# Meeting the Needs of Managed Spaces

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# The skinny…

Ever-growing interest in marine spatial management

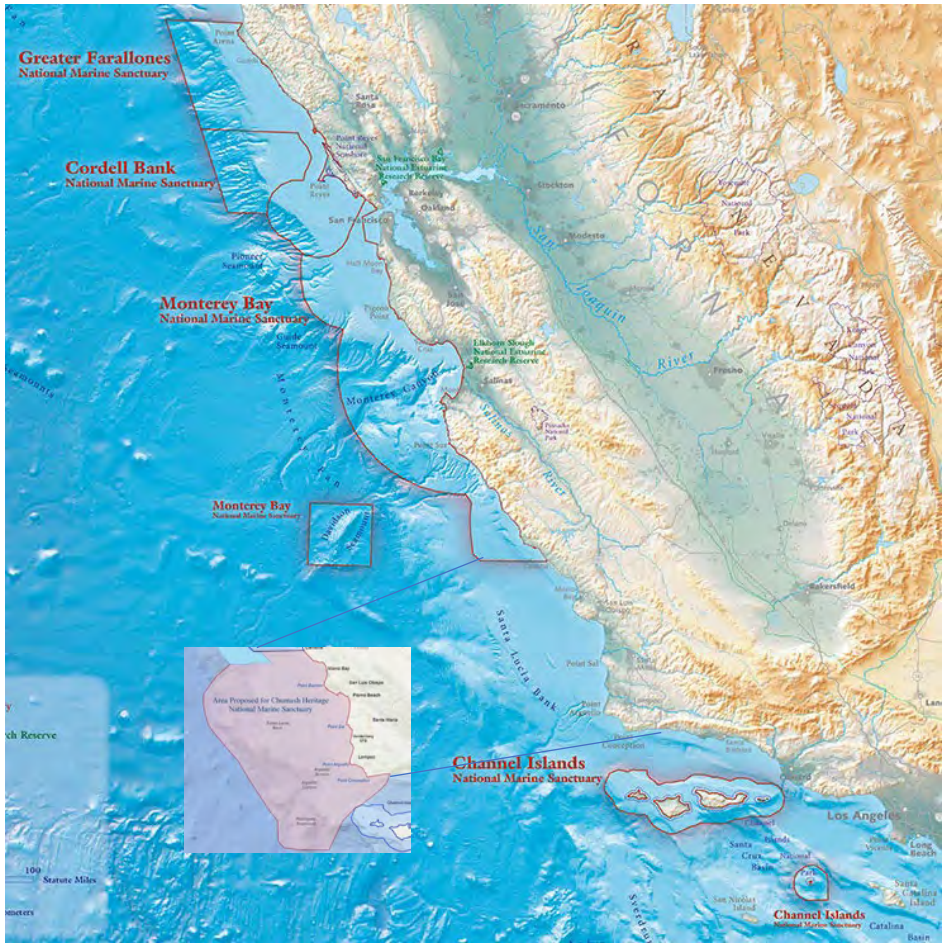
- Many different forms
- Particular interest in marine protected areas (MPAs)
- 30% by 2030 international, federal, and state initiatives
- Particularly effective conservation tool because of holistic ecosystem approach
- They vary in two fundamental ways:

  - form (species, habitat) and extent (partial vs no-take) of protection

  - single MPA vs MPA “network” (administrative vs ecological)

# West coast, especially California, has two primary forms of MPAs

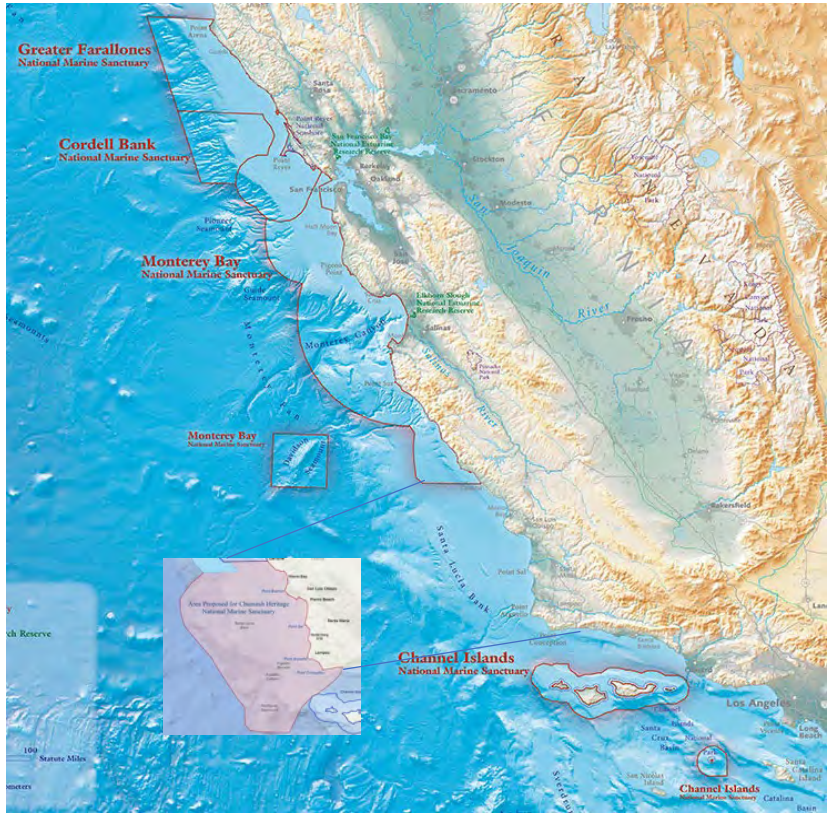
1. **National Marine Sanctuaries** (4-5 in California)
    - Greater Farallones
    - Cordell Bank
    - Monterey Bay
    - Chumash Heritage (proposed)
    - Channel Islands



# National Marine Sanctuary Goals

"safeguard marine areas with special ecological, cultural, and historical significance"

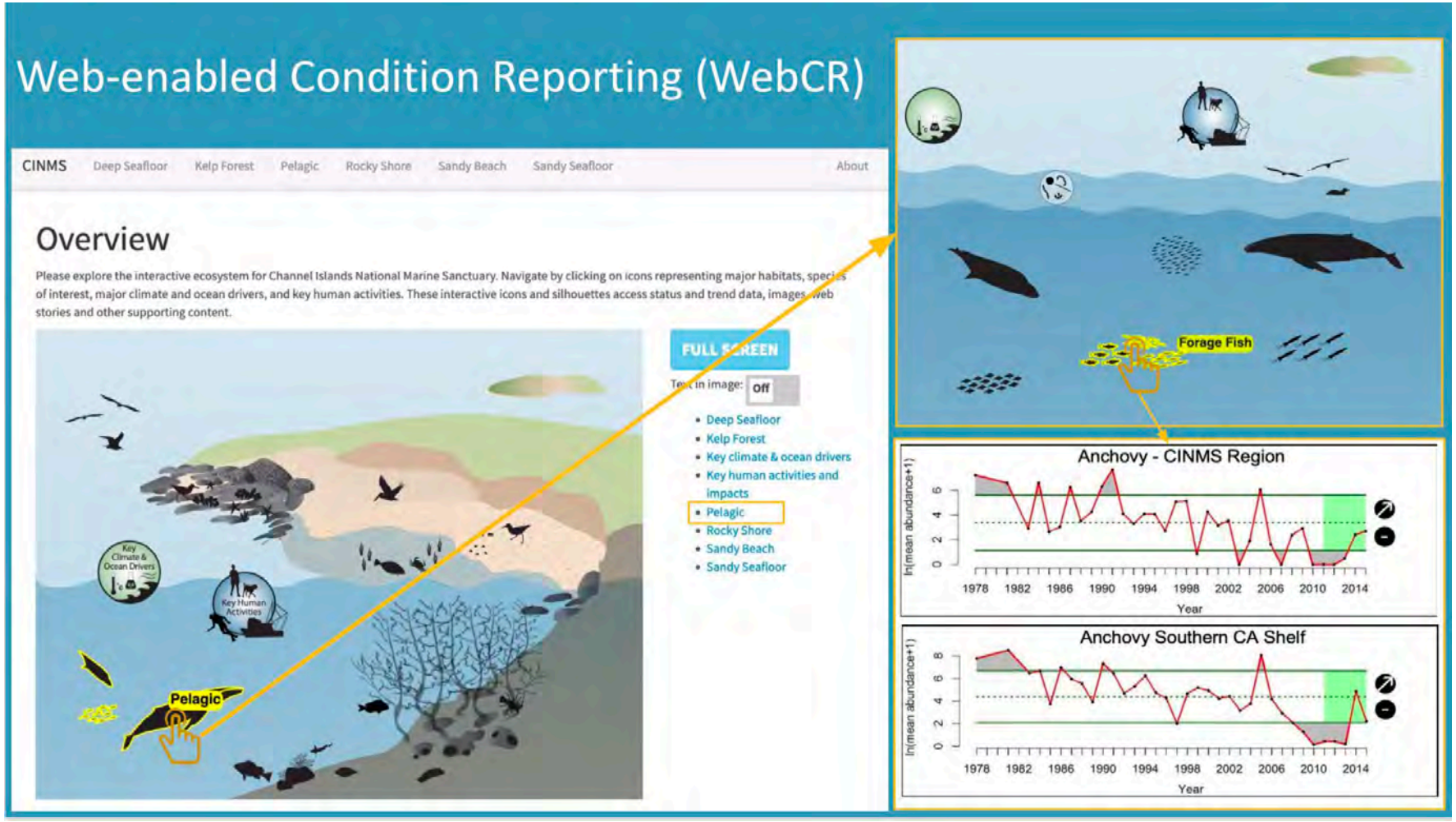
- habitat protection
  - seafloor
  - water quality
  - soundscapes
  - harmful algal blooms
- species and ecosystem conservation
  - natural biodiversity
  - ecosystem functioning



# National Marine Sanctuary Performance Evaluation

- Sanctuary Condition Reports
  - trends and state
  - pressures, resources, ecosystem services
- Climate Vulnerability Assessments
  - forecasting
- OOS's crucial to both

# National Marine Sanctuary Performance Evaluation




It’s about web-based automation and data streams

# West coast, especially California, has two primary forms of MPAs

## 2. California State MPA Network

- **124** MPAs **total** within state waters
- 48 **no-take** State Marine Reserves (SMRs)
- 10 **no-take** State Marine Conservation Areas
- 61 **partial-take** State Mar. Conservation Areas
- 5 SMRMAs (allow waterfowl hunting)

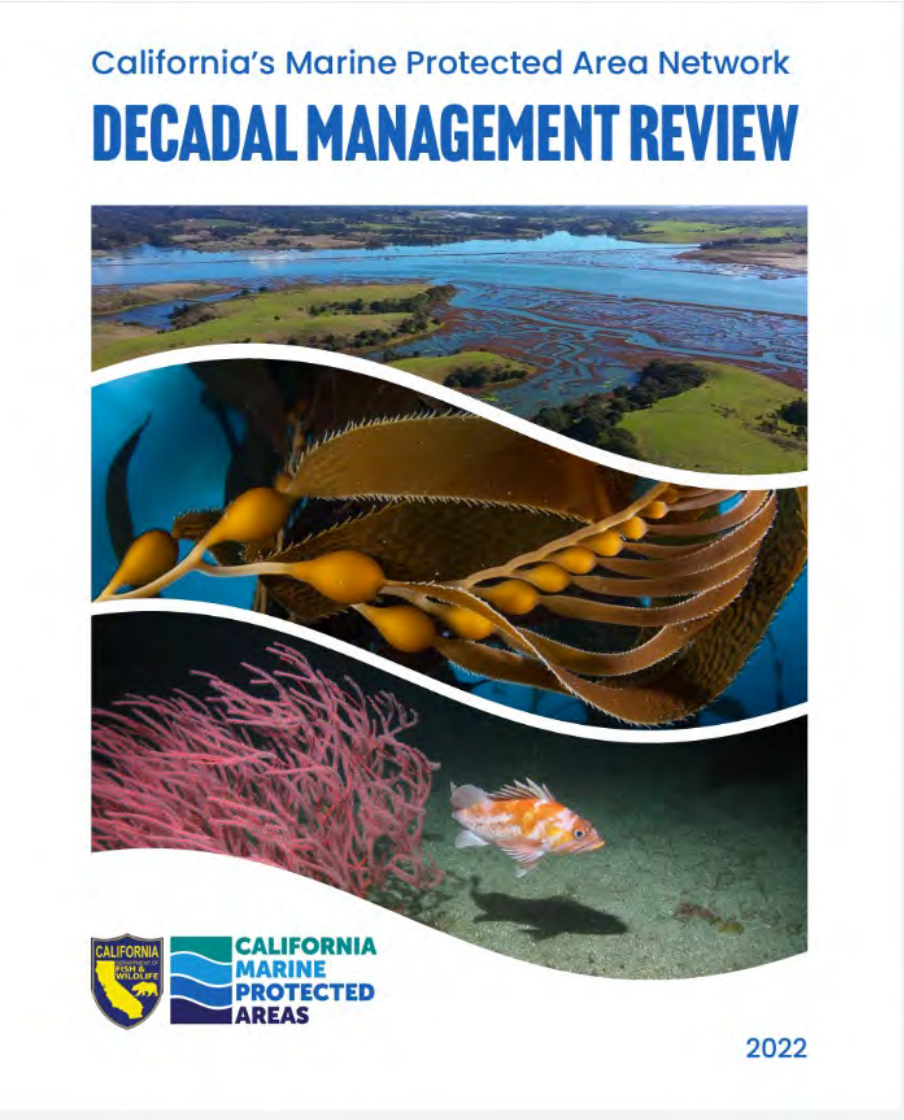
# California MPA Network Goals

1. Protect **natural diversity** and **ecosystem functions**.
2. Sustain and restore marine life **populations**.
3. Improve recreational, educational, and study **opportunities**.
4. Protect representative and unique **habitats**.
5. Clear objectives, effective management, adequate enforcement, sound science.
6. Ensure that MPAs are designed and managed as **a network**.

# California MPA Network Performance Evaluation

Two critical ecological assessments:

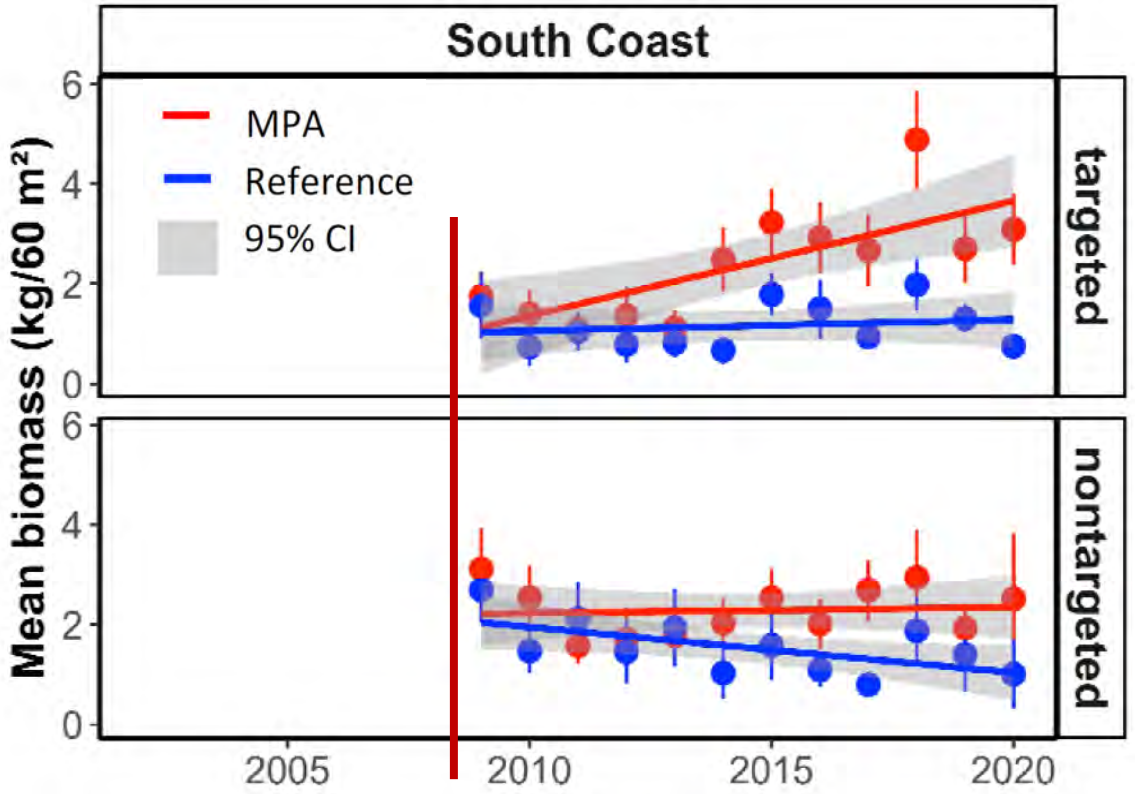
- Evaluate and **attribute** ecological conditions to the establishment of the MPAs
- Evaluate ecological **network** performance



# California MPA Network Performance Evaluation

1) Evaluate and **attribute** ecological conditions in nine coastal ecosystems to the establishment of the MPAs

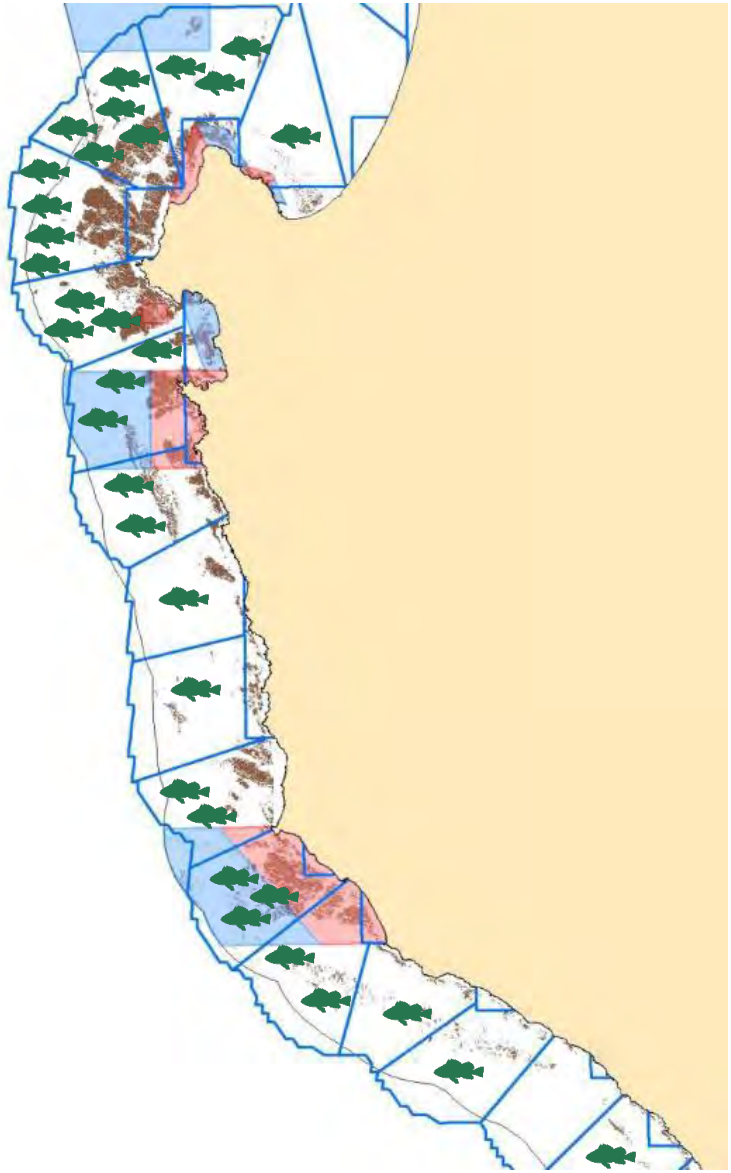
- Analytical design compares response variables (population, community, ecosystem) inside and outside of MPAs to determine if trajectories are diverging as hypothesized.
- Requires long-term ecological monitoring
- Requires long-term environmental monitoring



# California MPA Network Performance Evaluation

2) Evaluate ecological **network** performance

- Analytical design is to compare network-wide population connectivity (larval production, dispersal, delivery) and size with and without MPAs
- Requires ROMS, habitat maps, species life history and demographic variable, spatial and temporal patterns of fishing mortality
- Requires integrated **empirical** ecological and environmental monitoring



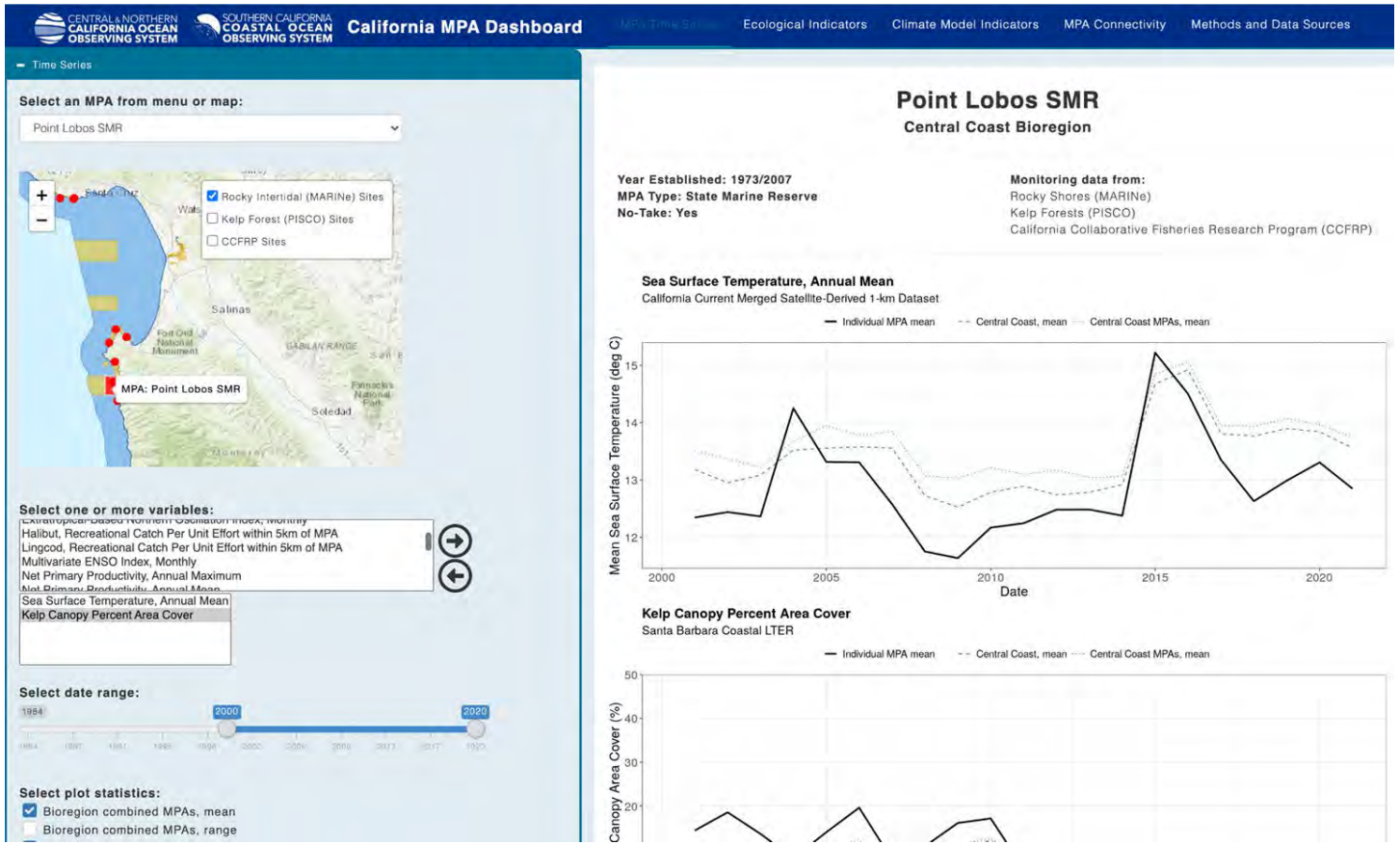
# California MPA Network Performance Evaluation

For both, **climatic perturbations impair and complicate evaluations**

- **Example:** 2014-16 marine heatwave
- Proper evaluation requires “near real-time” and forecasted, spatially explicit knowledge of environmental conditions
- Among these are **current** and **forecasted** regional ocean modeling system (ROMS) characterizations of **circulation** patterns and, preferably linked to **biotic** (nutrient-phytoplankton-zooplankton-detritus) responses (e.g., NEMURO)
- Past and near-term predictions must be **ground-truthed**

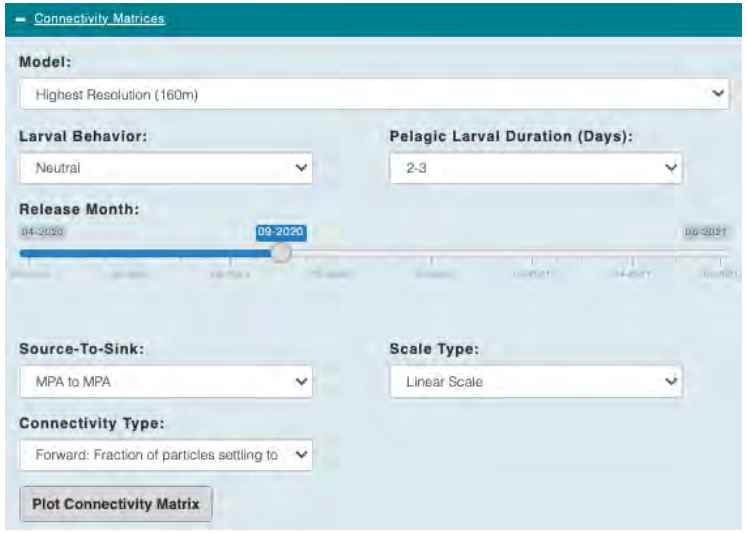
# California MPA Dashboard: mpa-dashboard.caloos.org

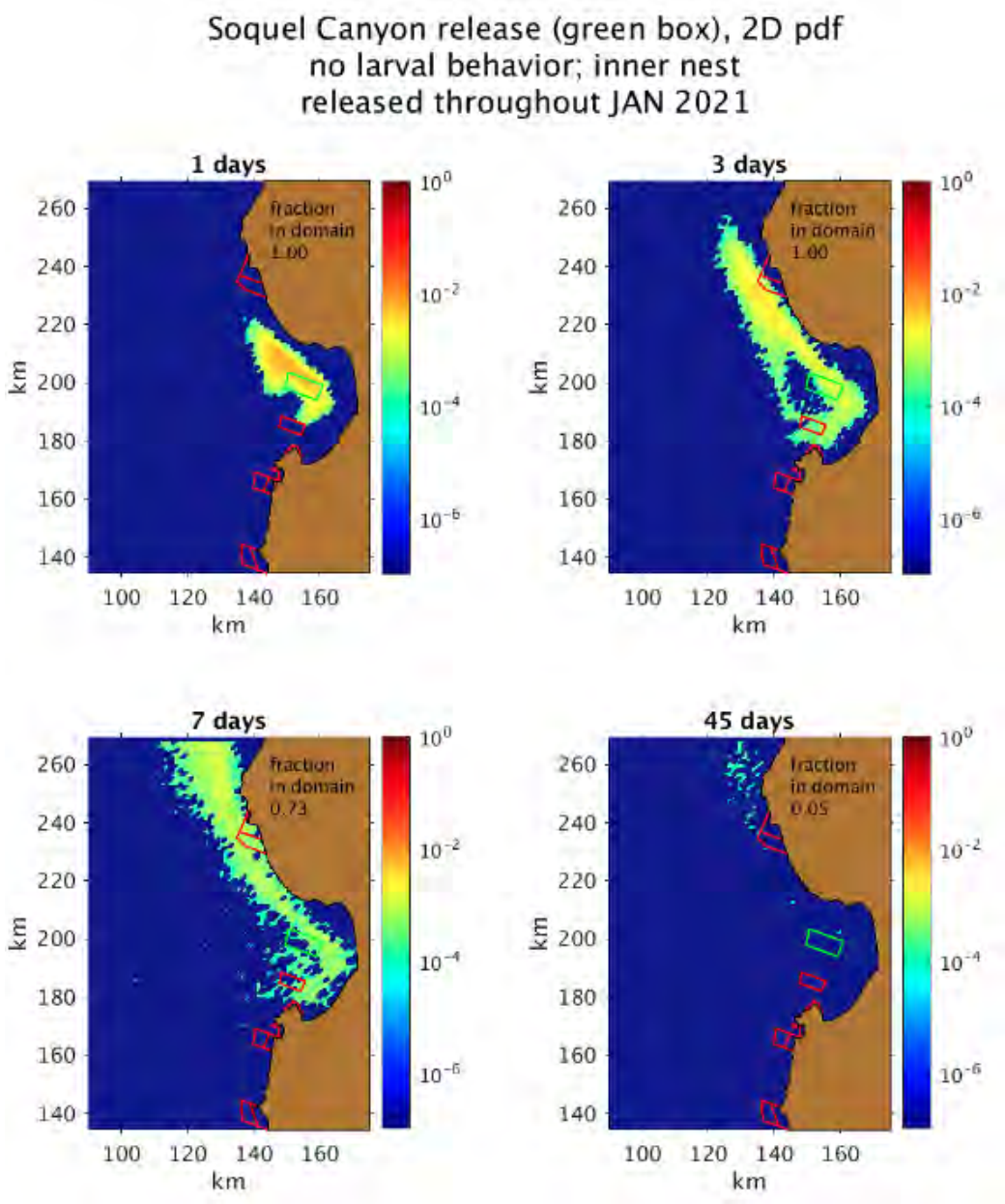
- Customized visualizations of the datasets via the interactive California MPA Dashboard application;
- Streamlined access to curated sets of environmental and ecological MPA data, generated through documented and replicable data processes;




N. Low, F. La Valle, LaScala-Gruenewald, Anderson, Ruhl, Edwards, et al.

# High-resolution models of MPA connectivity in MB region

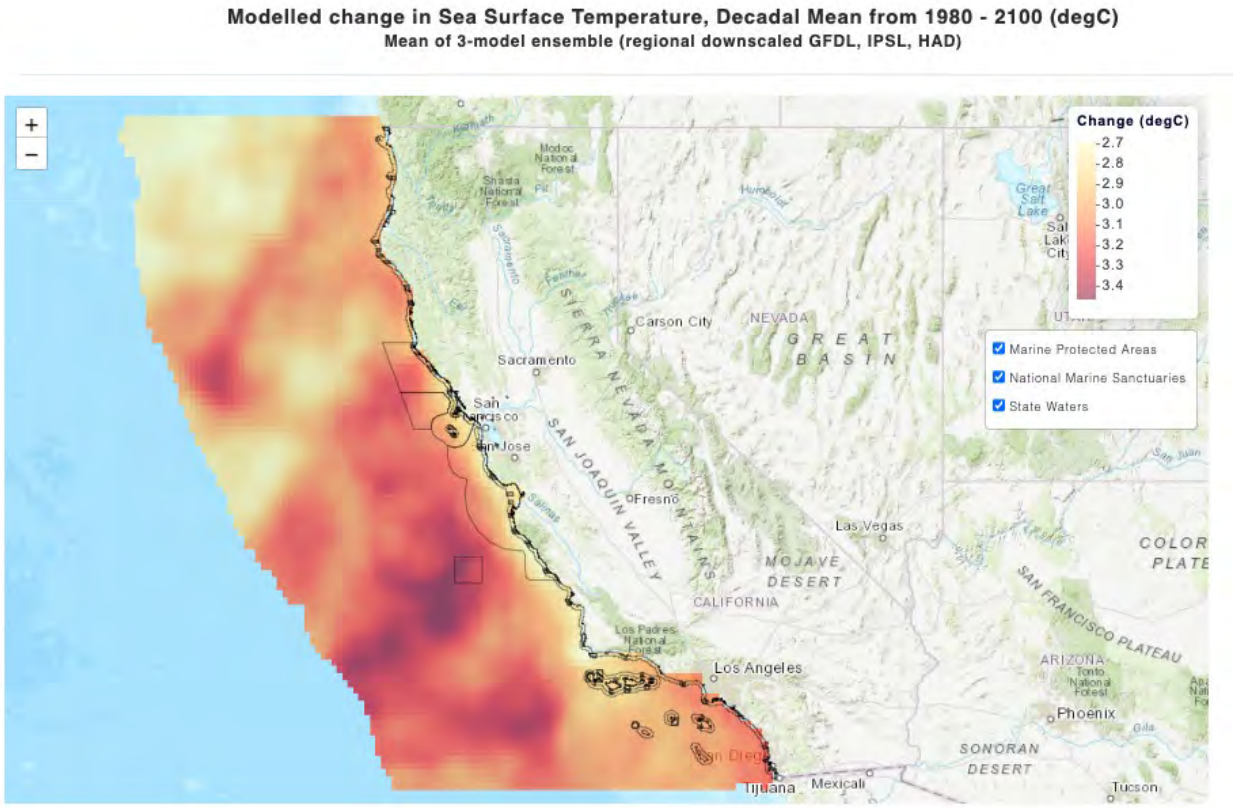


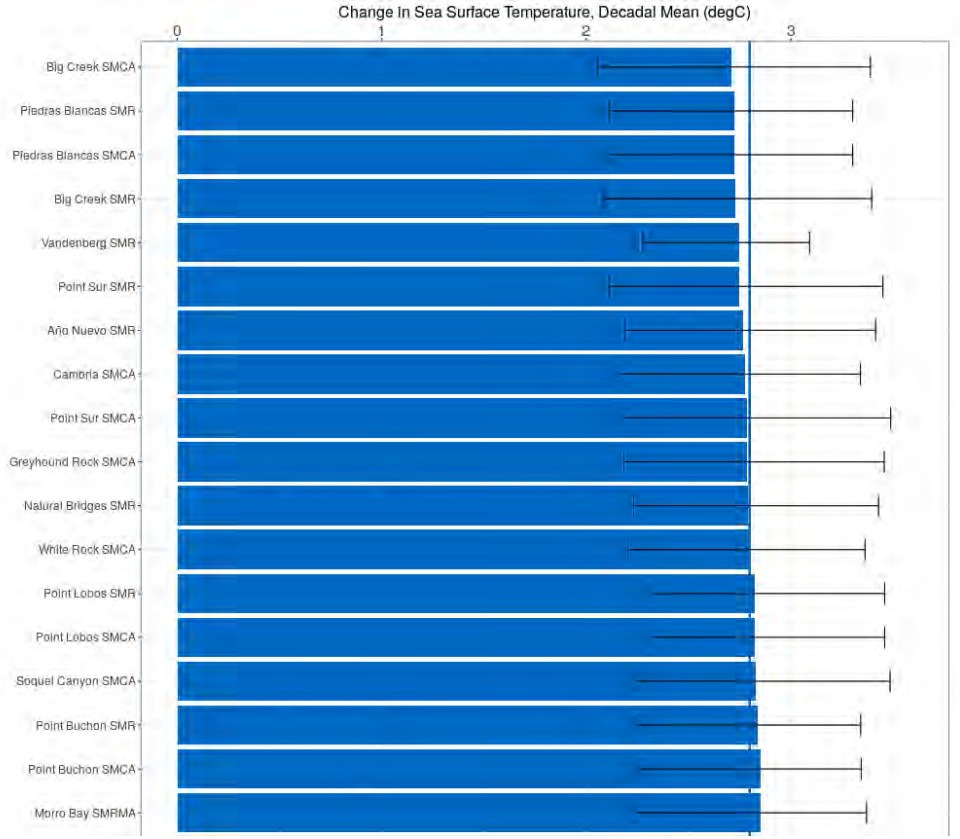




- Customizable release time, planktonic larval duration, and behavior (remaining in surface boundary layer, below it or vertically migrating)
- Across all key scenarios, all nearshore cells received modeled larvae from at least one of the MPA locations within the greater Monterey Bay area.
- This suggests that MPAs were sufficiently spaced that protected regions experienced larval exchange dependent on pelagic larval duration, time of release, and larval behavior.

# Estimates of climate change risk for bioregions and MPAs

- Regional Ocean Modeling System (ROMS) + North Pacific Ecosystem Model for Understanding Regional Oceanography (NEMURO), run with downscaled ESMs (Pozo Buil et al. 2021)
- Mapping ocean changes (1980-2100) for key climate indicators:
  SST (Decadal Mean, Max), Dissolved Oxygen (Decadal Mean), Chlorophyll a (Decadal Mean)
- Comparison of outputs by MPA, bioregions




*reference line = SST decadal mean across all Central Coast State waters

# Take Home

For both National Marine Sanctuaries and California MPA Network:

- Assessments require technology that facilitates…
- "Near real-time" (and preferably forecasting) coupled environmental-ecological **models** (e.g., ROMS, NEMURO)
- "Near real-time" **empirical** environmental AND ecological **data** to inform and ground truth models
- Web-enabled data accessibility

Otherwise, the ability to properly interpret ecological responses and network performance is greatly impaired

# Thank you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