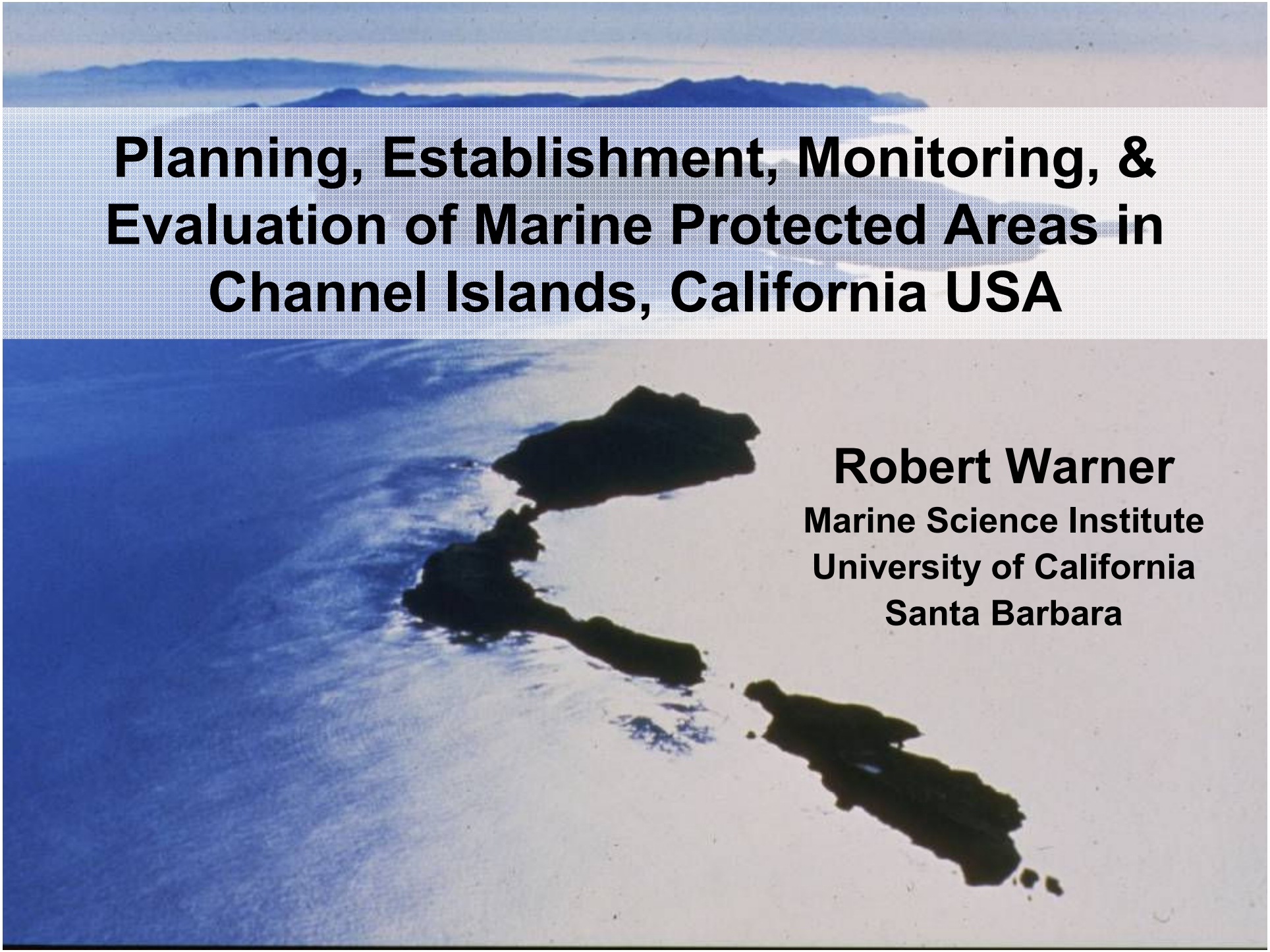
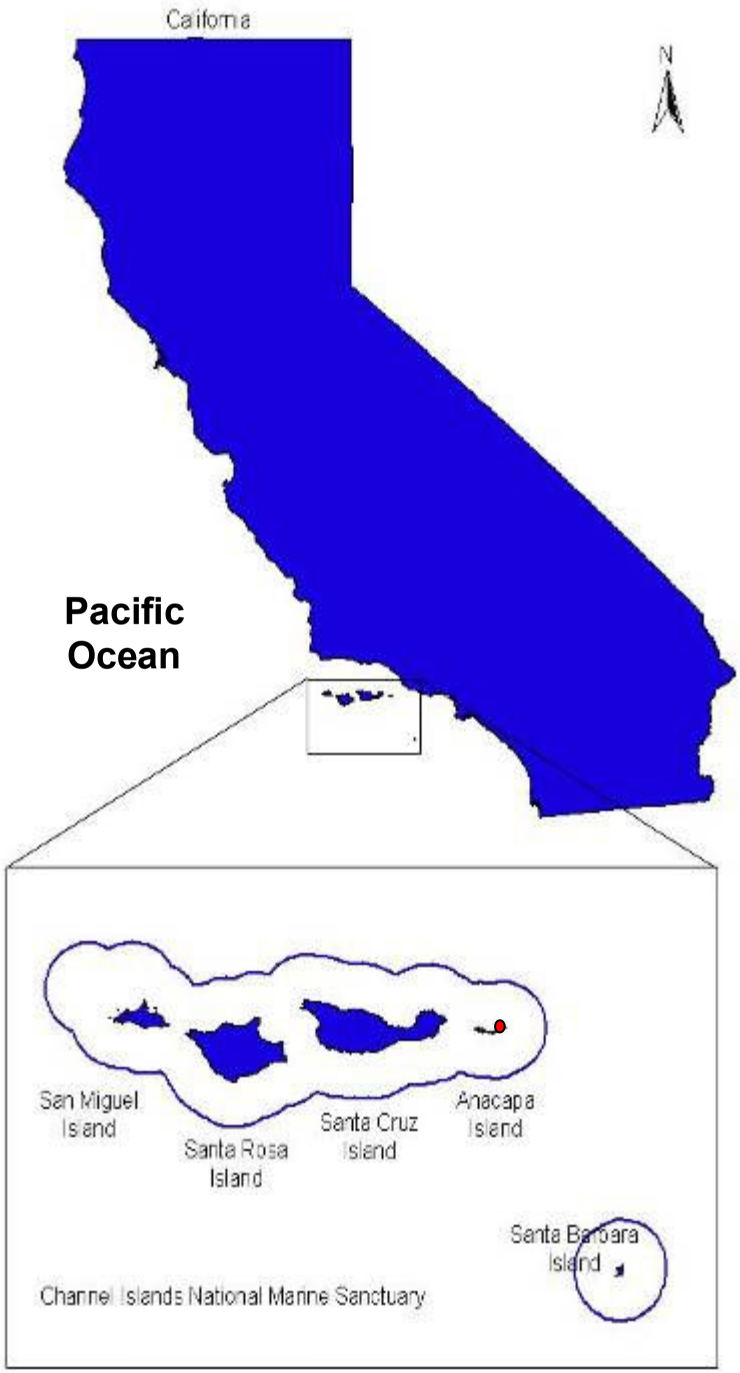
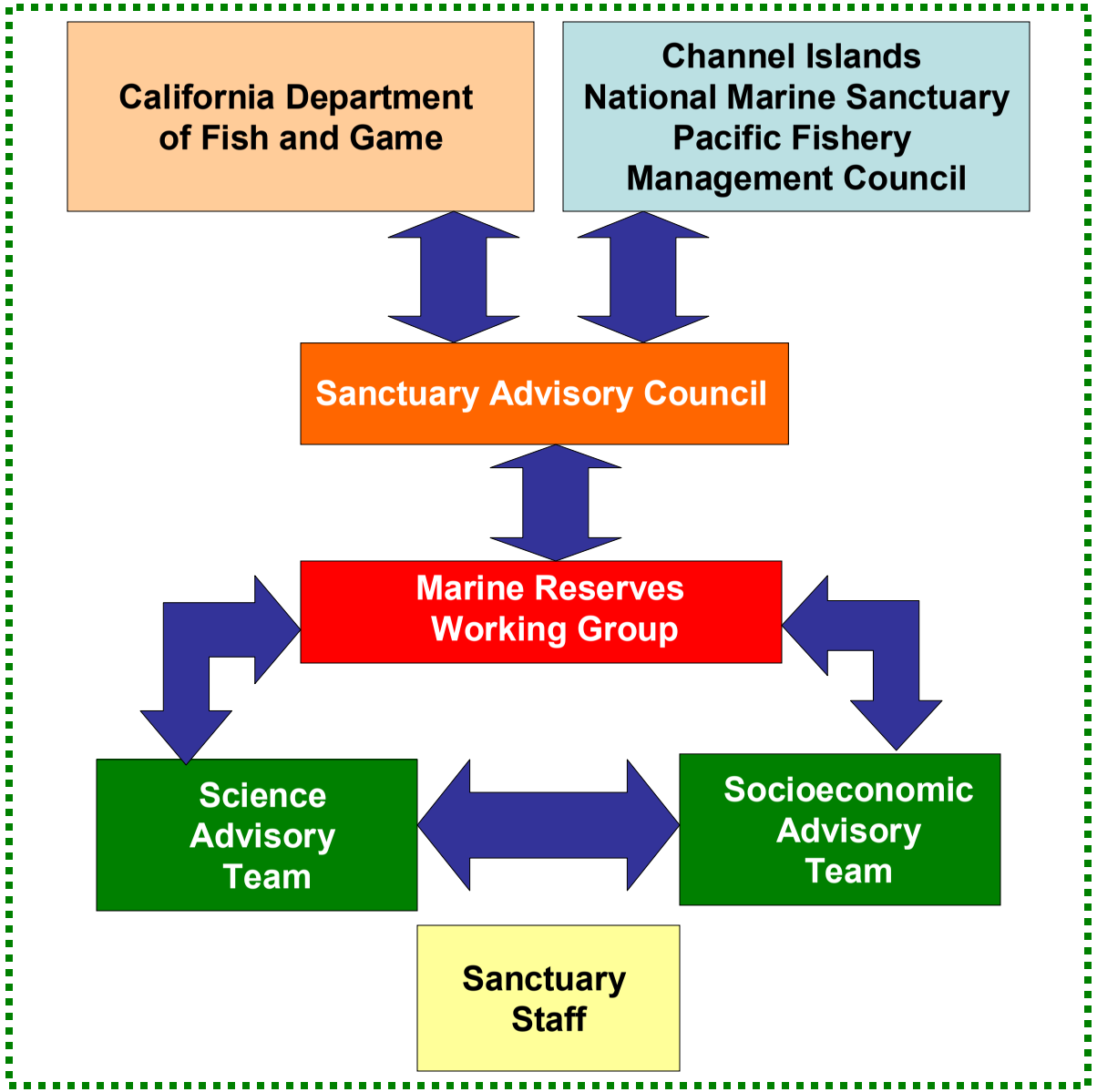
Planning, Establishment, Monitoring, & Evaluation of Marine Protected Areas in Channel Islands, California USA



Robert Warner
Marine Science Institute
University of California
Santa Barbara


California
N
Pacific Ocean
San Miguel Island
Santa Rosa Island
Santa Cruz Island
Anacapa Island
Santa Barbara Island
Channel Islands National Marine Sanctuary

Channel Islands Process



Consensus Problem Statement

"…The urbanization of southern California has significantly increased...the human demands on the ocean...

In recognizing the scarcity of many marine organisms relative to past abundance, any of the above factors could play a role.

Everyone concerned desires to…reverse or stop trends of resource decline, and to restore the integrity and resilience of impaired ecosystems..."

Channel Islands Marine Reserve Working Group (2000)

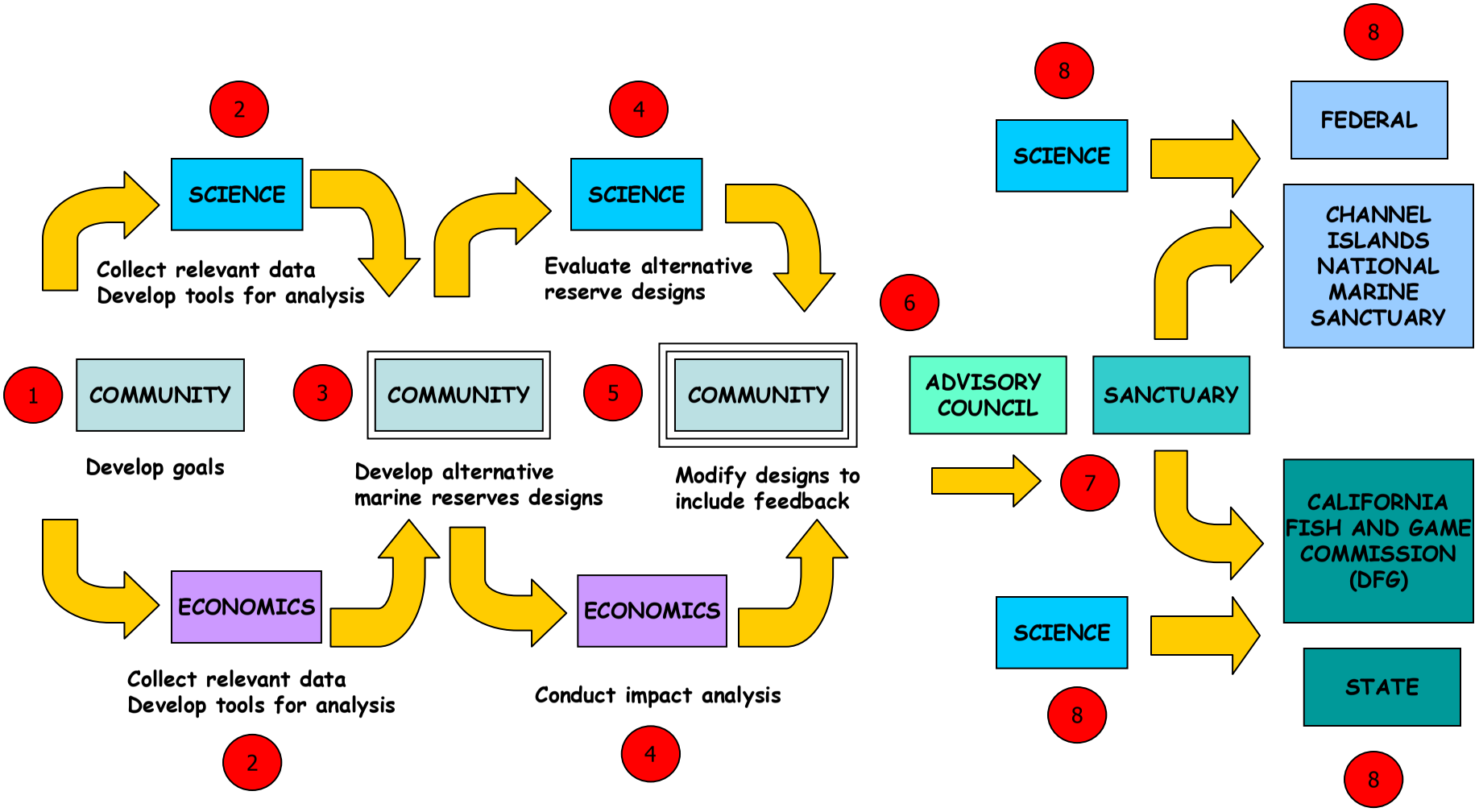
Consensus Problem Statement

"…To protect, maintain, restore, and enhance living marine resources, it is necessary to develop new management strategies that encompass an ecosystem perspective and promote collaboration between competing interests.

One strategy is to develop reserves where all harvest is prohibited…"

Channel Islands Marine Reserve Working Group (2000)

Overview of the Process



MRWG TASKS	SCIENCE PANEL INPUT
Develop goals and Objectives	← Provide evidence for reserve effectiveness, help shape goals
↓	
Decide on selection process (where, how big)	← Translate goals into criteria (NCEAS working group)
↓	
Develop reserve scenarios	← Use siting algorithms to develop alternatives
↓	
Evaluate alternatives	← Use same algorithms to evaluate for MRWG
↓	
Final recommendation	

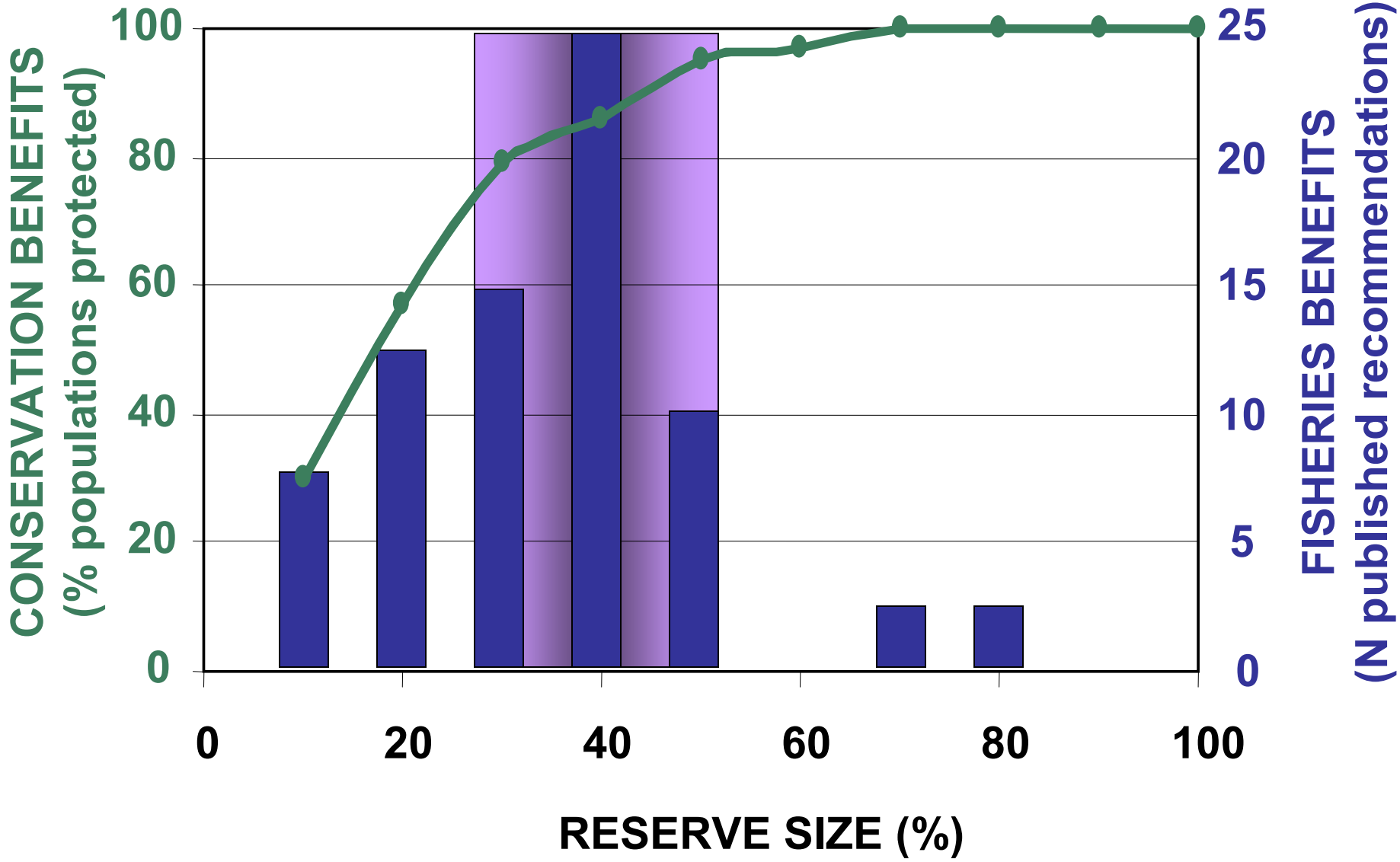
Goals for Marine Reserves

- *Protect ecosystem biodiversity*
- *Maintain long-term socio-economic viability and minimize short-term impacts*
- *Achieve sustainable fisheries*
- *Maintain areas for visitor, spiritual and recreational opportunities*
- *Provide educational and research opportunities*

Scientific Guidelines for Reserve Design

- **No single optimum network design (critical to allow flexibility)**
- **Include:** **all 'key' marine habitats in all biogeographic regions**
- **Extent:** **intertidal to deep water**
- **Size:** **30-50% of the study region**
- **Replication:** **3-5 replicates**
- **Consider:** **local resource use**
  stakeholder activities
  human perturbations
  natural catastrophes
- **Evaluate and monitor biological changes within MPAs.**

Recommended Reserve Size: 30-50%



Using siting algorithms to develop reserve alternatives: Sites/MARXAN

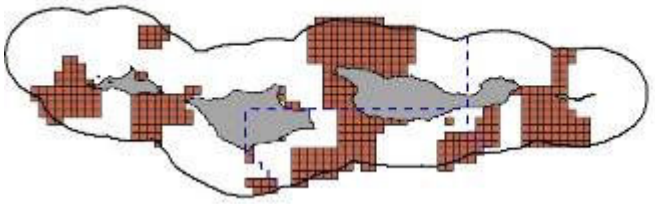
S. Andelman, I. Ball, F. Davis, D. Stoms

Site Selection Module developed by
I. Ball and H. Possingham

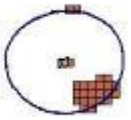
- Compares a very large number of alternative designs
- Identifies a variety of good solutions
- Attempts to meet conservation goals in a reserve network
- Attempts to minimize the total cost of the reserve network

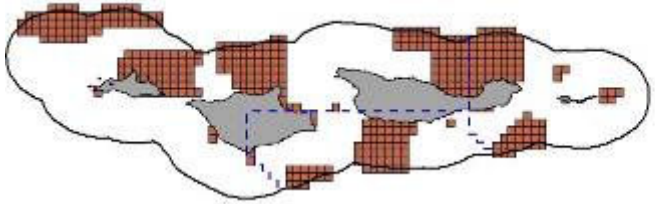
Range of Solutions

30% set aside

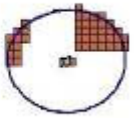


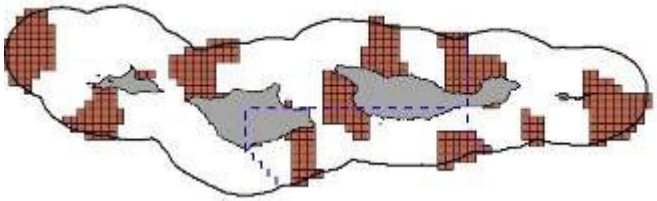
Option 1





Option 2





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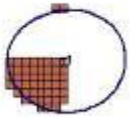
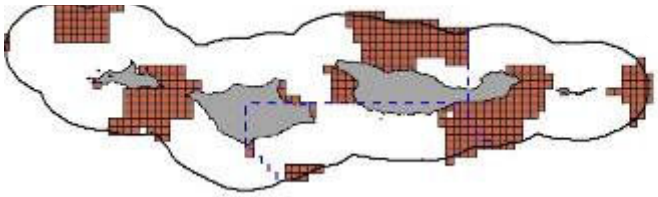
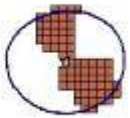
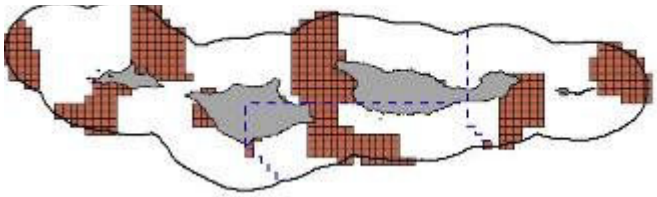


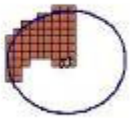


Option 4

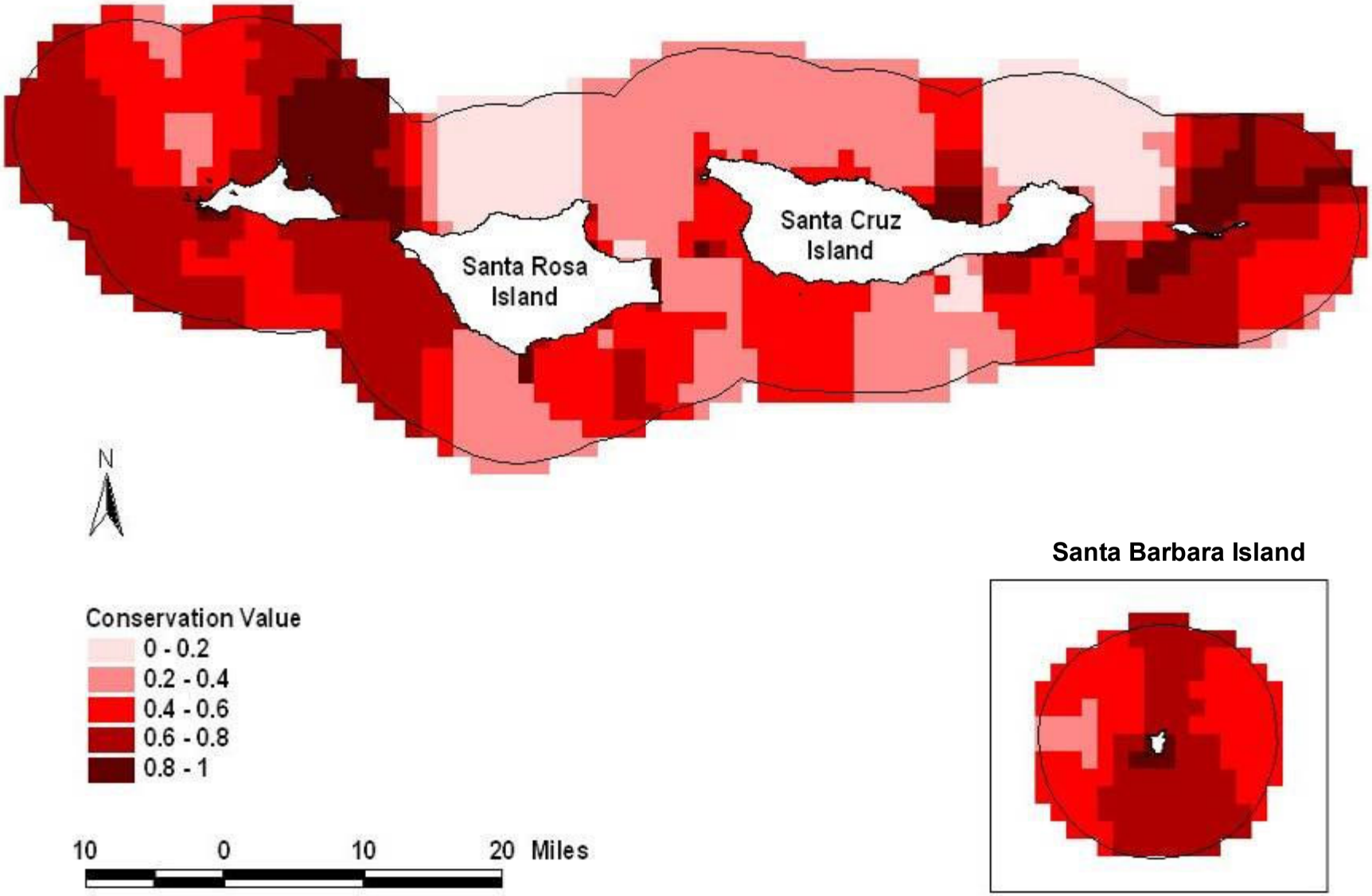




Option 5

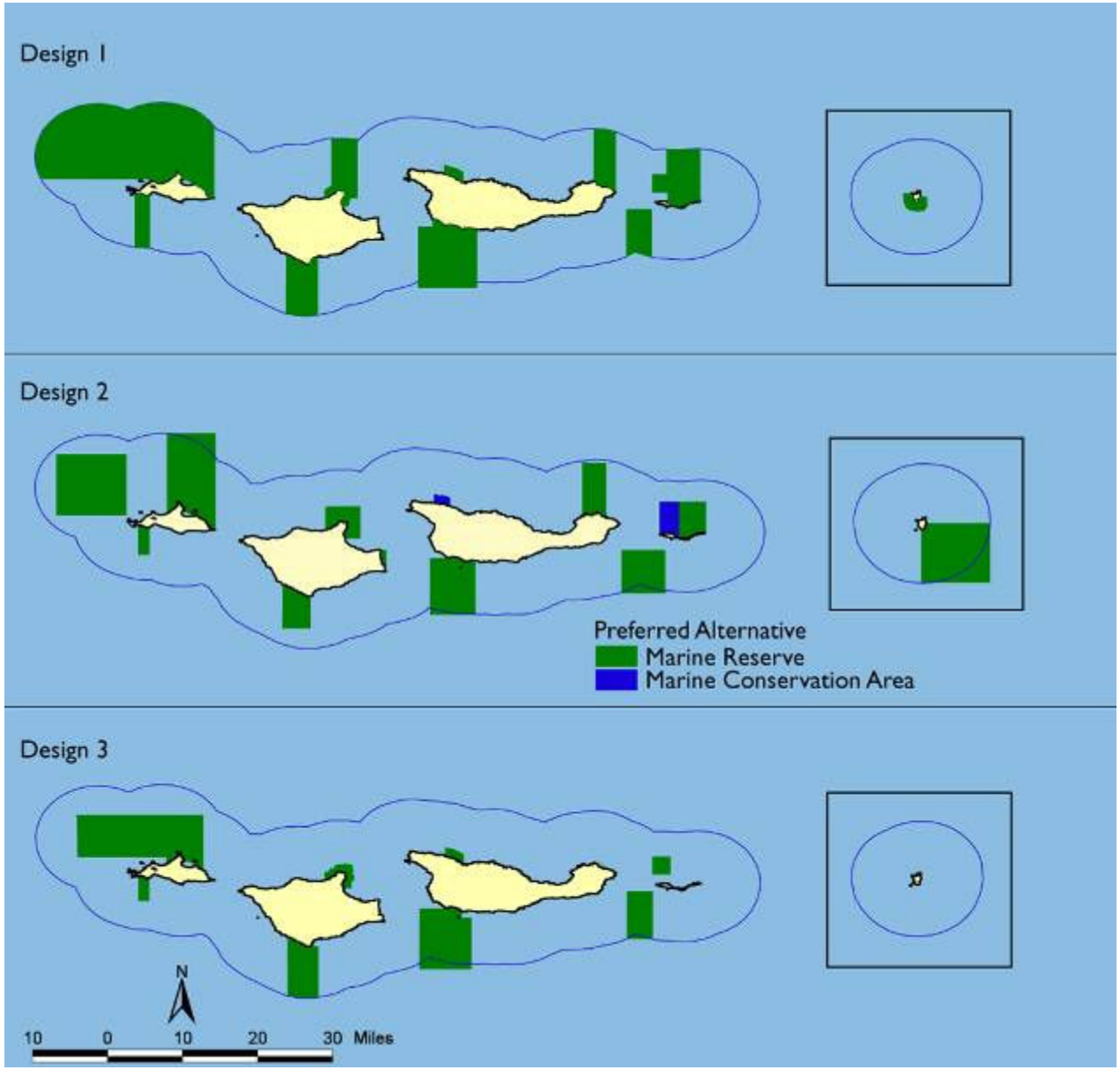


Irreplaceability Analysis

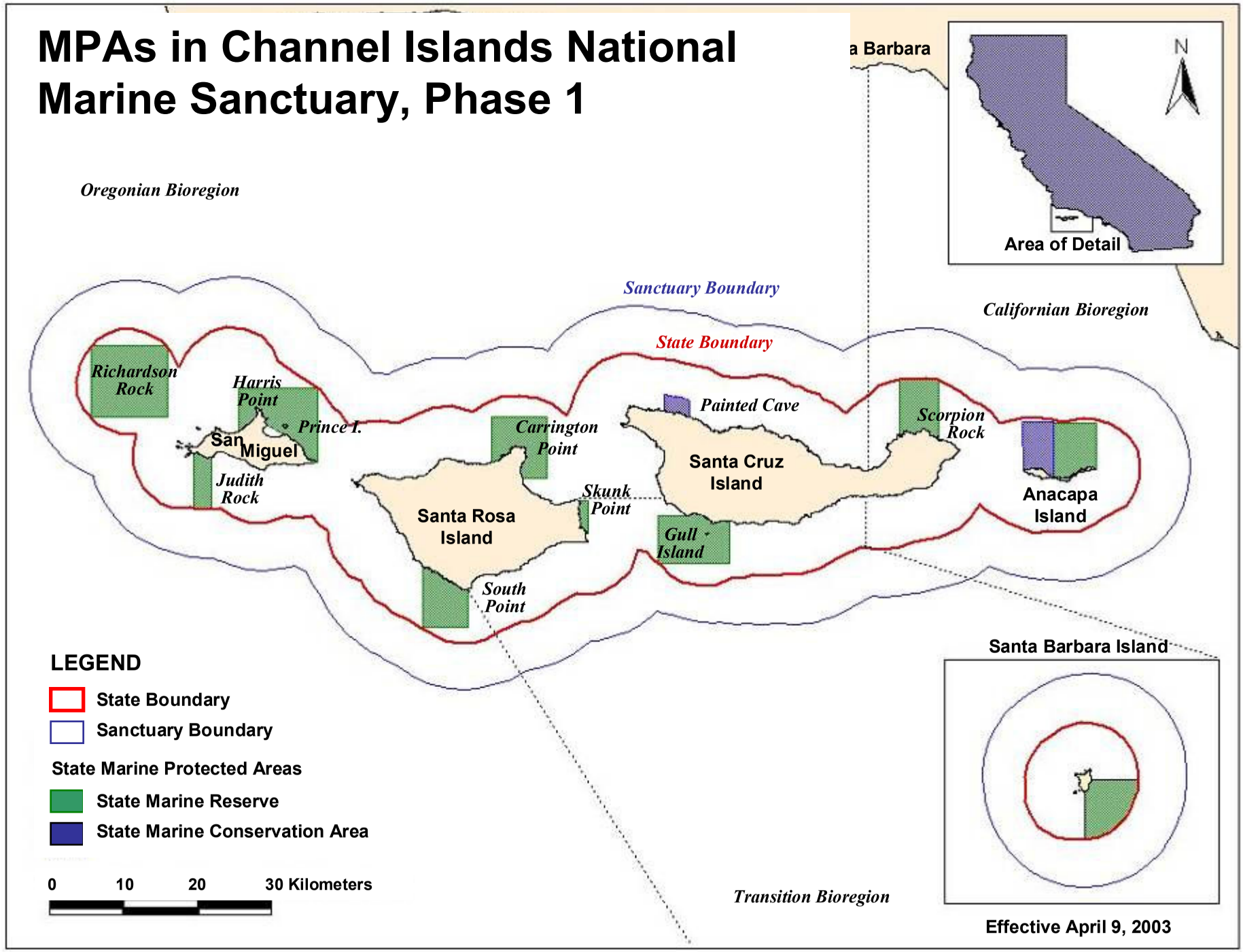


MRWG Spatial Analysis Tool: Use same algorithms to evaluate MRWG recommendations

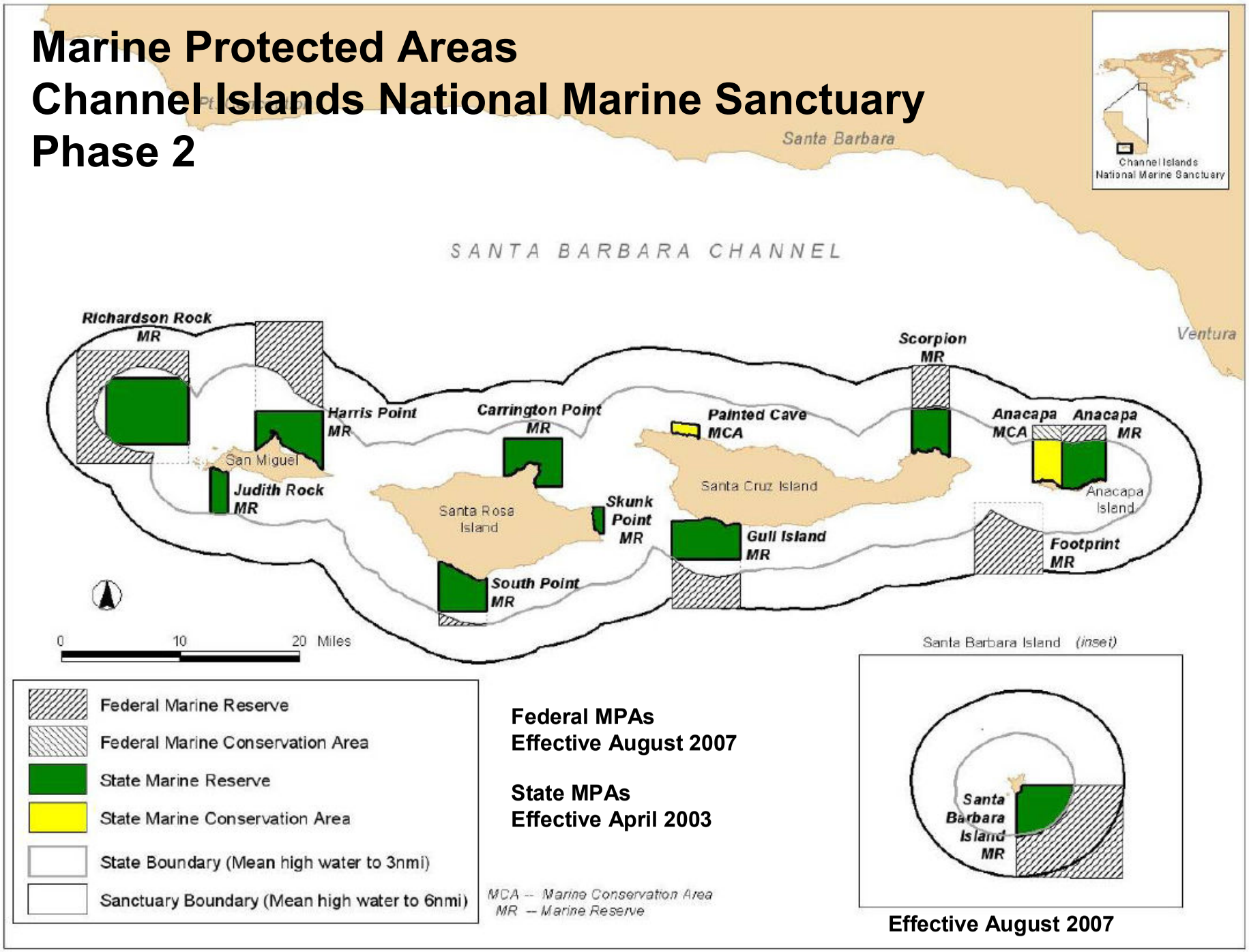
Options Generated by Marine Reserves Working Group



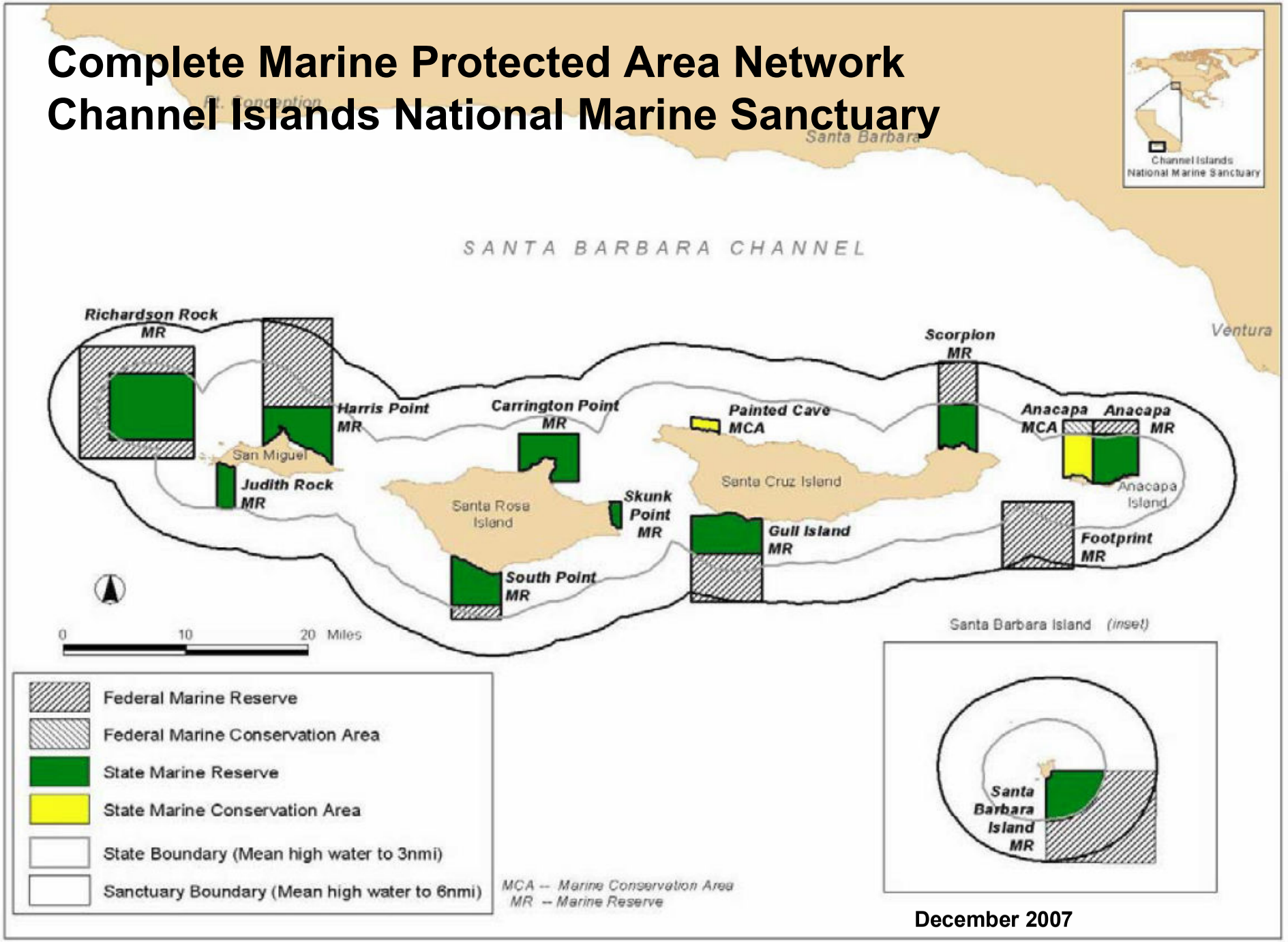
MPAs in Channel Islands National Marine Sanctuary, Phase 1



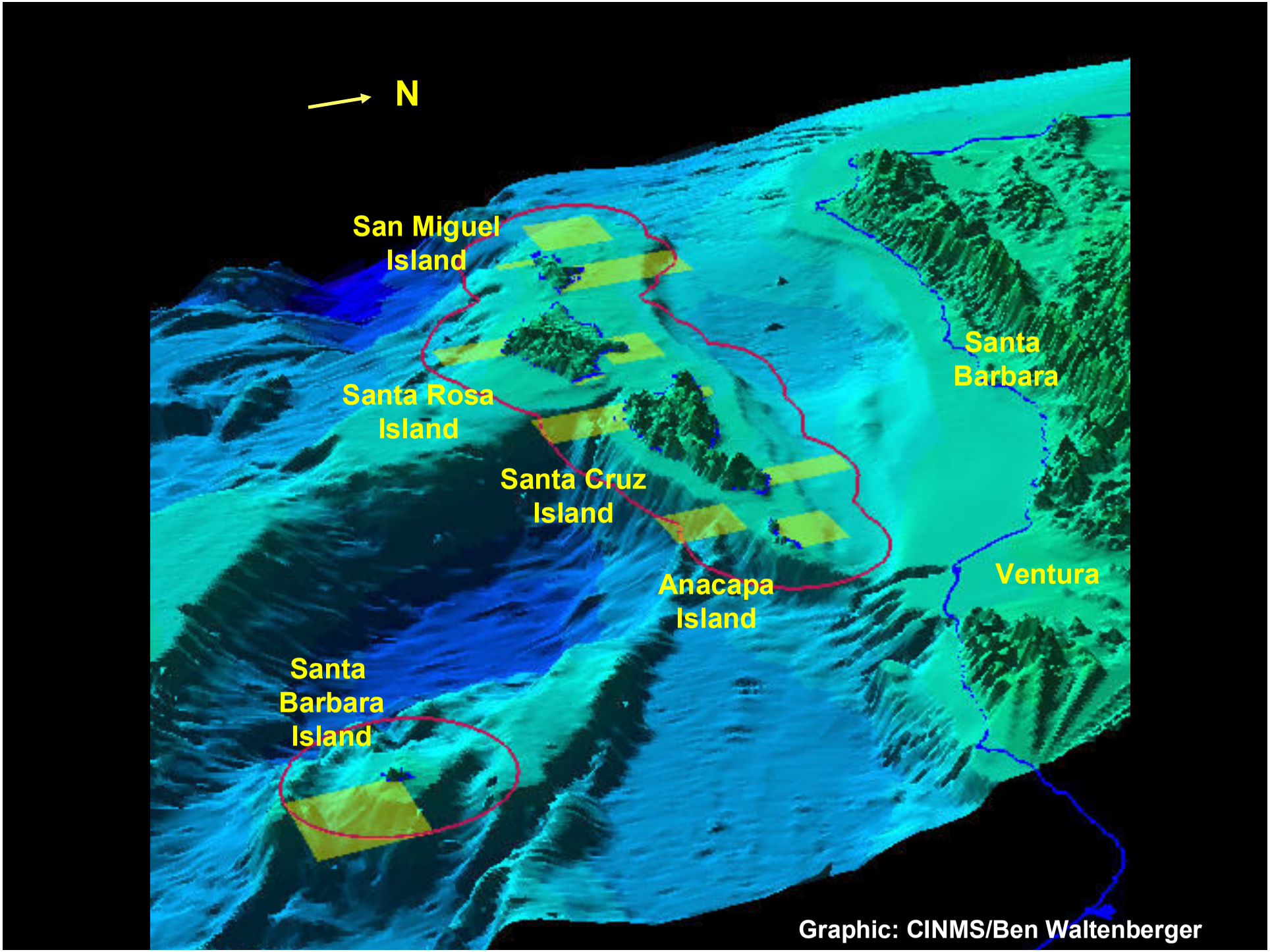
Marine Protected Areas
Channel Islands National Marine Sanctuary
Phase 2



Complete Marine Protected Area Network
Channel Islands National Marine Sanctuary



December 2007


N
San Miguel Island
Santa Rosa Island
Santa Cruz Island
Anacapa Island
Santa Barbara Island
Santa Barbara
Ventura
Graphic: CINMS/Ben Waltenberger

Size of Marine Protected Areas

Channel Islands National Marine Sanctuary

Type of MPA	No.	State Area (mi^2)	Federal Area (mi^2)	Total Area (mi^2)	% Study Region
No-take Reserves	11	108.2	146.3	254.5	20.3%
Conservation Areas (limited take)	2	9.1	2.3	11.4	0.9%
Total	13	117.3	148.6	265.9	21.2%

Channel Islands Marine Protected Areas

Monitoring Plan

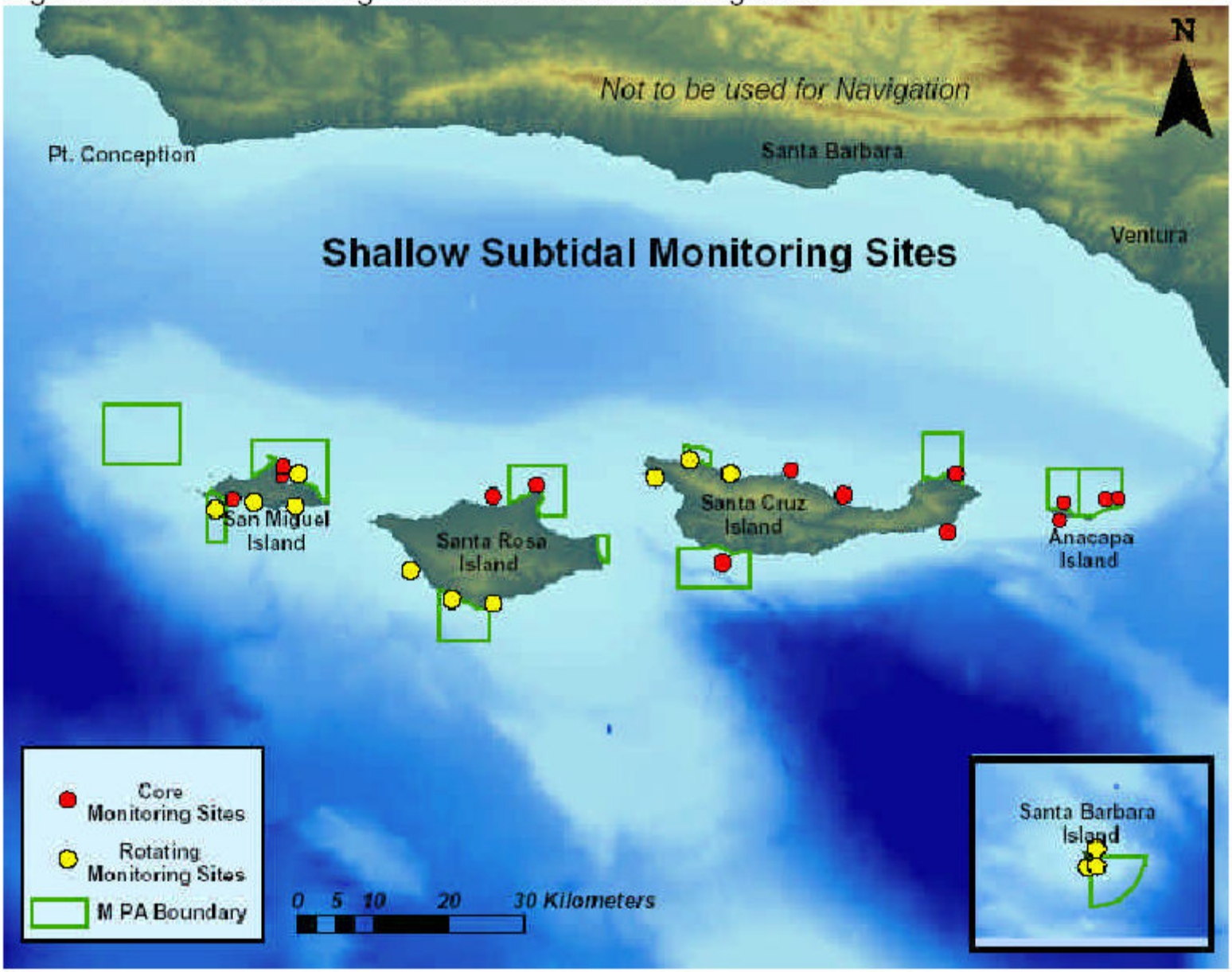
California Department of Fish & Game
February 2004

Key Questions about MPAs

- Abundance & size
- Species composition
- Marine habitats
- Spillover
- Catch rates
- Distribution of vessels

From CDFG Channel Islands MPA Monitoring Plan February 2004

Figure 1. Core and rotating shallow subtidal monitoring sites.



5-year review of Channel Islands MPAs: 2008

Fall 2007

MPA Monitoring Group meetings to assemble and analyze data, hosted by National Center for Ecological Analysis and Synthesis (NSF)

Feb 7-8, 2008

Special symposium on the first 5 years of monitoring the Channel Islands MPAs, Oxnard, California, USA

Dec 2008

California Fish and Game Commission review of the Channel Islands MPAs

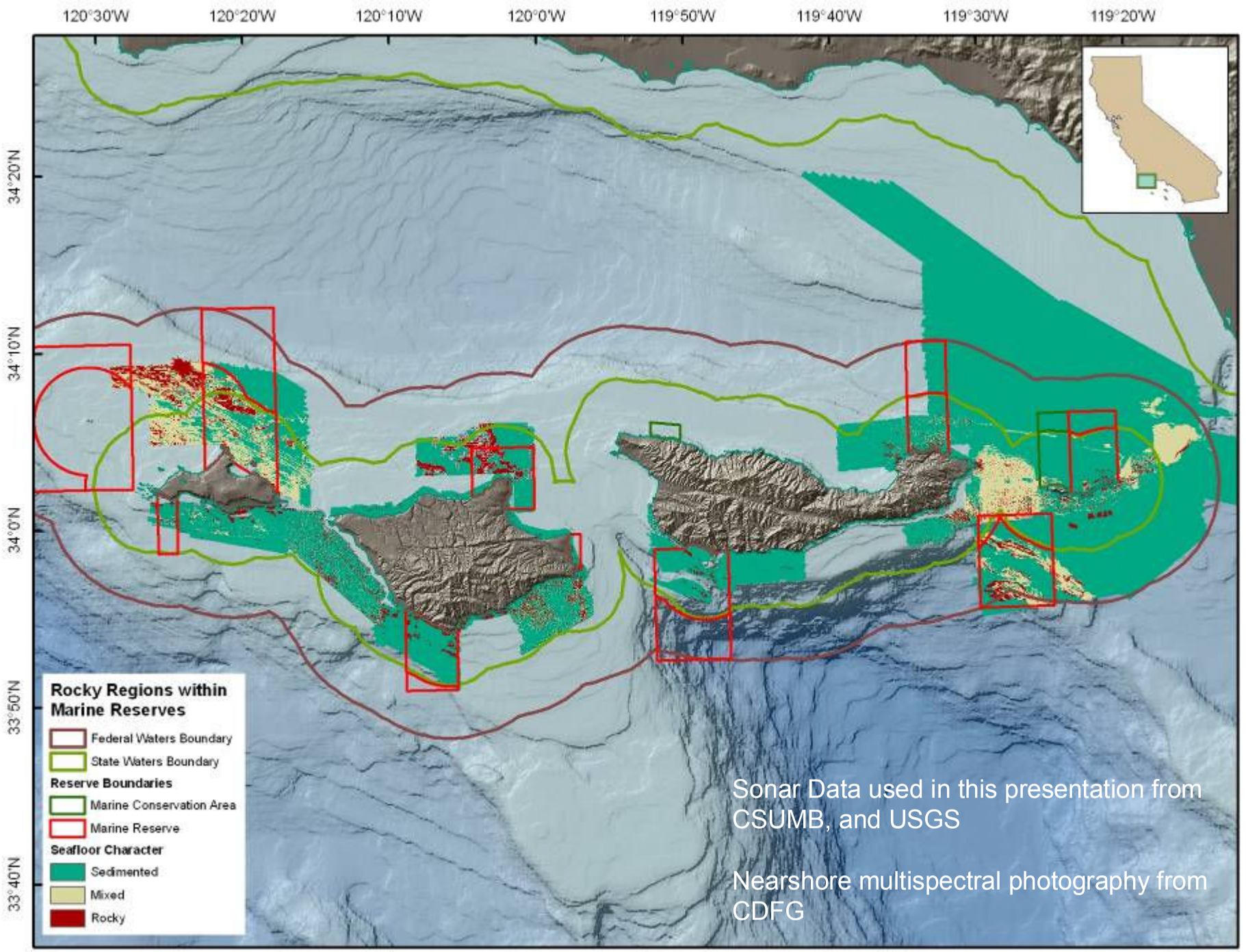
Ecological Monitoring

- Seafloor habitats
- Lobster trapping
- Abundance and size (SCUBA)
- Marine communities
- Fish abundance (ROV)
- Fish populations (volunteer divers)
- Fish movement (habitat effects)
- Fish movement (acoustic tagging)
- Kelp forest changes
- Ecosystem changes

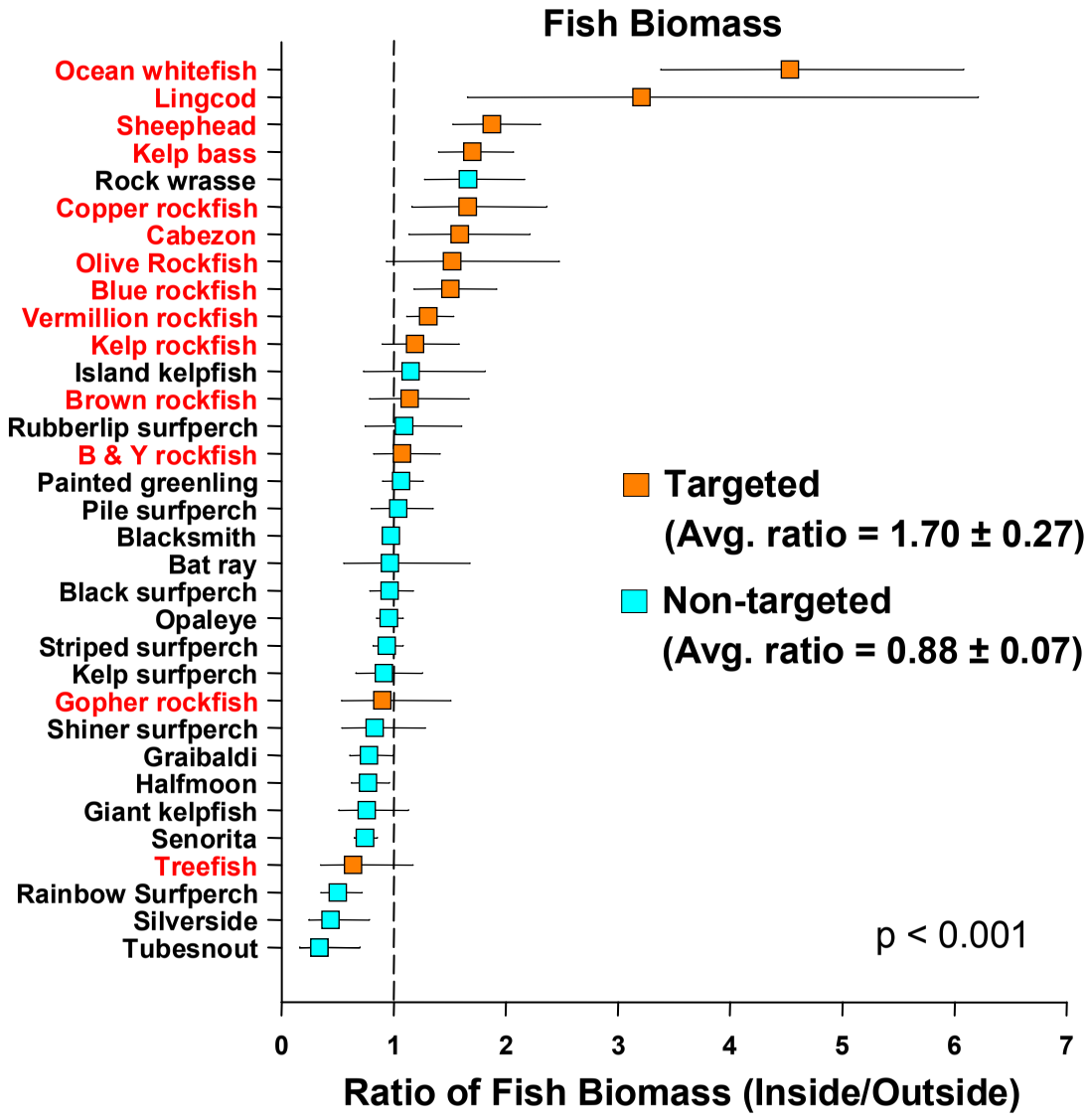
Socioeconomic Monitoring

- Vessel distributions
- Commercial fisheries
- Lobster fishery
- Recreational fishing
- Boater activities

From Special Symposium on the *First Five Years of Monitoring the Channel Islands Marine Protected Areas*, Oxnard, CA, February 8, 2008

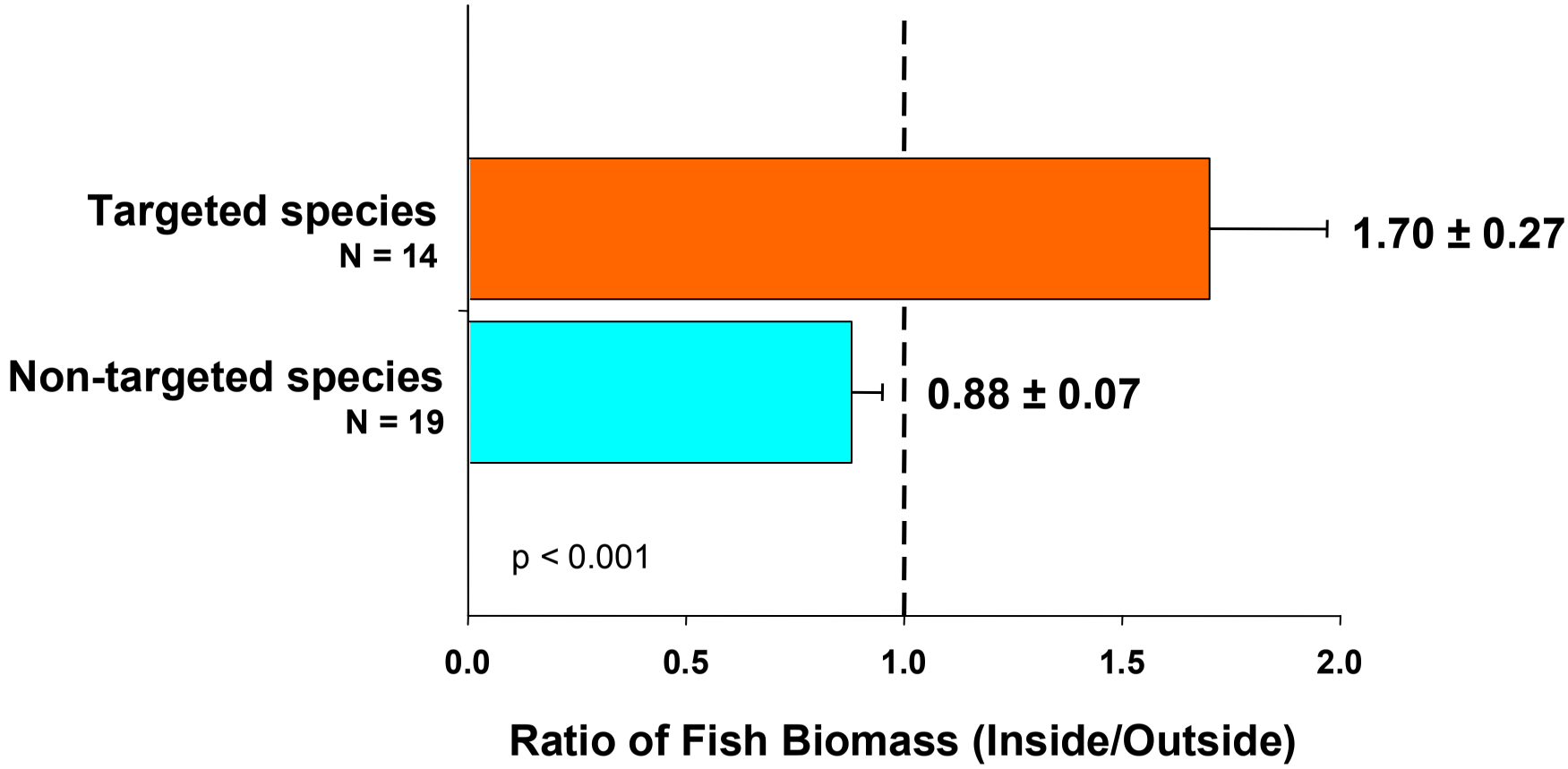

120°30'W
120°20'W
120°10'W
120°0'W
119°50'W
119°40'W
119°30'W
119°20'W
34°20'N
34°10'N
34°0'N
33°50'N
33°40'N
Rocky Regions within Marine Reserves
Federal Waters Boundary
State Waters Boundary
Reserve Boundaries
Marine Conservation Area
Marine Reserve
Seafloor Character
Sedimented
Mixed
Rocky
Sonar Data used in this presentation from CSUMB, and USGS
Nearshore multispectral photography from CDFG

Example: Biomass of targeted fish species is greater in reserves



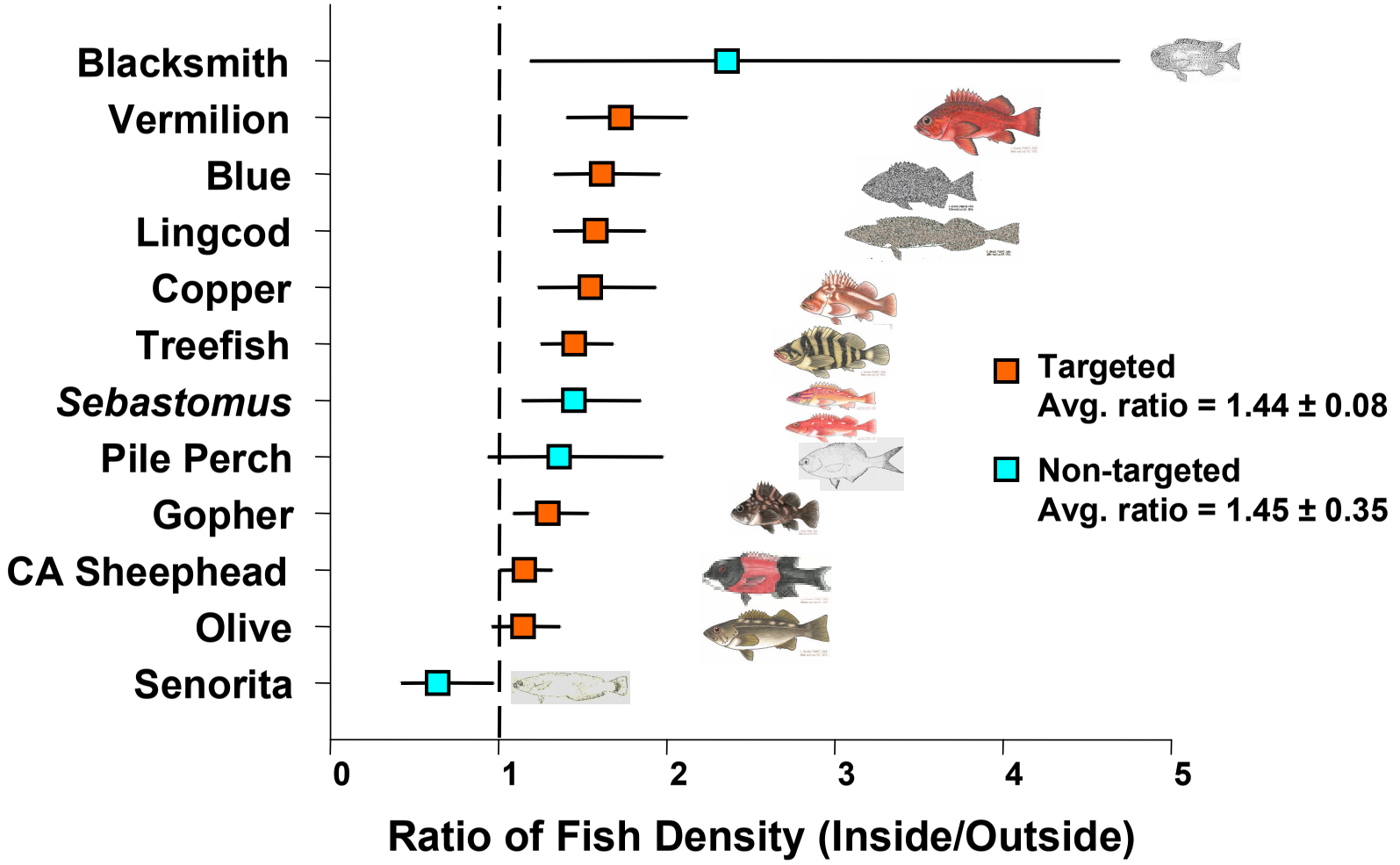
SCUBA Surveys (2005-2007)

Biomass of fish species inside vs. outside of reserves



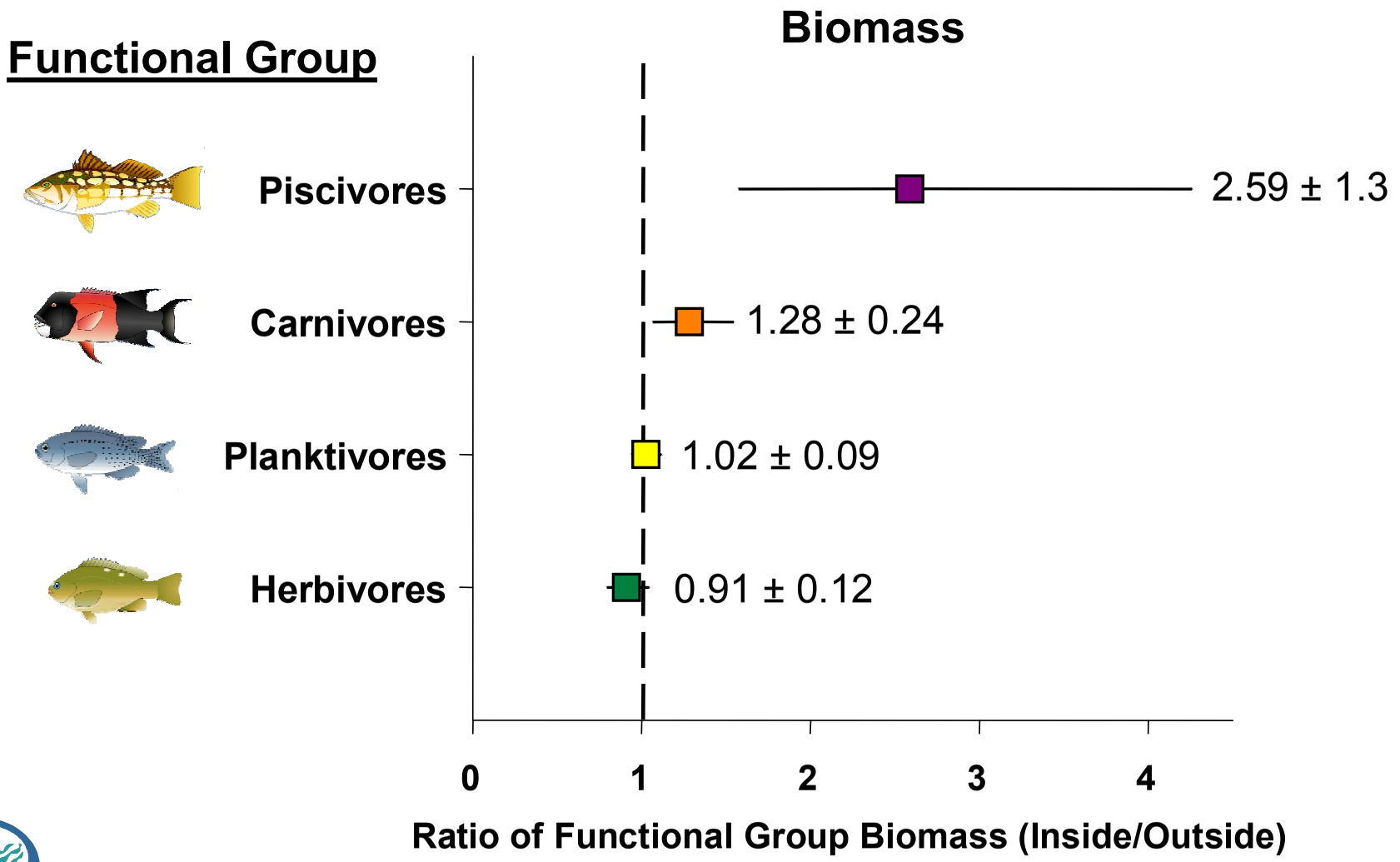
SCUBA Surveys (2005-2007)

Example: Fish Density from ROV Surveys in Deep Water



ROV Surveys (2005-2007)

Piscivores and carnivores show the strongest response to reserve protection



Important lessons for a bottom-up process

1. Early buy-in by all governmental agencies

2. Broad representation on the working group

3. Well-informed, active Science Panel involved in every step of the process:
   - Help to develop realistic goals
   - Translate these goals into criteria
   - Provide flexibility and alternatives so decision-making rests with the working group
   - Provide tools for working group to design and evaluate reserve alternatives

4. Include plans for long-term monitoring and evaluation

Key Players

- Channel Islands National Park (USA)
- California Department of Fish and Game
- Channel Islands National Marine Sanctuary
  - Marine Reserves Working Group, Science Advisory Panel, and Socioeconomic Advisory Team
- National Center for Ecological Analysis and Synthesis (NSF)
  - Marine Reserves Working Groups, MPA Monitoring Group
- Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)

Photo: Channel Islands National Marine Sanctuary

Bill Dewey

oto: Channel Islands National Marine Sanctuary

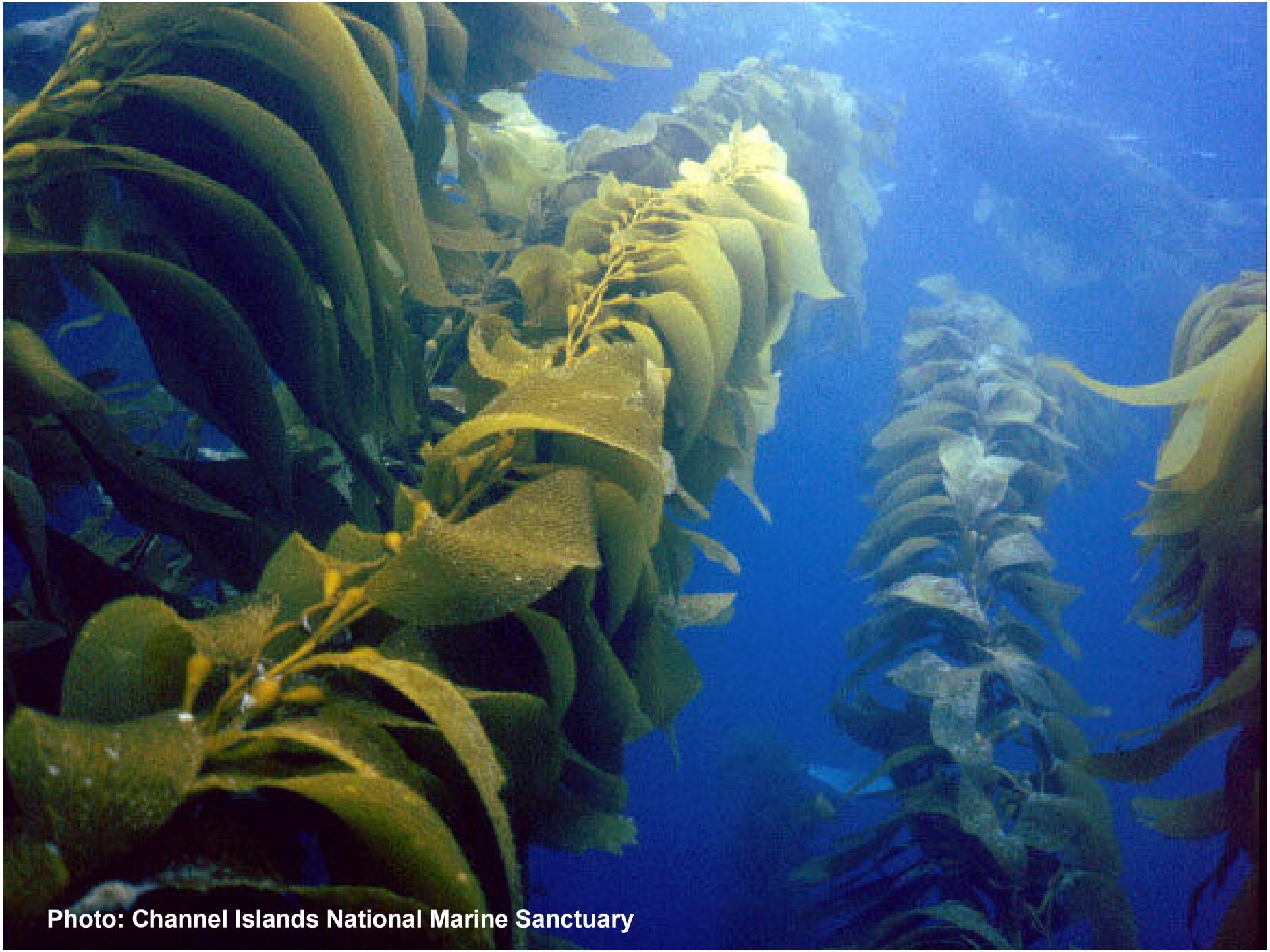


Photo: Channel Islands National Marine Sanctuary

Photo Credit: Annie Crawley
CINMS Image Library

Application of Sites/MARXAN

Site Selection Module attempts to minimize total cost of reserves:

$$Total\ Cost = \sum_i Cost\ site\ i \quad + \quad \sum_j Penalty\ \mathrm{cost}\ for\ element\ j \quad + \quad w_b \sum boundary\ length$$

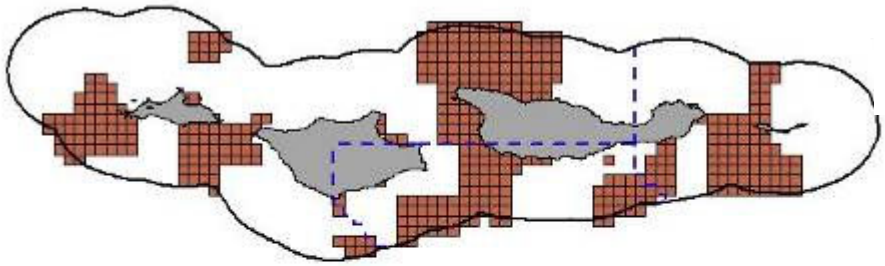
Parameters

- **Simulated Annealing**
- **Planning Units: 1 square nautical mile**
- **Annealing Iterations: 1,000,000**
- **Runs: 300-800, depending on size of biogeographic region**
- **Boundary Length Modifier: 0 - 1**

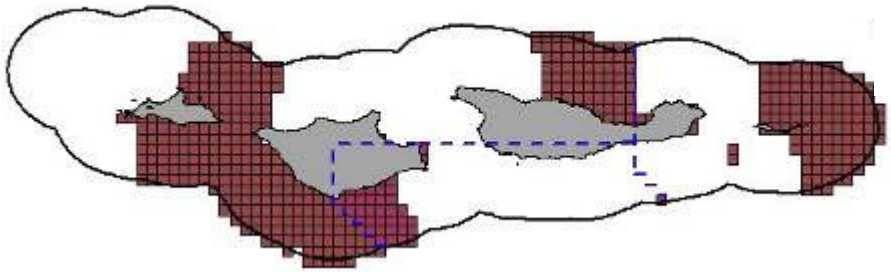
Large Range of Solutions

Conservation Target

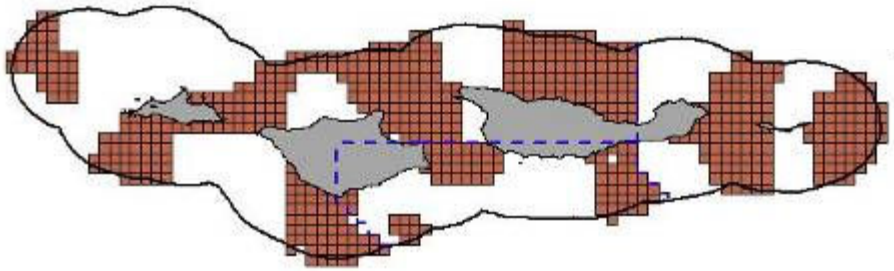
30%



40%

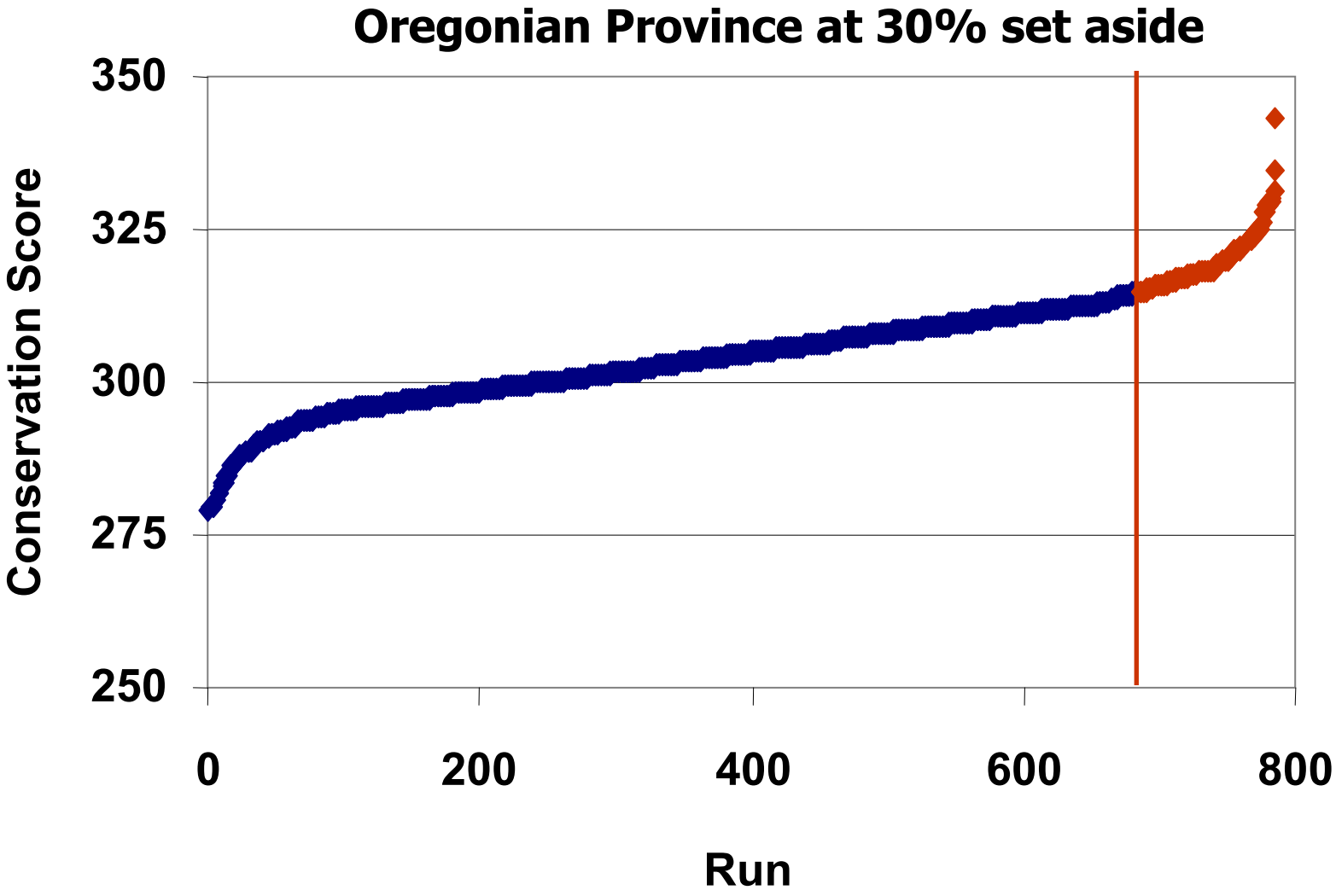


50%



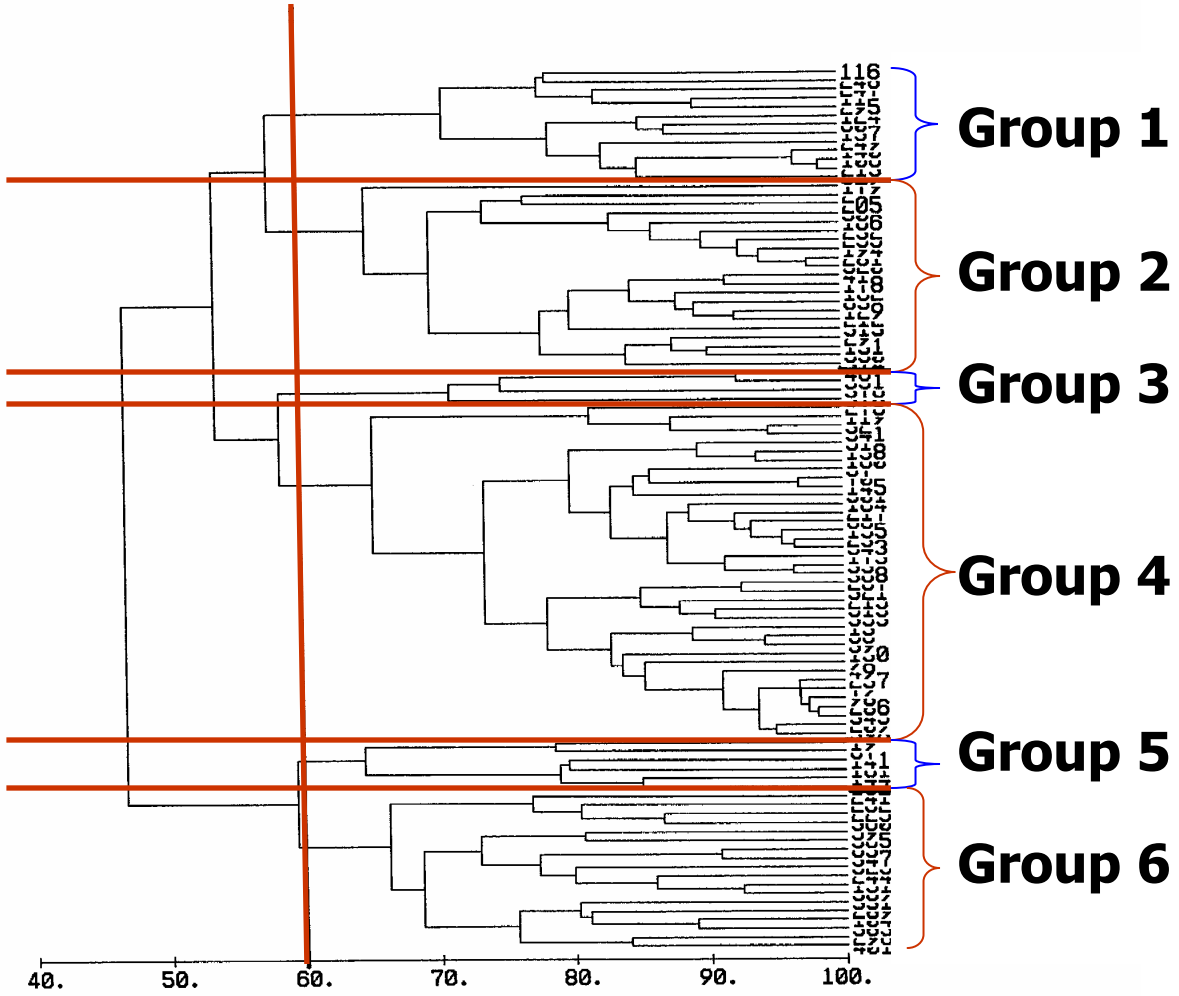
At BLM = 1

Solutions vary in their conservation scores



Cluster analysis: Are there distinct alternatives among top scores?

Transition Zone at 50% set aside



Bray-Curtis Similarity