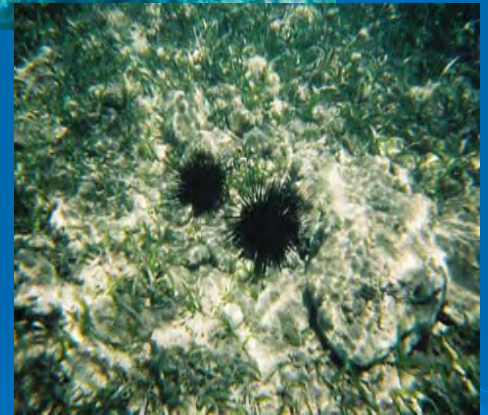
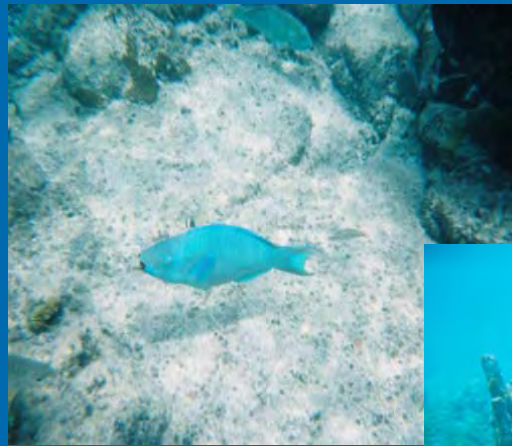


# Developing Biological Criteria to Protect Coral Reefs



24<sup>th</sup> Pacific Islands Conference  
June 21, 2005

Treda Smith  
Office of Science and Technology  
Office of Water  
Washington, DC



## Biocriteria for all Waters

- Streams and small rivers
- Wetlands
- Lakes and reservoirs
- Estuaries
- **Coral Reefs**
- Great Rivers
- Great Lakes
- Intermittent and ephemeral streams

# Terminology

- Bioassessments-- *are 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 water body.*
- Biocriteria– (**scientific**) *are quantified values representing the biological condition of aquatic communities in water bodies. (Bioindex)*
- Biocriteria– (**regulatory**) *are narrative descriptions or numerical values of the desired biological condition necessary to protect the designated aquatic life use, implemented in, or through water quality standards.*

# Biocriteria as a Regulatory Tool

## 1. Clean Water Act:

- 305(b) - Condition of the Nation's waters— Report to Congress
- 303(d) - List of impaired waters-- TMDLs
- 301(h) - POTW discharges to ocean waters
- 403(c) - Ocean discharge impact criteria
- 303(c) – Water Quality Standards Programs

## 2. Florida Keys NMS and Protection Act

## 3. Ocean Dumping Act (MPRSA)

## 4. Rivers and Harbors Act

## 5. Coastal Zone Management Act

# The Linkage From Stressor Effects To Ecosystem Response

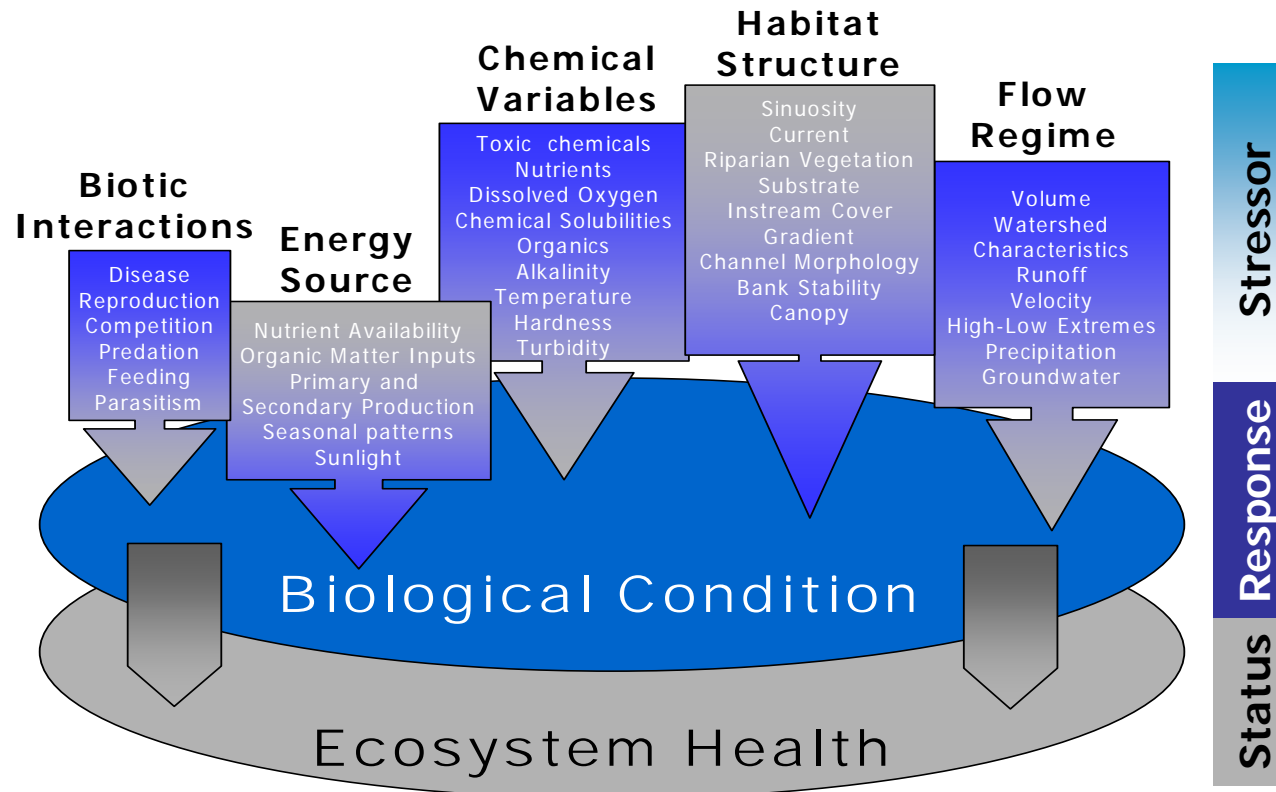


Figure 1. Five classes of environmental variables that affect water resource integrity and overall biological condition (modified from Karr et al. 1986).

# Clean Water Action Section 101(a)

## ➤ Purpose:

- “To restore and maintain the **chemical, physical and biological integrity** of the Nation’s waters”



# Biological Integrity

## Definition:

*“The ability of an aquatic ecosystem to support and maintain a balanced adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region.”*

# Elements of Ecological Integrity





# Statutory Authority

## Section 303(c)(2)(A):

*....State water quality standards shall consist of designated uses of navigable waters and the criteria for protecting such uses.*

*....State water quality standards shall protect and enhance the quality of water and serve the purposes of the Act, including protection and propagation of a balanced indigenous populations of fish, shellfish and wildlife (“fishable/swimmable”) and recreation in and on the water.*

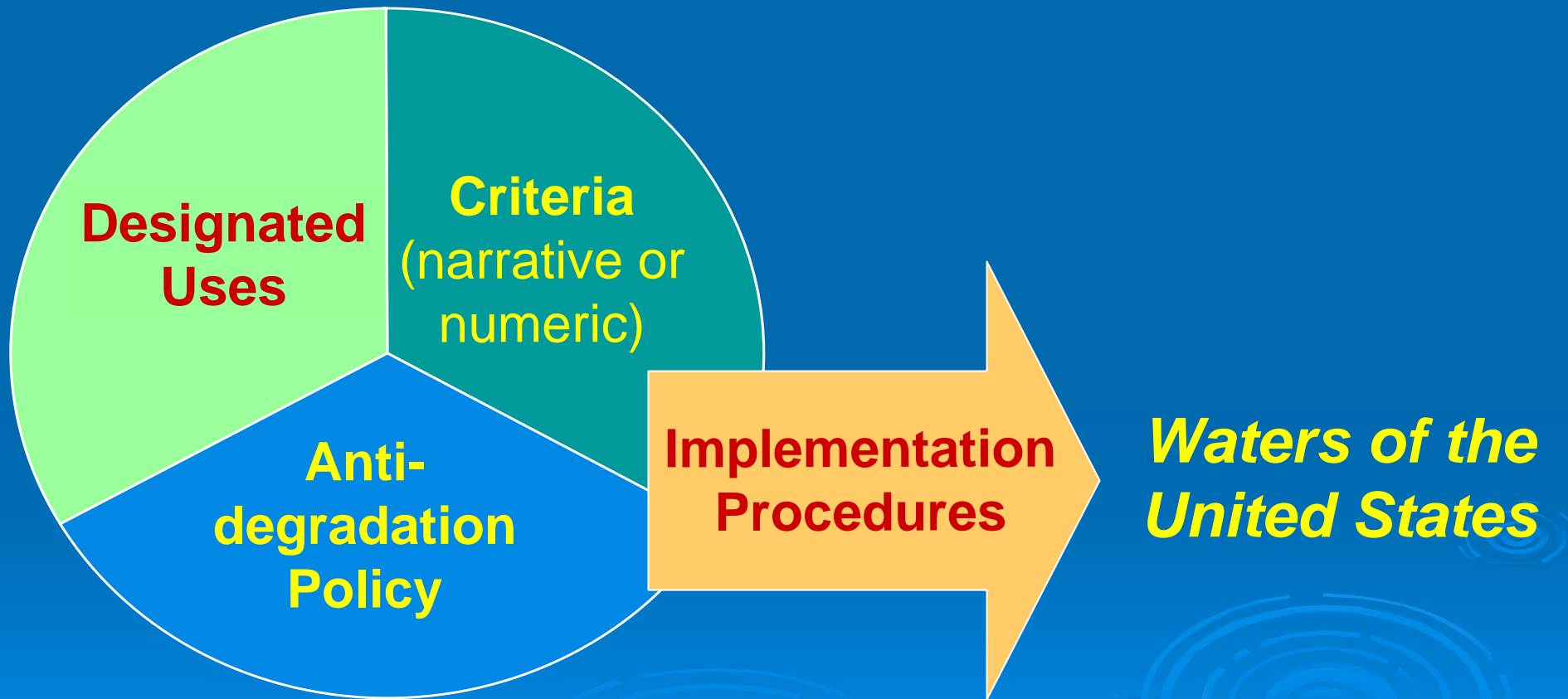
# Statutory Authority

## Section 304(a)(8):

*EPA shall.....develop and publish information on methods for establishing and measuring water quality criteria for toxic pollutants on other bases than pollutant-by-pollutant criteria, including **biological monitoring and assessment methods.***



# Water Quality Standards



# Types of Water Quality Criteria

- Biocriteria: (biological response)  
combined with
- Physical/Chemical Condition Criteria:  
(DO, temp., pH, sediment, turbidity, flow, nutrients, etc.)
- Stressor Management Criteria: (toxic chemicals, whole effluent toxicity criteria, contaminated sediment criteria)

# Key Definitions

- ✓ **Attribute**: any measurable component of a biological system.
- ✓ **Metric**: attribute that shows a quantitative change in value along a gradient of human influence.
- ✓ **Multimetric Index**: a number that integrates several biological metrics to express a site's condition or health.
- ✓ **Index of Biological Integrity (IBI)**: integrative expression of site conditions across multiple metrics.

# Index of Biotic Integrity

- Used extensively in various waterbody types (e.g. streams, small rivers)
- Measures divergence from biological integrity
  - Reference condition= biological integrity in multimetric bioassessment
- Society can accept this divergence or restore the site

# Important Biological Attributes

- **Community & assemblage structure**
  - Taxa richness, relative abundance, dominance, size frequency distribution
- **Taxonomic composition**
  - Identity, sensitivity (tolerant/intolerant), rare/endangered taxa
- **Individual condition**
  - Anomalies, contaminant levels, reproductive condition
- **Biological processes**
  - Trophic dynamics, productivity rates, bioerosion, predation, settlement/recruitment rate

# Important Biological Attributes

- Assess only pollutants which are bio-available
- Reveal biological effects at contaminant levels below current chemical analytical detection limits
- Assess synergistic, additive, or antagonistic relationships among pollutants
- Are useful in detecting human degradation caused by factors other than chemical contamination
  - temperature, turbidity, salinity, pH, light intensity, disease



# DEVELOPING BIOCRITERIA

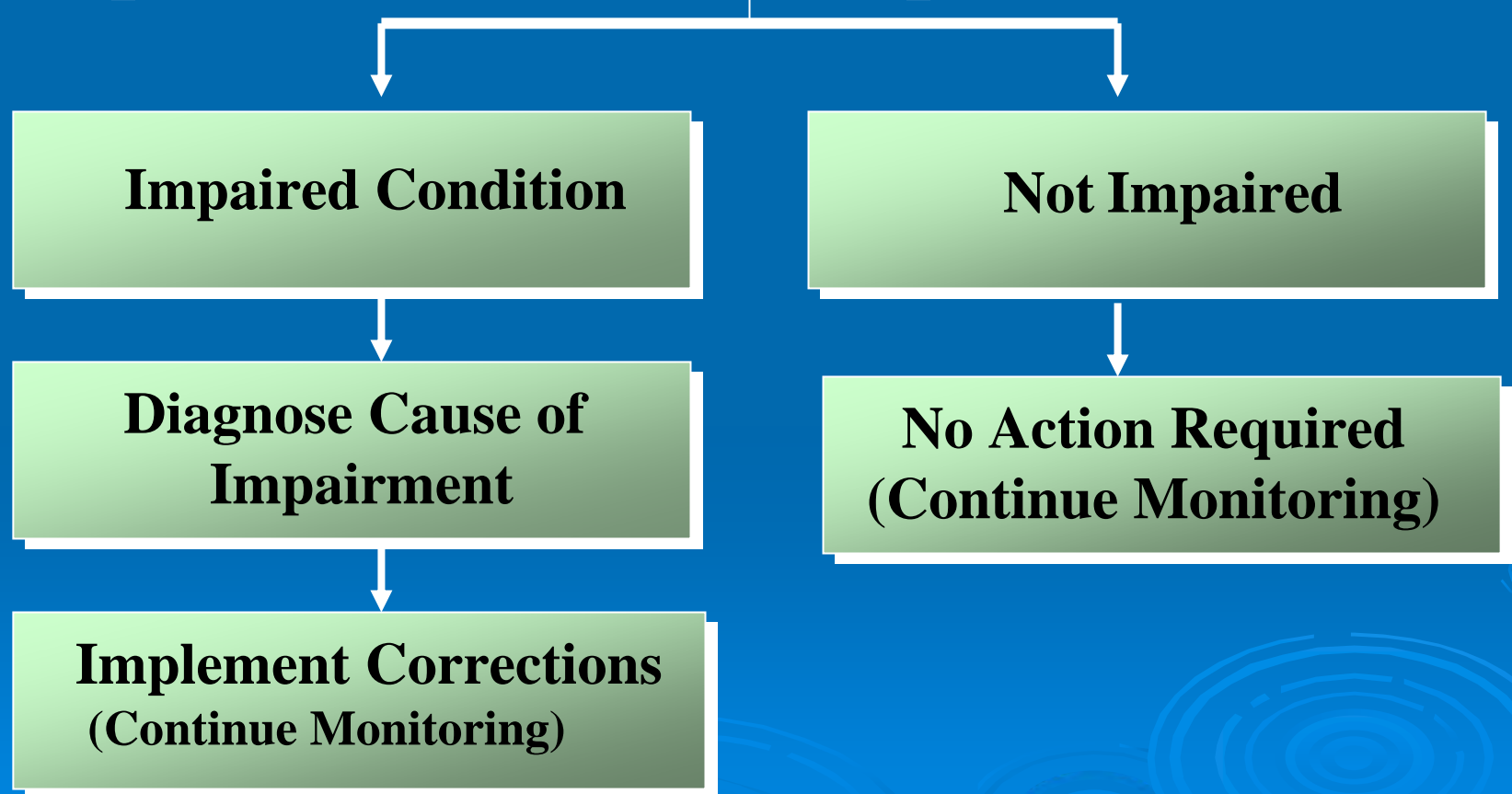
1. **Select Standardized, Consistent Biosurvey Protocols**
2. **Classify Water Bodies into Similar Groups or Classes**
3. **Identify Reference Sites in Each Class**
4. **Conduct Bioassessments at Unimpaired Reference Sites in Each Class**
5. **Derive Reference Conditions for Each Class**
6. **Conduct Bioassessments at Impacted Sites**

# DEVELOPING BIOCRITERIA

7. Test Attributes for Response to Gradient of Conditions
8. Select Responsive Metrics
9. Develop Scoring Criteria for Each Metric
10. Aggregate Metrics With Scoring Criteria to Derive Biocriteria Index
11. Develop Biocriteria for each Aquatic Life Use
12. Apply Biocriteria to all Water Bodies

# APPLYING BIOCRITERIA

Sample test sites and compare to biocriteria



# OHIO IBI Example

Eastern  
Corn Belt  
Plains

26

Huron-Erie  
Lake Plain

38

Erie-Ontario  
Lake Plain

Eastern  
Corn Belt  
Plains

40

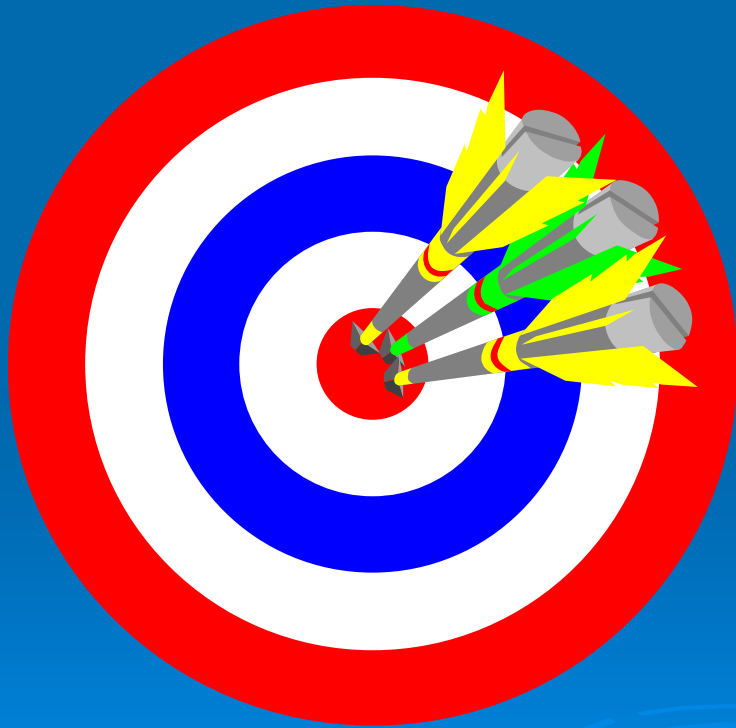
Western  
Allegheny  
Plateau

42

Interior  
Plateau

36

# Key Component of Biological Criteria



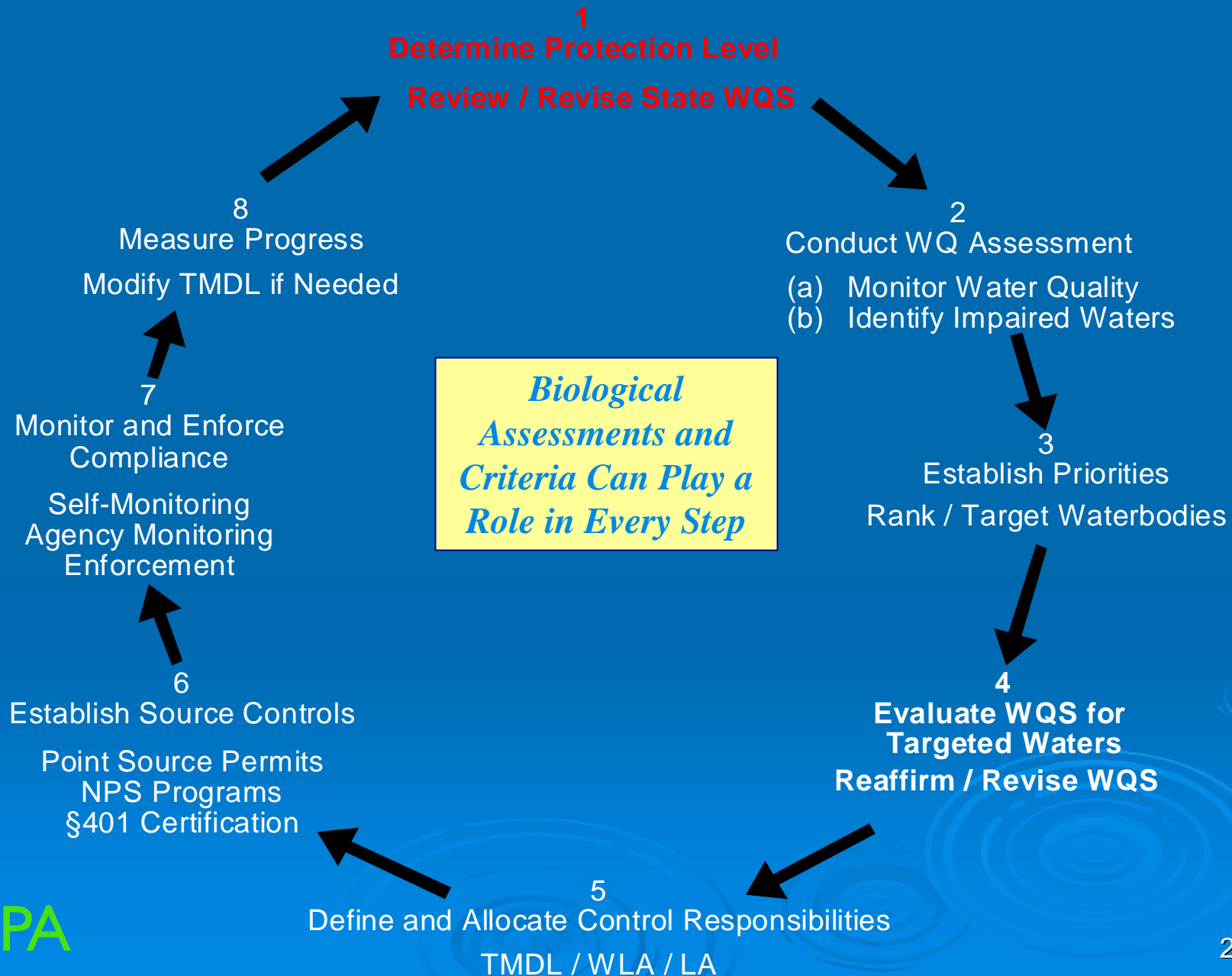
Reference  
Condition

# Define Reference Condition Using

- Reference sites (minimal human influence)
- Historical data
- Paleoecological data
- Experimental lab data
- Quantitative models
- Best professional judgement

Fixed reference conditions allow for the detection of cumulative impacts

# The Water Quality Management Cycle



# Biological Information Can Be Used in Water Quality Standards to:

- **Develop biological criteria to protect aquatic life uses** (*40 CFR 131.11*)
- **Describe existing uses** (*131.3(e)*)
- **Assign appropriate designated uses** (*131.10*)
- **Refine and subcategorize designated uses** (*131.10(c)*)
- **Help make attainment decisions** (*130.23*)



# Water Quality Standards of CNMI

## *“Section 5.1 Marine Waters*

*(a) CLASS AA- It is the objective of this class that these **waters remain in their natural pristine state as nearly as possible** with an absolute minimum of pollution or alteration of water quality from any human related source or actions.*

*The uses to be protected in this class of waters are the support and propagation of shellfish and other marine life, **conservation of coral reefs** and wilderness areas, ...*

# Status of Coral Reef Biocriteria Development

## Stony Coral Condition Methods Document

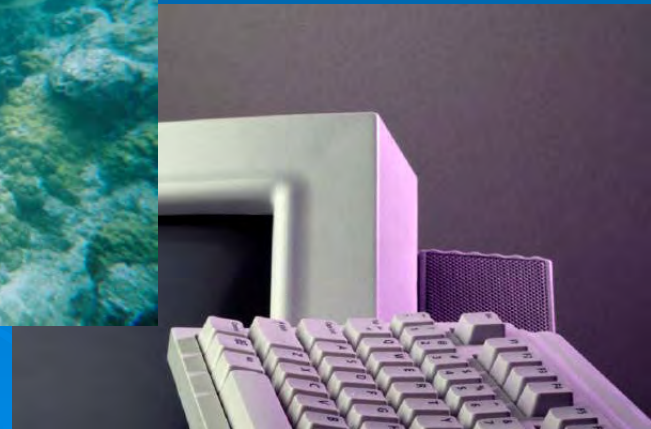
- Due 4<sup>th</sup> Quarter FY2006
- OW OST & ORD GED: Treda Smith and Bill Fisher
- First of many steps in process to develop biocriteria

# Technical Assistance and Guidance Documents

- Biological Assessments and Criteria: Crucial Components of Water Quality Programs (EPA 822-F-02-006)
- Development of Biological Criteria for Coral Reef Ecosystem Assessment
- Estuarine & Coastal Marine Waters: Bioassessment & Biocriteria Guidance (EPA-822-B-00-024)

# Web Sites

- <http://www.epa.gov/waterscience/biocriteria>
- <http://www.epa.gov/owow/oceans/coral/biocrit/cont.html>



# Contact Information

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