PERSPECTIVES ON A MATURING PROGRAM: INNOVATIVE WAYS TO ADDRESS NEW ISSUES

Stephen B. Weisberg
Southern California Coastal Water Research Project

BACKGROUND

- **EMAP is 18 years old**
  - 20 years if you count Thursday night pizza meetings
- **It has gone through a number of phases**
  - It's on the verge of another with its transition to the Office of Water
- **Goal of this presentation: Reflect on the program's changes to date**
  - Provide perspectives about its potential future

EMAP: THE EARLY YEARS

- **EMAP was founded on two simple principles**
  - Probability-based sampling
  - Biologically-based assessments

- **The early years were focused on research to adapt these simple concepts to a national scale program**
  - Is it triangles, pentagons or hexagons?
  - How many sites should be revisited each year?
  - How do you make biotic indices work across national-scale habitat gradients?

- **Reviews**
  - Endless reviews
  - More reviews

EMAP: THE MIDDLE YEARS

- **Finding a client for the products**

- **Initial client was a "Report to Congress"**
  - A single, yet-to-be-convinced, client does not make for a stable program
  - "You want how much money?!!!"

- **R-EMAP was a key part of the turnaround**
  - Created bottom-up demand for the program

ONE OF EPA'S MOST SUCCESSFUL PROGRAMS

- **EPA's primary mission is to educate and empower states, tribes, etc.**
  - EPA delegates authority to these groups
- **Prior to EMAP, virtually every monitoring program was based on chemical measurements at fixed sample sites**
  - Down the spine of an estuary
  - Near bridges on streams
- **Now, most States have a biologically-based, probability-based 305b survey**
  - Even found in most of the National Estuary Programs
- **The States became the program's best salespeople**
  - Two key graphics

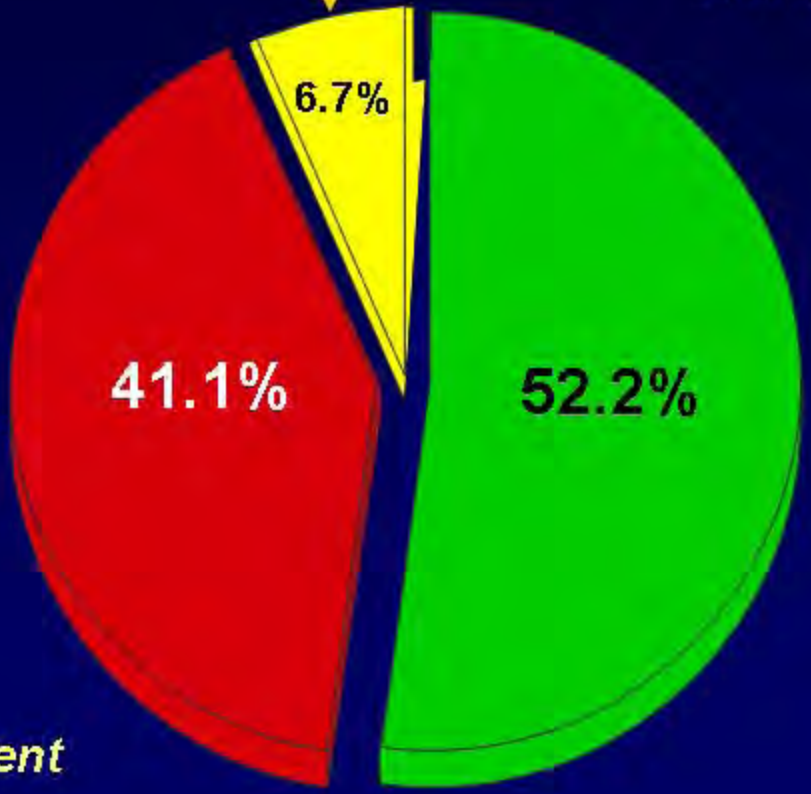
DNREC Aquatic Life Use Attainment
State of Delaware 1994 305b report
All nontidal streams

FIXED STATION

PROBABILISTIC

Consequences of Improper Indicator Usage: The Risk of Assessment Error

Type I Error: Chemical Exceedences did not Correspond to a Biological Impairment



Biocriteria Impairment ONLY

Chemical Impairment ONLY

Agreement (about status only)

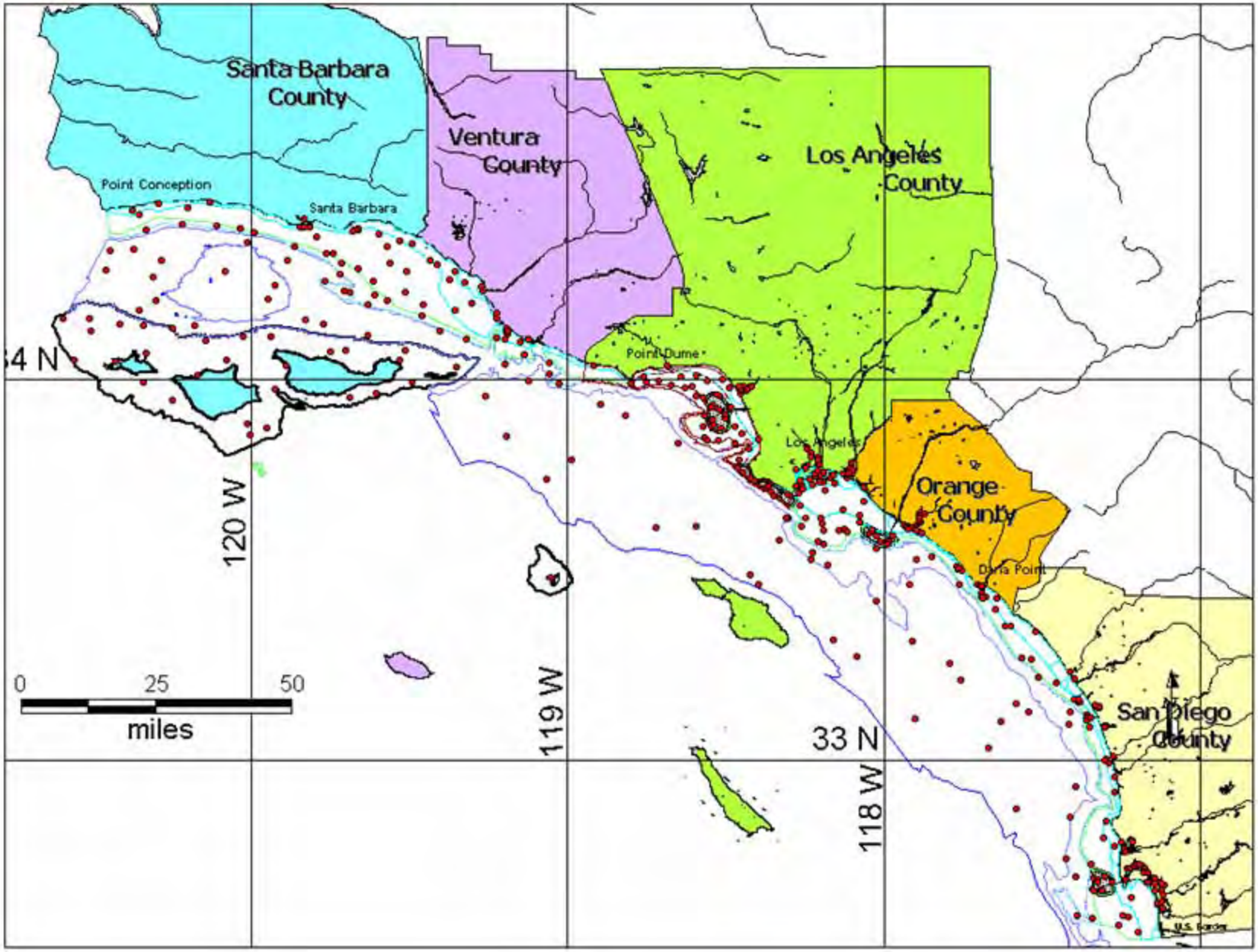
Type II Error: Biological Impairment was Missed by Chemical Sampling

2543 River and Stream Sampling Sites 1980-1992 (1994 Ohio 305b Report)

EMAP PRINCIPLES HAVE EVEN SPREAD TO THE NPDES PROGRAM

- **Southern California conducts regional monitoring every five years**
  - Approximately 400 sites
  - EMAP design
  - EMAP parameters
- **Implemented primarily by NPDES dischargers**
  - NPDES permits have been rewritten to allow exchange of redundant site-specific monitoring for participation in regional efforts
- **Sixty-six organizations participated in 2003**
  - Provides regional context for site-specific monitoring
  - Enhance data consistency and quality

Bight' 03 Sampling Stations



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EMAP: THE NEXT GENERATION

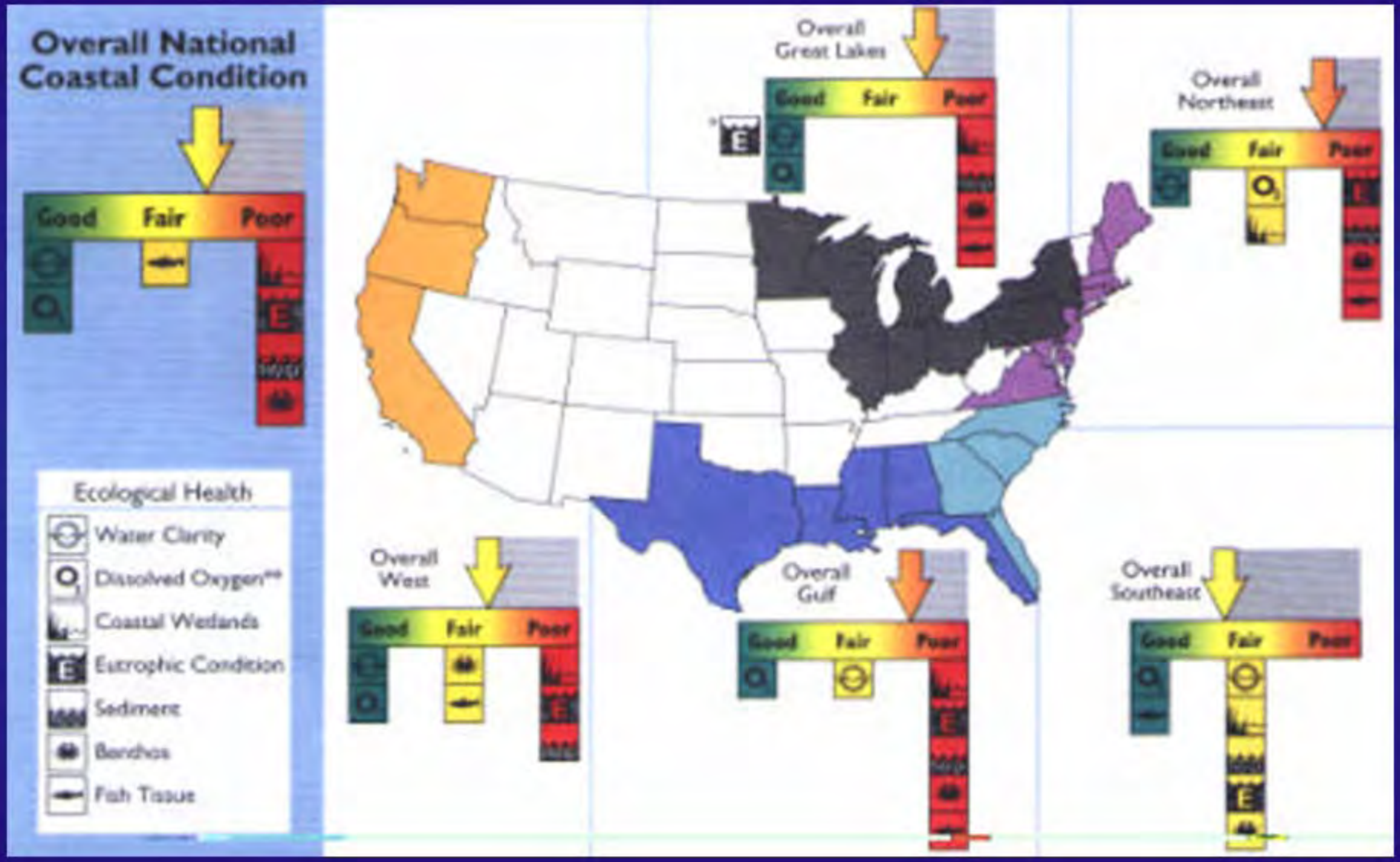
- **Former ORD Director: "This is application, not research"**
  - It belongs in a program office, not in the Office of Research and Development
- **My suggestion: Its neither application nor research**
  - It's both
  - ORD has never had such a good research to applications delivery system
- **The challenge is to identify research topics that continue to build the program while still intriguing the research community**

THREE AREAS OF POTENTIAL RESEARCH INTEREST

- Tools to better interpret the data that are already being collected
- Adaptation of the basic design principles to new habitats
- Development/adaptation of new, more advanced sampling approaches

BETTER INTERPRETATION OF EXISTING DATA

- **The National Coastal Assessment Report has room for continuing improvement**
- **Biotic indices are a collection of regionally-developed tools**
  - Not based on same parameters
  - Not benchmarked to the same reference conditions
- **Integration across indicators**
  - Need to enhance the conceptual framework


Overall National Coastal Condition
Good
Fair
Poor
Ecological Health
Water Clarity
Dissolved Oxygen
Coastal Wetlands
Eutrophic Condition
Sediment
Benthos
Fish Tissue
Overall Great Lakes
Overall Northeast
Overall West
Overall Gulf
Overall Southeast

CALIFORNIA'S SEDIMENT QUALITY OBJECTIVES

- **California has used EMAP data to develop enforceable standards**
  - The Sediment Quality Objectives are based on a triad of chemistry, toxicity and benthic macroinvertebrates
- **Benthos and toxicity are integrated to assess condition**
  - Chemistry and toxicity are integrated to verify that observed effects are chemically mediated
- **We have done some interesting work to assess how well this integration matches expert BPJ**

Station #	Reviewer 1	Reviewer 2	Reviewer 3	Reviewer 4	Reviewer 5	Reviewer 6	Original Framework	Alternate Framework
1	1	1	2	1	1	1	1	1
2	2	3	3	3	2	2	3	2
3	2	2	3	3	2	2	3	3
4	1	2	2	2	1	1	1	1
5	4	3	4	3	2	4	4	4
6	1	1	2	1	1	1	1	1
7	2	x	3	x	2	x	2	2
8	4	x	4	x	3	x	4	4
9	3	x	4	3	2	x	4	2
10	4	3	4	5	3	4	5	4
11	5	3	4	5	4	5	5	5
12	3	2	3	3	2	2	4	2
13	3	3	3	3	2	3	4	3
14	4	3	4	3	4	4	5	5
15	5	3	4	3	4	4	4	4
16	3	2	3	x	1	3	2	1
17	3	2	3	4	1	3	4	3
18	1	1	1	1	1	1	1	1
19	5	3	5	5	5	5	5	5
20	5	4	5	5	5	5	5	5
21	5	4	5	5	5	5	5	5
22	5	4	5	5	5	5	5	5
23	1	1	2	x	1	1	1	1
24	1	1	2	x	1	1	1	1
25	1	1	2	x	1	1	1	1

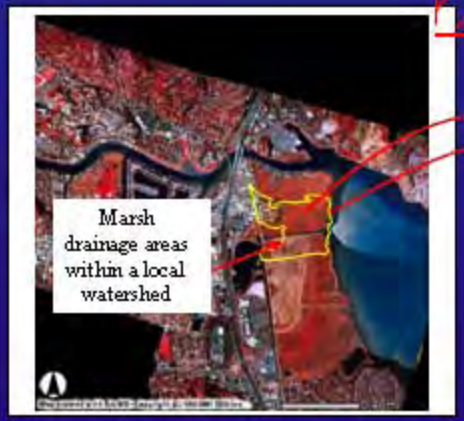
Unimpacted
Likely unimpacted
Possibly impacted
Likely impacted
Clearly impacted
x Inconclusive

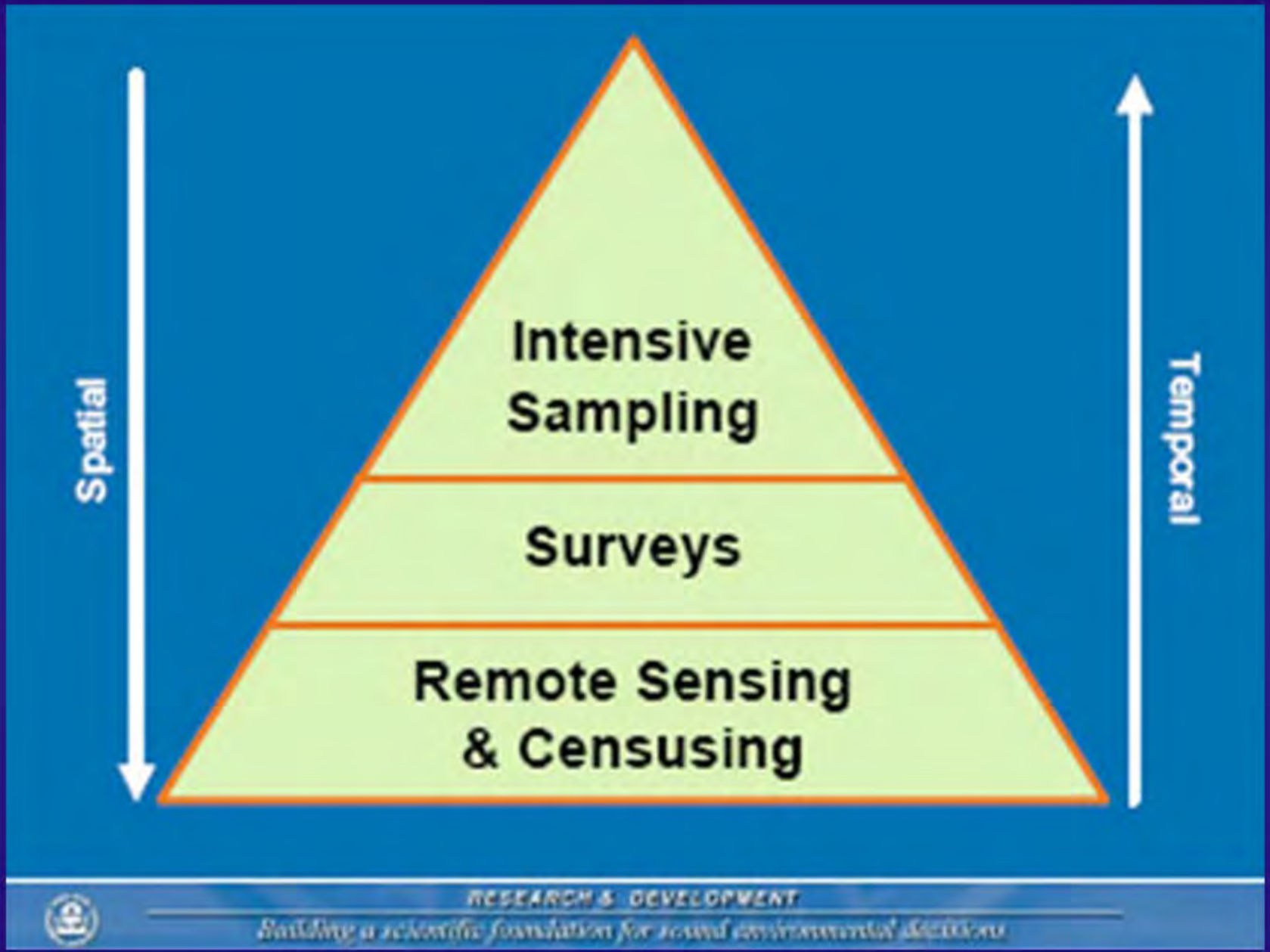
MOVING TO NEW HABITATS - WETLANDS

- **It's not a matter of using the same indicators**
  - The questions and scales of interest differ
- **Contaminants are not the key stressor**
  - Wetlands loss and type conversion
  - Habitat fragmentation
  - Hydrological modification
  - Invasive species
  - Sea level rise
- **Large gap between indicator research (i.e., EPA Star Grants) and implementation**

EMAP Research on Cost-Effective Sampling Designs for Wetland Monitoring

California EMAP 2002 developed cost-effective sampling designs that better addressed management questions at appropriate spatial scales

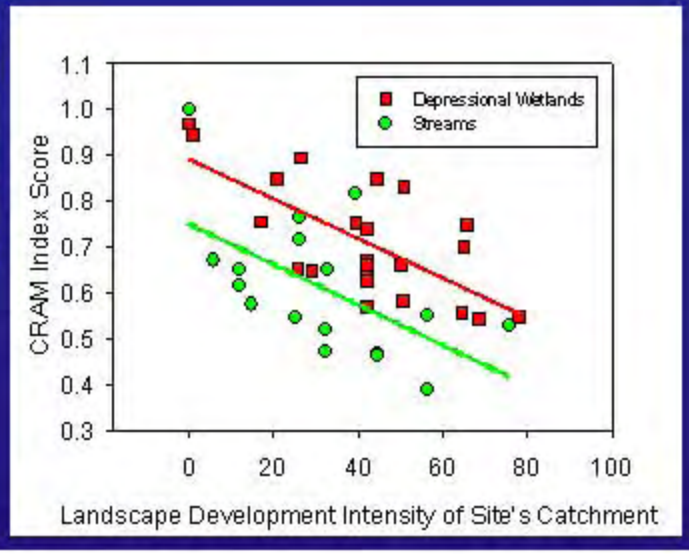



Spatial
Intensive Sampling
Surveys
Remote Sensing & Censusing
Temporal

DEVELOPING NOVEL INDICATORS THROUGH EMAP: CALIFORNIA EXAMPLE

Level 1: Landscape indicators of condition and stress

Habitat Fragmentation

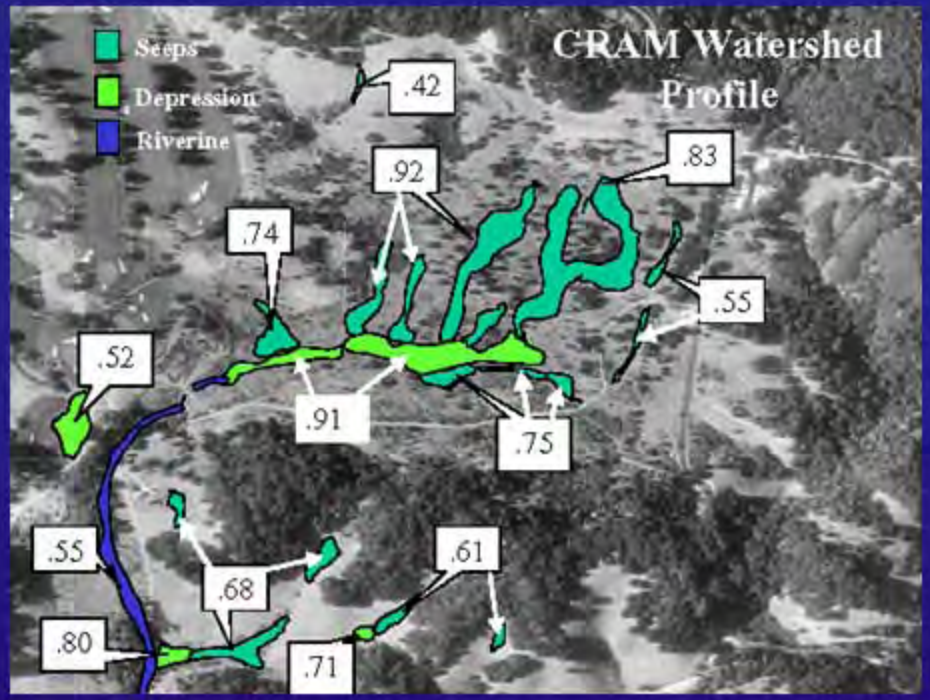


Land Use Disturbance on Wetlands

DEVELOPING NOVEL INDICATORS THROUGH EMAP: CALIFORNIA EXAMPLE

Level 2: California Rapid Assessment Method (CRAM)

- Rapid (2-4 hrs in field)
- Cost effective (~$1000 per site)
- Produced estimate of habitat condition
- Correlated to level 3 intensive indicators



DEVELOPING NOVEL INDICATORS THROUGH EMAP: CALIFORNIA EXAMPLE

Level 3: Standardized intensive protocols

STRESSORS & BIOAVAILABILITY
- Pore water & sediment metals and organics
- Plant & plant exudate metals and organics
- Estrogenic & dioxin-like compounds in sediment
- Forms of Se, Hg, pesticides & Hg methylation potential Dissolved inorganic N & N isotope ratios
- Fecal coliform bacteria & pathogens
- Wetland fragmentation & drainage

MICROBIAL & PLANT RESPONSES
- Phytochelatin status
- Bacteria: bioluminescent, ammonia oxidizers, selenate & arsenate reducers, metal transformers
- Sediment protein & detrital C:N ratio
- Biomass accumulation
- Fluorescence emission by PAM
- Spectroradiograms, chlorosis, water content
- Changes: distribution, abundance, & senescence

ANIMAL RESPONSES
- Metallothionein status
- P-450 and acetylcholinesterase enzymes
- Choriogenin in male fish
- Apoptosis, DNA damage, histopathology
- Fecundity, gamete viability, fertilization, GSI
- Embryo/larval development & growth
- Sex ratio/imposex/intersex
- Parasites & pathogens

ECOSYSTEM RESPONSES
- Richness, evenness, dominance, diversity & multitaxa IBI
- Ratio of exotics to natives
- Ratio of herbivore + detritivore to consumer biomass
- C & N stable isotope ratios
- Trophic support: detritus decomposition rates & litter
- Biogeochemical performance: ammonification, decomposition, & nitrification rates

Developing and piloting of level 3 indicators in regional monitoring programs

DEVELOPMENT OF NEW MEASUREMENT TECHNIQUES

- **Molecular methods**
  - Bar-coding of biota
  - Cheaper and faster than manual sorting and identification
- **Deployed continuous monitoring**
  - Sensor technology has come a long way in 20 years
  - Necessary to characterize fluctuating parameters, such as nutrients
  - Biotic sensors, for parameters such as bacteria will soon be possible
- **Integration with physical measurements**
  - Integrated ocean observing system is becoming a reality
  - Opportunity for EMAP to get into the game is now

MOORING

GLIDER

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ANTENNAS BEING DEPLOYED THROUGHOUT CALIFORNIA TO MAP OCEAN CURRENTS

Southern California Regions

Morro Bay
Santa Barbara Channel
Ventura County
Los Angeles
South Channel Islands
Orange County
North San Diego
San Diego / Mexico

Available Products

Automated Shore Stations
Manual Shore Stations
Bathymetry
Moorings
Meteorological Stations
Satellite Imagery
Shoreline Water Quality
Surface Current Maps
- Overview
- Santa Barbara
- San Diego / Mexico

Surface Winds & Rainfall
Wave Conditions (CDIP)
Cast Data (Ships & Gliders)

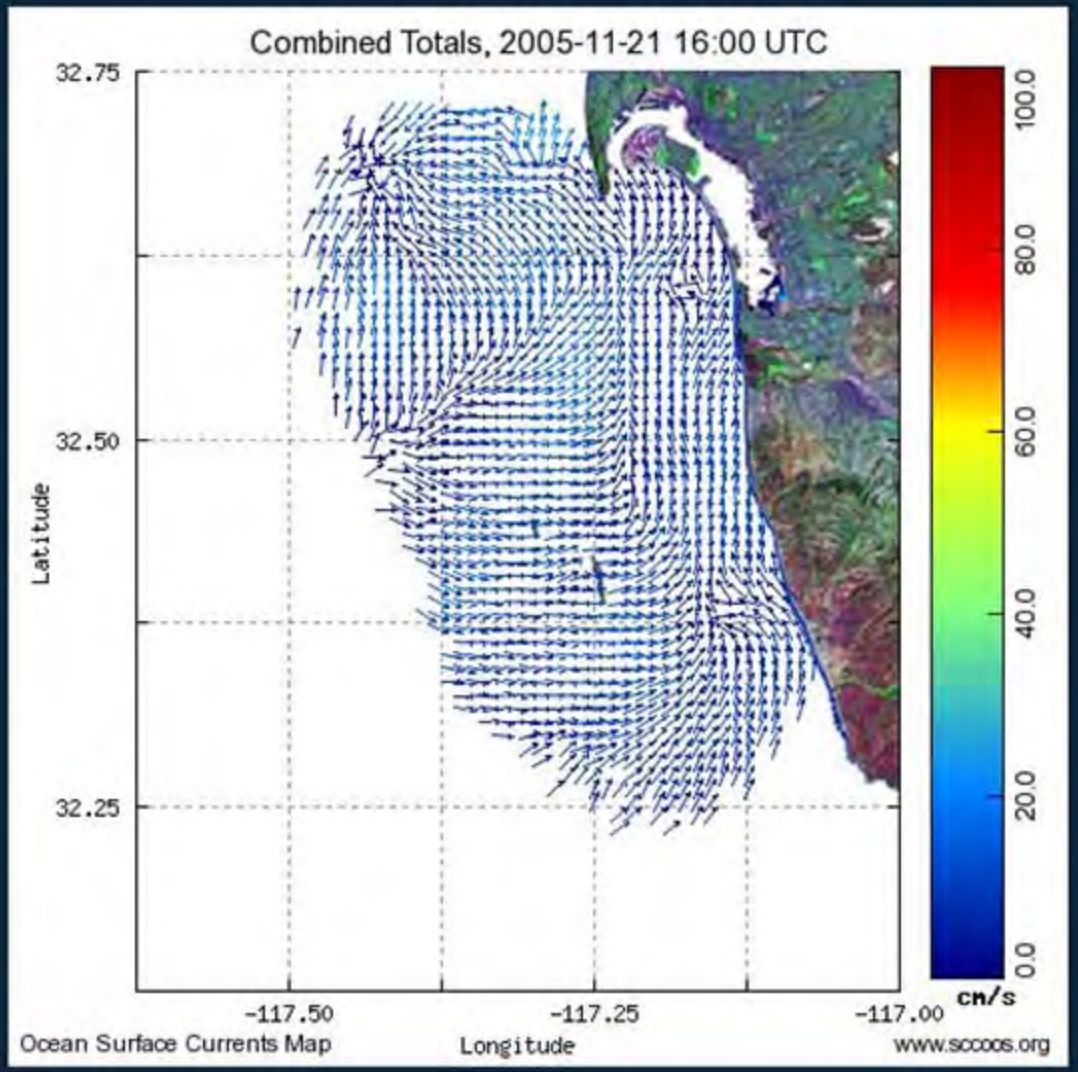
Grab Raw Data

CODAR Surface Currents - San Diego & Ensenada

UTC Time: 2005-11-21 18:20:43
Local Time: 2005-11-21 10:20:43

Hourly Totals
Current Time Sample: 2005-11-21 16:00 UTC

Ani -23 -22 -21 -20 -19 -18 -17 -16 -15 -14 -13 -12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 NOW
Now Showing



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