Developing Multi-Indicator Assessments

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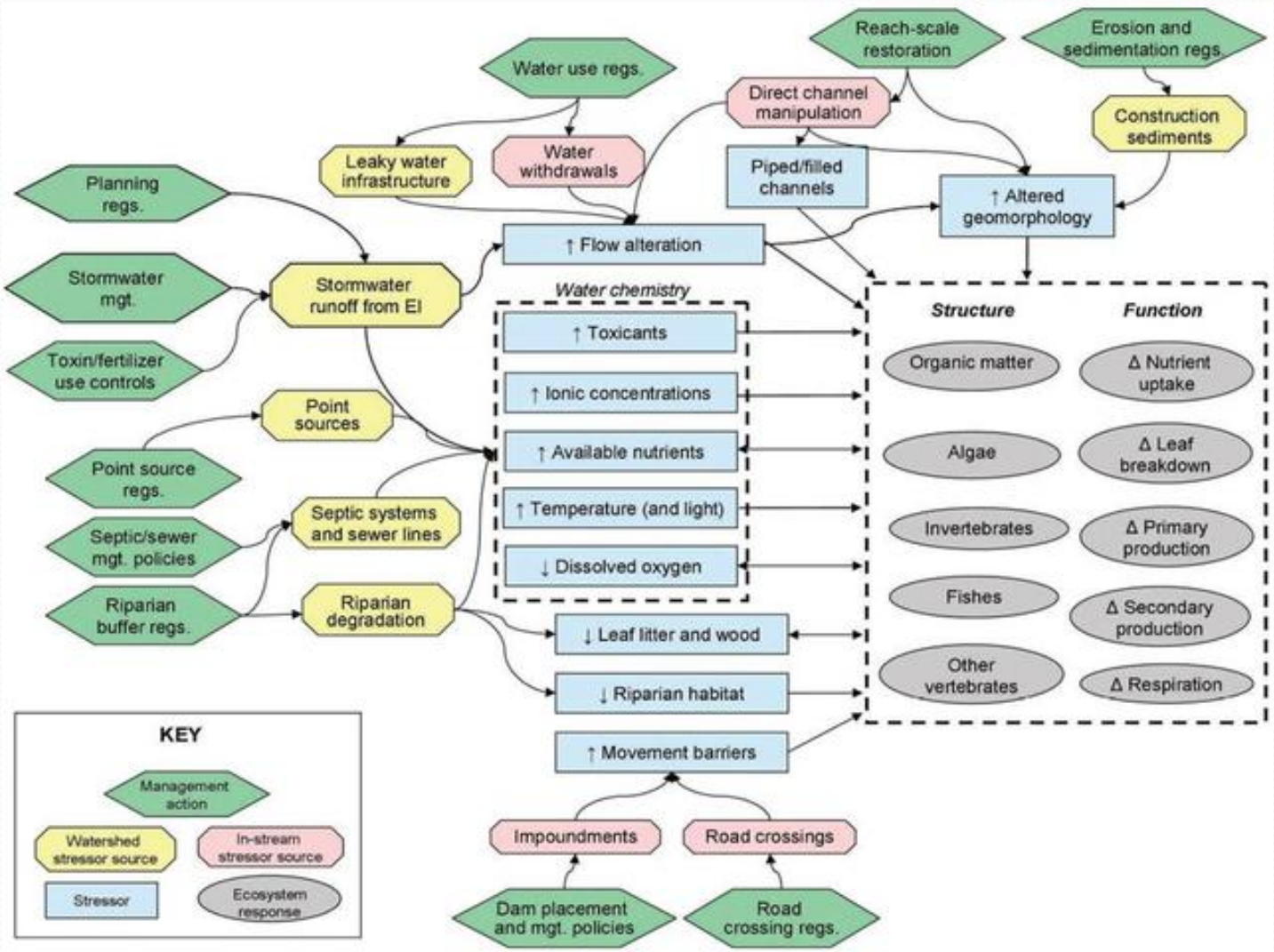
CABW 2014: Special Session on Multi-Indicator Integration

Questions Seem Simple

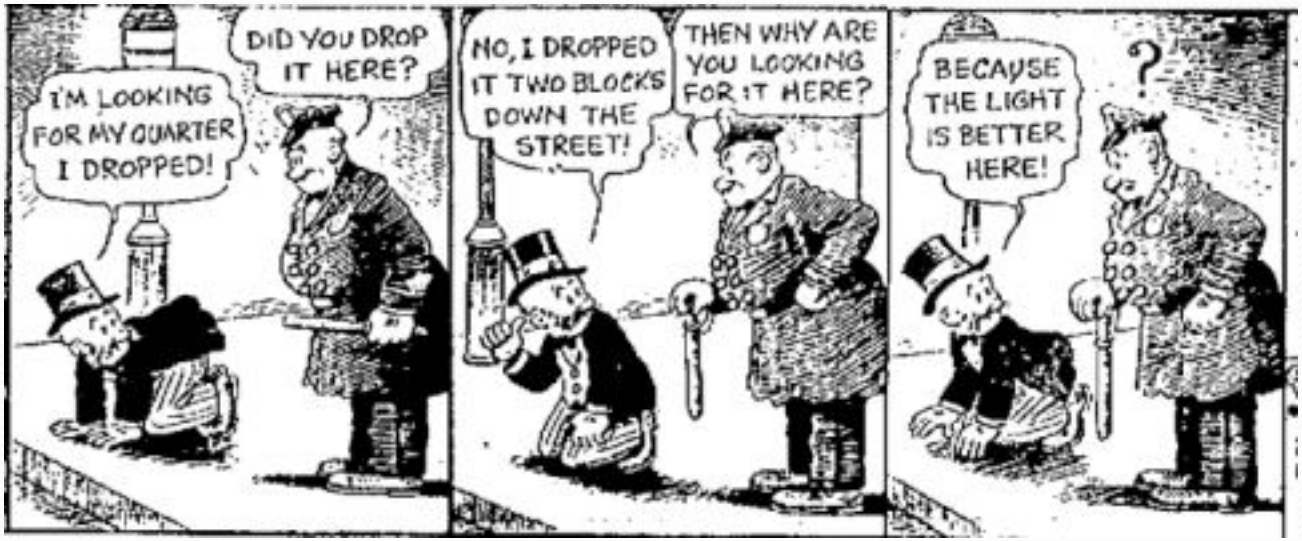
- How healthy are our streams?
- Are conditions getting better or worse?
- What are the highest priority problems?
- What should the management / restoration priorities be?
- Are management actions working?

But Systems Are Complex

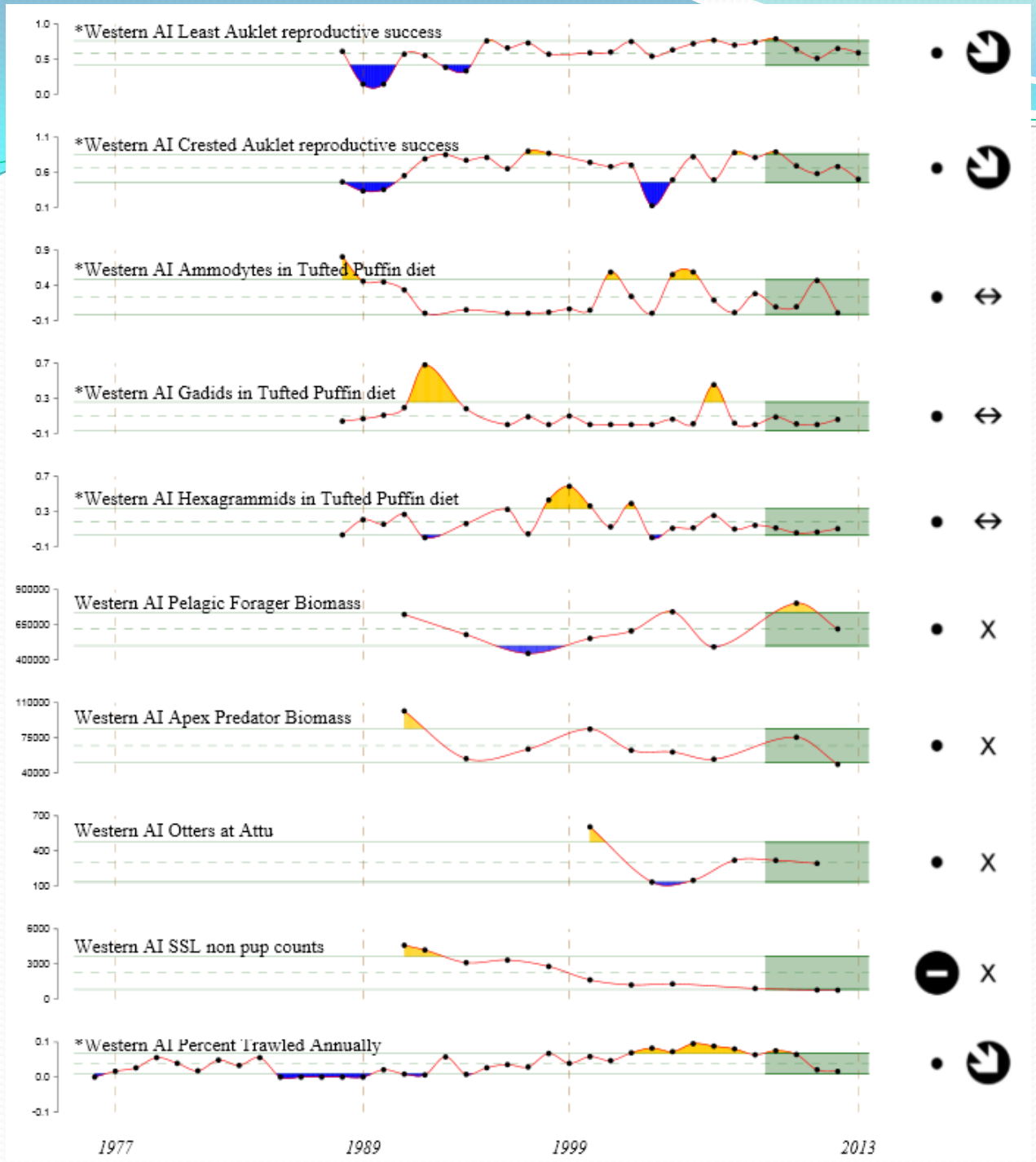


https://riverrestoration.wikispaces.com/Urban+streams

So We Measure What's Easy



- Single chemicals or indicator organisms
- Simple comparisons to benchmarks or thresholds
- Simple trends
- Station-by-station data presentation and analysis
- Shy away from process metrics



Or Measure Lots of Indicators

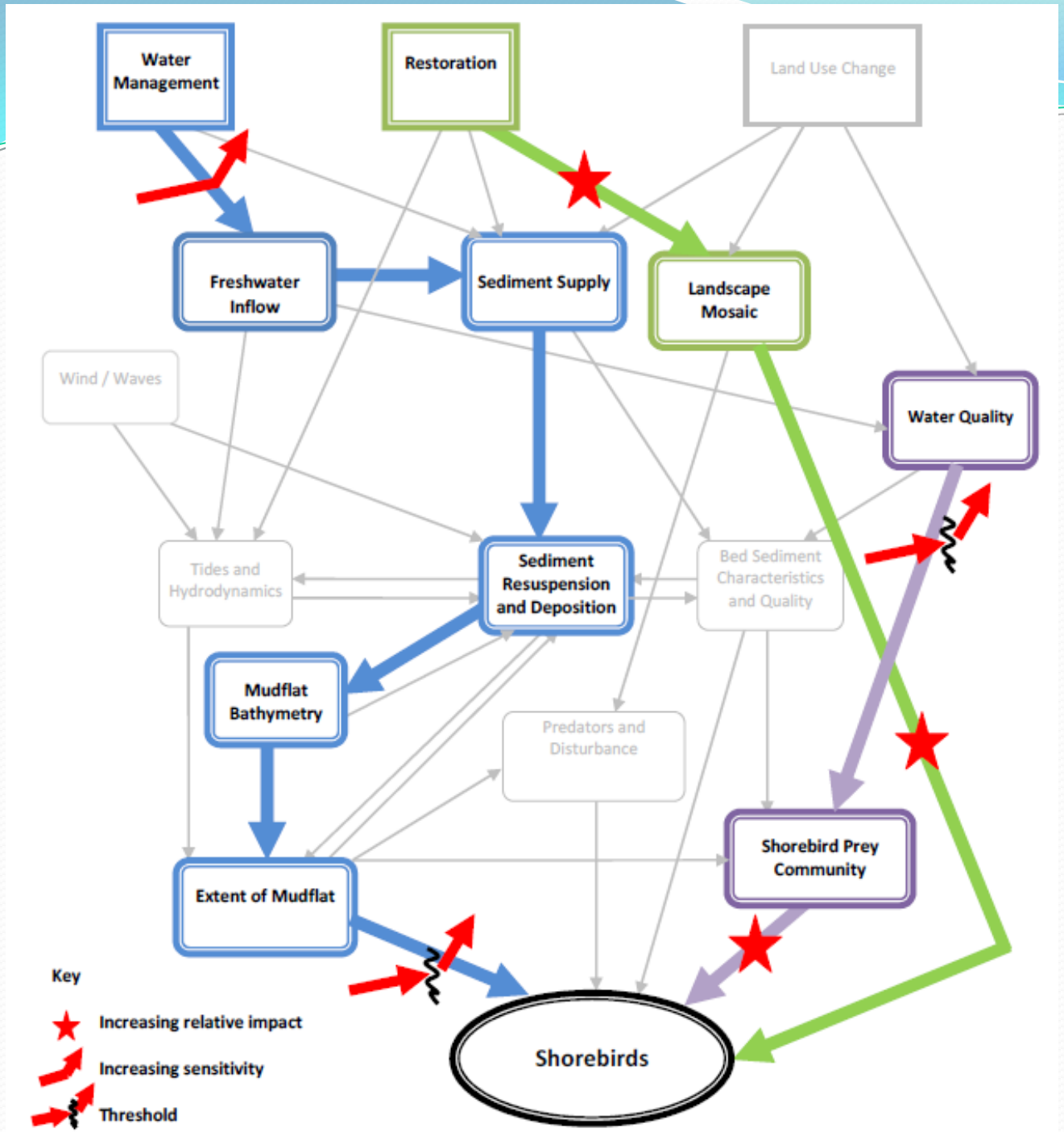
2009-2013 Mean

- 1 s.d. above mean
- 1 s.d. below mean
- within 1 s.d. of mean
- X fewer than 2 data points

2009-2013 Trend

- increase by 1 s.d. over time window
- decrease by 1 s.d. over time window
- ↔ change <1 s.d. over window
- X fewer than 3 data points

Western Aleutian Islands 2013
Ecosystem Report Card
NOAA Alaska Fisheries Science Center



The Right Frame Can Help

How will climate change affect shorebirds in San Francisco estuary?

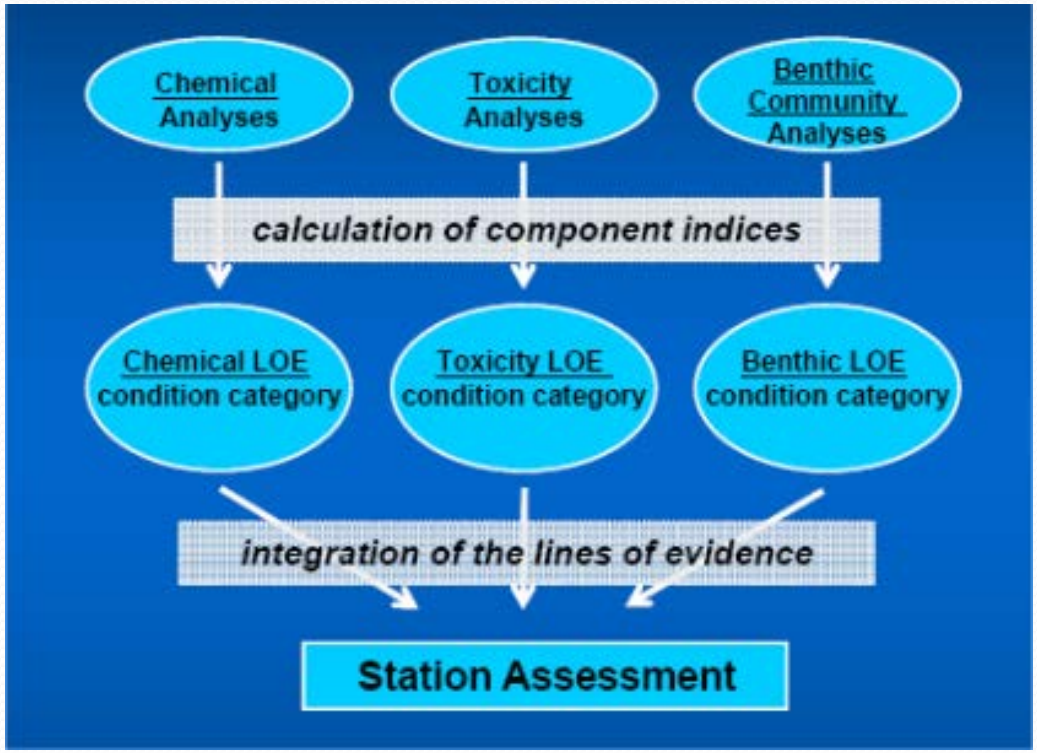
Process models help sort through and prioritize indicators for integrated assessments

Climate Ready Estuaries Vulnerability Assessment USEPA

Illustrative Examples

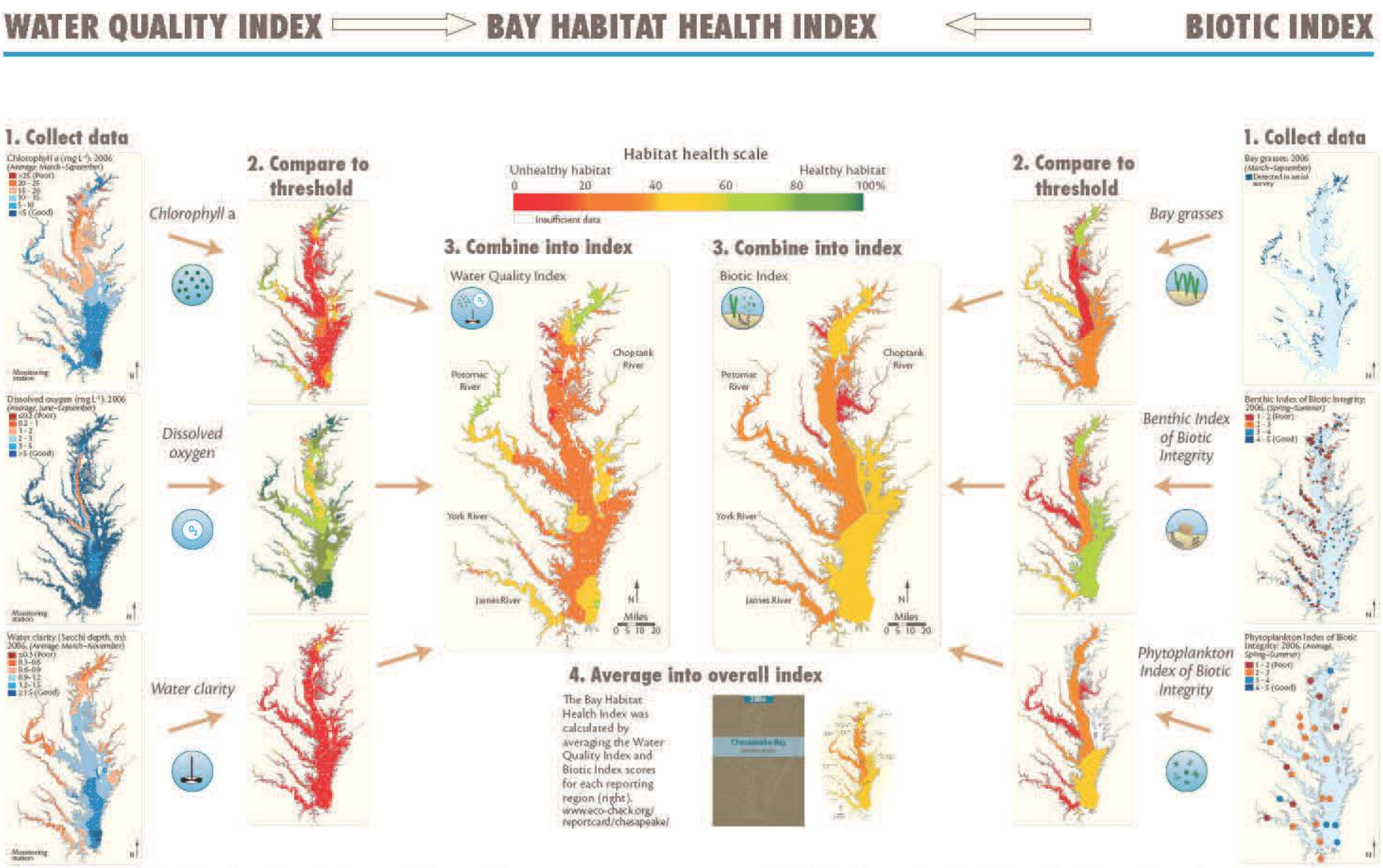
- Sediment Quality Objectives
  - Tight focus on contaminant effects
- Chesapeake Bay
  - Broader range of indicators, water quality and biology
  - Coordinated program
- USFS Watershed Condition Framework
  - Structured assessment
  - All available information, physical, chemical, biology
- San Diego River Watershed
  - Wider net to capture as much as possible
  - Both data and synthesized assessment products

Tight Focus: SQOs

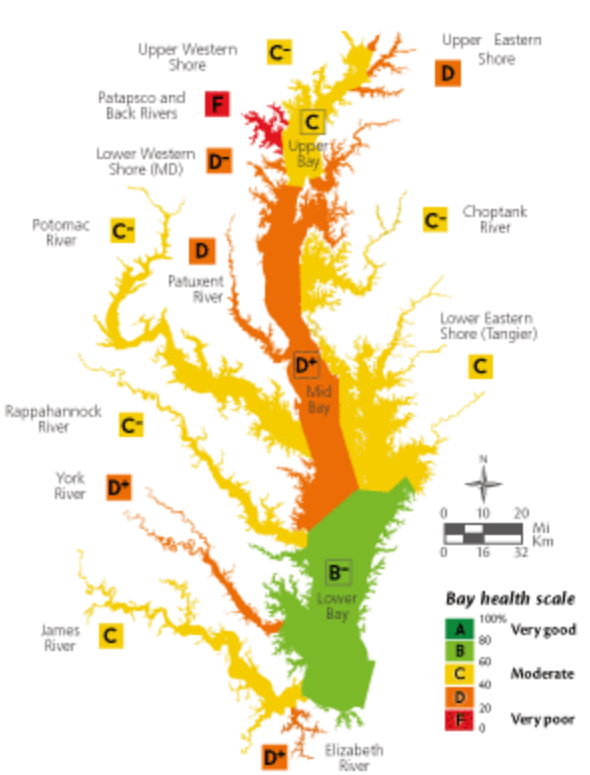


- Presence of contaminant effects measured by three clearly defined indicators
- Intensive analytical effort to define inter-relationships and thresholds
- Development of new assessment tools
- Investigation of multiple scoring and assessment scenarios
- Methods manuals and technical papers
- Large effort
- New program could define monitoring requirements and forestall many problems typical of integrated assessments

Broader Range: Chesapeake Bay



Patterns and Trends



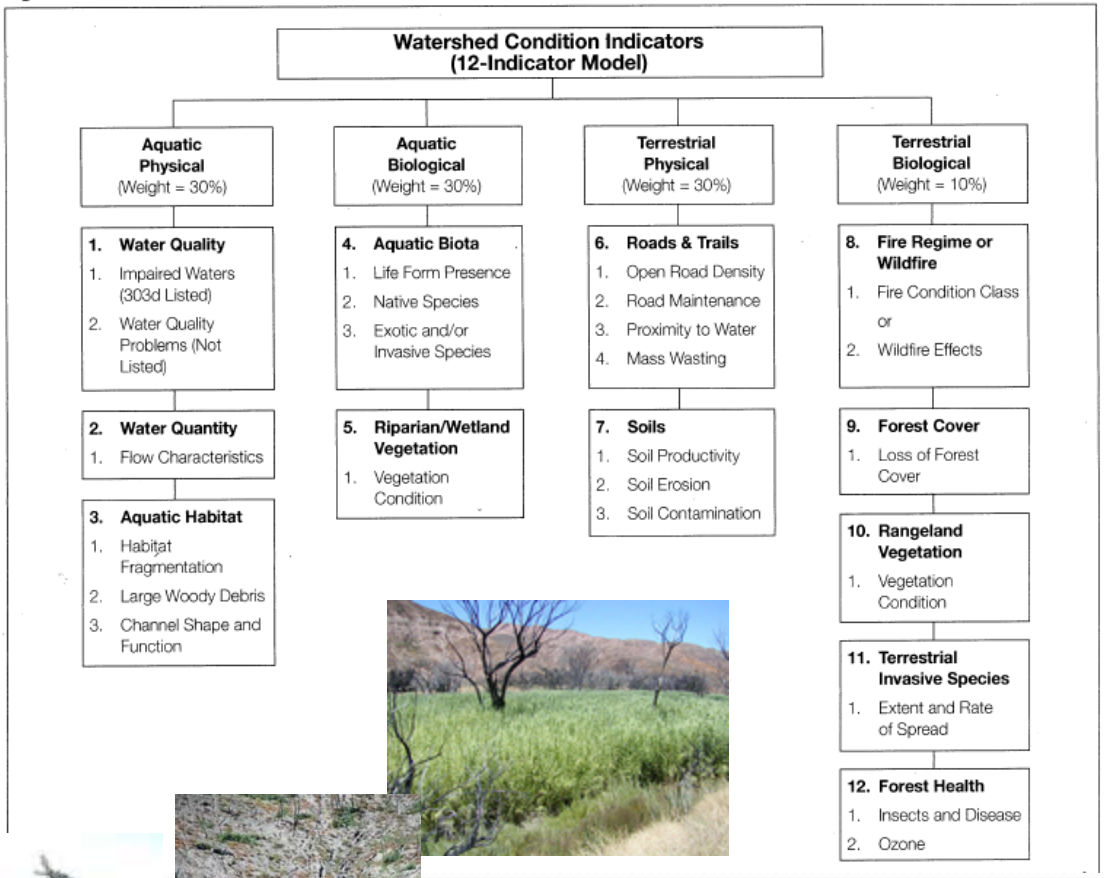
- Coordinated set of indicators
- Integrated regional sampling
- Consistent sampling methods
- Consistent scoring methods
- Coordinated program management

http://ian.umces.edu/ecocheck/report-cards/chesapeake-bay/2013/

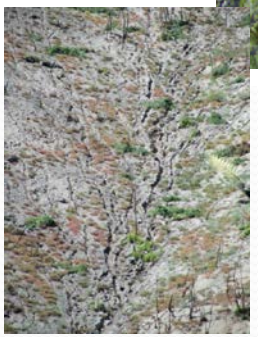
USFS Watershed Condition Framework

- Weighted average of terrestrial and aquatic physical and biological characteristics
- 12 core indicators and 23 attributes, scored 0 - 3
- All available information, quantitative, qualitative, and BPJ
- Scoring thresholds and protocols
- Multiple levels of aggregation

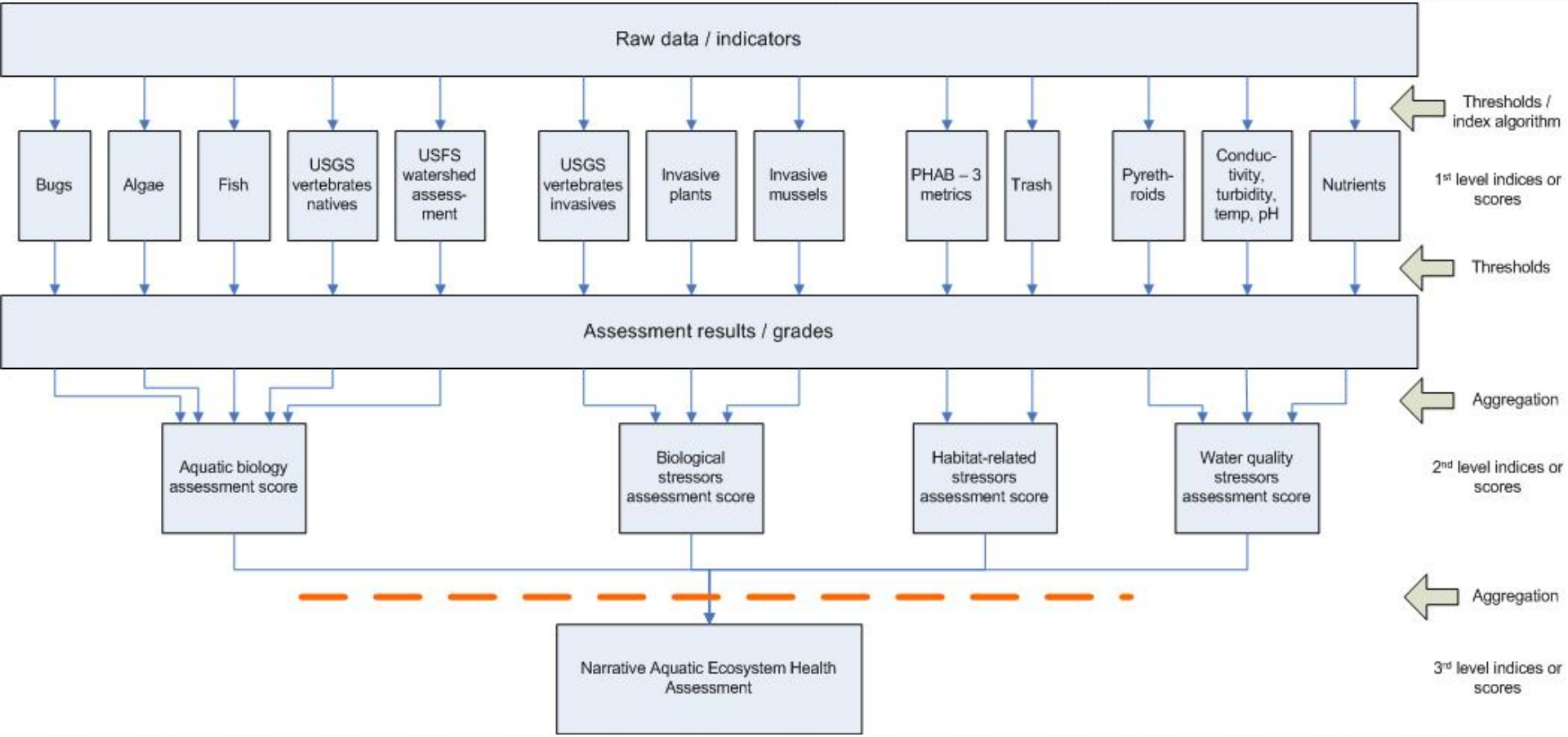
Figure 2.—*Core national watershed condition indicators and attributes.*





Widest Net: San Diego River



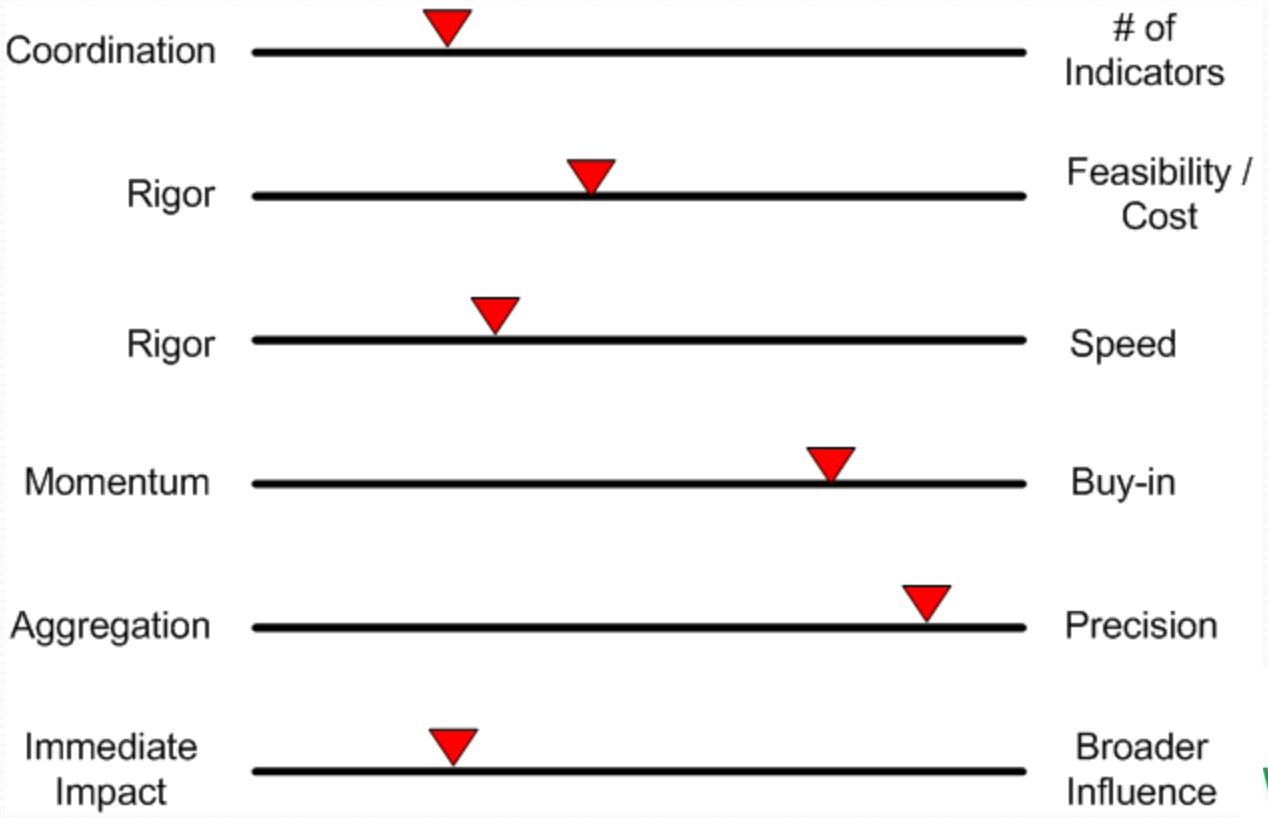
Challenges Related to Widening Scope

- Scope
  - Multiple possible goals, scopes
  - Meaning of “integration” not clear
- Process
  - Motivation often vague and/or emerges over time
  - Maintaining momentum and buy-in
- Design
  - Inconsistent spatial and temporal coverage
  - Some indicators cannot be measured at all desired scales
  - Combination of random and targeted designs
  - Combination of quantitative and qualitative data
- Relationships
  - More complex with more endpoints
  - Fuzzy between biological endpoints and things that can be managed

Yet More Challenges

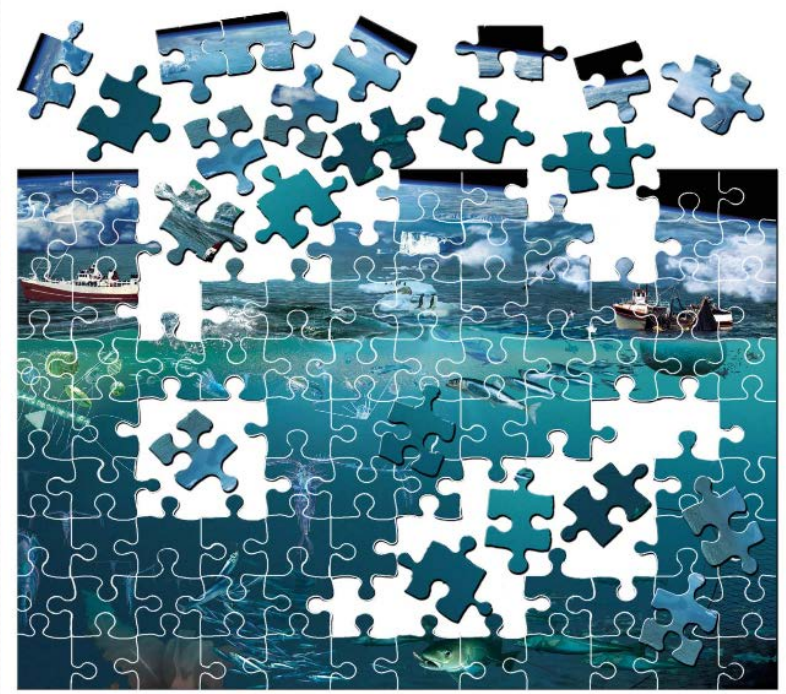
- Assessment & scoring
  - Data distributed across multiple programs and locations
  - No standard assessment methods for many indicators
  - Multiple possible thresholds for some indicators
  - Scores based on different approaches and on different scales
  - Meaningful integration must be defined
    - Over space and time
    - Across indicators
- Reporting and data access
  - Multiple audiences and needs
  - Increased cost and complexity

Unavoidable Tradeoffs



Good, fast, cheap: pick any two
(Engineering maxim)

More Thorough Assessments



- Understanding system structure and function requires multiple indicators, or:
- The whole is greater than the sum of the parts
- Pressing questions require broader, integrated assessments