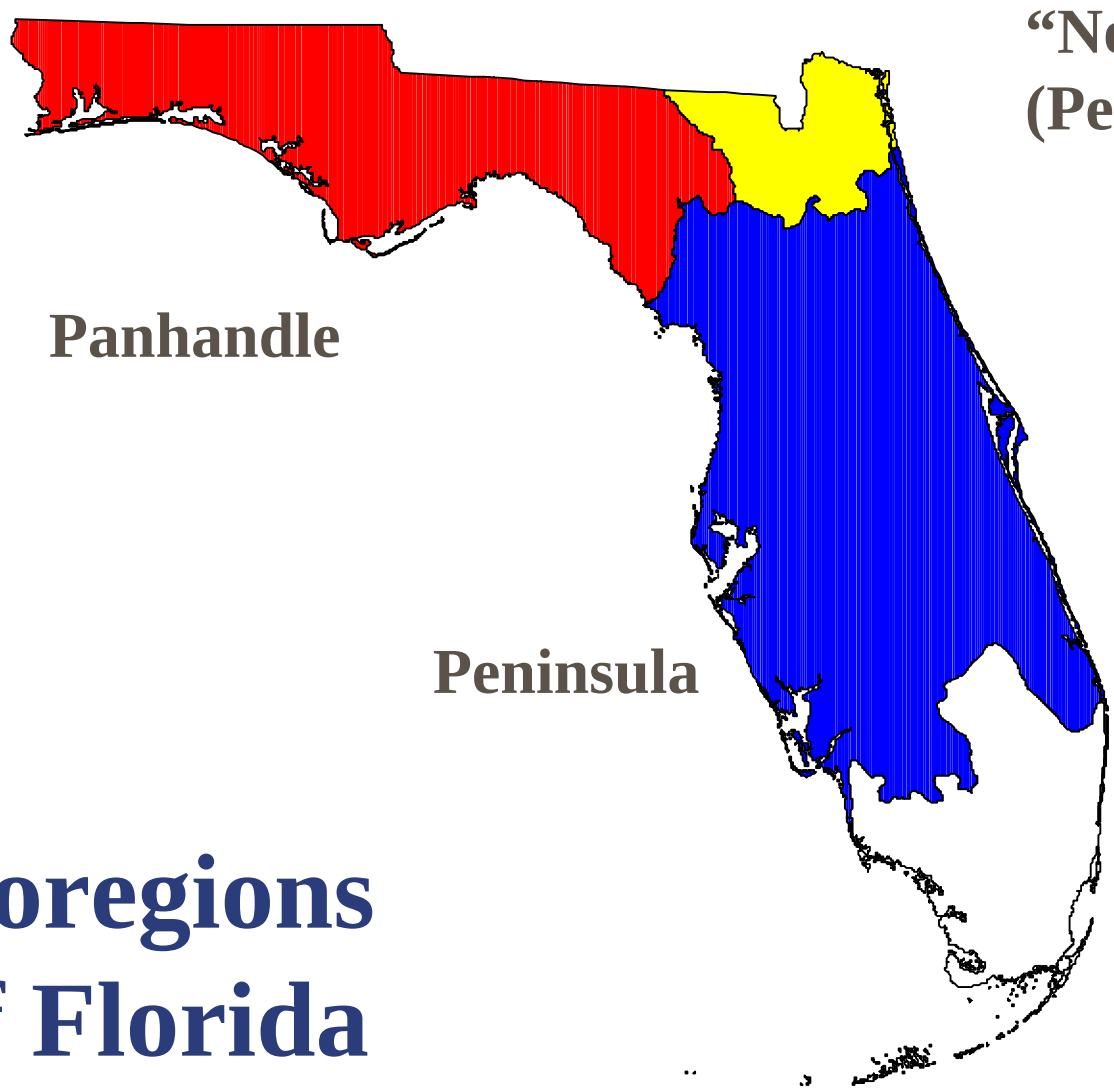
Bioassessment Program Steps

1. Classify environments (e.g., regionalization)
2. Standardize sampling methods
3. Develop assessment approach (IBI)
4. Perform biological surveys
5. Select metrics (positive biological signals)
6. Incorporate Quality Assurance activities
7. Incorporate training and testing (certification)
8. Integrate into programs
9. Report results (Ecosummaries)
10. Revise biocriteria

1. Classify environments (regionalization)



Bioregions of Florida



Ecoregion 76 not included


2. Standardize methods
Dipnet
Sampling

Stream Bioassessments (SCI + BioRecon)

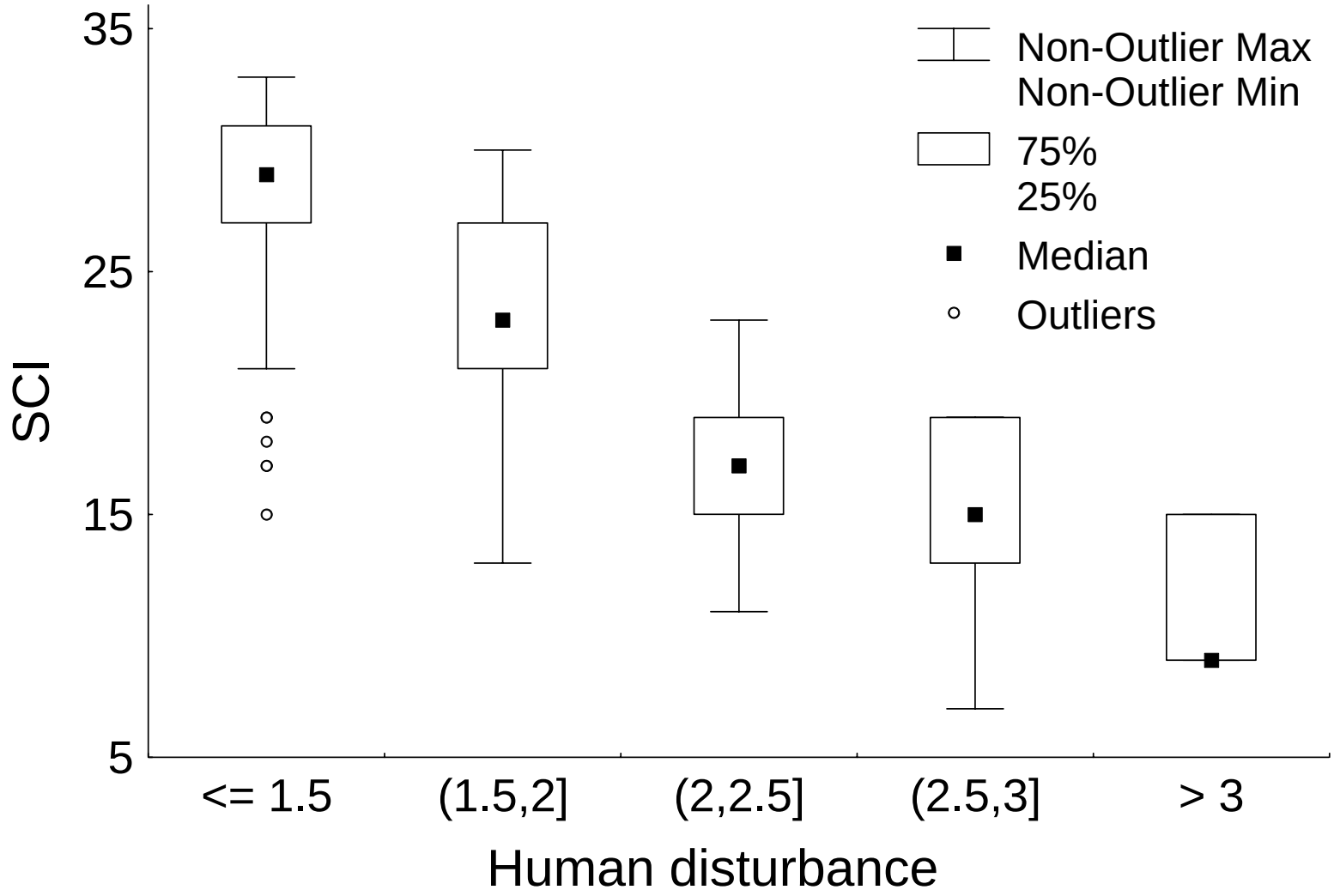
- Habitat Assessment Procedures
- Physical/Chemical Characterization

3. Develop assessment approach (IBI)

- Stream Condition Index (20 dip net sweeps - macroinverts)
- BioRecon (4 dip net sweeps - macroinverts)
- Lake Condition Index (ponar grabs)
- Floristic Quality Index (macrophytes)
- Wetlands Condition Index (vegetation, macroinvertebrates, algae)

4. Perform bioassessments

5. Select metrics



Components of the Stream Condition Index (SCI)

	Response to disturbance
Taxa Richness	Decrease
EPT Index	Decrease
% Contribution Dominant Taxon	Increase
Florida Index	Decrease
# Chironomidae	Decrease
% Filter-feeders	Decrease
% Diptera	Increase

Recalibrating SCI tool:

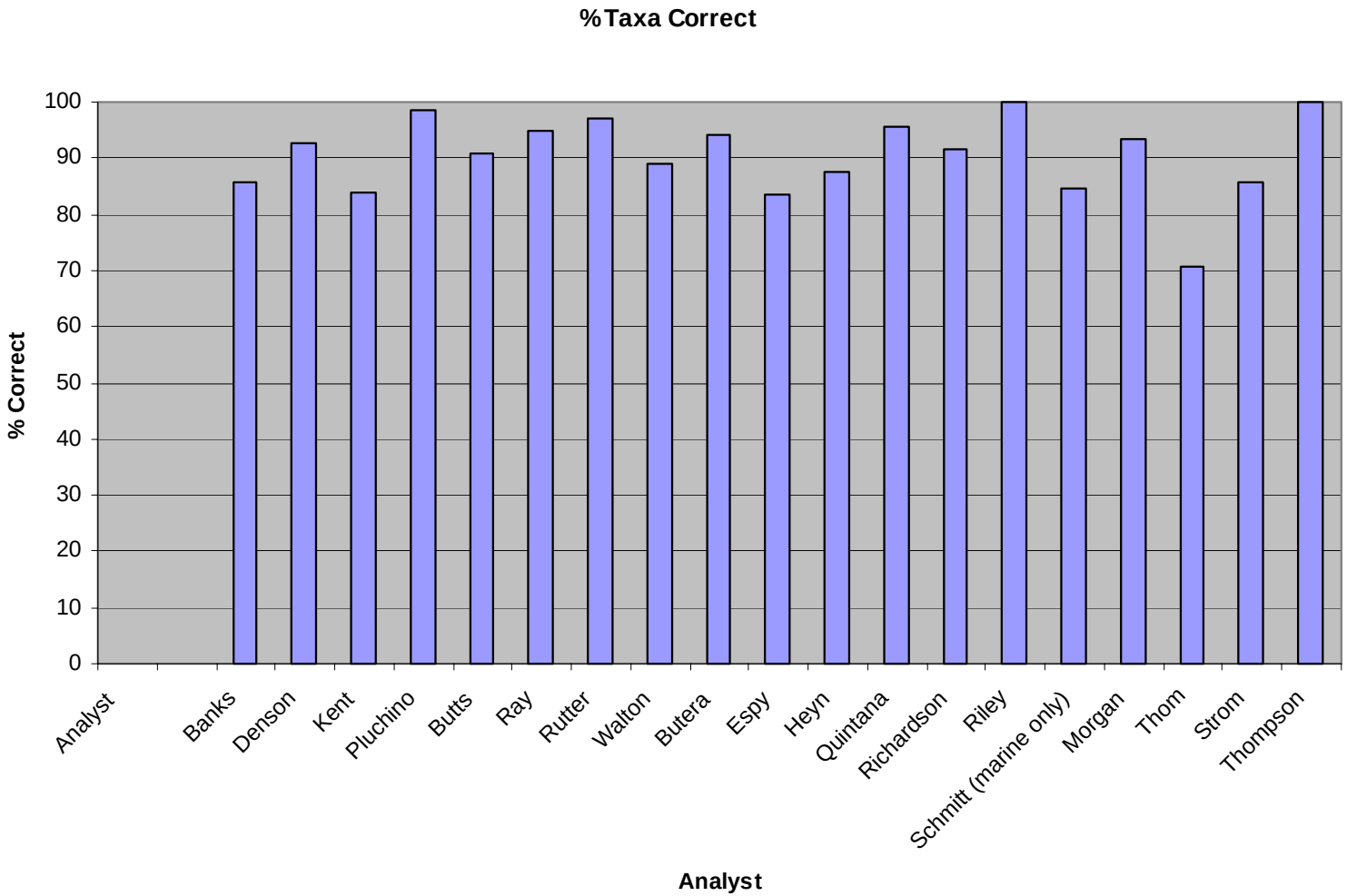
- ***Leska Fore*** – Statistical Design, Inc.
- First draft due spring ‘03
- 10 metrics for SCI

6. Incorporate QA

Bioassessment Program Quality Assurance Activities at FDEP

- Habitat Assessment Testing (Certification)
- SCI/BioRecon field audits
- Taxonomic Round Robins
- Intra-DEP Variability Studies
- Ongoing taxonomic manual updates
- Expert taxonomic verifications

Taxonomic RR Results



7. Training & Testing Program

- DEP - ongoing, continuous training
- Consultants
- Water Management Districts
- County and City Governments
- Regulated Industries

8. DEP Programs Using Bioassessments

App 1 - TMDL
App 2 - Springs Initiative
App 3 - Point Source Studies
App 4 - Ambient Monitoring
App 5 - RCRA (Hazardous Waste)
App 6 - Forestry BMP Effectiveness
App 7 - Mitigation Studies

Application 1: TMDL Program

- Impaired Waters Rule - Ch. 62-303, F.A.C.
- Collect biological, habitat, and water quality data to support FDEP's Impaired Waters Rule and TMDL Program
  - De-listing tool
  - Listing tool
  - Verification tool
  - Tool to evaluate watershed remediation
- 2 SCIs or Biorecons to list or de-list

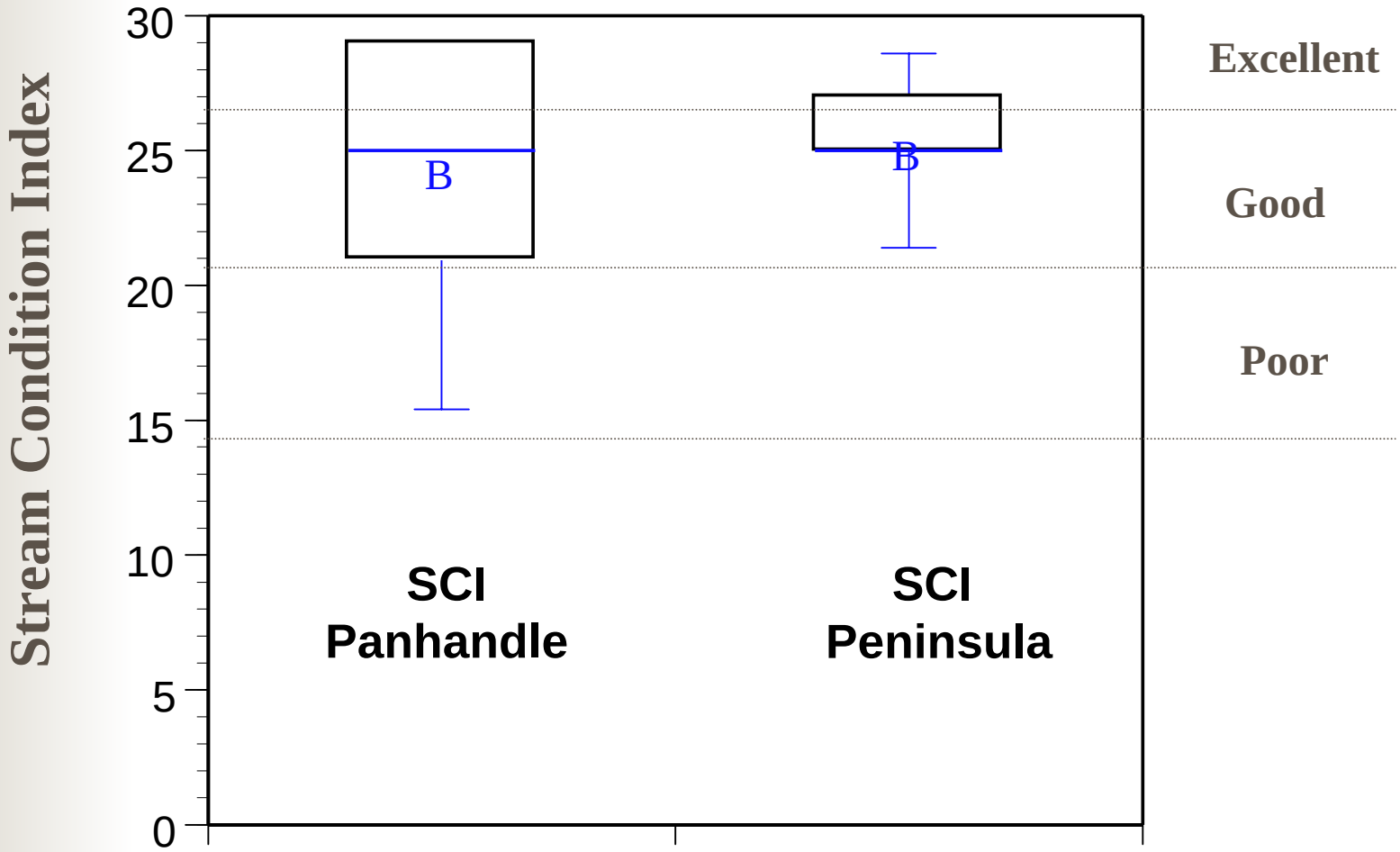
Application 2:
Florida Springs Program

Pictured: Ichetucknee Springs

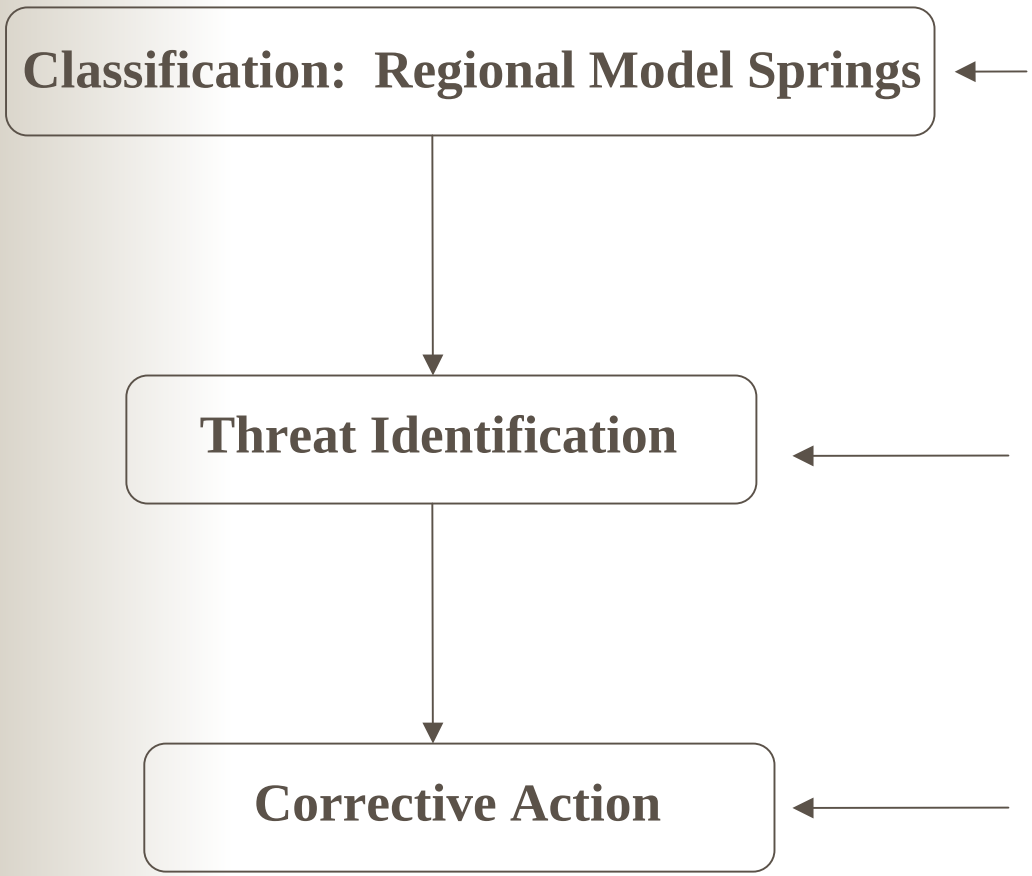
What's Different about Springs?

- More constant flow
- More alkaline (higher pH) water
- Better transparency
- More submerged aquatic vegetation
- Lower dissolved oxygen at boil
- Nitrate-nitrite levels increasing

Health of Spring-Dominated Streams Compared with Reference Sites

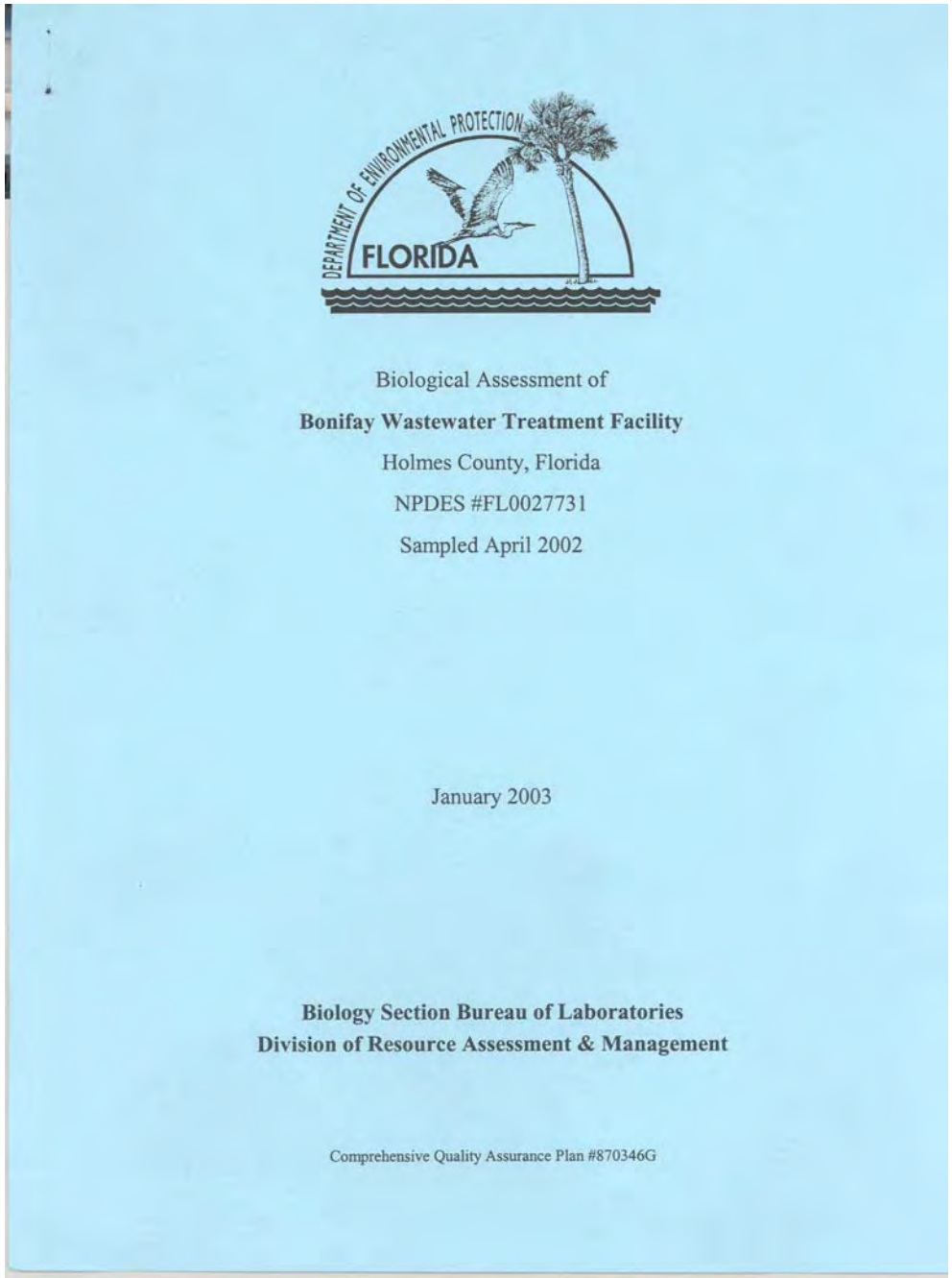


Springs Protection Strategy



Application 3: Point Source Program

Fifth Year Inspections (NPDES)



Toxics

Bioassay

Chemistry

Bioassessment

Florida Department of Environmental Protection

Fifth Year Inspection Summary

Discharger:	Bonifay Waste Water Treatment Facility
County:	Holmes
NPDES Number:	FL0027731
Permit Expiration:	31 July 2002
Date Sampled:	15 and 16 April 2002

Toxics Sampling Inspection **(XSI)**

Date Sampled: 15 April 2002

Results: Aluminum, cadmium, copper, iron, lead and zinc were found in the effluent at levels that complied with Class III Water Quality Standards. Silver was found in the effluent (0.25 µg/L) at a level that exceeded Class III Water Quality Standards (0.07 µg/L) (62-302.530(60) FAC). Diazinon (0.067 µg/L) was detected in the effluent. Total residual chlorine measured in the bioassay sample in the laboratory (0.54 mg/L) exceeded permit limits and Class III Water Quality Standards (FAC 62-302.530(19)) by a factor of more than 50.

Compliance Biomonitoring Inspection **(CBI)**

Date Sampled: 15 April 2002

Results: The effluent sample was toxic to both the fish, *Cyprinella leedsi*, and the water flea, *Ceriodaphnia dubia*, a violation of Class III Water Quality Standards (FAC 62-302.530 (62)). A dechlorinated aliquot of the effluent sample was not toxic to the fish, *Cyprinella leedsi*, or to the water flea, *Ceriodaphnia dubia*, during 48-hour acute screening bioassays.

Water Quality Inspection **(WQI)**

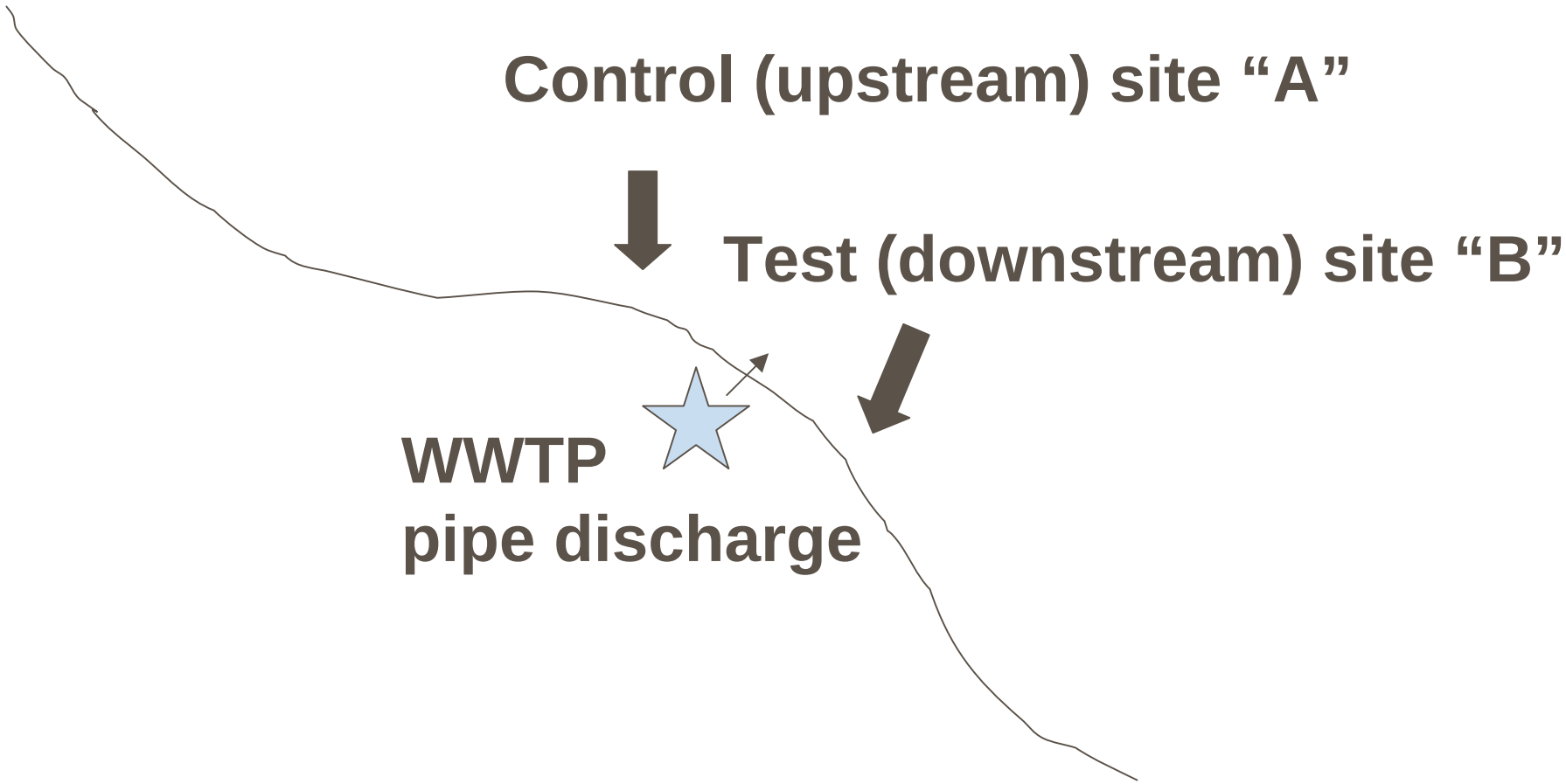
Date Sampled: 15 April 2002

Results: Effluent concentrations of ortho-phosphate (0.68 mg/L), total phosphorus (0.87 mg/L), ammonia (0.53 mg/L), nitrate+nitrite (0.28 mg/L), and total Kjeldahl nitrogen (1.5 mg/L) contributed to enrichment of nitrogen and phosphorus at the Test Site. The Test Site values were found to be greater than 40-80% of other Florida waters. In contrast, the nutrients at the Control Site were only greater than 20-30% of typical of Florida streams, except ammonia (0.072 mg/L), which was greater than about 40% of typical Florida streams. The Control Site AGP value (6.0 mg dry weight/L) was just over the "problem threshold" of 5.0 mg dry weight/L, while the Test Site value (18.5 mg dry weight/L) was more than three times the problem threshold. The effluent AGP was 30.8 mg dry weight/L. These results are a further indication of enrichment downstream of the facility due to the effluent.

Impact Bioassessment Inspection **(IBI)**

Date Sampled: 15 and 16 April 2002

Results: Macroinvertebrate community data suggest degradation at the Test Site related to the facility's effluent. The Shannon-Weaver Diversity Index was 63% lower at the Test Site (0.9) compared to the Control Site (2.4), a violation of the Class III Biological Integrity Criterion (62-302.530 (11) FAC). Quantitative macroinvertebrate data showed 95.6% of the total community consisted of dipterans and the number of individuals rose from 87 at the Control Site to 1,811 at the Test Site. These results may indicate an increase in productivity in response to nutrient enrichment from the facility. In qualitative dipnet data, the dominant taxon comprised 81.6% of the community compared with 25.5%, and taxa richness was 68% lower at the Test Site compared to the Control Site. The Control Site received a SCI score of 21, which placed it in the "Good" category, while the Test Site received the lowest possible score of 7, placing it in the "Very Poor" category. Periphyton cell density was twice as high at the Test Site compared to the Control Site, reflecting a ten-fold increase in percentage of green algae at the Test Site. This change in algal community structure may also be related to the facility's effluent. The SCI and algal community composition data indicate an imbalance of flora or fauna, a violation of FAC 62-302.530 (48)(b).


Control (upstream) site “A”
Test (downstream) site “B”
WWTP
pipe discharge

Control Site A

Table 6. *Stream Condition Index*

Bonifay WWTF Control Site	Value	5	3	1	Score
Total Number of Taxa	22	≥31	30-16	<16	3
Number of EPT Taxa	0	≥7	6-4	<4	1
Number of Chironomid Taxa	9	≥9	8-5	<5	5
Percent Contribution of Dominant Taxon	25.5	≤22	23-61	>61	3
Percent Diptera	16.4	-	≤50	>50	3
Florida Index	2	≥16	15-8	<8	1
Percent Suspension Feeders and Filterers	23.2	≥12	11-6	<6	5
Total Score		**Panhandle**			**21**
Interpretation of Scores by Region		**Excellent**			27-33
		Good			21-26
		Poor			14-20
		Very Poor			7-13

Summer Index Period: April 1-October 31. Stream Condition Index (SCI) for Florida Panhandle. Values calculated from benthic macroinvertebrates collected with 20 standardized dipnet sweeps (Barbour *et al.* 1996a, b).

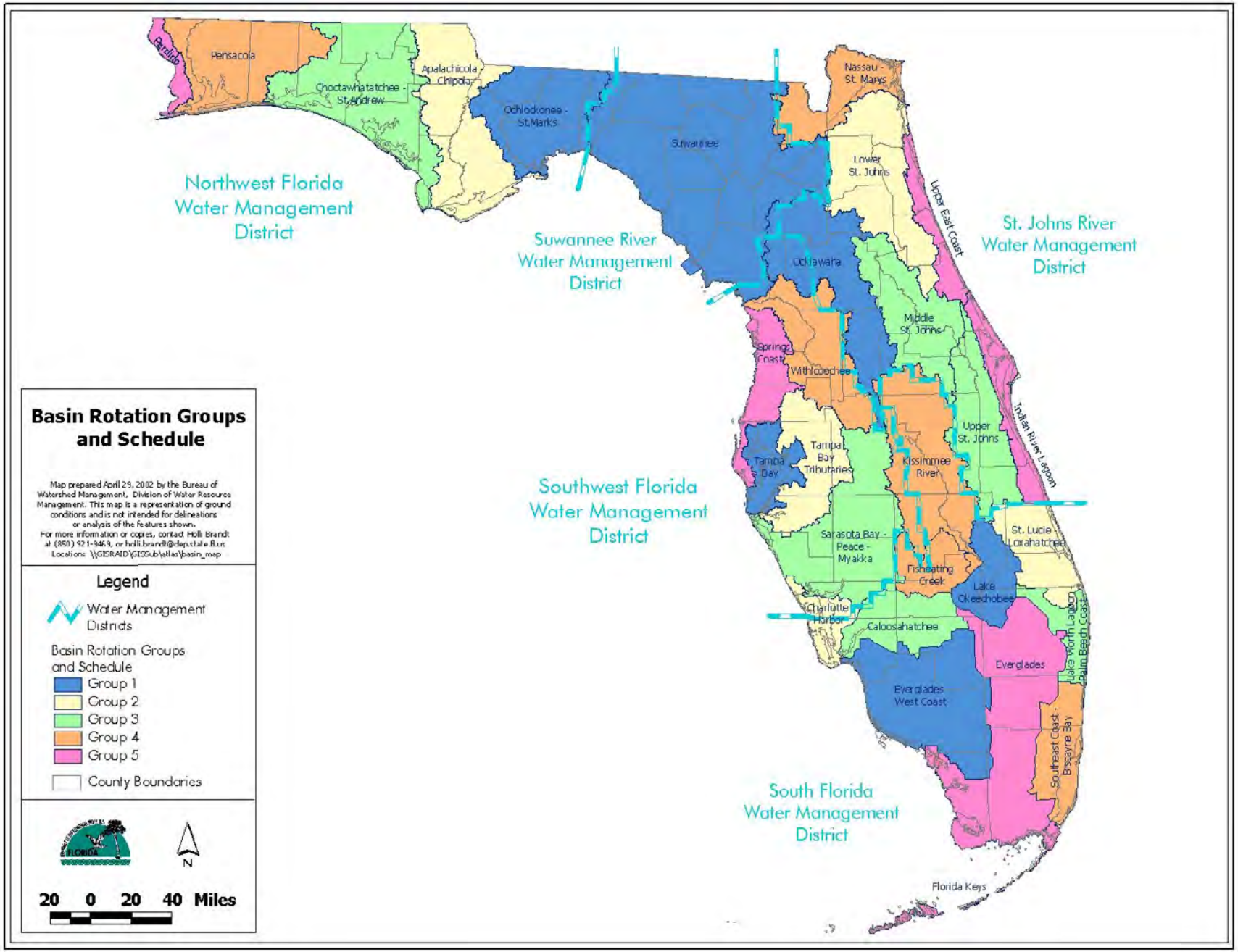
Test Site B

Bonifay WWTF Test Site	Value	5	3	1	Score
Total Number of Taxa	7	≥31	30-16	<16	1
Number of EPT Taxa	0	≥7	6-4	<4	1
Number of Chironomid Taxa	4	≥9	8-5	<5	1
Percent Contribution of Dominant Taxon	81.6	≤22	23-61	>61	1
Percent Diptera	88.6	-	≤50	>50	1
Florida Index	1	≥16	15-8	<8	1
Percent Suspension Feeders and Filterers	0.9	≥12	11-6	<6	1
Total Score		**Panhandle**			**7**
Interpretation of Scores by Region		**Excellent**			27-33
		Good			21-26
		Poor			14-20
		Very Poor			7-13

Summer Index Period: April 1-October 31. Stream Condition Index (SCI) for Florida Panhandle. Values calculated from benthic macroinvertebrates collected with 20 standardized dipnet sweeps (Barbour *et al.* 1996a, b).

Application 4:
Ambient Monitoring Program

- Probabilistic network
- 5-year rotating basin program


Basin Rotation Groups and Schedule
Map prepared April 29, 2002 by the Bureau of Watershed Management, Division of Water Resource Management. This map is a representation of ground conditions and is not intended for delineations or analysis of the features shown.
For more information or copies, contact Holli Brandt at (850) 921-9469, or holli.brandt@dep.state.fl.us
Location: \\GISRAID\GIS\sub\atlas\basin_map
Legend
Water Management Districts
Basin Rotation Groups and Schedule
Group 1
Group 2
Group 3
Group 4
Group 5
County Boundaries
FLORIDA
N
20 0 20 40 Miles
Northwest Florida Water Management District
Suwannee River Water Management District
St. Johns River Water Management District
Southwest Florida Water Management District
South Florida Water Management District
Perdido
Pensacola
Choctawhatchee - St.Andrew
Apalachicola - Chipola
Ochlockonee - St.Marks
Suwannee
Nassau - St. Marys
Lower St. Johns
Upper East Coast
Ocklawaha
Middle St. Johns
Springs Coast
Withlacoochee
Tampa Bay
Tampa Bay Tributaries
Kissimmee River
Upper St. Johns
Indian River Lagoon
Sarasota Bay - Peace - Myakka
Fisheating Creek
Lake Okeechobee
St. Lucie - Loxahatchee
Charlotte Harbor
Caloosahatchee
Everglades
Everglades West Coast
Lake Worth Lagoon - Palm Beach Coast
Southeast Coast - Biscayne Bay
Florida Keys

Ambient Monitoring Program – cont.

- Selected tools = Stream Condition Index, and Floristic Quality Index
- To describe condition of individual rotating basins (yearly)
- To describe statewide conditions (5 years) -- 305(b) report
- To report on effectiveness of all water programs going on both statewide and in each basin

Application 5: Resource Conservation and Recovery Act (RCRA)

- Joint endeavor by DEP Waste Division and Water Division

- SCI tool requested by Waste Mgt. Division

RCRA Site

Hazardous Waste (RCRA) Studies

- Concern: leachate from waste sites impacting aquatic systems
- Designed ecological assessments with Waste Management staff
- Answers the question: Is leachate affecting nearby stream communities?

Application 6: Effectiveness of Forestry Best Management Practices

- Joint project between Florida DEP, Florida Department of Agriculture and the silviculture industry.

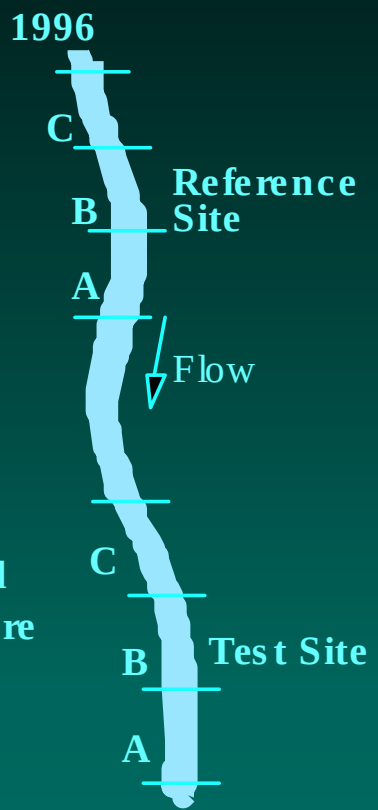
- Purpose: to determine if forestry BMPs, when properly applied, protect aquatic biota in adjacent streams

Examples of forestry BMPs

- Undisturbed buffer zone (SMZ)
- Site preparation to prevent erosion
- Control fertilizers and pesticides
- Design roads/drainage easements for minimum erosion/deposition

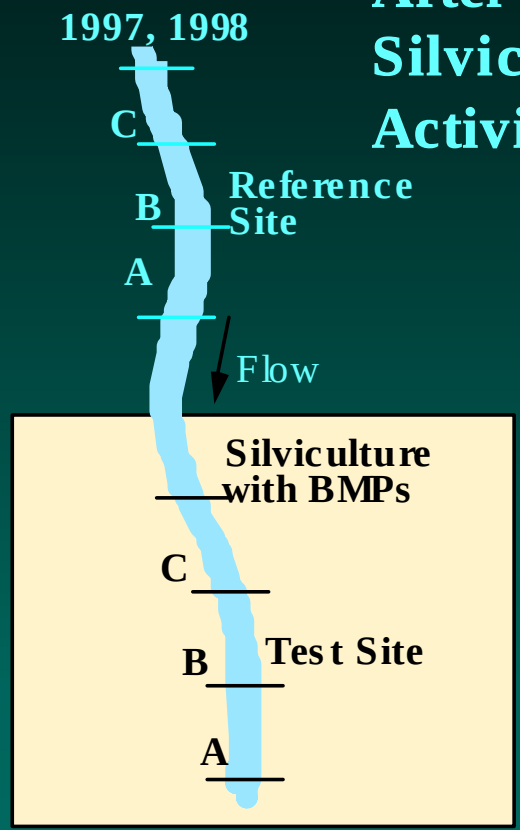
Experimental Design

Before Silviculture Activities

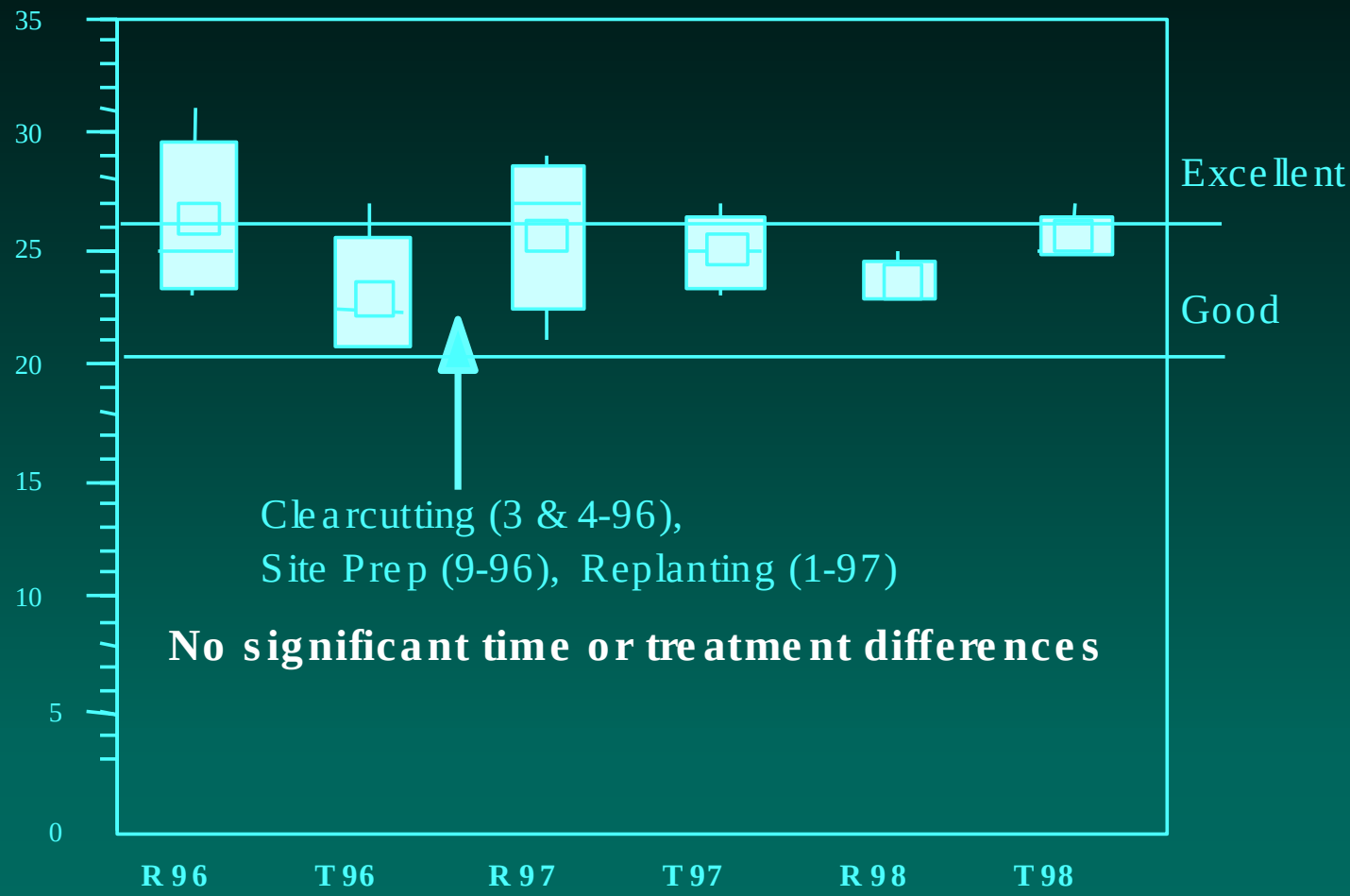


Proposed Silviculture Area

After Silviculture Activities



San Julia SCI Results



Application 7: Wetland Mitigation Program

- Reclaimed phosphate streams
- Wetland restoration sites

9. Reporting

Bio-Reconnaissance

EcoSummary

BioRecon Report

Stream Health

White Oak Creek below County Road 191 Santa Rosa County
March 16, 2000

BioRecon: A rapid, cost-effective screening mechanism for identification of biological impairment

Purpose

A bioassessment was performed on White Oak Creek in an effort to document the environmental health of streams flowing into the Yellow River Aquatic Preserve (YRAP). The BioRecon was conducted in partnership with the YRAP staff.

Background

White Oak Creek at the bioassessment site is a second order stream originating above I-10 about 5 miles south of Milton in Santa Rosa County (Lat. 30° 32' 00.5" Long. 87° 03' 08.5"). This stream flows to White Oak Bayou in Blackwater Bay, at Eagle Point, then into Pensacola Bay. This site drains the Gulf Coast Flatwoods subecoregion (75a).

Results

The BioRecon indicated an impaired biological community. All 3 biological indicators failed thresholds established for a healthy aquatic wildlife community:

Biometrics	Value	Thresholds
Taxa Richness	17	≥24
Florida Index	4	≥22
EPT	3	≥17

The biota was dominated by pollution tolerant aquatic wildlife. The impoundment created by the CR-191 road culvert caused water quality problems in White Oak Creek. The dissolved oxygen concentrations (3-4.7 mg/l in March, 2 mg/l in May) did not meet State Water Quality Standards. The May biochemical demand was very high (5.1 mg/l) with elevated nutrients (ammonia 89 ug/l, nitrogen 1000 ug/l, phosphorus 61 ug/l) present. The elevated nutrients led to an algae bloom with a very high chlorophyll A concentration of 56 ug/l. Sediments were anaerobic with a hydrogen sulfide odor. Silt smothering of fish and wildlife habitats was severe.

Significance

This White Oak Creek site did not meet Class III State Water Quality Standards 62-302 for recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The dam effects of the CR191 culvert crossing contributed to White Oak Creek not meeting State designated use. Organic sediment and nutrient loading from the impoundment created an elevated biochemical oxygen demand (5.1mg/l) that caused oxygen depletion. Reduced stream flow from the damming negatively affect the system's fish and wildlife nursery function. Altered habitats from culverts and clearing streambank riparian zones negatively affects the Yellow River Aquatic Preserve's fish and wildlife in White Oak Bayou and the lower portion of Blackwater Bay. Reduced flows, nutrient, and organic sediment loading could affect the federally endangered Gulf of Mexico sturgeon.

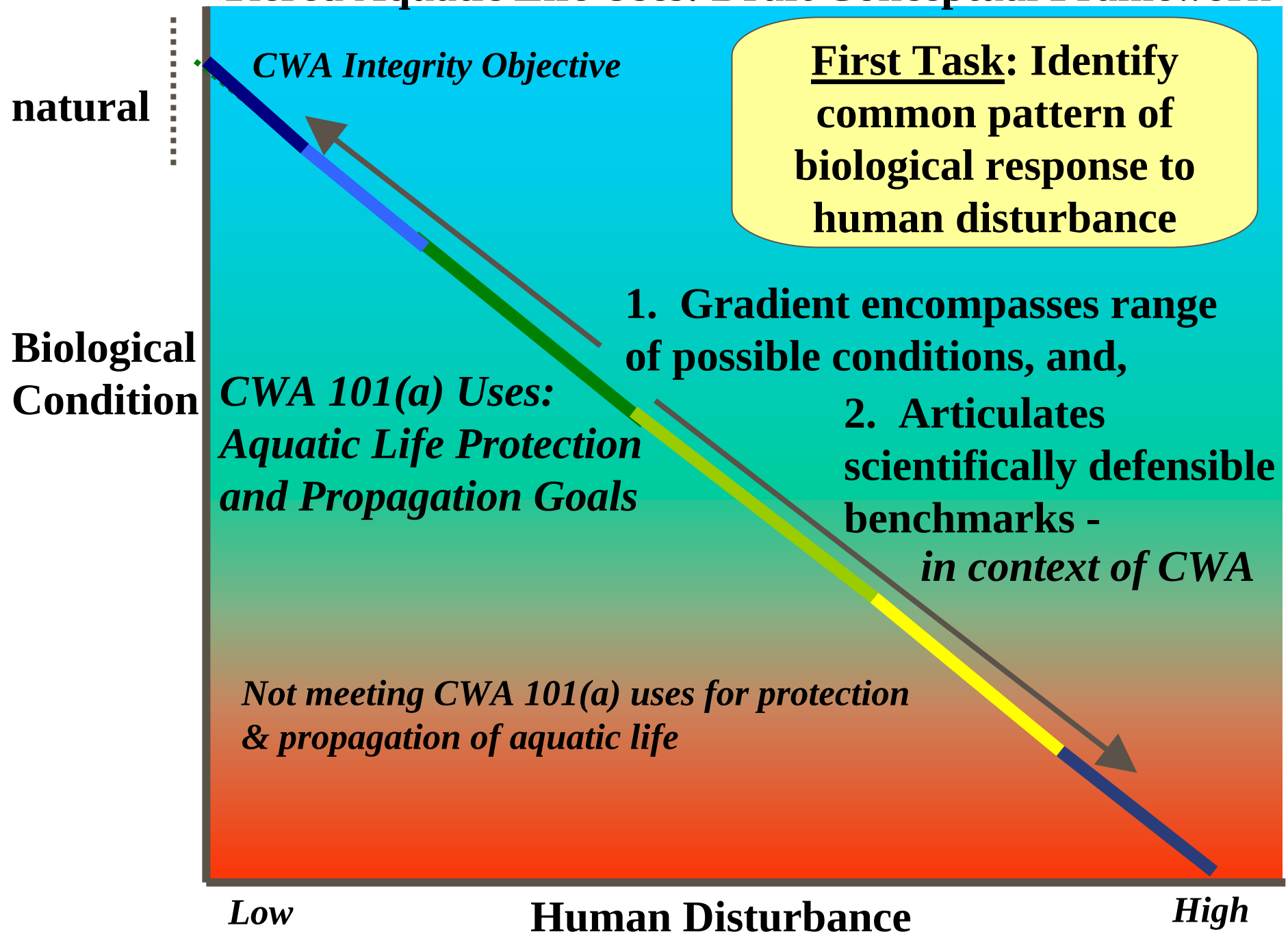
Suggestions

Restoration of the stream's natural hydrology (i.e. flow, quantity) and preserving riparian wetland forests buffer zones would benefit the Aquatic Preserve's fish and wildlife community including the sturgeon. Replacing culverts with bridges that span the streamside wetlands and restoration of the watershed's natural hydrological patterns could enhance Live Oak Bayou as a nursery area for aquatic wildlife in the Pensacola Bay basin. Nutrient sources that created the algae bloom were unknown. Background nutrient concentrations in area watersheds are naturally very low. Possibly fallout from 2 major industrial manufacturing air pollution dischargers within 3 and 5 miles of the watershed is a nutrient source. **For more information, contact Donald Ray, FDEP Northwest District, 160 Governmental Center, Pensacola, FL 32501 (850) 595-8300 x1126 or SC 695-8300**

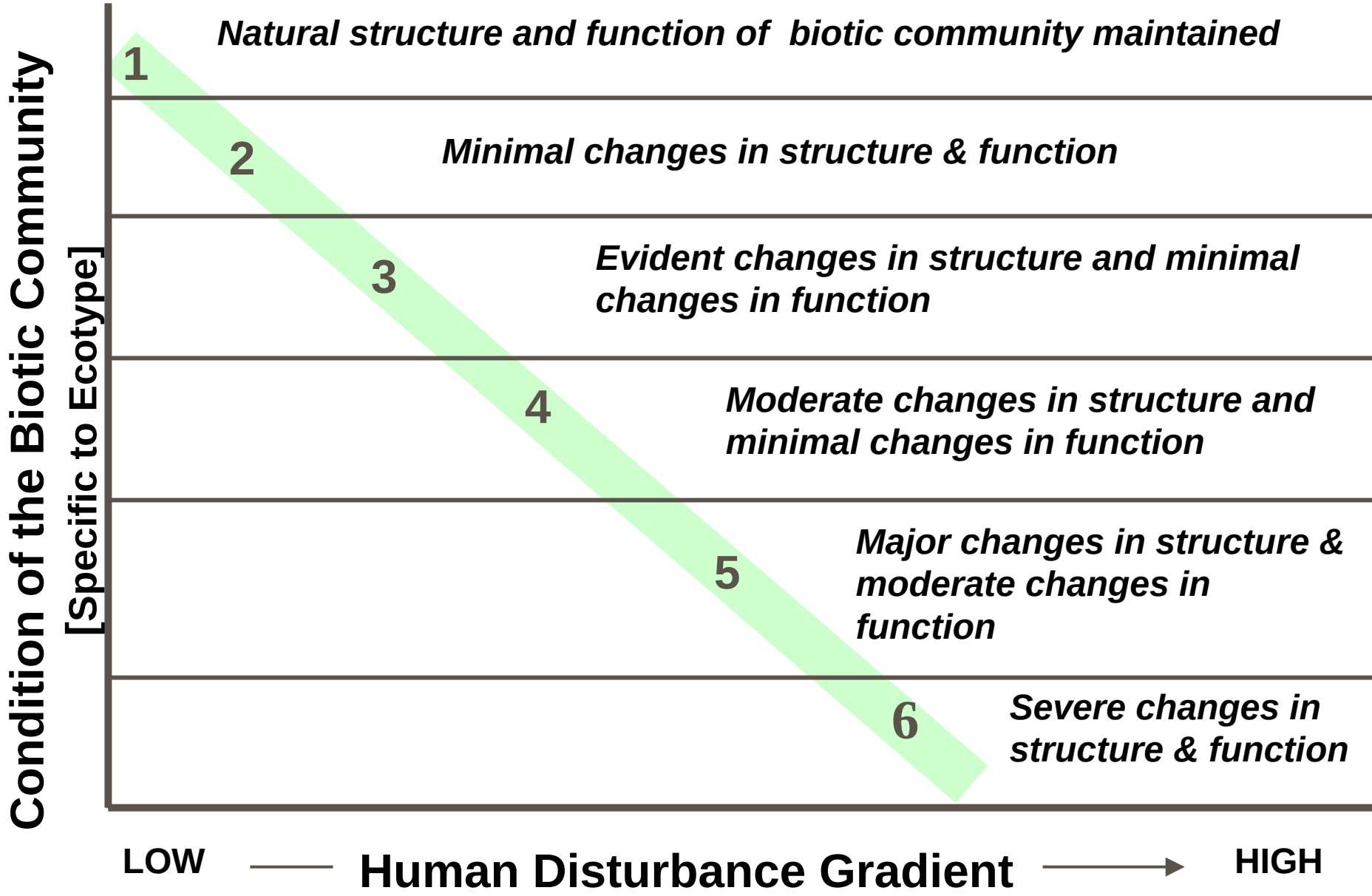
10. Develop or revise biocriteria

- Integrate into Tiered Aquatic Life Use System (TALUS)

Tiered Aquatic Life Uses: Draft Conceptual Framework



Tiered Aquatic Life Use Conceptual Model: Draft Biological Tiers



Conclusions

- FDEP Bioassessment Program provides practical support for a variety of FDEP programs
- QA and training are critical for demonstrating legal defensibility

It’s all about clean water for future generations!

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APP 101

Use of Biological Information and Biocriteria in Maine's Water Quality Program

Presented by

David Courtemanch, Maine Department of Environmental Protection

Why Use Biocriteria? Because they tell us things that other criteria don't.

- Provides a direct measure of goal attainment - measure of impact
- Integrates water quality information from multiple stressors for an extended time frame

So Why Aren't Biocriteria Used?

- **Complexity of the information - biomonitoring is extremely data rich**
- **Perceived conflict with existing criteria**
- **Cause and source may not be apparent - low enforcement value**
- **No readily available models**

Maine Uses Biocriteria for the Following Purposes

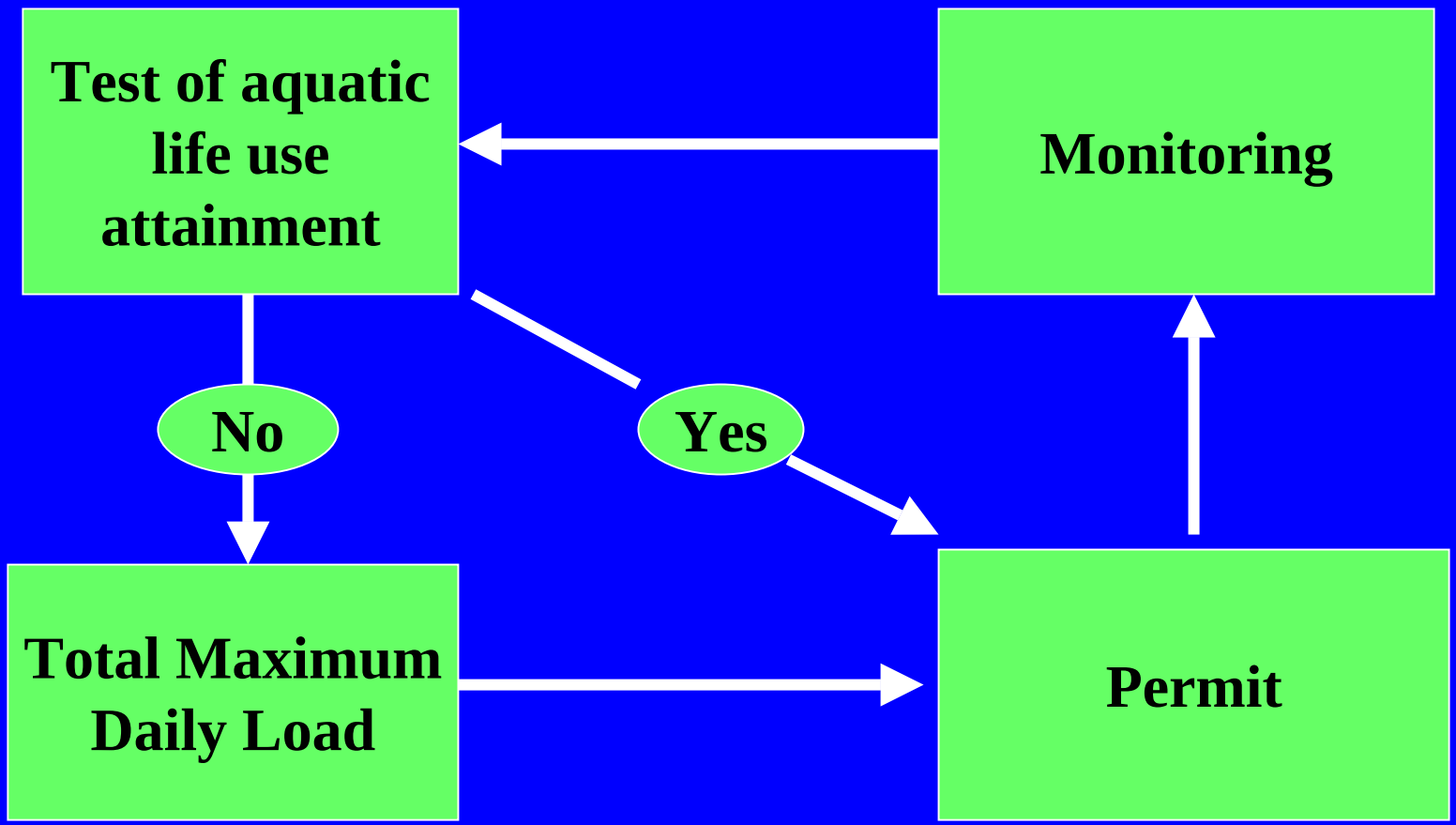
- Standards (including antidegradation)
- Assessment
- Reporting - 305(b) and 303(d)
- Wastewater permitting - NPDES, State, TMDLs, Stormwater?
- Site permitting
- 401 (Hydro) certification
- Enforcement

Assessment and Reporting

- **305(b) - 121 (28%) of 425 waterbody segments in 2002 305(b) report have biological criteria used in assessment**

- **303(d) - 42 (36%) of 117 listed river and stream segments are based on biological criteria**

General Schematic of Permitting



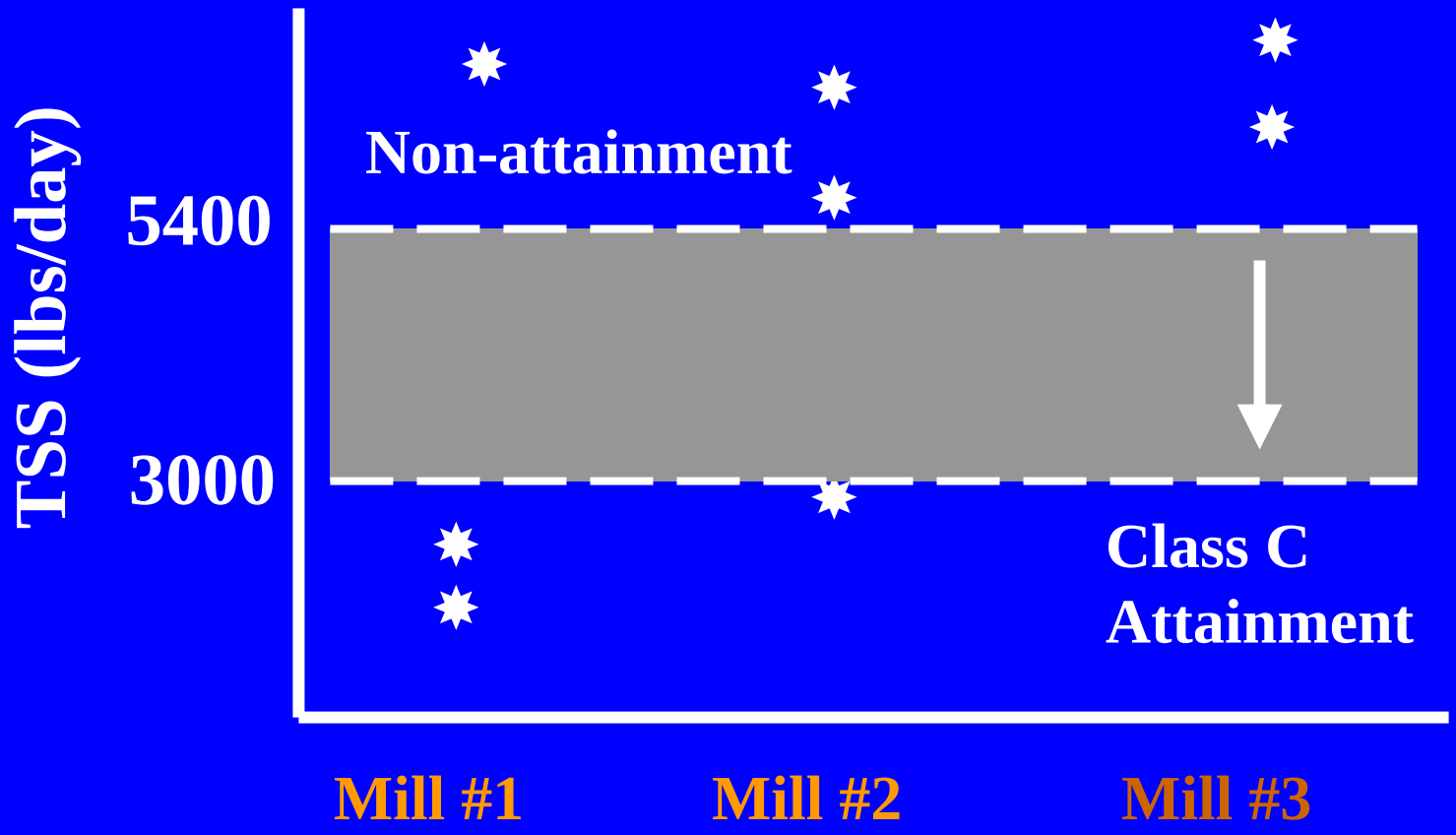
Using Biocriteria
to Set Permit Conditions
Case: Presumpscot River, Maine

highly flow regulated with pulp and paper, municipal and stormwater wasteloads

Presumpscot River

- TMDL evaluation determined impact from low oxygen, low flow and high suspended solids.
- Stressor Identification Evaluation (SIE) identified TSS as the primary agent
- State lacked AWQC for solids
- Importation of biocriteria/solids data from another river to set permit limits

Aquatic Life Attainment Based on Prorated TSS Loading



Incorporation of biocriteria as permit limits! Case: Aquaculture permitting for marine waters

- **Pen culture - production facility, waste treatment system, and receiving water are all the same water**
- **Establishment of impact zones**
- **Establishment of biomonitoring based warning criteria and impact criteria**

"supports all indigenous species…without detrimental change"

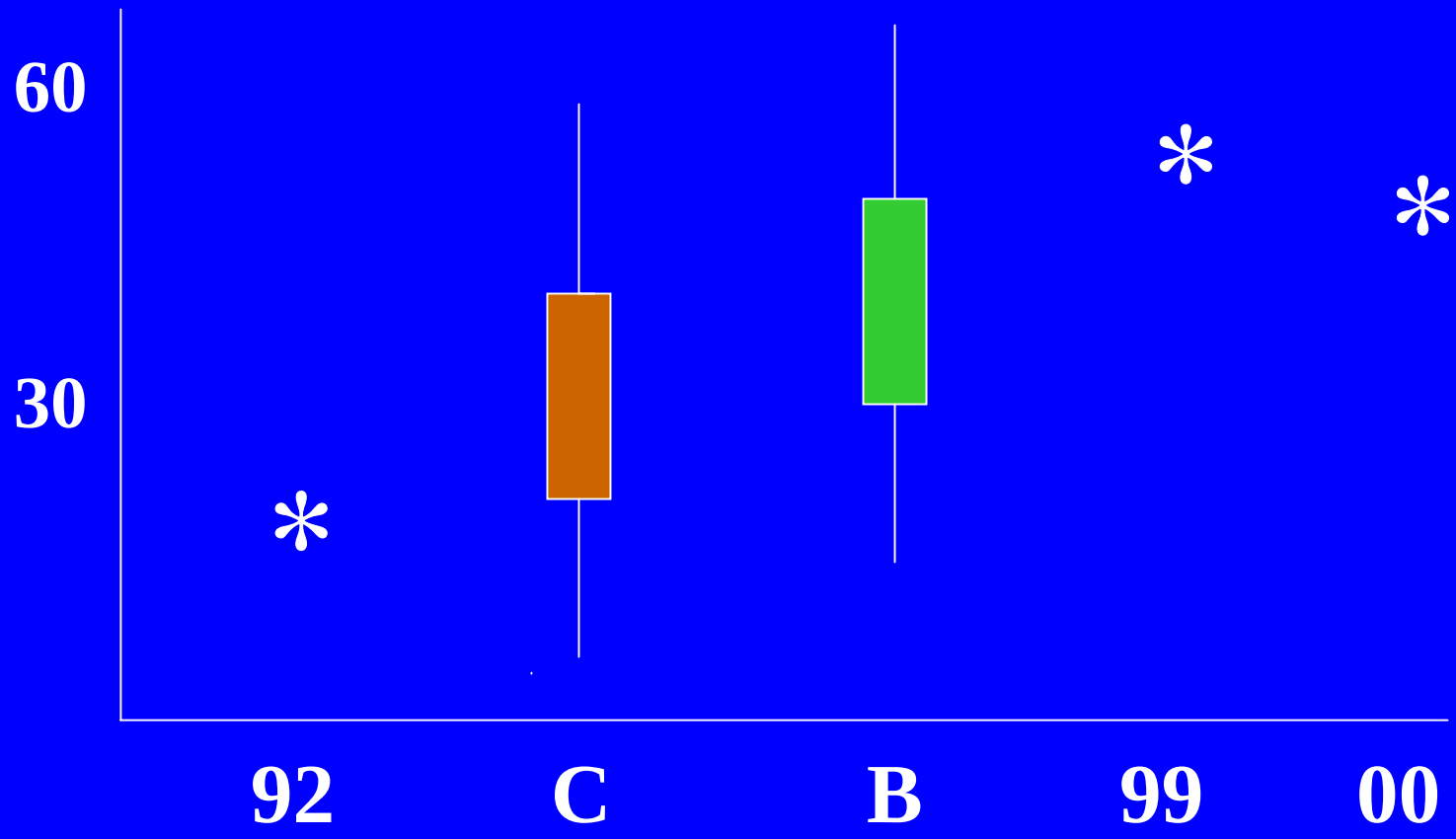
Metric	Warning	Impact
Redox	0 to –100mV	<-100mV
Beggiatoa	Visible, patchy	>50% coverage
Tolerant taxa	>80% dominance	Report
Sensitive taxa	>50% reduction	Report
Taxa richness	>25% reduction	Report

Using Biocriteria in Water Quality Certification Edwards Dam, Kennebec River

- Good water quality except aquatic life goals not attained due to degraded habitat
- Impoundment prevented migration, impaired indigenous fish populations
- Certification used to force decision for dam removal

Kennebec River - Edwards Dam

Taxa Richness



For More Information

- Biomonitoring Web Site
  - http://www.state.me.us/dep/blwq/docmonitoring/biomonitoring/index.htm
- Fifteen Year Retrospective
  - http://www.state.me.us/dep/blwq/docmonitoring/biomonitoring/biorep2000.htm
- E-mail
  - BioME@maine.gov