# The Southern California Coastal Water Research Project Authority (SCCWRP)


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**Executive Director**

# MY CHARGE

- Describe my organization and our geography
- Our major resource management issues and/or policy drivers
- The science investments we are making to guide management
- Challenges and key lessons learned

# WHAT IS SCCWRP?

- **Joint Powers Agency founded in 1969**
- **Our mission: Provide an unbiased scientific foundation for water quality management in California**
  - We don’t do policy
  - We don’t do regulation
  - However, we judge success on whether our science is being used by those who do policy and regulation
- **Member organizations include city, county, state, and federal agencies**
  - Unique combination of regulators and dischargers

# MEMBER ORGANIZATIONS

Los Angeles County Sanitation Districts

City of Los Angeles

Orange County Sanitation District

City of San Diego

Ventura County Watershed Protection Division

Los Angeles County Flood Control District

Orange County Public Works

County of San Diego

San Diego Regional Water Quality Board

Santa Ana Regional Water Quality Board

Los Angeles Regional Water Quality Board

State Water Resources Control Board

U.S. Environmental Protection Agency

California Ocean Protection Council

# COMMISSION

- **Governing board that includes decision leaders from each member agency**
  - Meets quarterly
- **Unique interface between science and management**
  - The core strength of the organization

# THE GEOGRAPHY WE STUDY

- **Southern California coastal ocean**
  - About 200 miles of coastline (Santa Barbara to the Mexican Border)
  - 20 million people within 50 miles of the coast
  - Smaller, steeper watersheds than Chesapeake Bay

- **Distinct wet and dry seasons**
  - 10 inches of rain total
  - Almost all between December and March


- **Separate wastewater and stormwater systems**

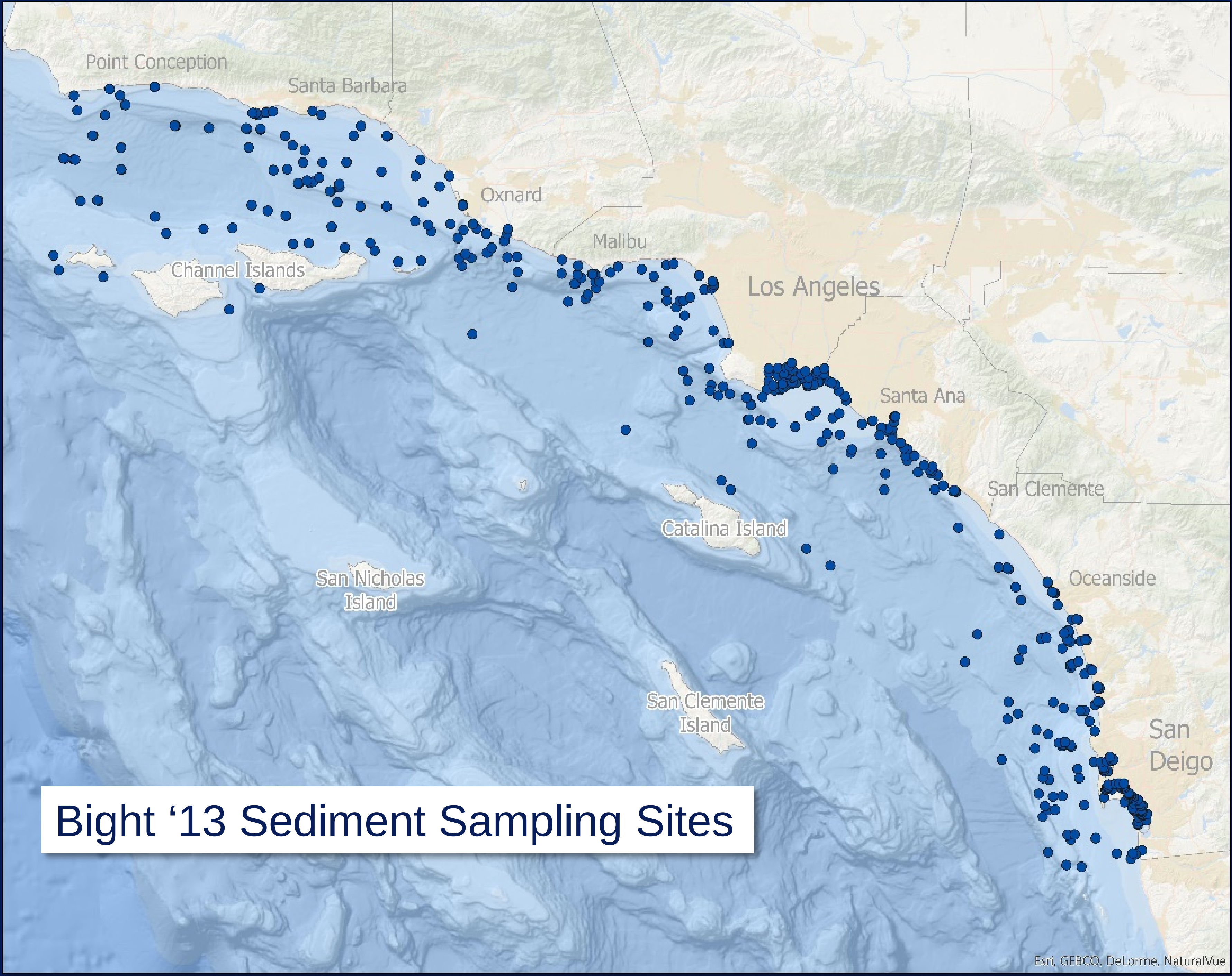
- **Hypoxia and nutrients are not our primary issue**

# MAJOR MANAGEMENT ISSUES

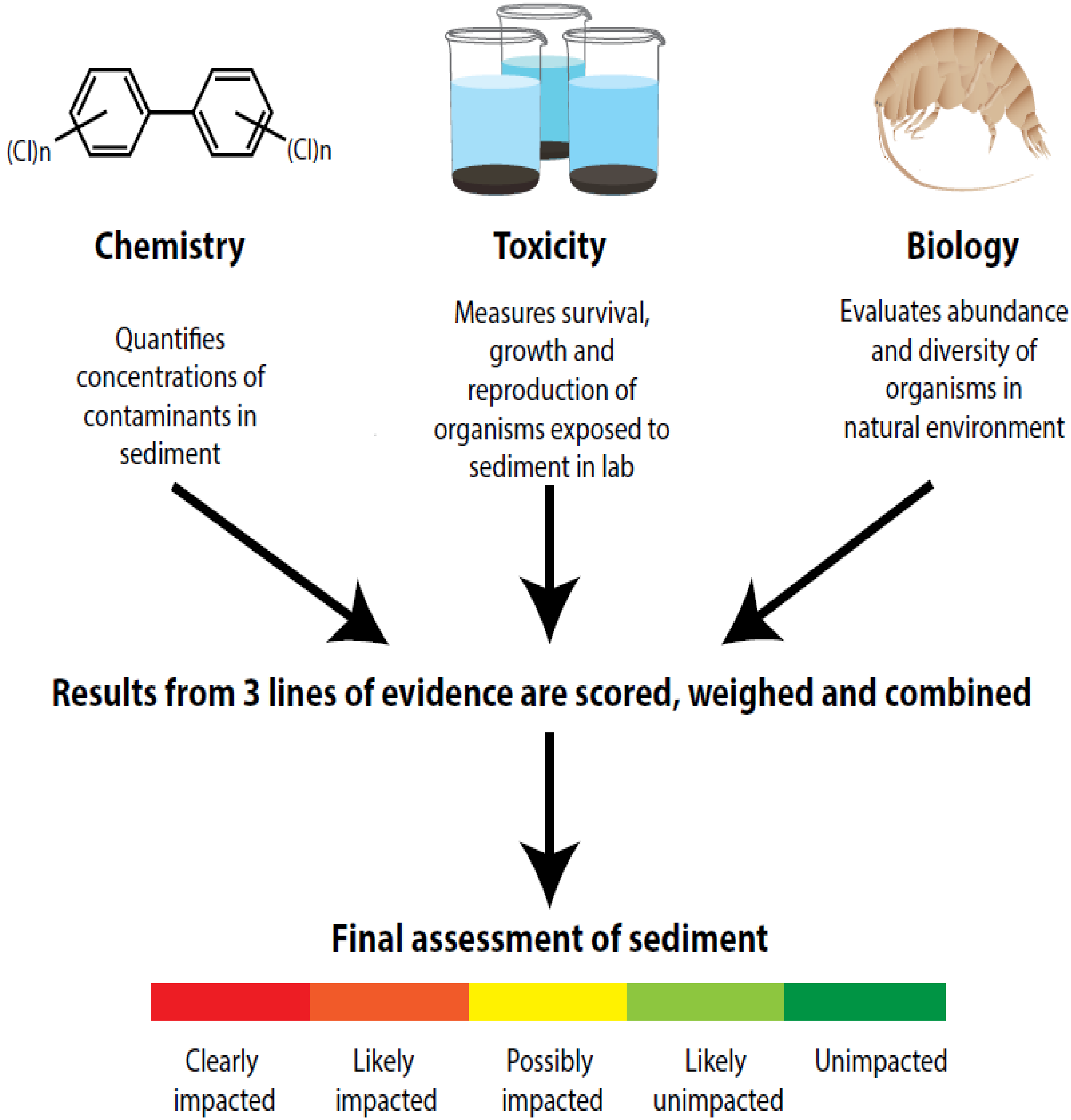
- **Historically, focus has been on traditional toxics**
  - However, toxic inputs have been lowered by more than 95%
  - Regional monitoring has documented the management success

- **Beach water quality is also prominent**
  - Key part of the California culture
  - Most of  our dry weather beach problems have been solved
  - Remaining challenge is wet weather

- **However, the things that most interest my Commission are the things we know the least about**
  - They also have some management initiatives around things they do know




# Bight '13 Sediment Sampling Sites


(Cl)n
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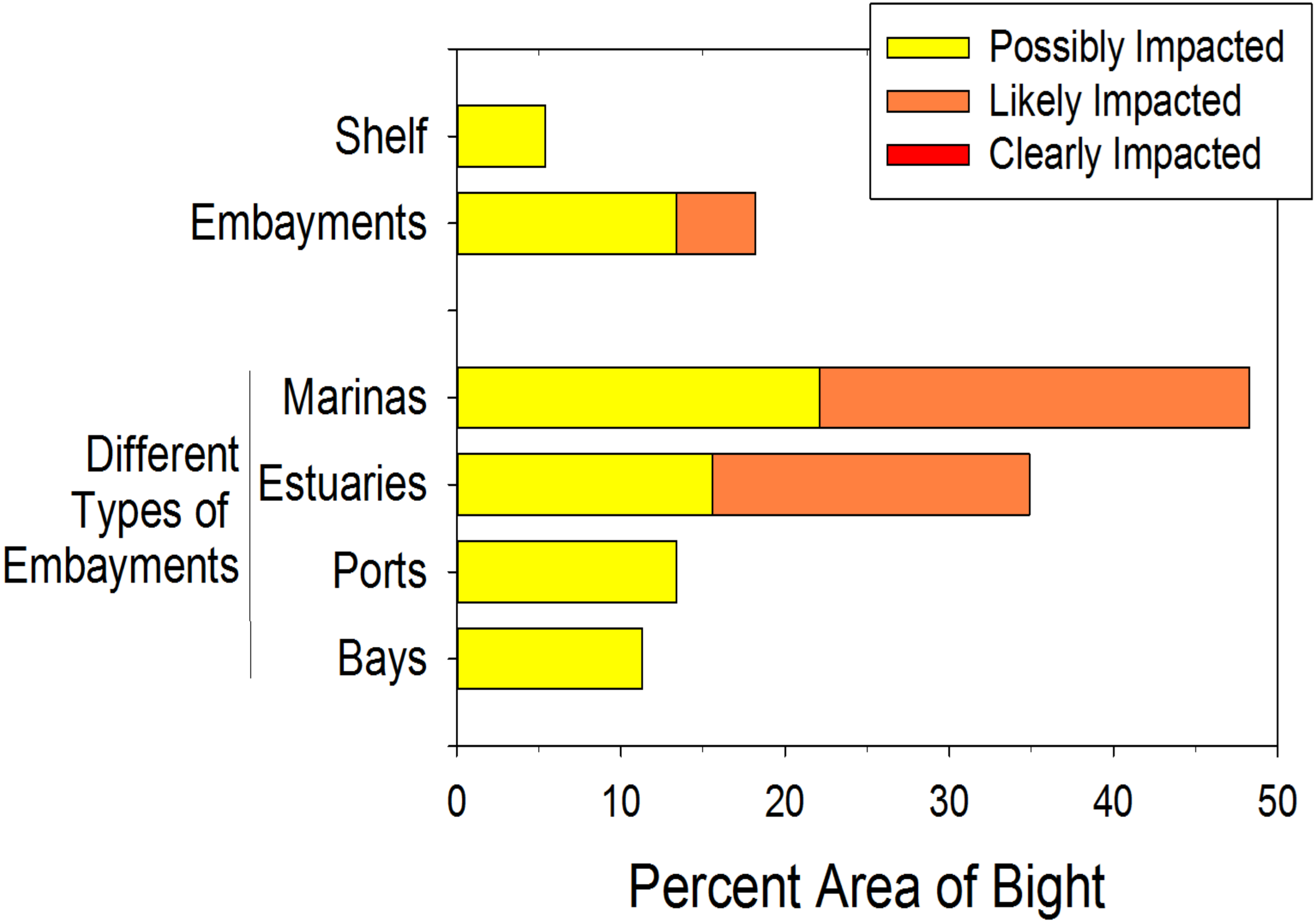
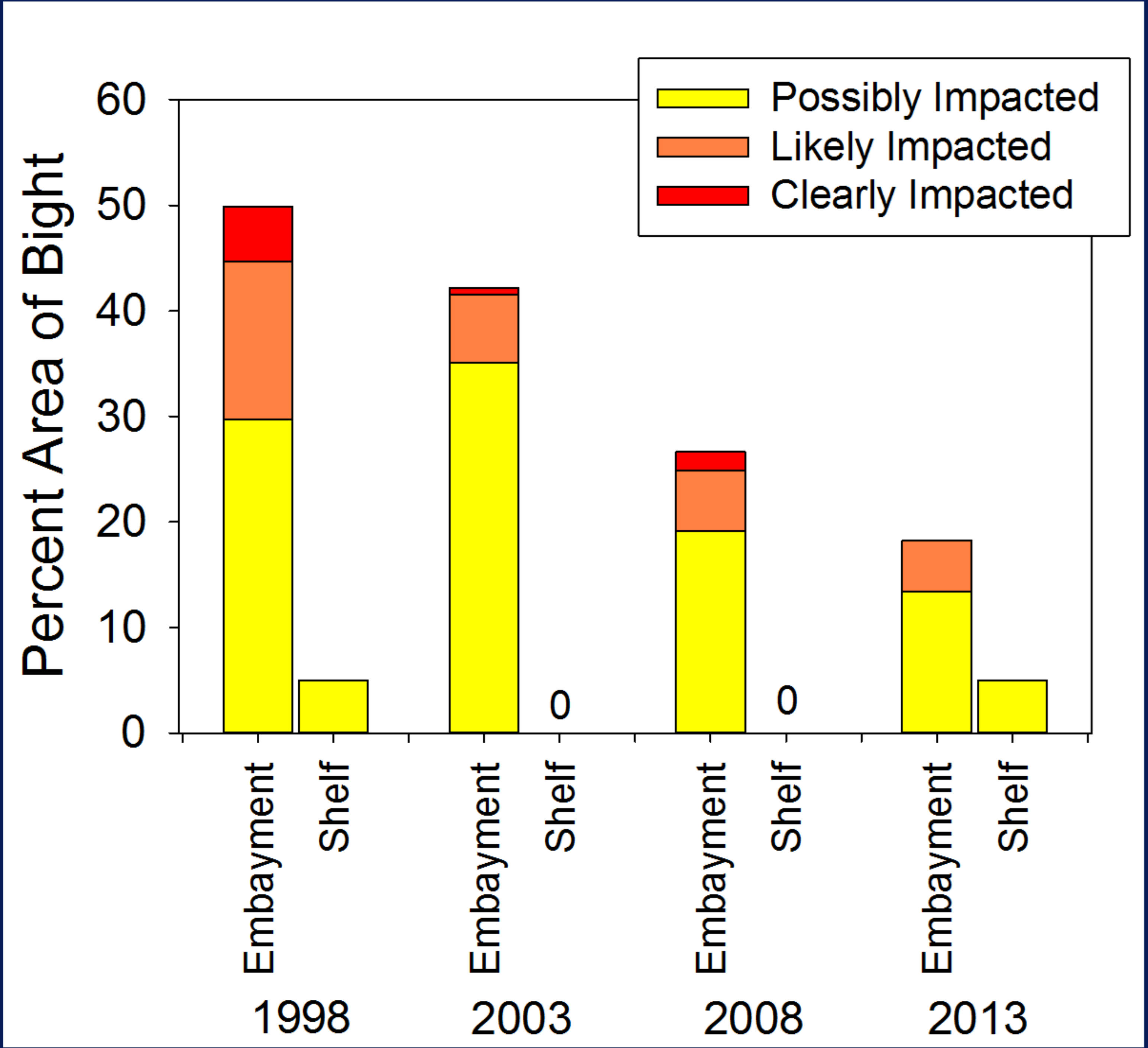
Chemistry
Quantifies concentrations of contaminants in sediment
Toxicity
Measures survival, growth and reproduction of organisms exposed to sediment in lab
Biology
Evaluates abundance and diversity of organisms in natural environment
Results from 3 lines of evidence are scored, weighed and combined
Final assessment of sediment
Clearly impacted
Likely impacted
Possibly impacted
Likely unimpacted
Unimpacted


Possibly Impacted
Likely Impacted
Clearly Impacted
Shelf
Embayments
Different Types of Embayments
Marinas
Estuaries
Ports
Bays
0
10
20
30
40
50
Percent Area of Bight


Possibly Impacted
Likely Impacted
Clearly Impacted
Percent Area of Bight
60
50
40
30
20
10
0
0
0
Embayment
Shelf
Embayment
Shelf
Embayment
Shelf
Embayment
Shelf
1998
2003
2008
2013

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# BIGGEST MANAGEMENT INTERESTS

- **Unknowns**
  - Climate change
  - Emerging contaminants
  - Harmful algal blooms

- **Initiatives**
  - Bioassessment/biostimulatory policy
  - Trash policy
  - Water reuse
  - Transitioning monitoring to molecular methods

# CLIMATE CHANGE

- **Our conceptual model: Increased atmospheric carbon dioxide will affect the coastal waters in four ways:**

- **Acidification**
  - $CO_2$ diffusion directly into coastal waters

- **Increases in water temperature**

- **Sea level rise**

- **Changes in rainfall and stream flow patterns**

# SCCWRP ACIDIFICATION RESEARCH

- **Improving acidification measurement approaches**
  - Evaluating and improving existing sensors
  - Standardizing use of new ISFET sensors
  - Testing new prototype sensors developed through the XPRIZE

- **Condition assessments**
  - Regional surveys of acidification conditions
  - Examining whether biota in the SCB are being affected

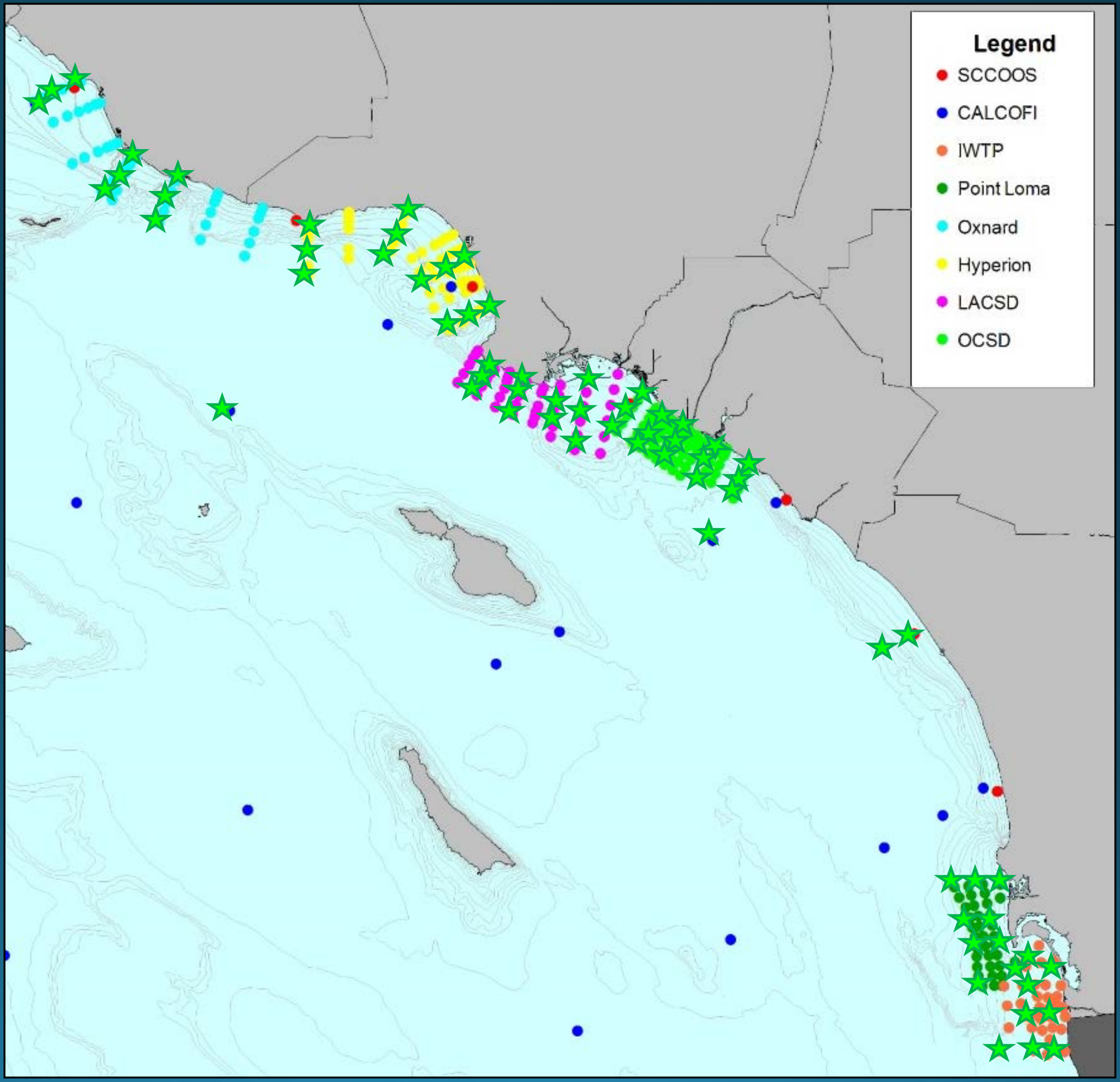
- **Coupled physical/biogeochemical modeling**
  - Addressing the effects of local nutrient emissions

- **Developing management targets**
  - What are the critical thresholds for acidification?

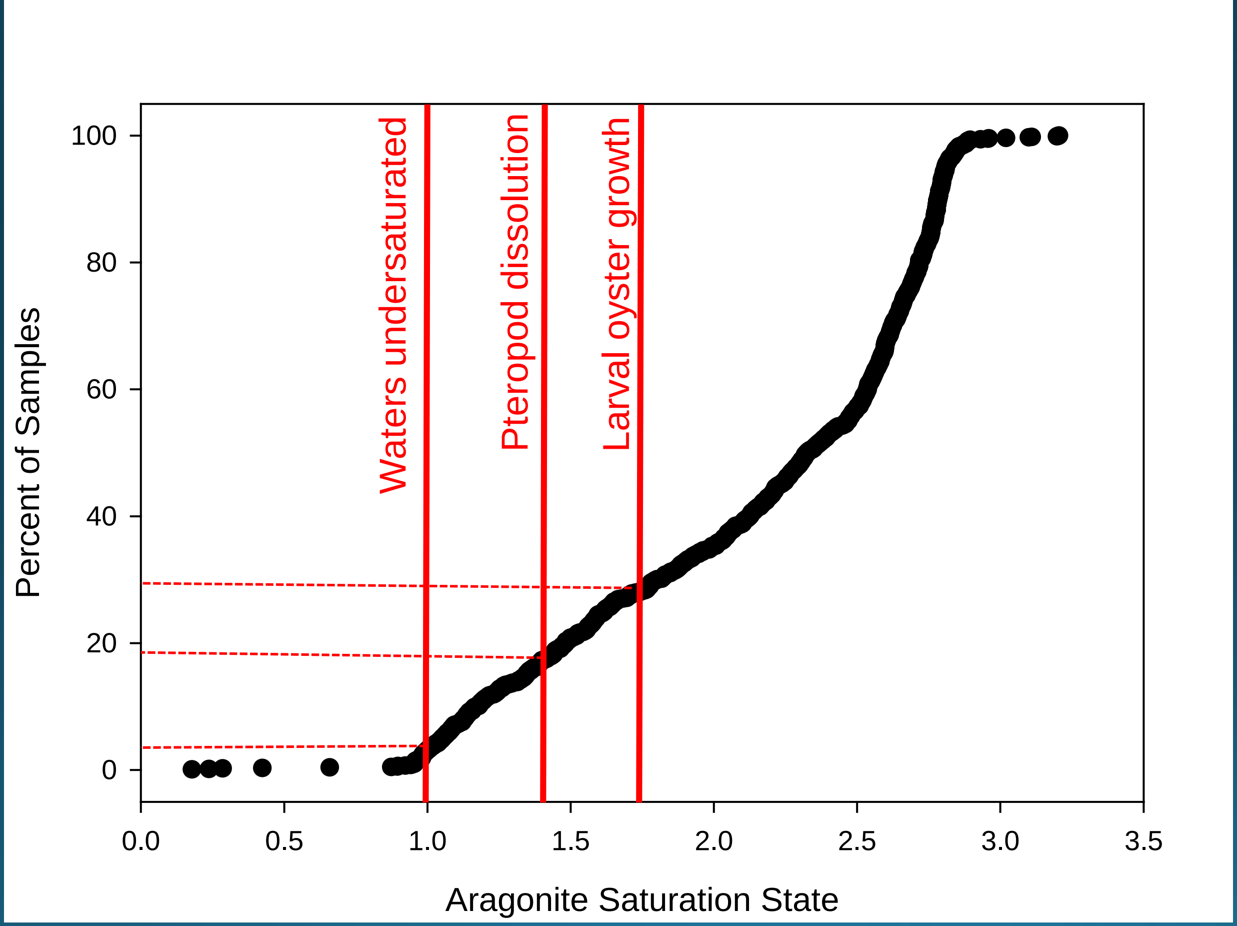
# Regional Assessment of Acidification Condition

- Collect bottle samples for pH and total alkalinity and calculate aragonite saturation state
  - Quarterly sampling for 2 years
  - 2-3 depths per station

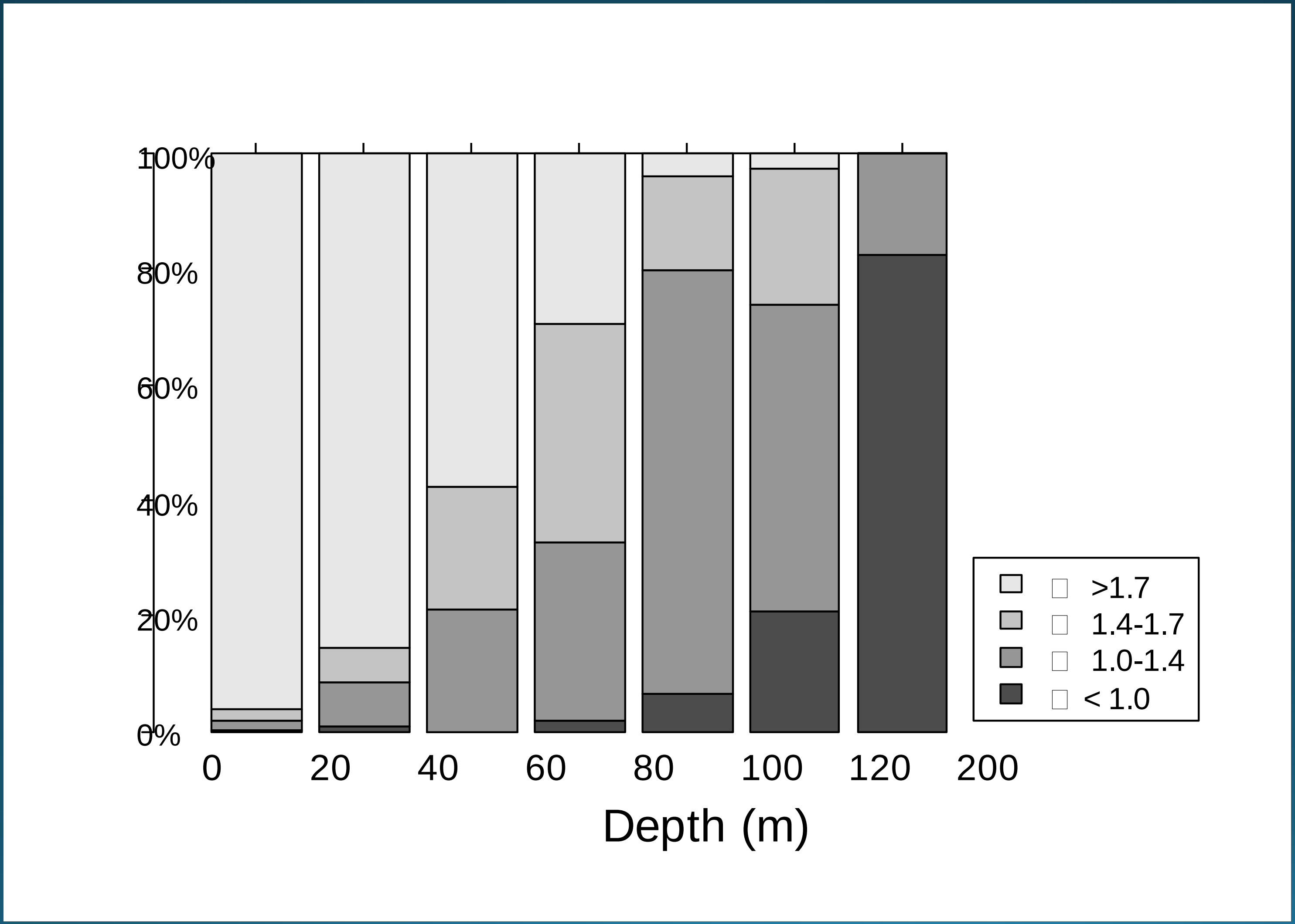
- pH samples analyzed spectrophotometrically
  - Gold standard for measurements



# Aragonite Saturation State in the SCB



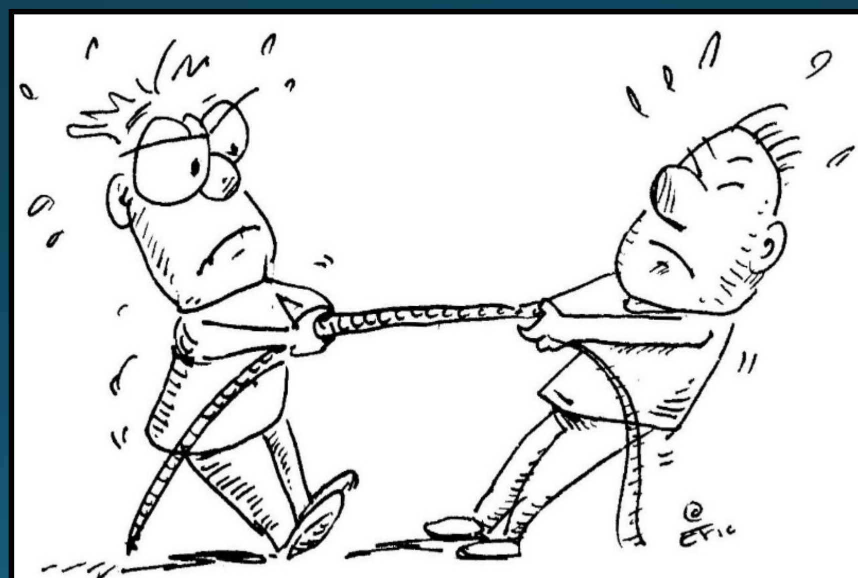
# Aragonite Saturation By Depth



# Are Anthropogenic Nutrients Important in an Upwelling Dominated Region?

**Two Opposing Views:**

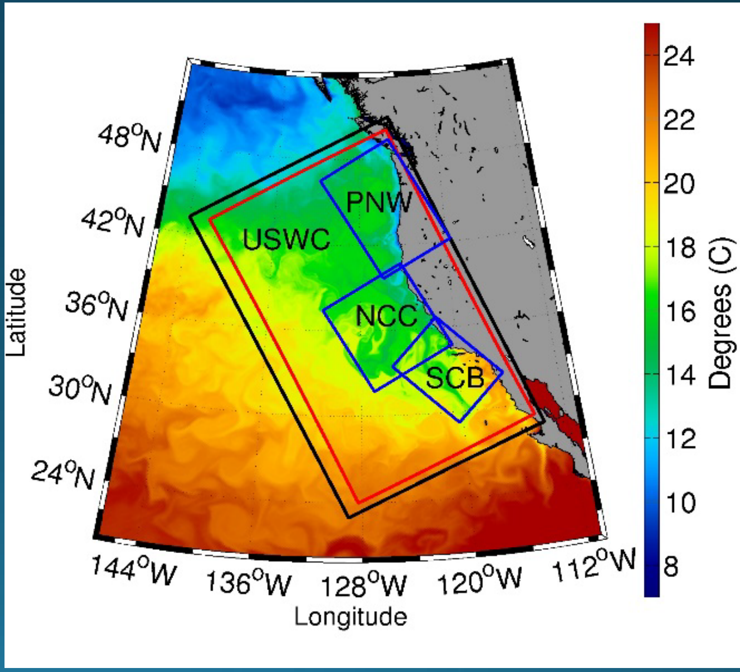
California coastal waters are dominated by upwelling, therefore anthropogenic nutrients are not a primary driver



Local anthropogenic inputs can exacerbate global drivers, potentially pushing DO and pH to ecological tipping-points

# COUPLED PHYSICAL BIOGEOCHEMICAL MODELING

- Develop OAH model of California Current System (CCS), with regional downscaling
  - So. California Bight, Central Coast, and the Oregon Coast
- Use the model to understand the relative contributions of :
  - Natural climate variability
  - Anthropogenically-induced climate change
  - Anthropogenic inputs
- Transmit these findings to coastal zone water quality and marine resource managers



# Developing a Water Quality Goal

- Existing water quality criteria are for pH > 6.5
  - These were developed 40 years ago and do not represent current science knowledge
  - They were designed to assess local effects from a discharge, not a regional effect

- Thresholds are critical to interpreting modeling and monitoring products
  - How much change is meaningful?

# Water Quality Goals Are a Challenge

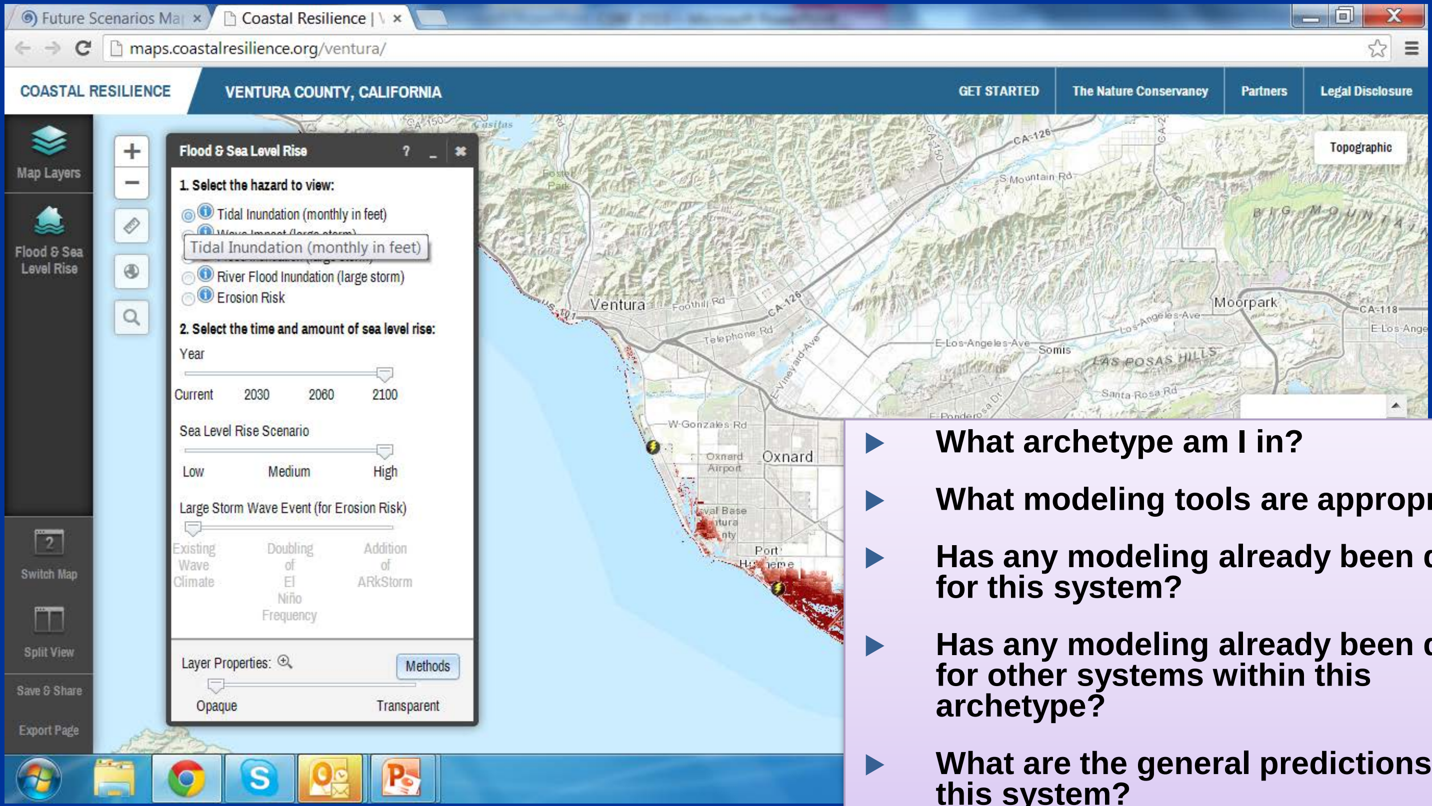
- Which parameter?
  - pH
  - $pCO_2$
  - Aragonite saturation state
- What metric?
  - Magnitude
  - Duration
  - Frequency
- What organism do we use to establish the level?
  - Species (e.g., calcifier vs. non-calcifier)
  - Developmental stage (e.g., larvae vs. adults)
  - Physiological state (e.g., dietary status → energy to deal with stress)
- What response?
  - Behavior: hearing, smell, balance, anxiety
  - Metabolism: respiration rate, growth
  - Calcification: shell formation, earbones
  - Ultimately, it must relate to fitness

# ACIDIFICATION THRESHOLDS APPROACH

- **Best professional judgment**
  - Bring in a dozen experts for selected taxonomic groups
  - Lock them in a room for three days
  - See what they can come up with
  - Potentially supplement that with metaanalysis
- **Planning to do this for three taxa over the next year**
  - Pteropods
  - Oysters
  - Fish or sea urchins?
- **Will do the first of these in the fall**

# SCCWRP RESEARCH ON SEA LEVEL RISE

- **Examining wetland vulnerability to SLR**
  - Partnering with experts who have developed SLR models
  - Adding biological responses to those models
  - Designing decision-support visualization tools




- **What archetype am I in?**
- **What modeling tools are appropriate?**
- **Has any modeling already been done for this system?**
- **Has any modeling already been done for other systems within this archetype?**
- **What are the general predictions for this system?**

# CHANGING RAINFALL

- **Flow patterns expected to change**
  - Anticipate more dry days, with precipitation falling during a shorter rainy season with bigger storms
  - Snowmelt and peak streamflow occurring 1-4 weeks earlier
- **Altered flow patterns will affect habitat**
  - Salinity changes
  - Riparian zone losses
  - Will also accentuate the potential conflict between drinking water removal and in-stream flow needs for biota
- **Our research is focused on biological flow needs**
  - Most flow requirements presently based on endangered species
  - Need flow requirements for the biological communities the State is starting to use as the basis for stream quality management

# WATER TEMPERATURE RESEARCH

- **Historical community assessments to predict likely biological changes**
  - Our members have more than 40 years of monitoring data
  - Examine changes that took place during La Nina and El Nino years

- **Incorporation of changing temperature regimes into our physical/biogeochemical models**
  - How will a stronger thermocline affect primary productivity, hypoxia and acidification?

- **Ensuring that biological indices/thresholds remain relevant**
  - In response to both changing water temperature and changing flow patterns

# Many CECs, Few Answers

*Which CECs pose the greatest risk to ecological and human health?*

*How do we monitor for CECs?*

*How low is low enough?*

Our member agencies need guidance for receiving waters

CA Recycled Water Policy requires monitoring of CECs

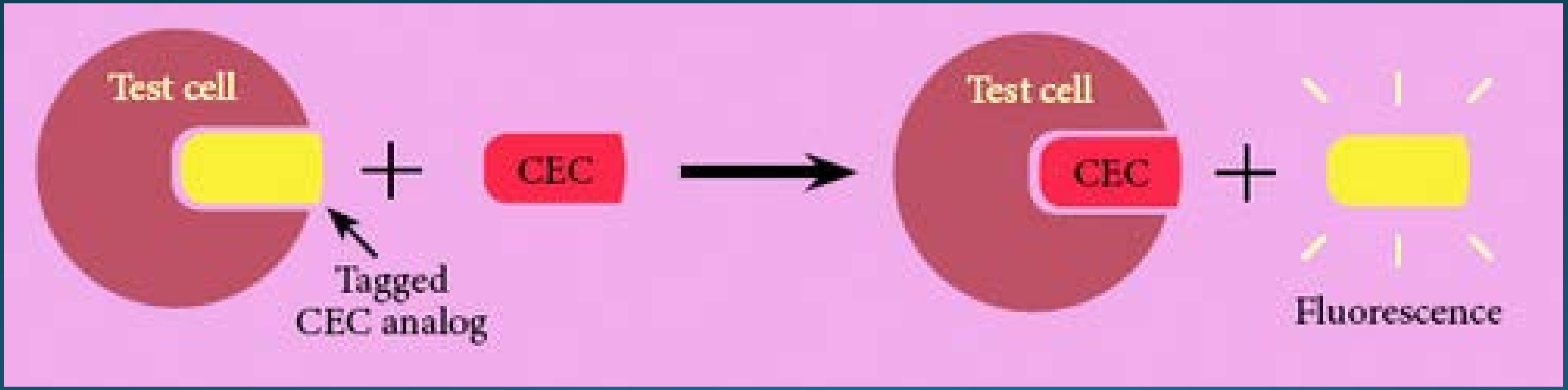
# *Targeted monitoring* is a short-term fix

- 3 receiving water scenarios
  - effluent dominated river
  - coastal embayment
  - ocean outfall zone
- 17 individual CECs
  - PPCPs, hormones, pesticides
- Water, sediment and tissue
- Monitoring trigger quotient
  - MTQ = measured/toxicity
  - << 1 no problem
  - $\geq$ 1 take action

| Water | Sediment | Tissue |
|---|---|---|
| bisphenol A | PBDE-47, -99 | PBDE-47, -99 |
| diclofenac | PFOS | PFOS |
| 17β-estradiol | BBP, BEHP | |
| estrone | nonylphenol | |
| ibuprofen | | |
| galaxolide | | |
| permethrin | permethrin | |
| fipronil | fipronil | |
| bifenthrin | bifenthrin | |
| chlorpyrifos | | |
| triclosan | | |

# *Bioanalytical screening* is a <u>long-term solution…</u>

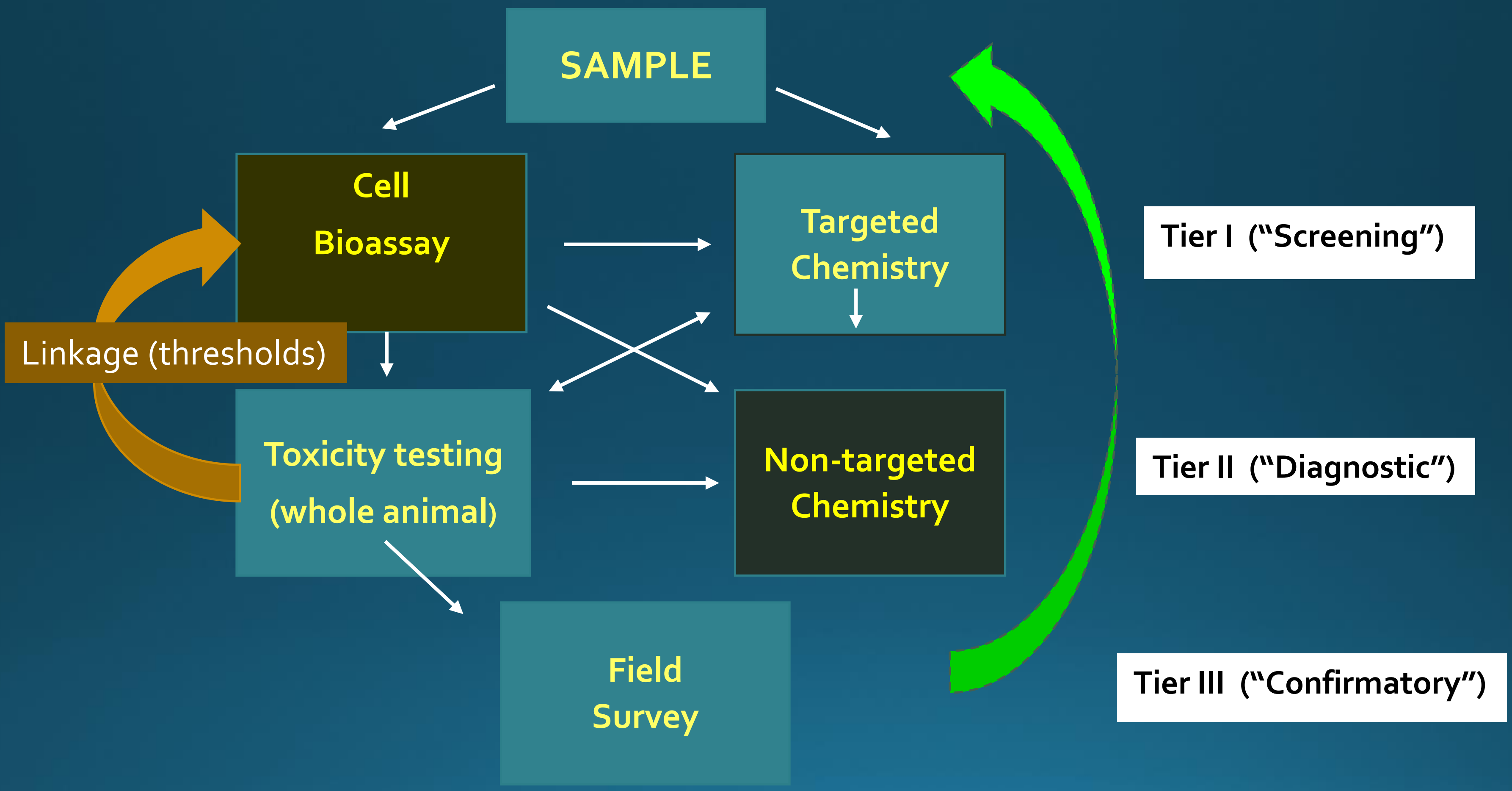
- *In vitro (cellular)* bioassays screen by "mode of action" (MOA)
  - Integrates the response of all chemicals with a common MOA
  - Cell responses can be linked to organism toxicity
  - Robust cell lines are being adapted for water quality applications
  - Water quality community is investing in this technology



# We are developing a “bioscreening” toolbox…

| ENDPOINT | SIGNIFICANCE |
|---|---|
| Estrogenicity (Estrogen Receptor or ER) | Impaired reproduction, feminization of males |
| Androgenicity (Androgen Receptor or AR) | Impaired reproduction, masculinization of females |
| Glucocorticoid Activity (Glucocorticoid receptor or GR) | Impaired development, immune diseases |
| Aryl Hydrocarbon Receptor (AhR) | Dioxin-like toxicity, cancer, tissue damage |
| Tumor suppressor protein response element (p53RE) | DNA damage, mutagencity, cancer |
| Peroxisome proliferator activated receptor (PPAR) | Metabolic disorders, impaired immune function, cancer |

# Our CEC Monitoring Framework



# CHALLENGES AND KEY LESSONS LEARNED

- **Formal connection to the management community**
  - The managers "own" the organization
  - They (and their lead scientists) are part of every project from the start

- **Scientific consensus**
  - Managers don't want to act on the basis of one scientist's opinion
  - They need scientific consensus
  - Scientists generally aren't very good at that

- **Partnership is the key**
  - Partnership needs to extend beyond scientists and managers
  - NGOs need to be a big part of the conversation

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# OTHER TOPICS YOU ASKED ME TO TOUCH ON

- **What are our funding sources?**
  - What proportion of resources is allocated to different types of scientific investments?
- **How are priorities established?**
- **Who conducts the work (state agencies, academic institutions, etc.)?**

# FUNDING SOURCES

- **SCCWRP's money comes in three chunks**
- **25% are member agency "dues"**
  - Unencumbered money that allows us to proactively address new issues
- **50% from member agencies as targeted research projects**
- **25% as contracts/grants from outside sources**
  - Federal agencies
  - Foundations
  - Other municipalities

# ALLOCATION AMONG DIFFERENT TYPES OF SCIENTIFIC INVESTMENTS?

| | |
|---|---|
| Bioassessment | 783,653 |
| Climate Change | 951,439 |
| Contaminants of Emerging Concern | 765,862 |
| Ecohydrology | 382,957 |
| Eutrophication | 668,449 |
| Information Technology and Visualization | 343,355 |
| Microbial Water Quality | 1,065,021 |
| Regional Monitoring | 807,453 |
| Sediment Quality | 1,110,912 |

# HOW ARE PRIORITIES ESTABLISHED?

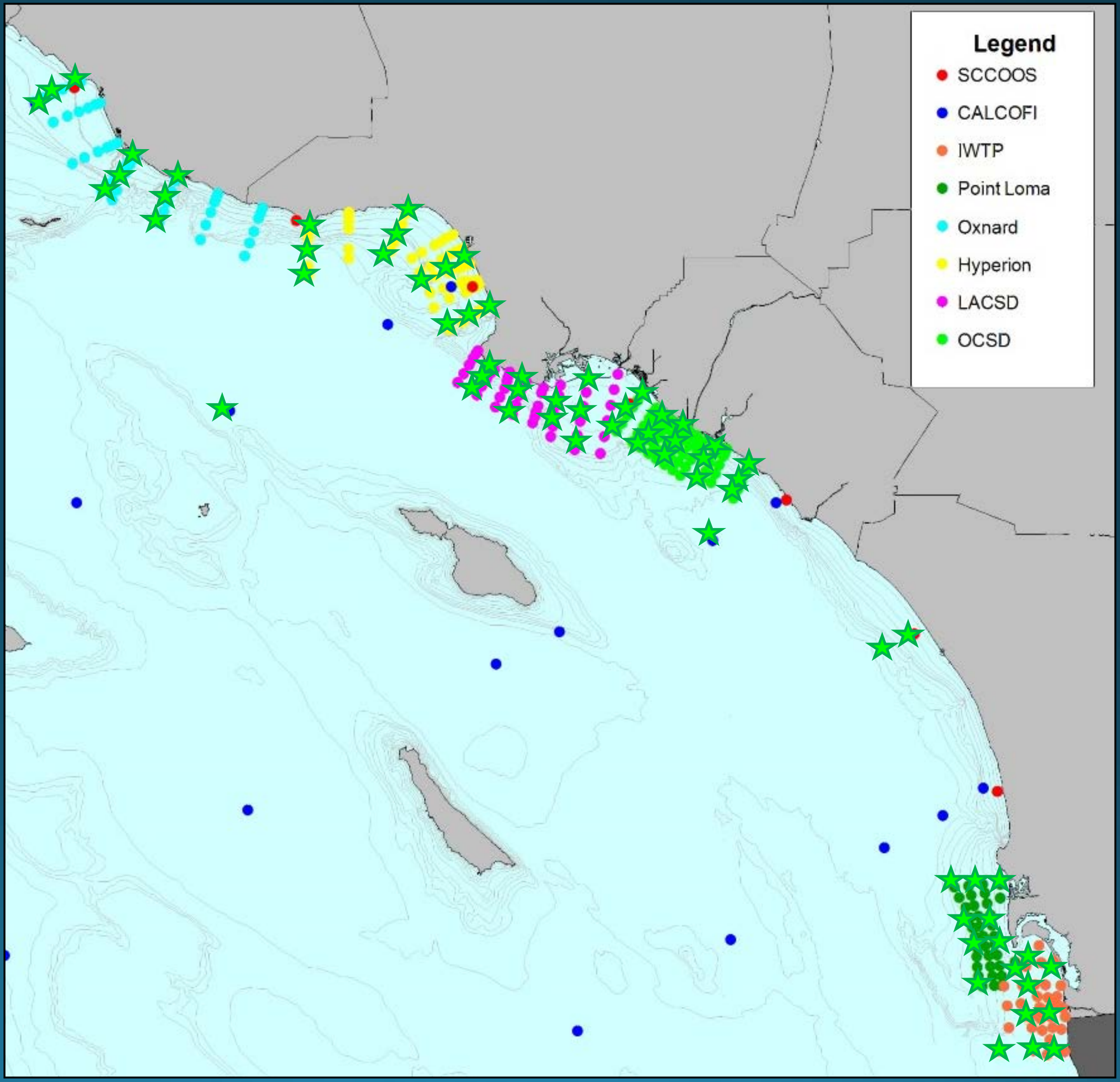
- **Research is typically initiated by SCCWRP scientists**
  - Have only had two projects requested by the Commission in 21 years
- **Vetted by the member agency's lead scientists**
  - We engage them in ten year planning about each research theme
  - We ask them for their priorities among research themes
  - We also ask them for priorities among projects within themes
- **Final decision lies with me**
  - Is it consistent with the mission?
  - Is it a member agency priority (or should it be)?
  - Is there external funding?
  - Is the proposed work high quality?
  - Are there external partners?

# WHO CONDUCTS THE WORK?

- **We have a staff of 45 and 15000 sq ft of laboratories**
- **However, 97% of our projects are done in partnership**
  - We have published with 177 different institutions in the last four years
- **Partnership achieves many objectives**
  - Brings more ideas to the party
  - Helps share the funding burden
  - Most important: A key step toward scientific consensus

# pH Sensor Evaluation: Approach

- Side-by-side comparison of bottle measurements of pH and SeaBird Sensors
- 5 agencies participating
- 2-3 depths per station
- Quarterly sampling for 2 years

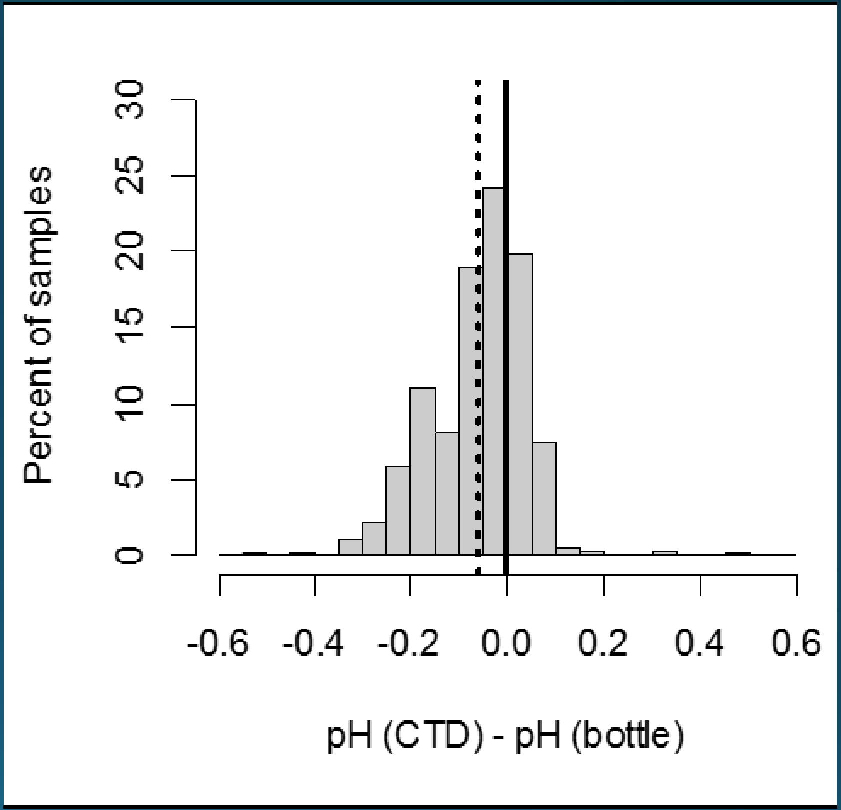


# pH Sensor Evaluation: Results

- Wide range of differences: -0.509 to 0.4787 pH units

- CTD measurements often under predict actual pH
  - Mean offset = 0.06 pH units

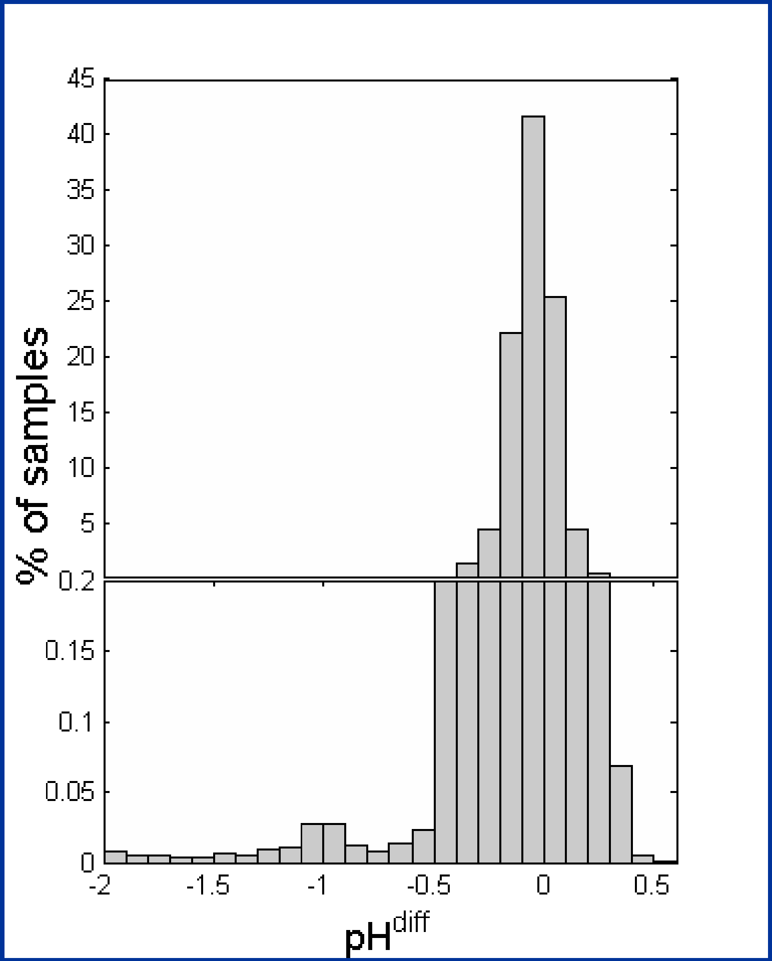
- Average absolute difference was 0.09 pH units



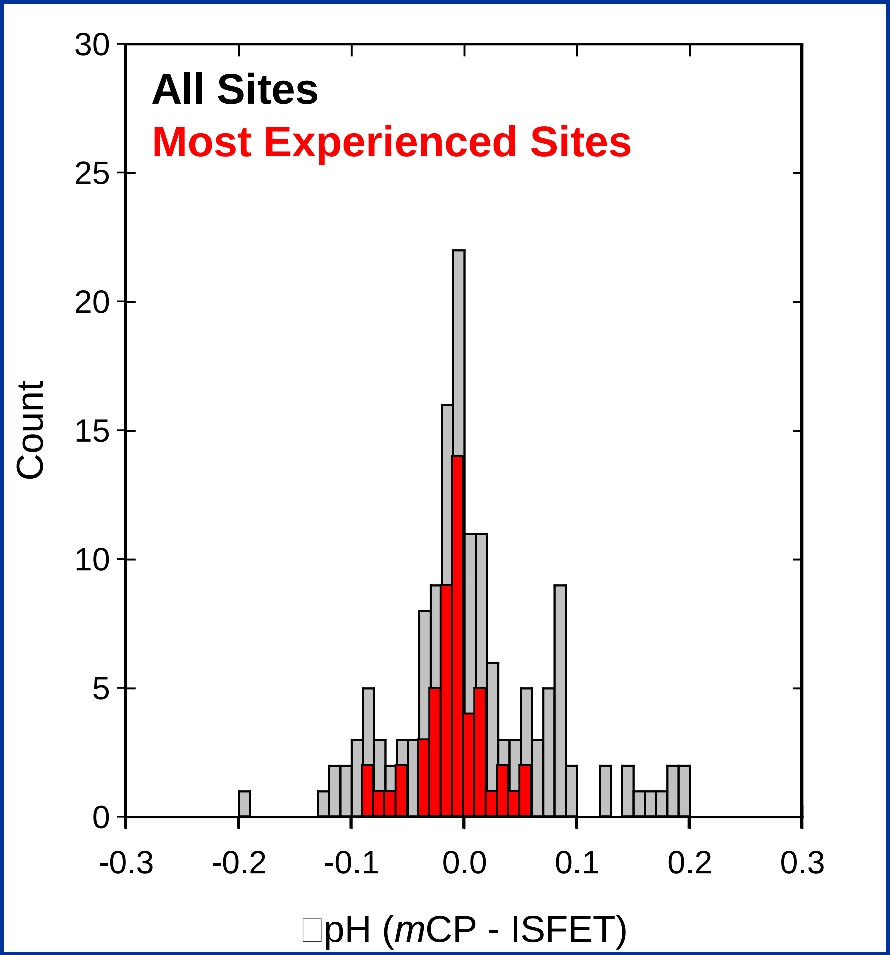

California Ocean Plan:

“pH shall not be changed at any time more than 0.2 units from that which occurs naturally”

# EVALUATING DURAFET pH SENSORS




Difference between present sensors and reference pH




Difference between DuraFET sensors and reference pH