Developing a Submerged Aquatic Vegetation Monitoring & Assessment Program for Southern California

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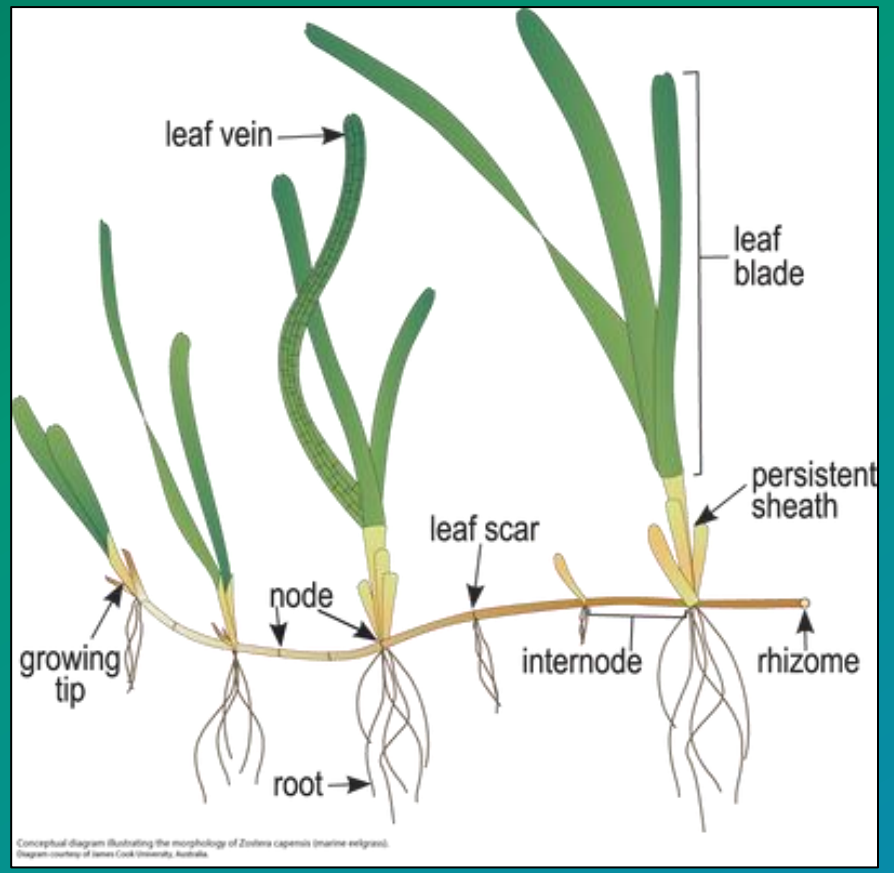
SCCWRP
Established 1969

Take Home Messages

- SCCWRP has developed a framework for assessment of eelgrass in California
- We've conducted the first regional assessment of eelgrass condition using this framework
- We've been able to validate our conceptual structure-function model for nekton habitat utilization
- The approach is being adopted by the Southern California community and generating interest across the wider west coast eelgrass community

Seagrasses

- Seagrasses or Submerged Aquatic Vegetation (SAV) are flowering plants that live in the shallow waters of the coastal zone
  - There are five different species in California
    - *Ruppia maritima, Zostera marina, Zostera pacifica, Phyllospadix torreyi, & Phyllospadix scouleri*
  - The most common species in California are eelgrass
    - *Z. marina* and *Z. pacifica*
- SAV are key part of coastal ecosystems



SAV in California's Regulatory Environment

- Eelgrass is the focal point of a variety of state and federal environmental policies
  - California Eelgrass Mitigation Policy (CEMP), essential fish habitat, species of concern
  - Interest in use for estuarine beneficial uses, biostimulatory program, sediment quality objectives

California Lacks an Eelgrass Bioassessment Tool

- Understanding the extent, condition, or functioning of eelgrass beds to inform management needs
- We lack the tools for producing these types of data
  - There are project-based mapping efforts that periodically occur and provide snap-shot measures of extent
- The “Any grass, is good grass” paradigm is not sufficient

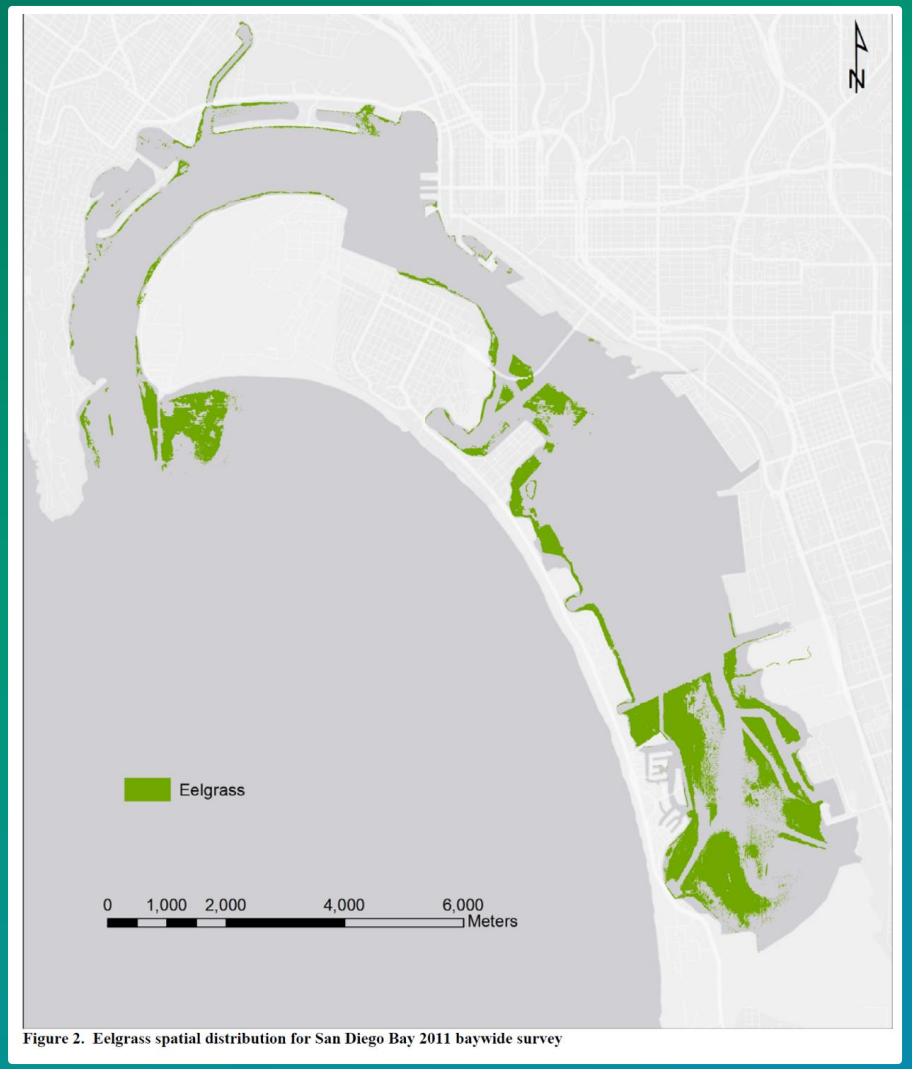


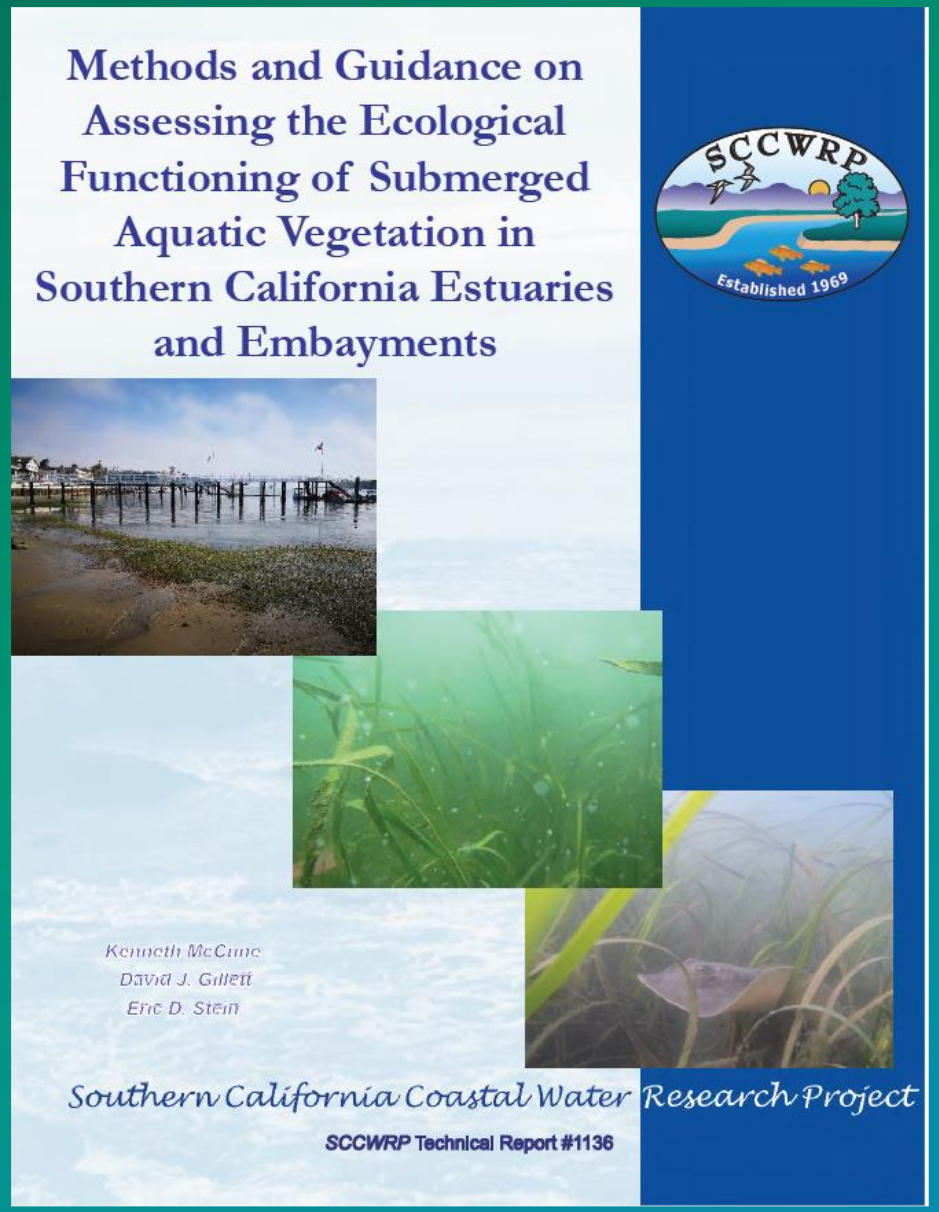
Figure 2. Eelgrass spatial distribution for San Diego Bay 2011 baywide survey

Bioassessment & Environmental Engineers

- Environmental engineers like eelgrass present unique challenges to traditional bioassessment
  - Traditionally, we use the condition of a biological resource to infer the condition of their location
    - Algae, benthic invertebrates, fish, etc.
- Eelgrass has a dual nature in their ecosystem
  - Biological resource
  - Unique habitat for other organisms
- A good eelgrass bioassessment tool needs to address both aspects

Developing an Assessment Framework

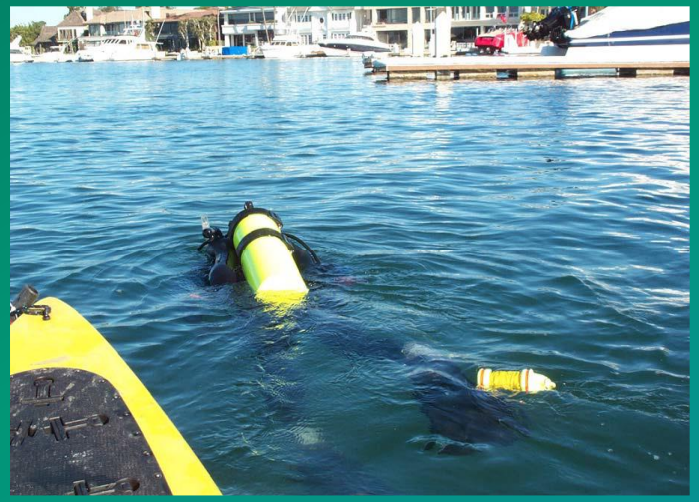
- Tier 1 – Condition & Extent (eelgrass as habitat)
  - How much eelgrass is there relative to what would be there in the absence of disturbance?
- Tier 2 – Condition & Health (eelgrass as resource)
  - How healthy is a given SAV bed relative to reference conditions?
- Tier 3 – Condition & Function (eelgrass as habitat and resource)
  - Is a given SAV bed providing ecosystem functions at rates of reference conditions?



sccwrp.org/publications

A Focus on Ecosystem Function

- The goal is to assess the condition of a given eelgrass bed through the lens of its likelihood of supporting designated ecosystem services
  - Using structural proxies to infer ecosystem services
- Garnered the greatest interest among our local, state, and federal partners
  - Development and refinement of field and lab SOPs
  - Field intercalibration of dive teams from around the region
  - Development of data infrastructure
  - Development of draft condition index



Conceptual Models

- We worked with eelgrass experts to develop models of how structure is linked to function
- Each column represents a consensus opinion on the structural aspects predictive of functions
  - Important to validate these models

Ecosystem Functions

Eelgrass Structural Metrics

	Substrate stabilization	Carbon Seqestration	Primary Production	Secondary Production	Improving Water Quality	Nekton Habitat	Waterfowl Habitat
Above ground biomass		Moderate	Strong	Strong	Moderate		
Above ground Carbon and Nitrogen content			Moderate	Moderate			
Below ground biomass	Moderate	Moderate	Moderate	Moderate			
Below ground Carbon and Nitrogen content			Weak				
Patch area	Strong	Moderate					Strong
Area to perimeter ratio						Moderate	
Percent cover					Weak	Strong	
Shoot density	Strong		Strong	Strong	Strong	Strong	
Leaves per shoot			Strong	Strong			
Flowering shoot density			Strong				
Shoot height	Moderate			Strong	Strong	Strong	Strong
Leaf area	Moderate		Strong		Strong	Strong	
Epiphyte biomass			Strong	Strong			
Redox potential discontinuity (RPD) depth		Strong					
Infauna diversity				Moderate		Moderate	
Infauna biomass				Strong			
Epifauna diversity				Moderate		Moderate	
Epifauna biomass				Strong			
Contaminant content of blades					Moderate		

Enter the WPDG Program

- We had a new assessment framework for eelgrass that was technically sound
  - Based on consensus of eelgrass scientists and the target management community
  - We conducted a beta test of the framework in a single embayment
- Our goal was to expand it to regional-scale application
  - Refine the methods and interpretation tools
  - Demonstrate its utility to the scientific and management community
  - Help facilitate its adoption into regular monitoring practices
- Regional Eelgrass Survey of Condition and Quality
  - RESCQ

Setting Ourselves Benchmarks

- The long-term goal is to create an eelgrass monitoring program that is adopted by the regional management community
- Project benchmarks towards that goal
  - Apply the Tier 3 assessment framework at a regional scale
  - Provide a regional assessment of eelgrass condition
  - Refine the field and lab SOPs as needed
  - Develop data infrastructure
  - Validate/refine Nekton Habitat structure-function model


Let’s Do Some Monitoring!

SAV Monitoring Sampling Sites

Sample Frame

- We used a ran
  probabilistic s
  design
  - Allows us to
    weighted infe
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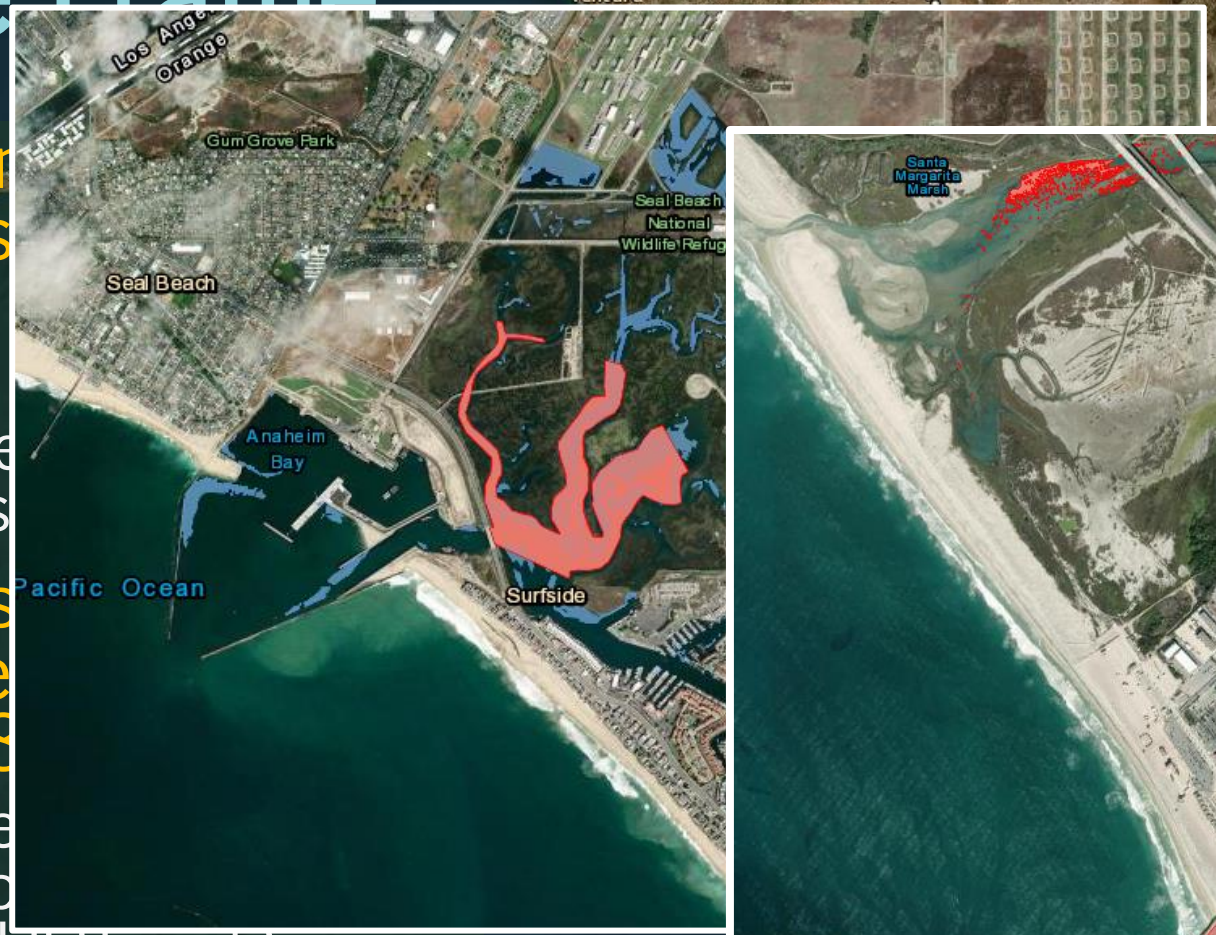
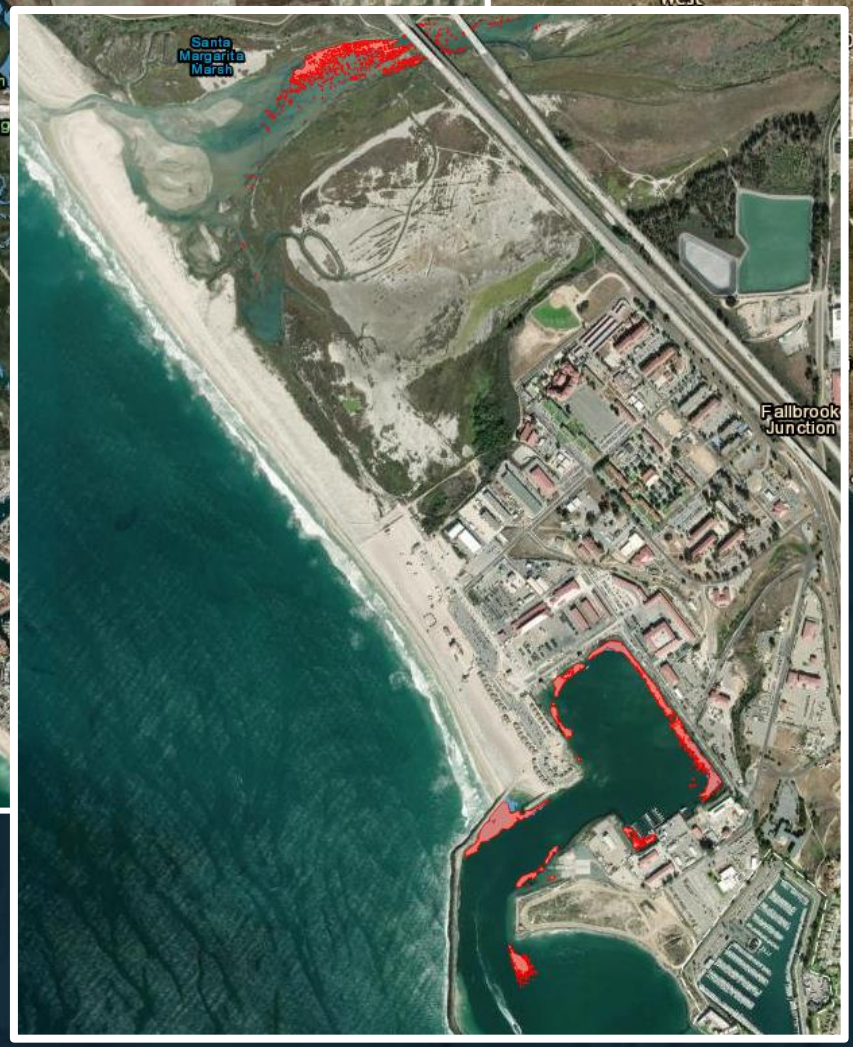
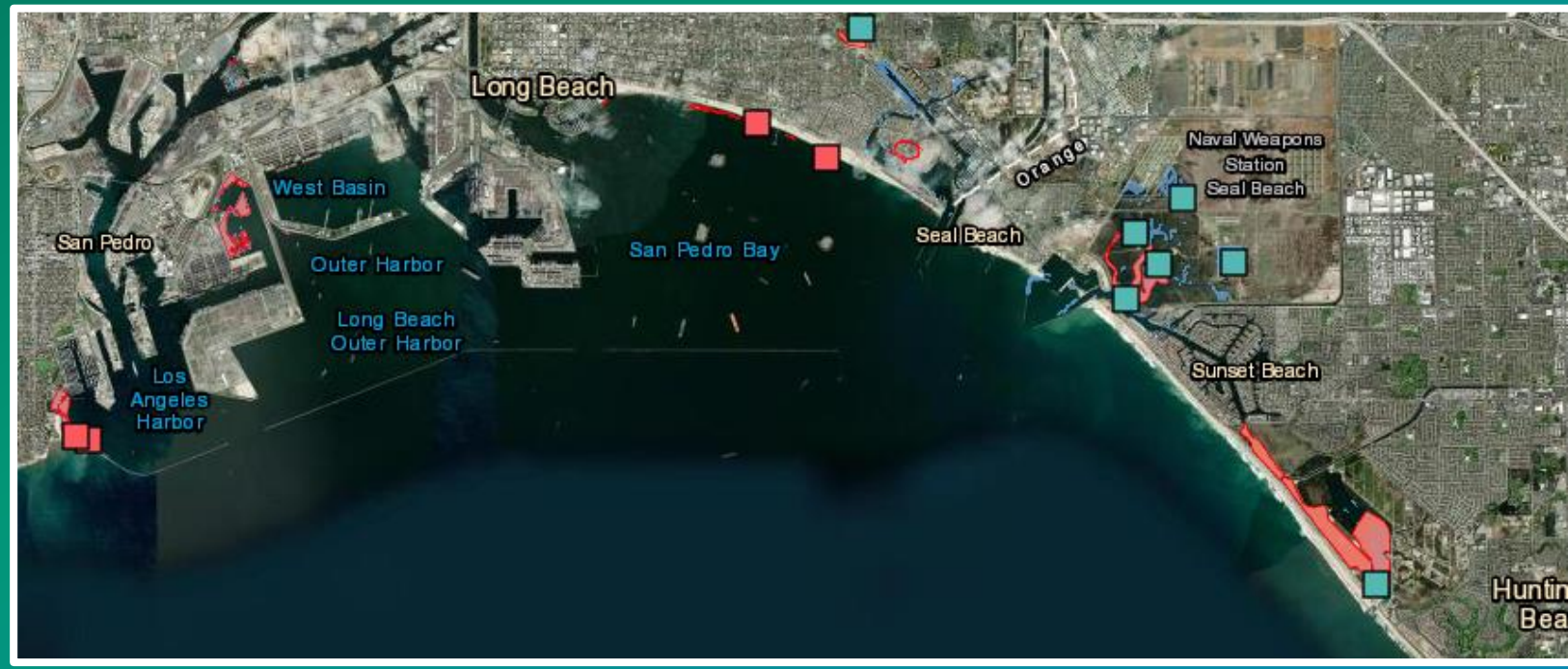
- Created a bas
  eelgrass obse
  the previous 8
  - Supplemente
    mapping effo
    SCCWRP-CSULB and San
    Diego Regional Board



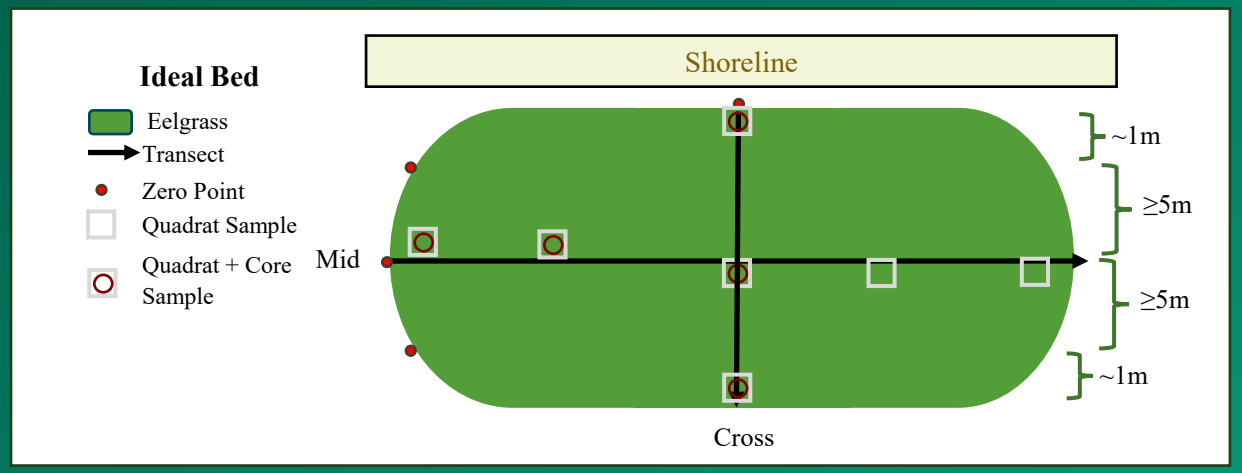


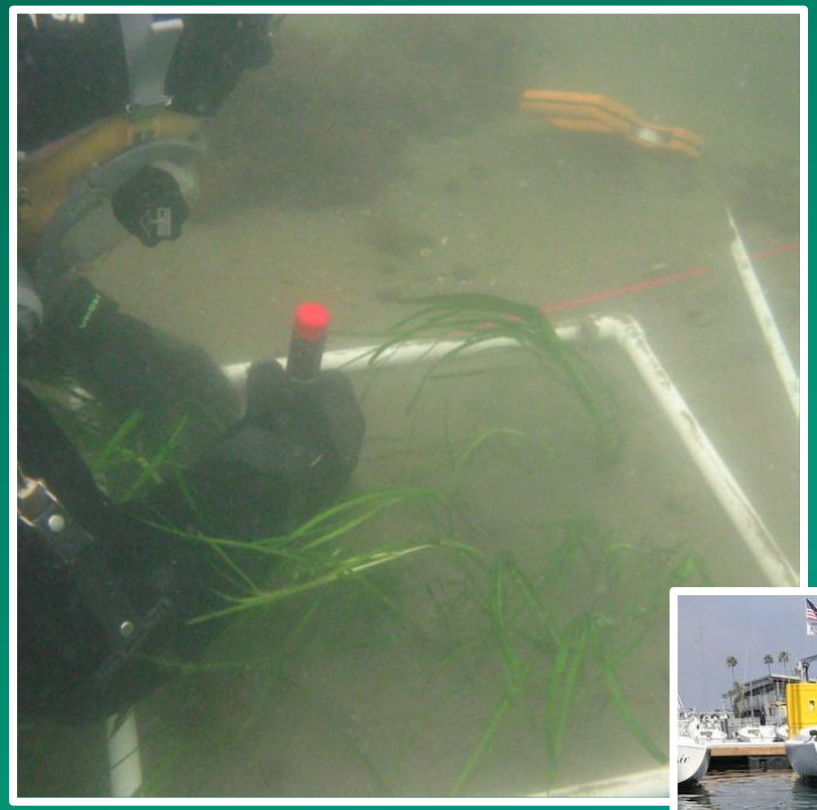
Site Selection

- Divided maps into 500 m^2 sample units
- Stratified the sample frame into Large Embayments, Small Embayments, and Estuaries
  - Allows for more even geographic coverage across the region
- Randomly selected 30 sites
  - 10 per stratum
  - Plus 30 overdraws sites per stratum

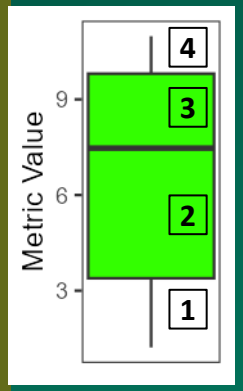


Field Sampling

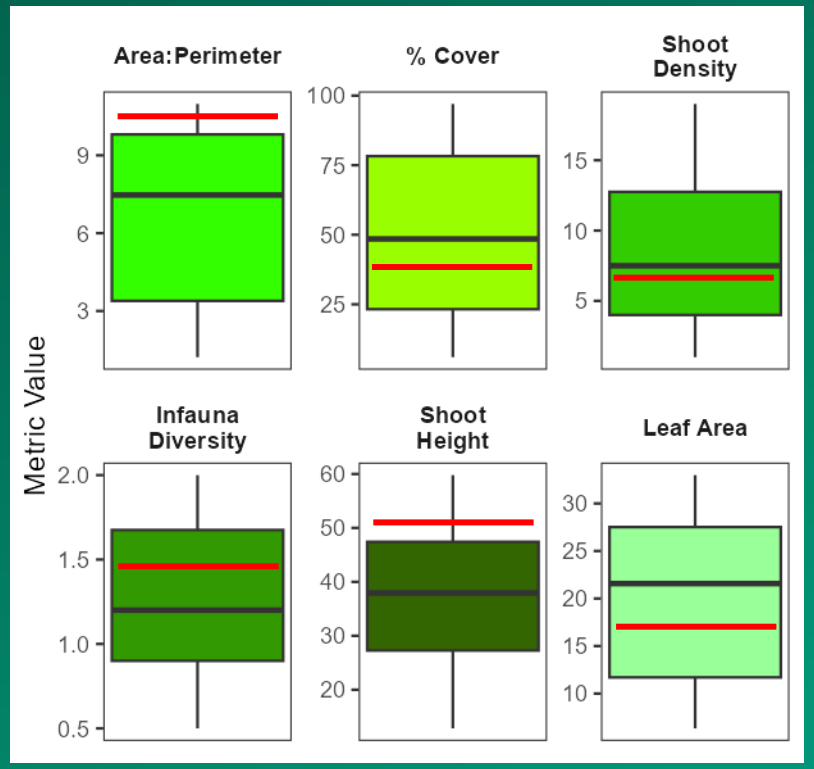




Draft Eelgrass Condition Index



Nekton Habitat Utilization



Nekton Habitat Utilization

Metric	Score
Area: Perimeter	4
% Cover	2
Shoot Density	2
Infauna Diversity	3
Shoot Height	4
Leaf Area	2

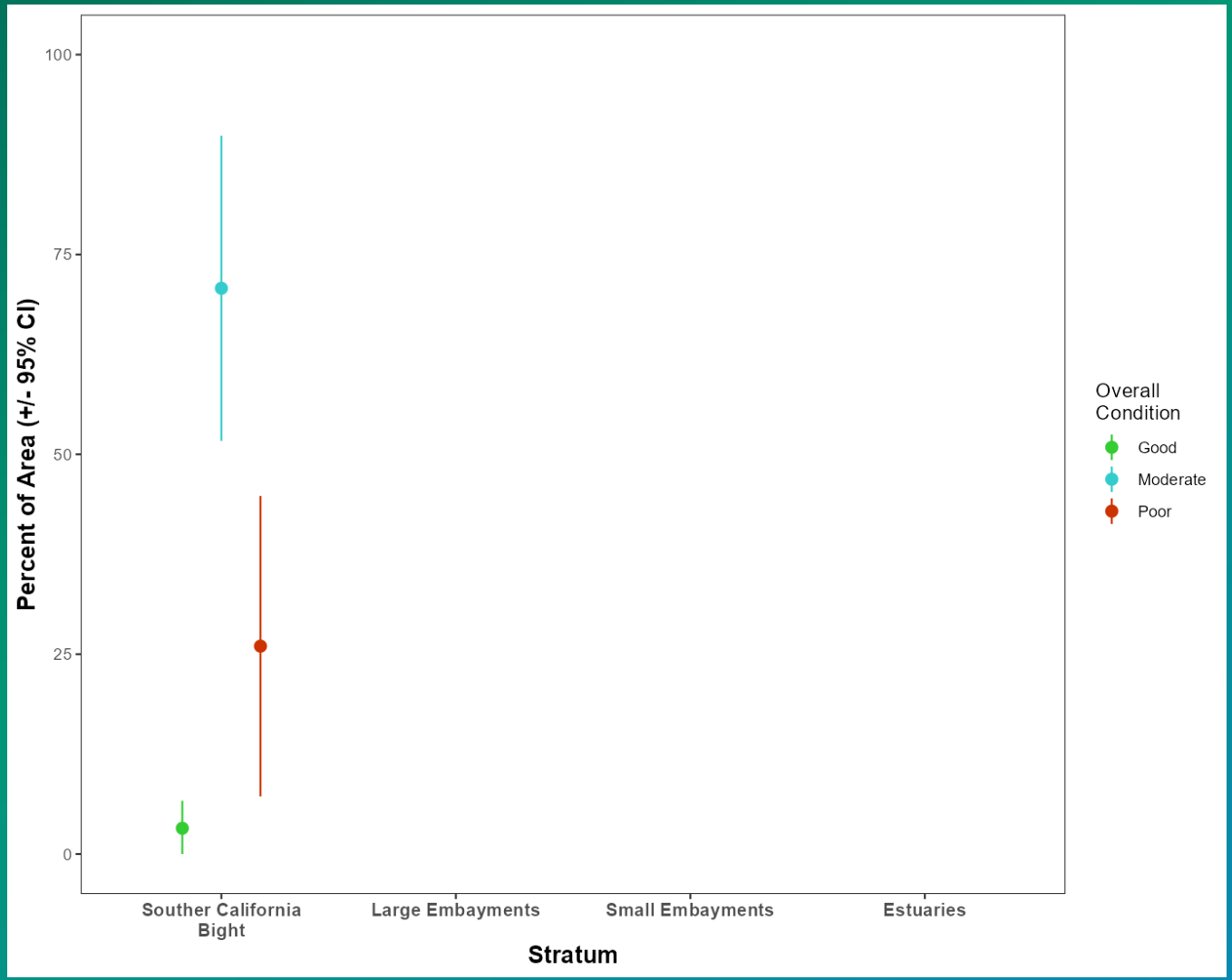
Nekton Habitat Score
2.83

Overall Score
3.22

Substrate Stabilization	Carbon Sequestration	Primary Production	Secondary Production	Water Quality	Nekton Habitat	Waterfowl Habitat
3.25	3.1	2.99	3.54	3.71	2.83	3.12

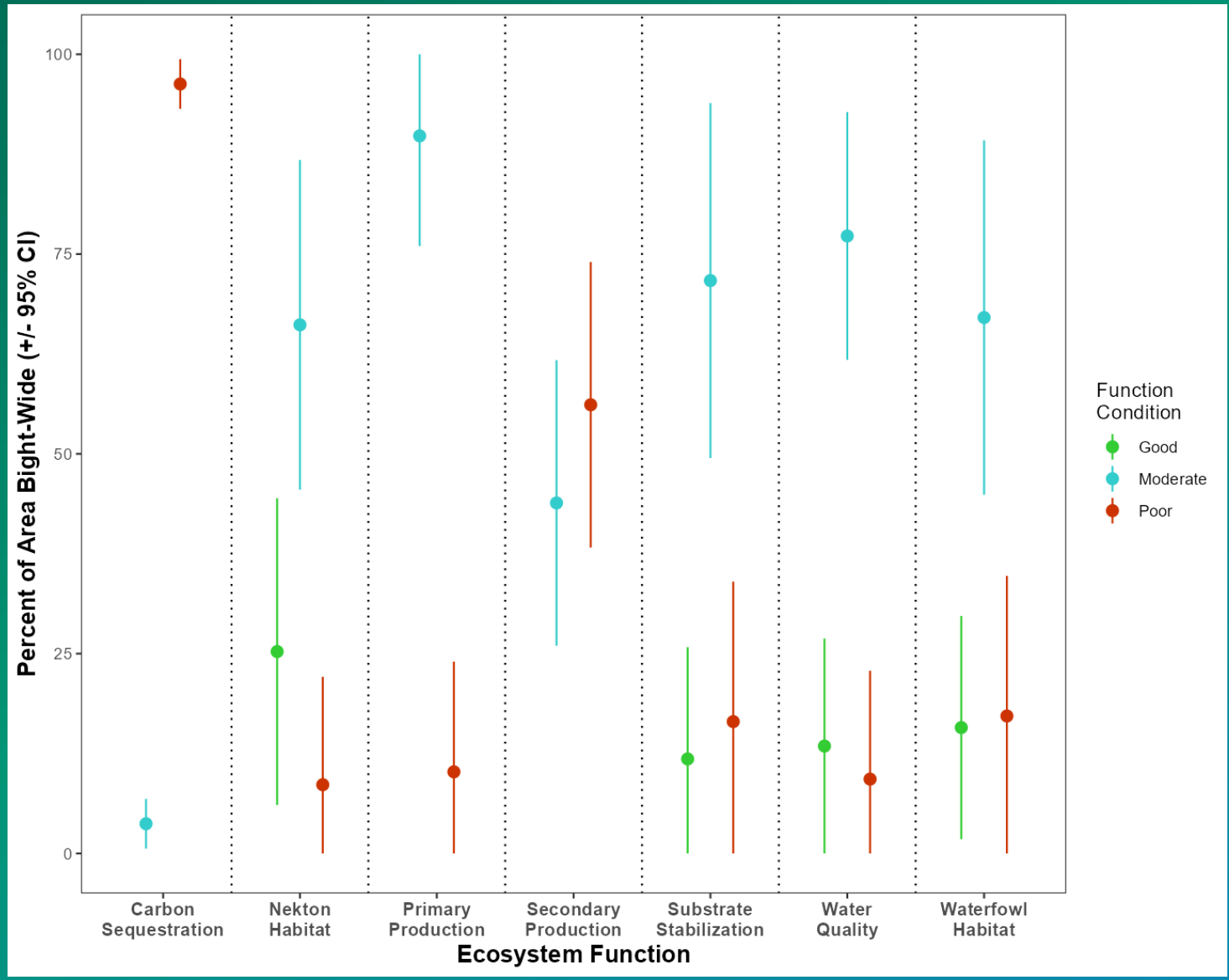
Draft RESCQ Results

- A majority of the region's eelgrass beds are in moderate condition
- Conditions are relative consistent across the different strata
  - The estuaries stratum contains all of the good condition beds



Draft RESCQ Results

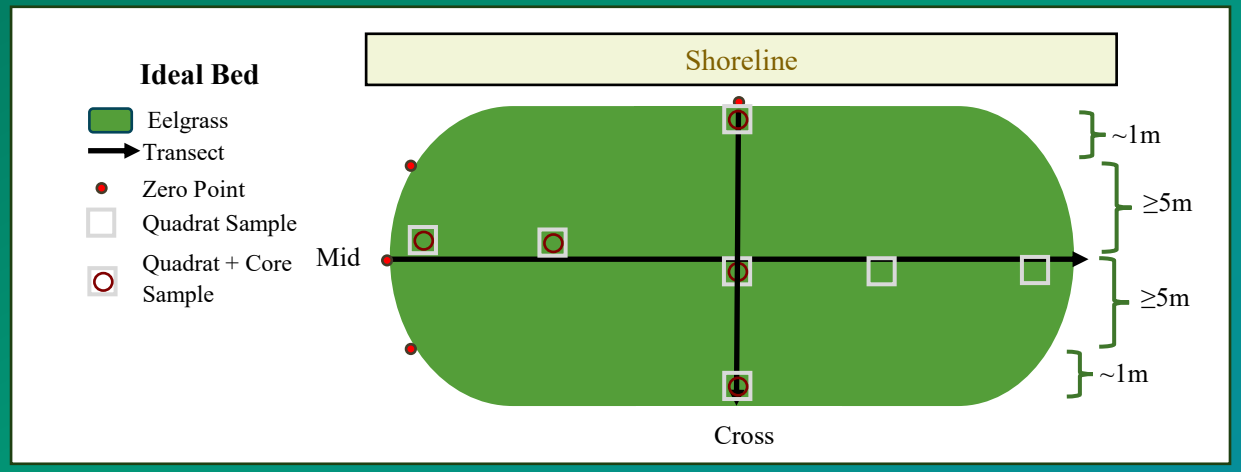
- Region-wide patterns were relatively consistent across the component functions
  - Most of the area was in moderate condition
  - Low amounts of poor condition
- Carbon sequestration and 2° production were outliers
  - Poor condition dominated



Refining SOPs

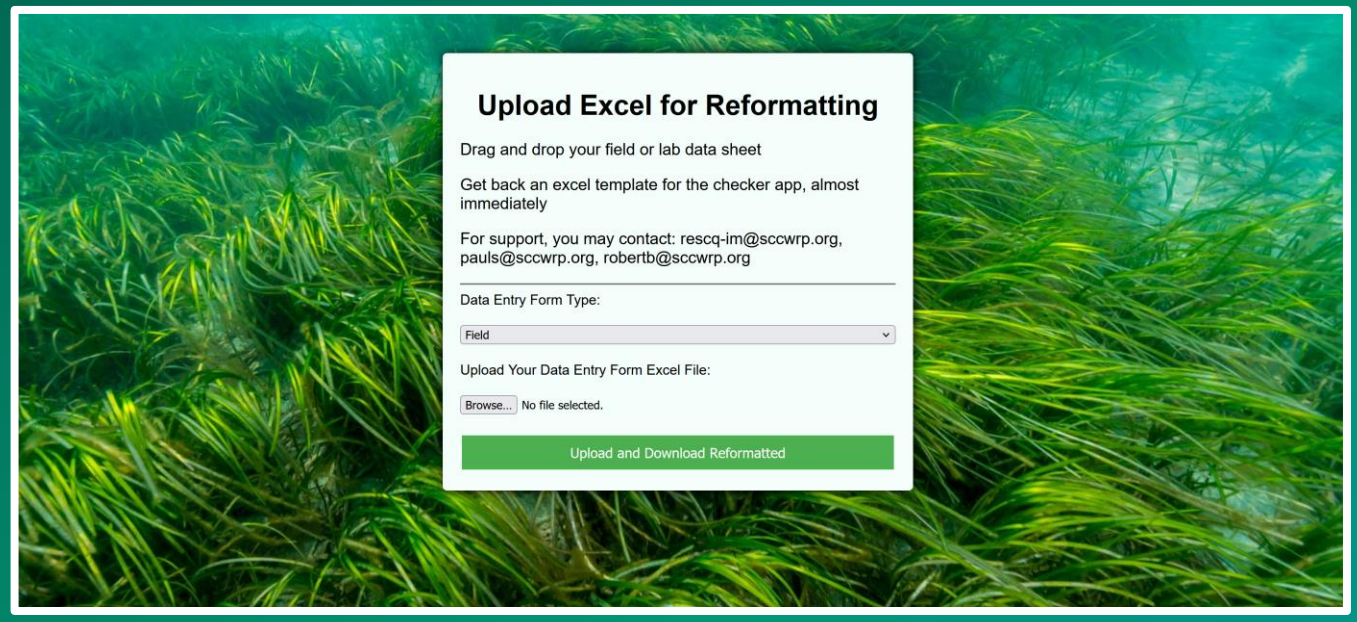
- Eelgrass beds are not uniform things
  - Effects of edges and depth
  - Random patchiness
- We collect a lot of samples within a bed
  - It takes time
- Finding how much variability is enough
  - Influence on index performance

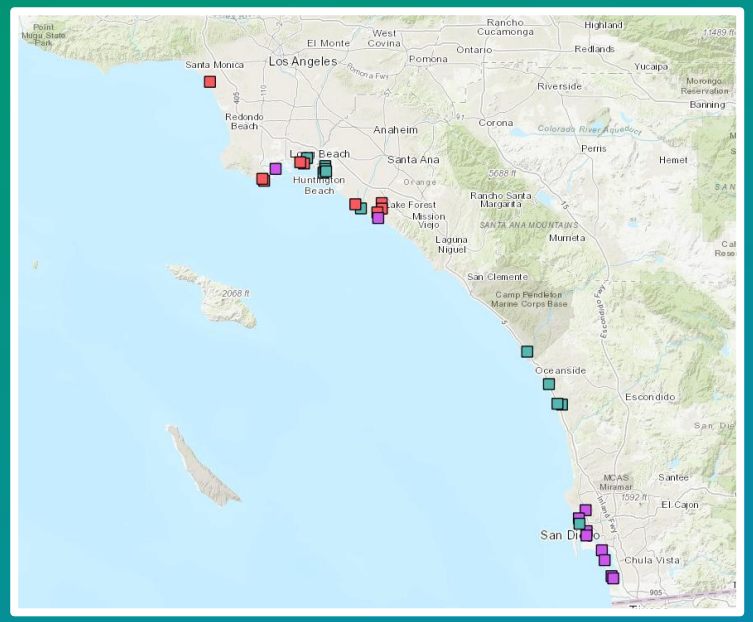
Field Sampling Schematic



Data Infrastructure

- Online documentation
  - Lab and field SOPs
  - Data collection forms
  - Data entry forms
  - Base maps
- Data portal
  - Central repository of data collected with these methods
  - Data checkers to ensure QC of data inputs
  - Basic analyses and visualizations





Validating Nekton Habitat Utilization

- Nekton habi
  - Area:Perim
    Shoot Heig
    Diversity
- Directly mea
  and abunda
  - Baited cam
    water colu
- Determine if
  are the best
  - Or are othe

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Meeting our Benchmarks?

- Project benchmarks
  - Apply the Tier 3 assessment framework at a regional scale ✓
  - Provide a regional assessment of eelgrass condition ✓
  - Refine the field and lab SOPs as needed ≈
  - Develop data infrastructure ≈
  - Validate/refine Nekton Habitat structure-function model ✓

Adoption of Our Framework by the Community

- Eelgrass researchers using our framework and tools of their own volition
  - We are getting there
- The Southern California Bight Program incorporated an SAV element for the first time in the 2023 survey
  - $200k + in kind funding
- NOAA west coast SAVE program is interested in using our approach

NOAA FISHERIES

CALIFORNIA WATER BOARDS San Diego - R9

CALIFORNIA WATER BOARDS Santa Ana - R8

UC SANTA BARBARA Marine Science Institute

Nearshore (SAVE) Project

Submerged Aquatic Vegetation Evaluation

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Questions?

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