National Park Service

U. S. Department of the Interior

Measuring MPA Effectiveness in Channel Islands National Park, California 1982-2004

Gary E. Davis

Visiting Chief Scientist

Ocean Programs, Washington D. C.

Today

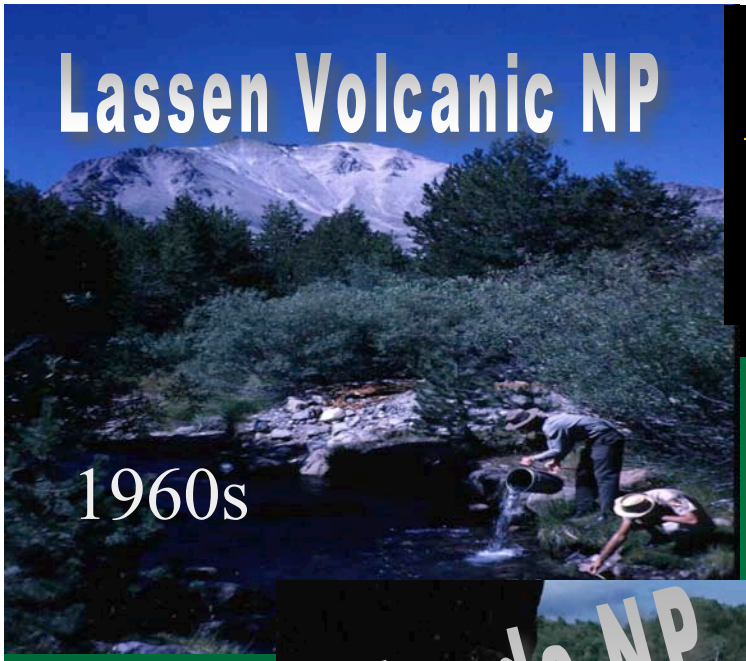
- Describe a monitoring program design process
- Show how the process was used for Channel Islands National Park
- Present results of 20 years of monitoring
- Discuss how those results lead to changes in conservation strategies

Conclusions

Monitoring Ecological 'Vital Signs' of MPAs:

- Produces better, faster and cheaper stewardship
- Facilitates scientific collaboration
- Helps build information-based social consensus
- Revealed that protecting habitat and water quality alone were insufficient to sustain fishing & ecological integrity at the California Channel Islands

A Personal Odyssey 1964-2005



Park Stewardship Program Functions

- KNOW & understand resource conditions
- RESTORE impaired ecosystems
- PROTECT resources & ecosystems, and mitigate threats
- CONNECT people to parks

Vital Signs Monitoring Cornerstone of Stewardship

- Provides knowledge of resource conditions
- Increases understanding of how resources interact
- Improves predictions of ecosystem behavior
- Guides restoration actions
- Informs protection and mitigation efforts
- Provides stories to connect people to nature

Ask the Right Questions

"You would be surprised at the number of years it took me to see clearly what some of the problems were which had to be solved…looking back, I think it was more difficult to see what the problems were than to solve them."

Charles Darwin

Four-Step Vital Signs Monitoring Design Process

- Set Goals
  - Why monitor?
- Conceptual Model
  - What is it?
- Protocol Development
  - How to do it (SOPs + Rationale)
- Implementation Plan
  - Where, when, who?

Monitoring Step-down Plan

Davis, G. E. 2005. National Park stewardship and 'vital signs' monitoring: a case study from Channel Islands National Park, California. *Aquatic Conservation: Marine and Freshwater Ecosystems* 15:71-89.

Why Monitor Natural Resources?

THE ANSWER DETERMINES:

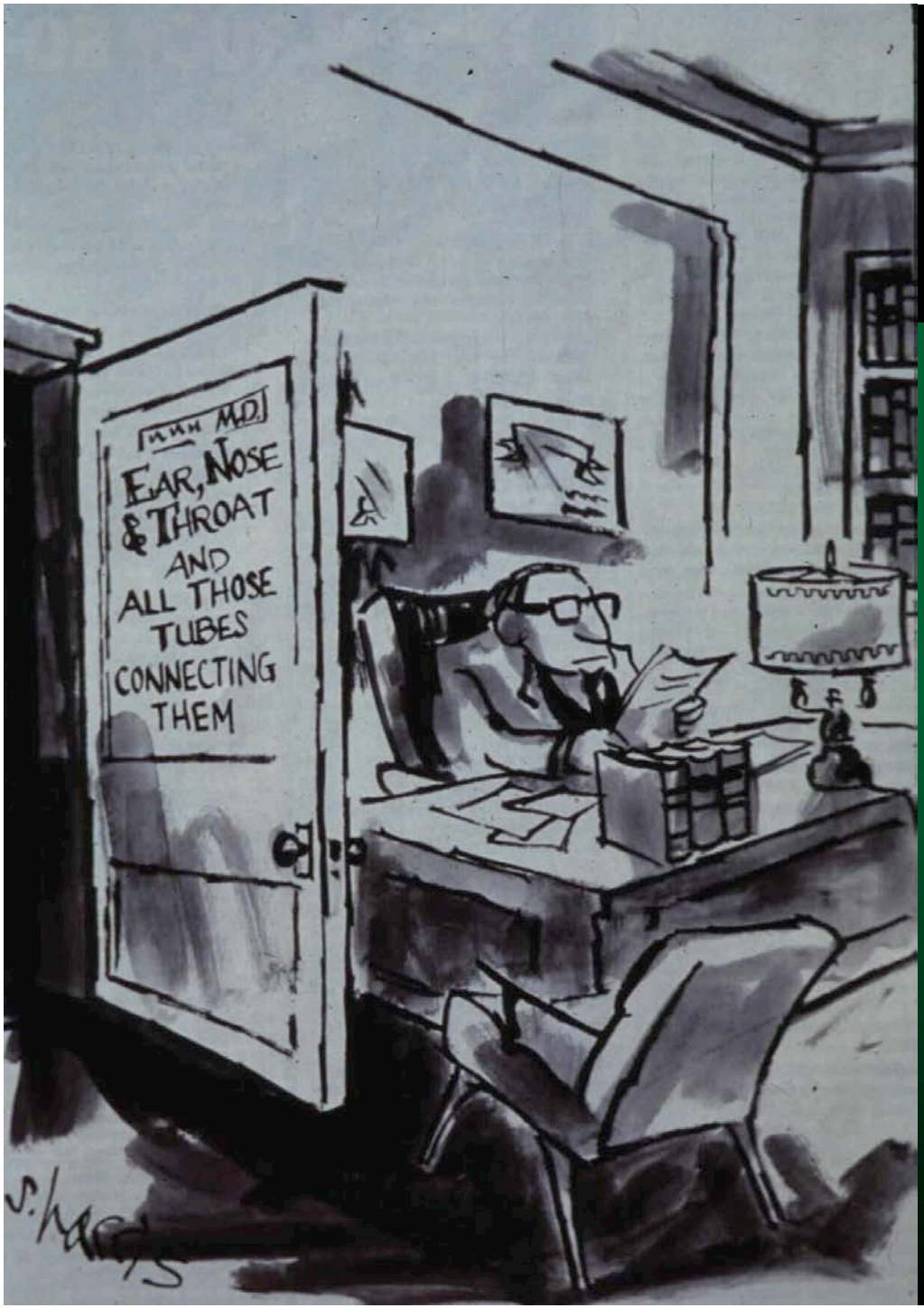
- What to measure
- When to measure
- Where to measure
- How to measure
- Accuracy and precision needed
- How to report results

Factors Driving the Need to Monitor–Stressors

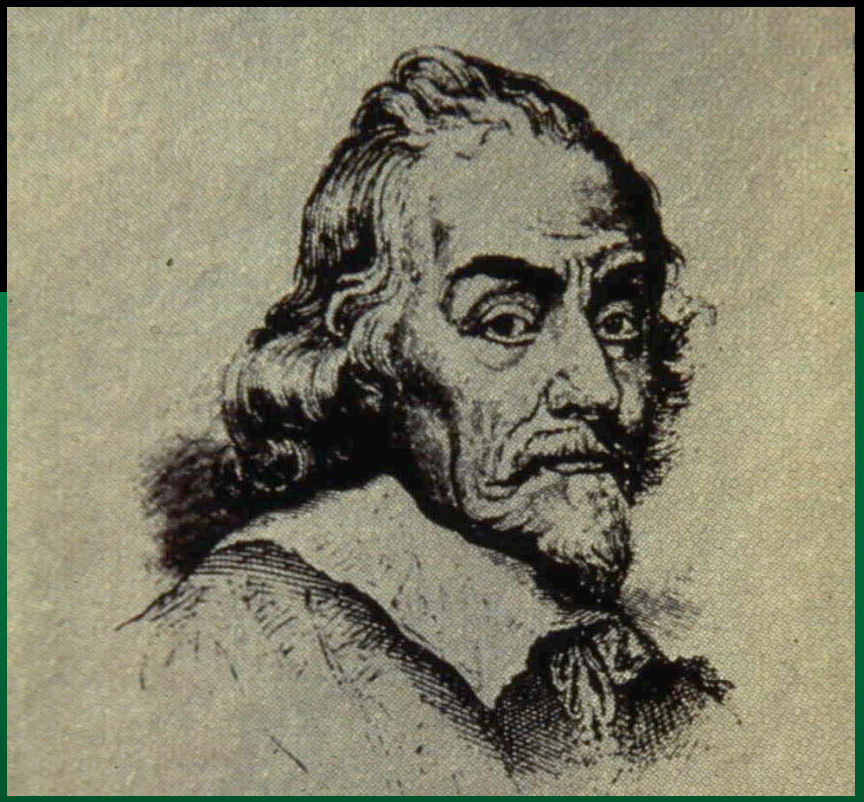
- Habitat fragmentation
- Unsustainable uses
- Altered air, water, soil
- Alien species

Goals of Vital Signs Monitoring Programs

- Identify status & trends in ecosystem health
- Provide early warnings to reduce costs and increase treatment success
- Define normal limits of variation
- Suggest remedial treatments
- Frame research hypotheses
- Determine legal compliance



Conservation Is Health Care For The Environment and Ecosystems



Ecology Is Still In The 17th Century Relative To Medicine

William Harvey in 1628 showed that the heart was a pump and that its function was to pump blood to the body through a series of circles-the circulatory system

Parameters of Population Dynamics for Monitoring

- Abundance
- Distribution
- Age structure
- Reproduction
- Recruitment
- Growth rate
- Mortality rate

Population Dynamics As Ecological Vital Signs

- Integrates many environmental factors
- Direct interpretation
- Early warnings
- Sampling techniques well developed
- Remedial actions available
- Inter-species comparisons aid cause-effect analyses
- Conservation laws focused on species

A Healthy Ecosystem

- Has all its parts
- Has no extra parts
- Responds normally to perturbation
- Is resilient, resists alien invasions
- Possesses capacity for self-renewal

The Land Ethic

"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."

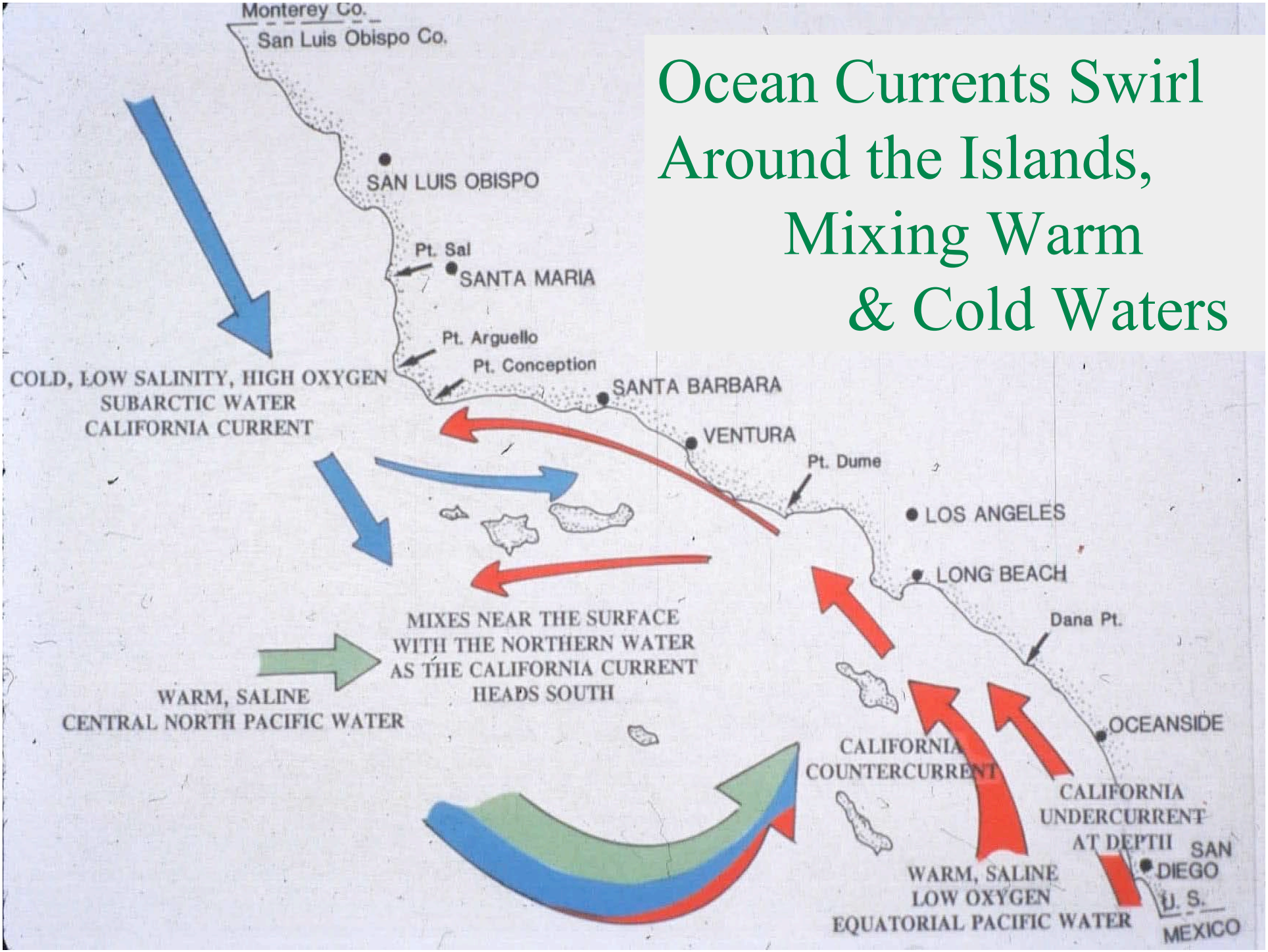
Aldo Leopold, 1949

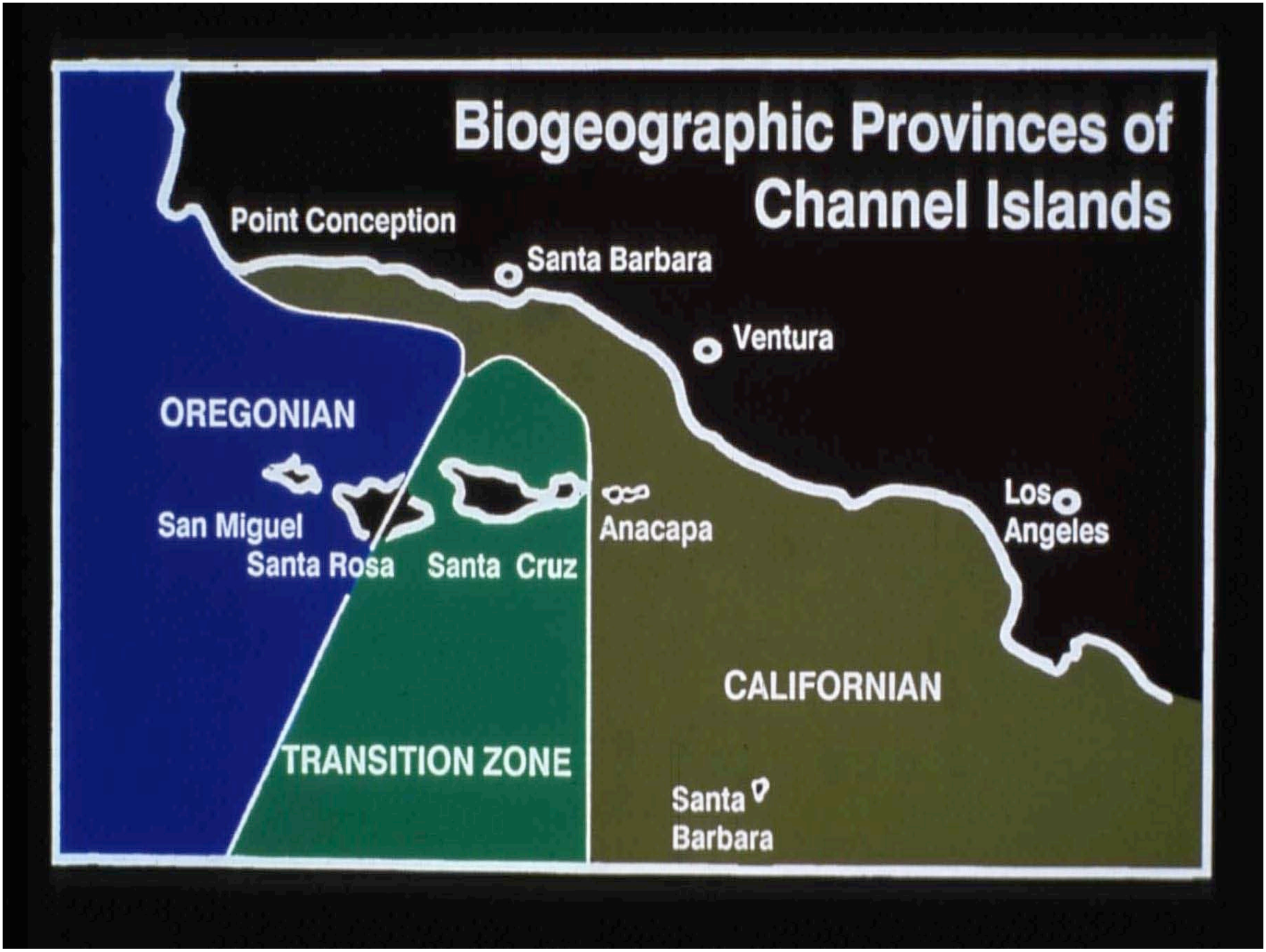
A Sand County Almanac

Prologue 1938-1980

Channel Islands National Monument

Ocean Currents Swirl Around the Islands, Mixing Warm & Cold Waters




Biogeographic Provinces of Channel Islands
Point Conception
Santa Barbara
Ventura
OREGONIAN
San Miguel
Santa Rosa
Santa Cruz
Anacapa
Los Angeles
CALIFORNIAN
TRANSITION ZONE
Santa Barbara

Protocol Design Study

Kelp Forest Monitoring

Protocol Design Objectives

- Select taxa, environmental factors, and parameters to monitor
- Adapt or develop & test sampling methods to detect 40% changes in mean values, with $\alpha=0.5$ and $\beta=0.20$
- Select & apply analytical tools
- Select reporting media & design formats
- Recommend how to implement protocol

Vital Signs Selection Criteria

- Representative, broad ecological array
- Common, dominant, structural
- Special legal status
- Endemic species
- Exploited species
- Invasive alien species
- Charismatic species
- Practical


KELP FOREST DISTRIBUTION

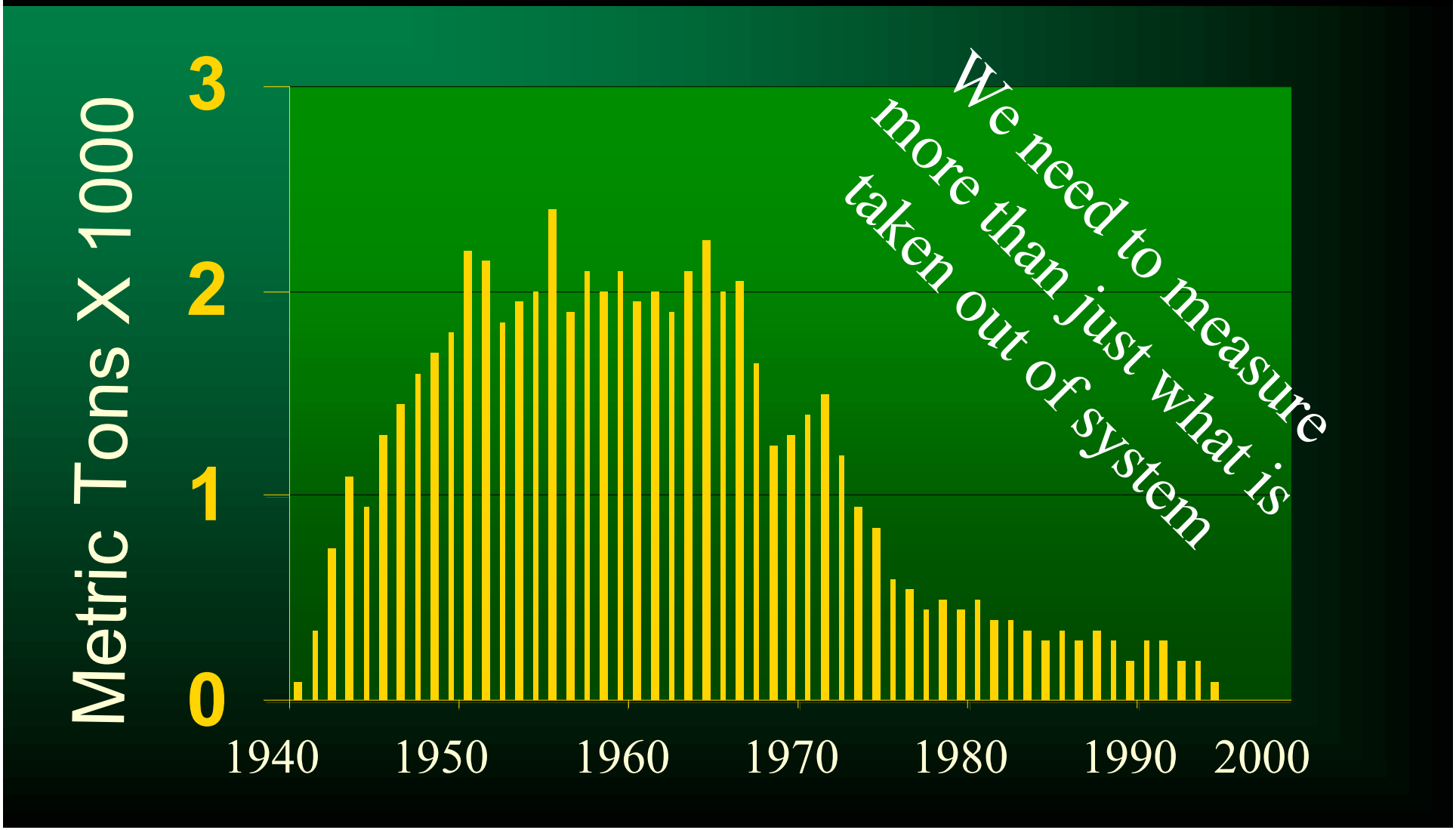

SANTA BARBARA
PT. CONCEPTION
VENTURA
SAN MIGUEL
SANTA CRUZ
ANACAPA
SANTA ROSA
SANTA BARBARA

Multiple Techniques

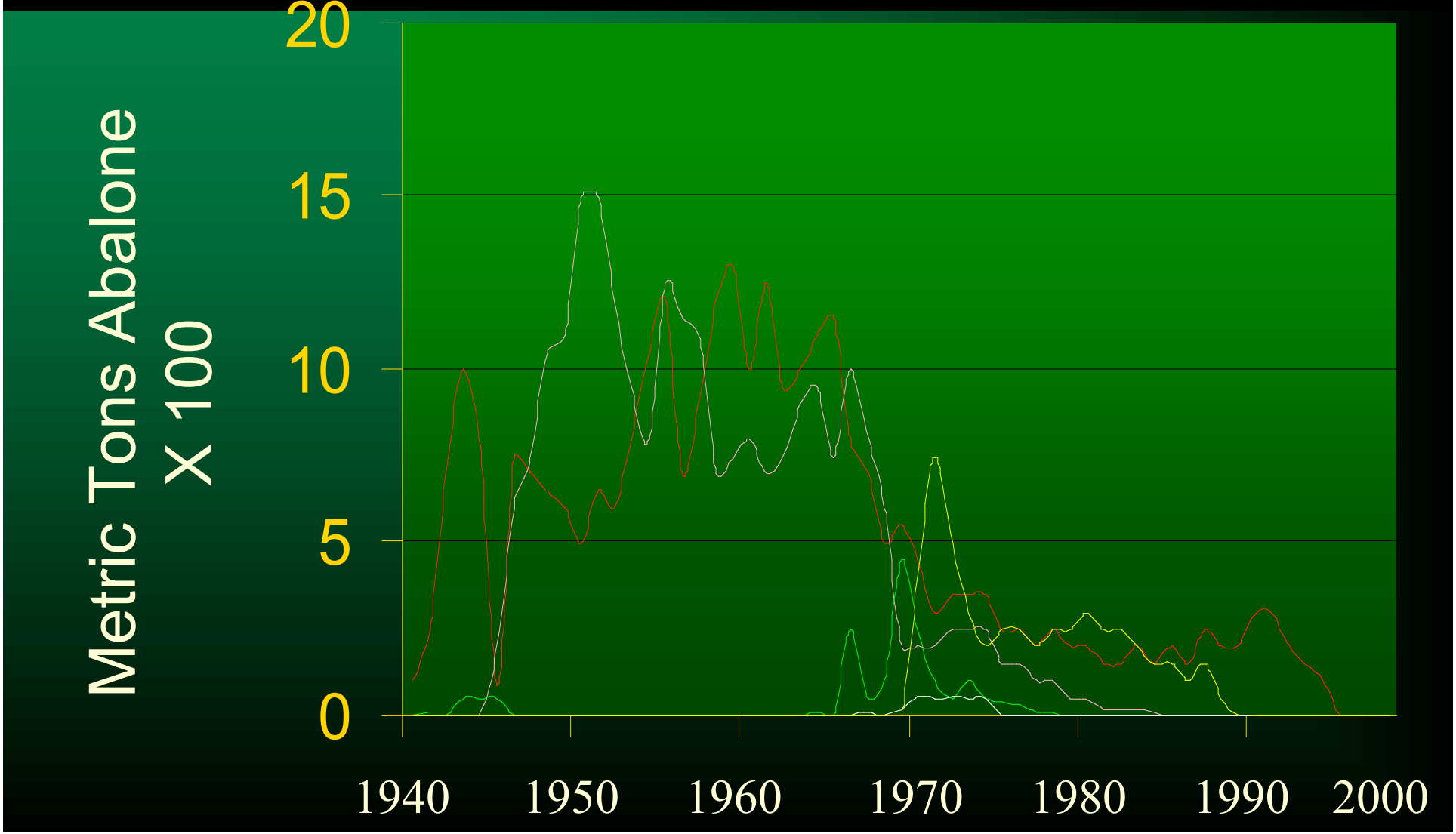
Kelp Forest Sampling Techniques

- Quadrates (20 @ 1 x 2 m, 10 @ 2 x 5 m)
- Band Transects (12 @ 3 x 20 m)
- Random Point Contact Plots (25 @ 1.5 x 0.5 m)
- Roving Diver Fish Counts (10 @ 20 x 100 m)
- Artificial Recruitment Modules (7 @ 21 m^2)
- Size Frequency Measurements (*in situ*)
- Sea Temperature (Continuously)
- Aerial Photos (kelp surface canopy)

Commercial Landings
California Abalone Fisheries

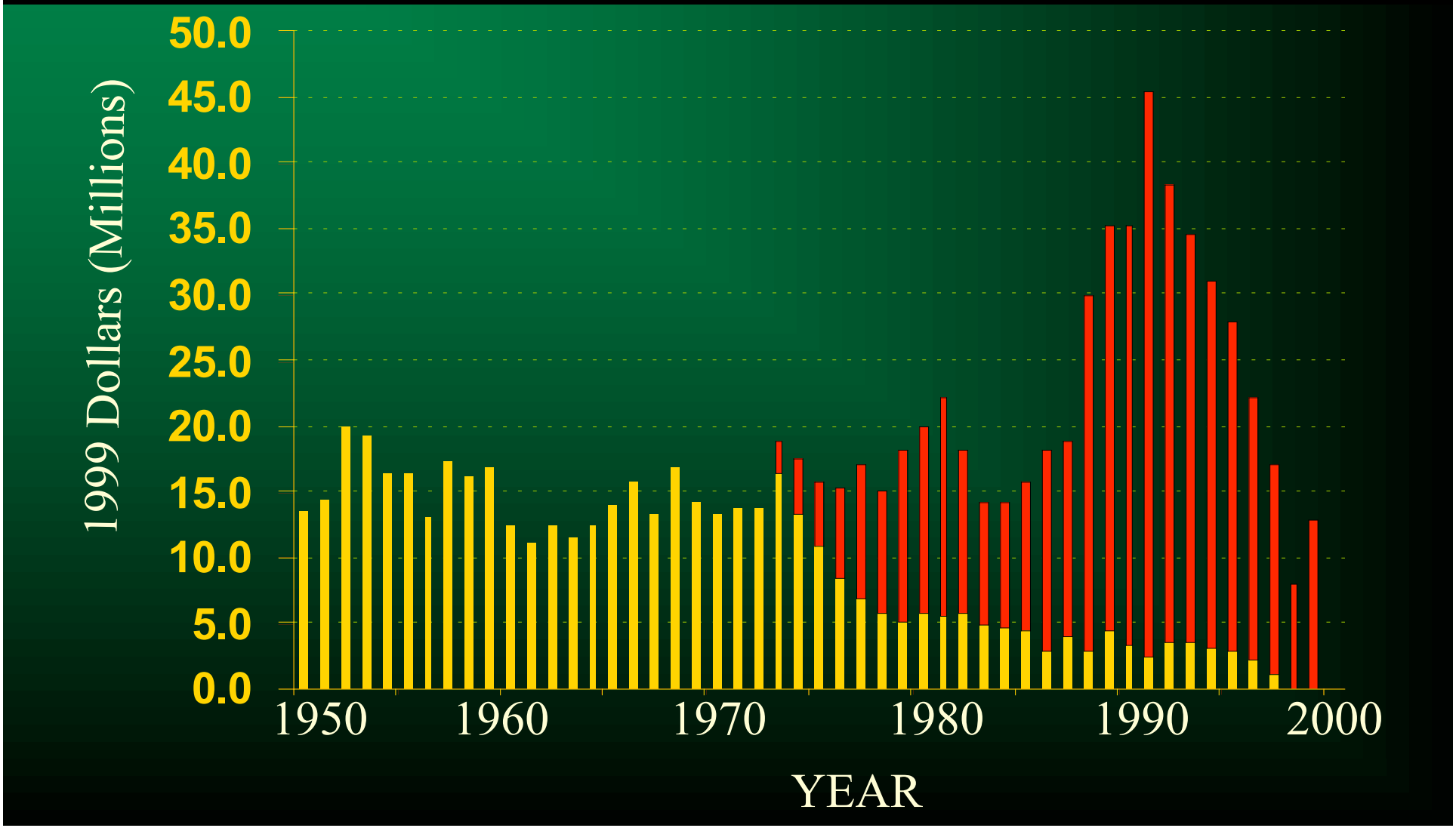


Serial Depletion Hides Impacts

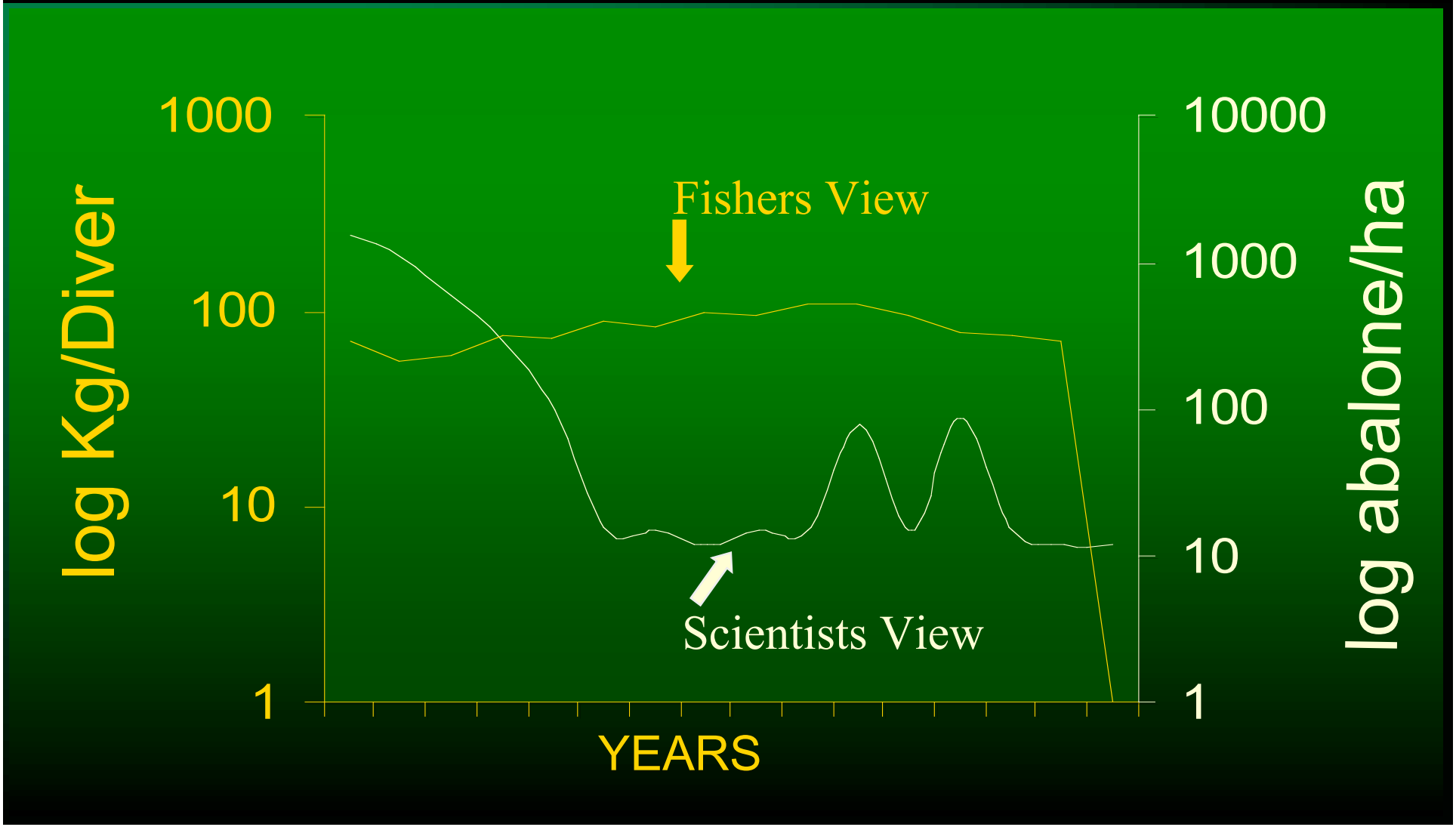


After Abalones…

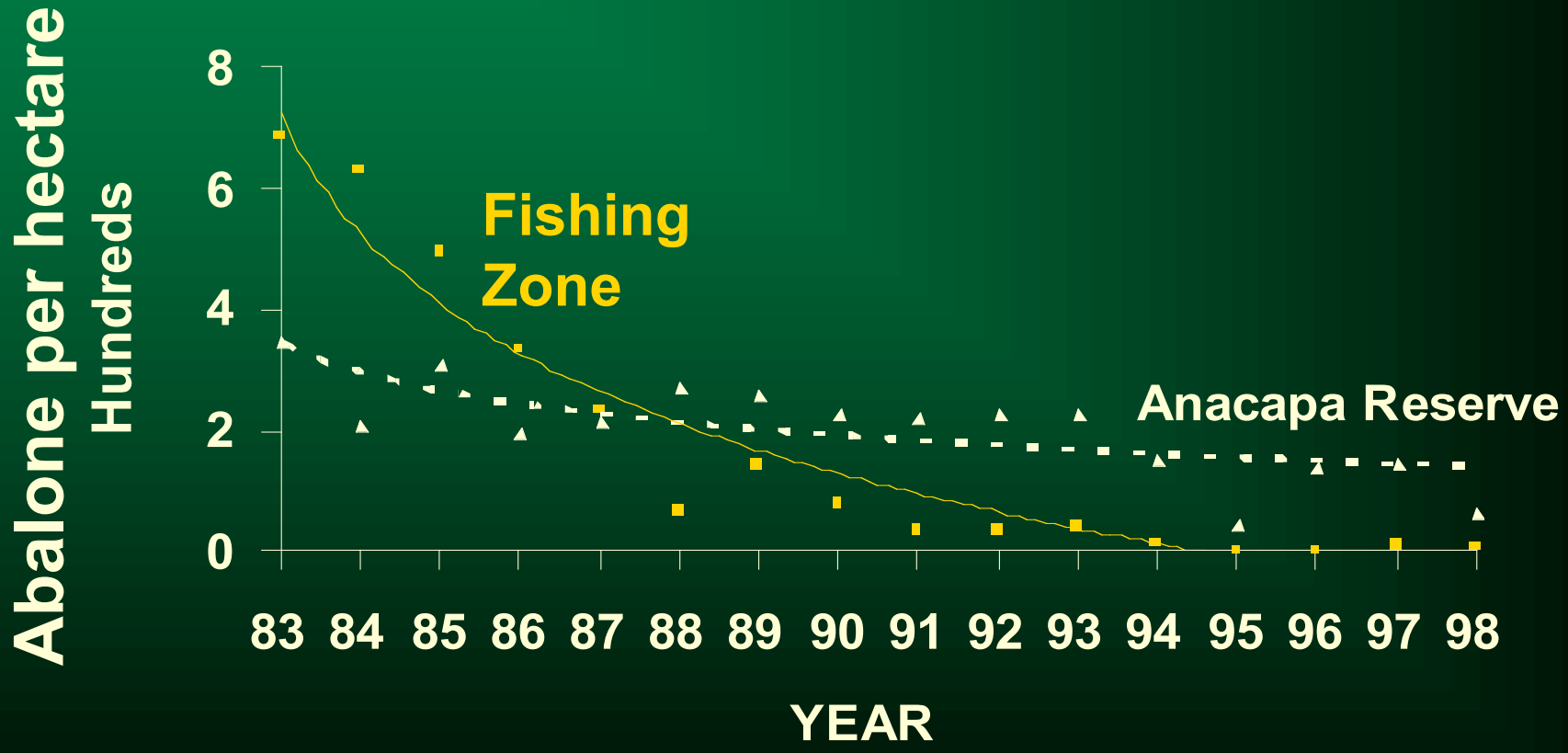
Red Sea Urchins



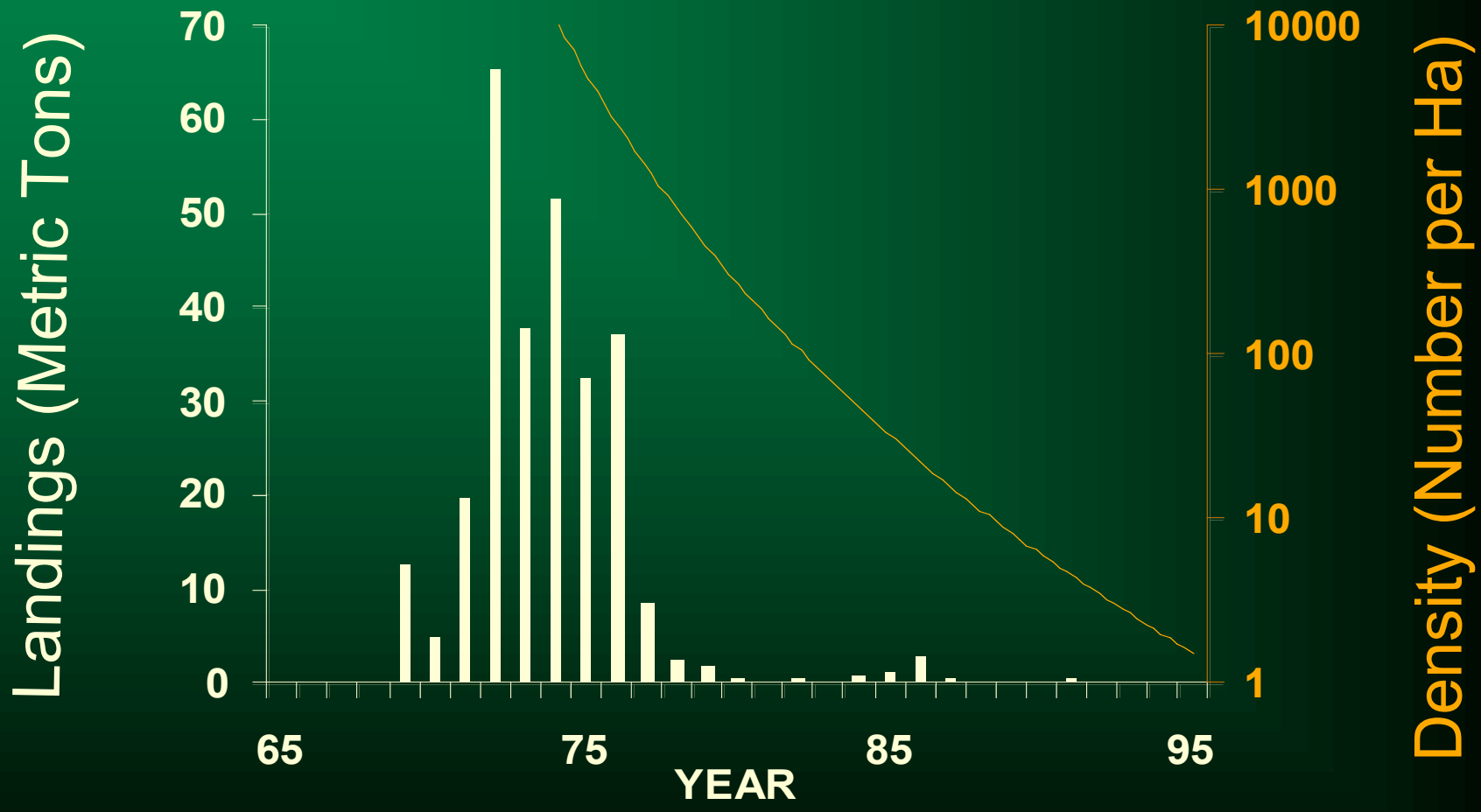
Catch Rate & Abundance Give Different Perspectives



Abalone


Abalone per hectare
Hundreds
8
6
4
2
0
Fishing Zone
Anacapa Reserve
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98
YEAR

White Abalone
Haliotis Sorenseni

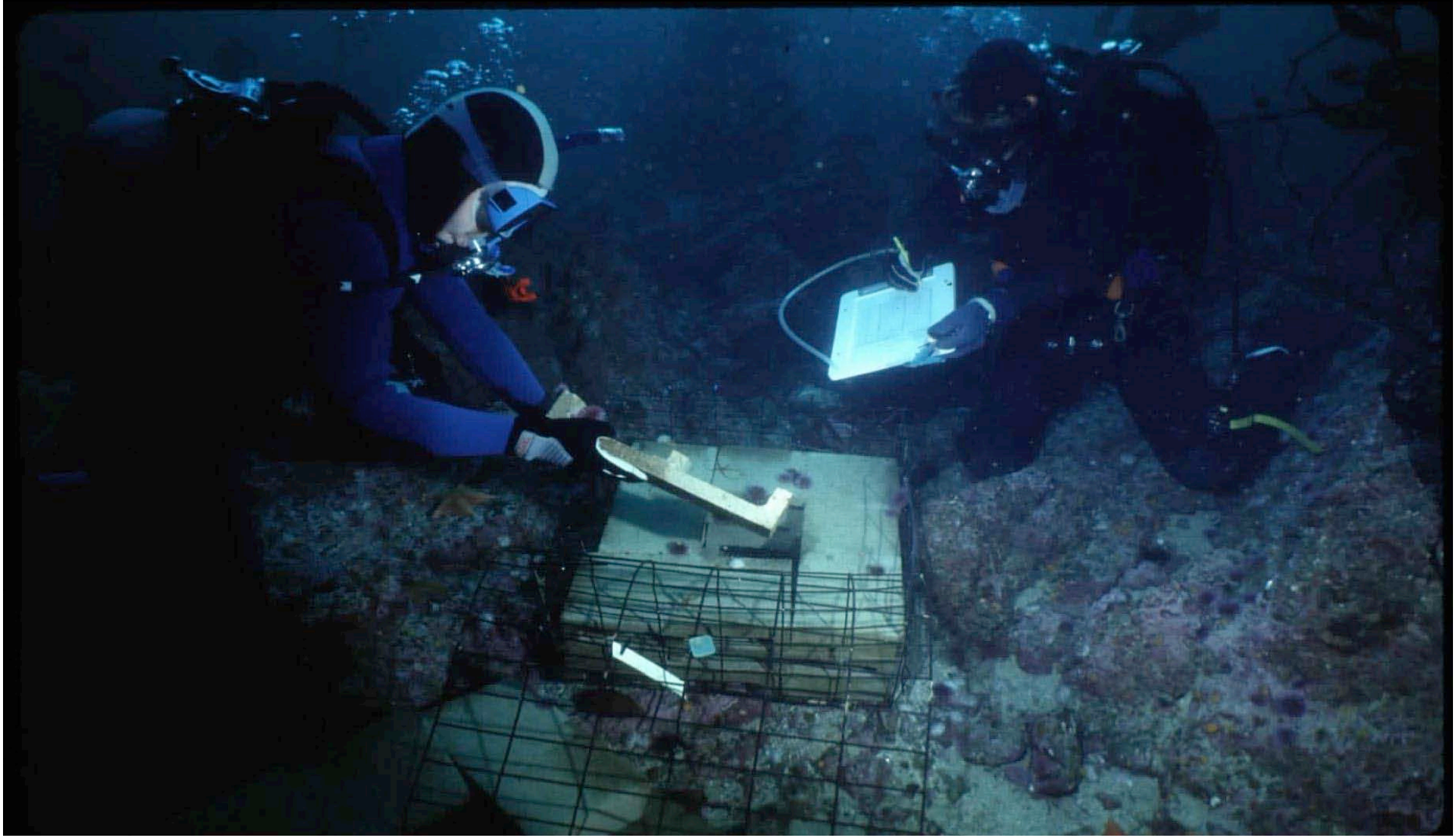


Early warning from monitoring was critical

White abalone survival now depends on captive breeding

Key to Abalone Restoration...

Adult Density & Juvenile Recruitment

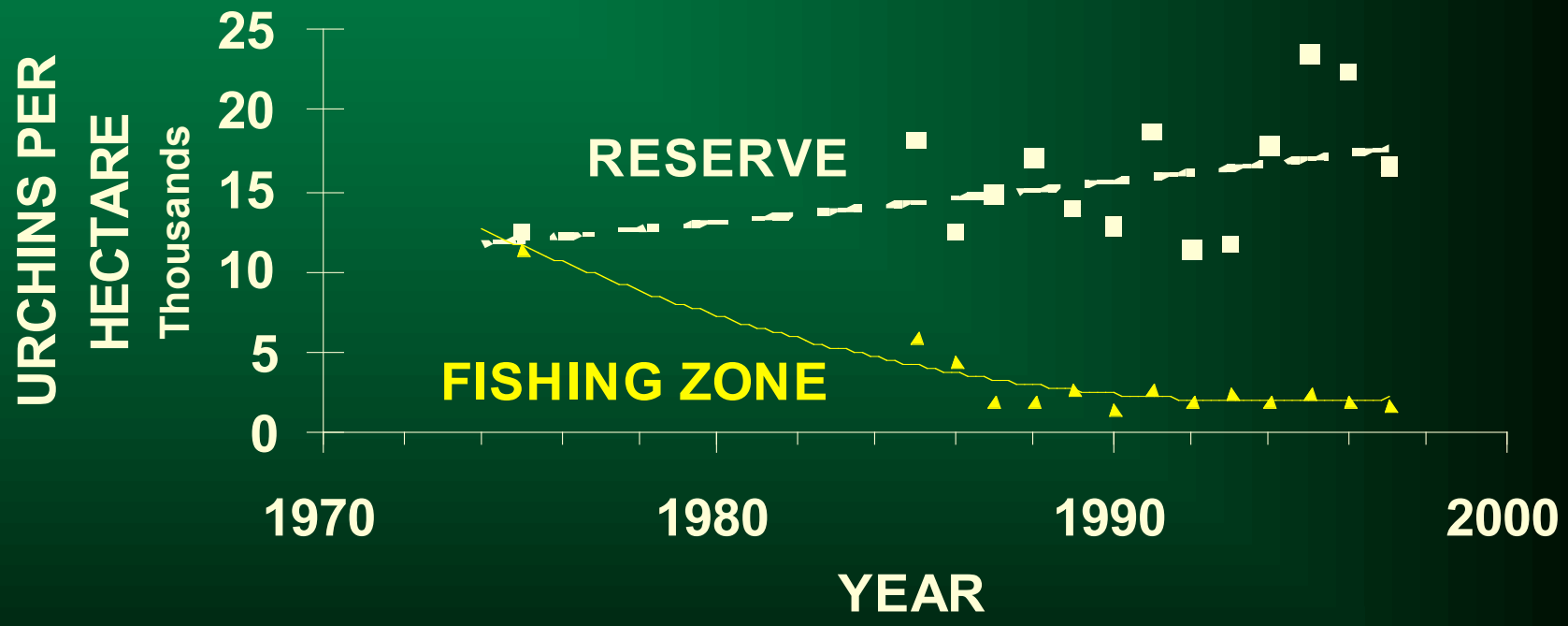


Unsustainable Exploitation

- California Abalone Fisheries - five species
- Lessons
  - Fragmented habitats & populations at risk
  - Serial depletion hides impacts
  - Early warnings are valuable
  - Help frame research questions
  - Measure efficacy of management schemes

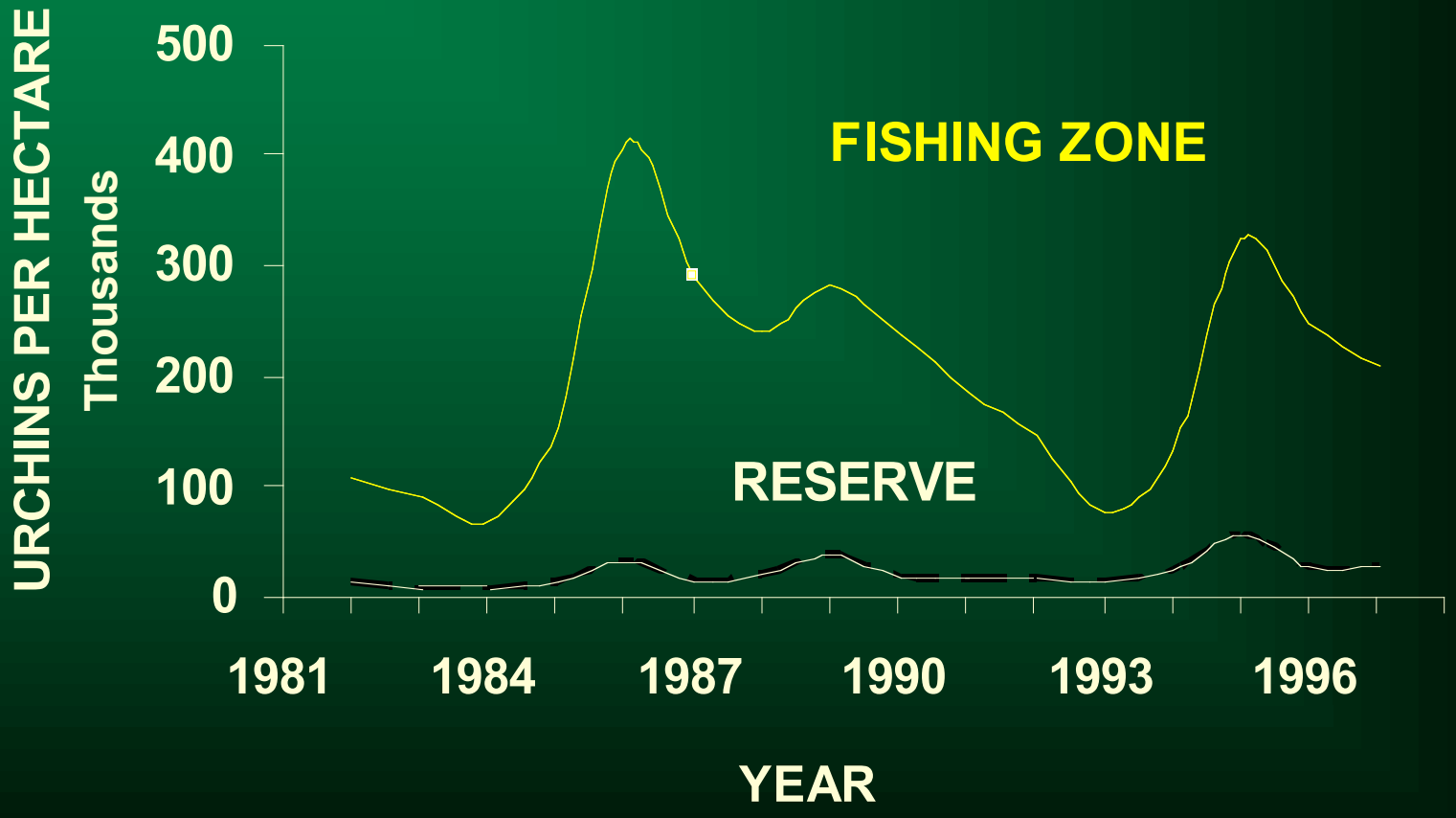
1st rule of intelligent tinkering…
save all the pieces

Large Red Sea Urchins*



* > 105 mm

Purple Sea Urchins



Kelp Forests Destablized

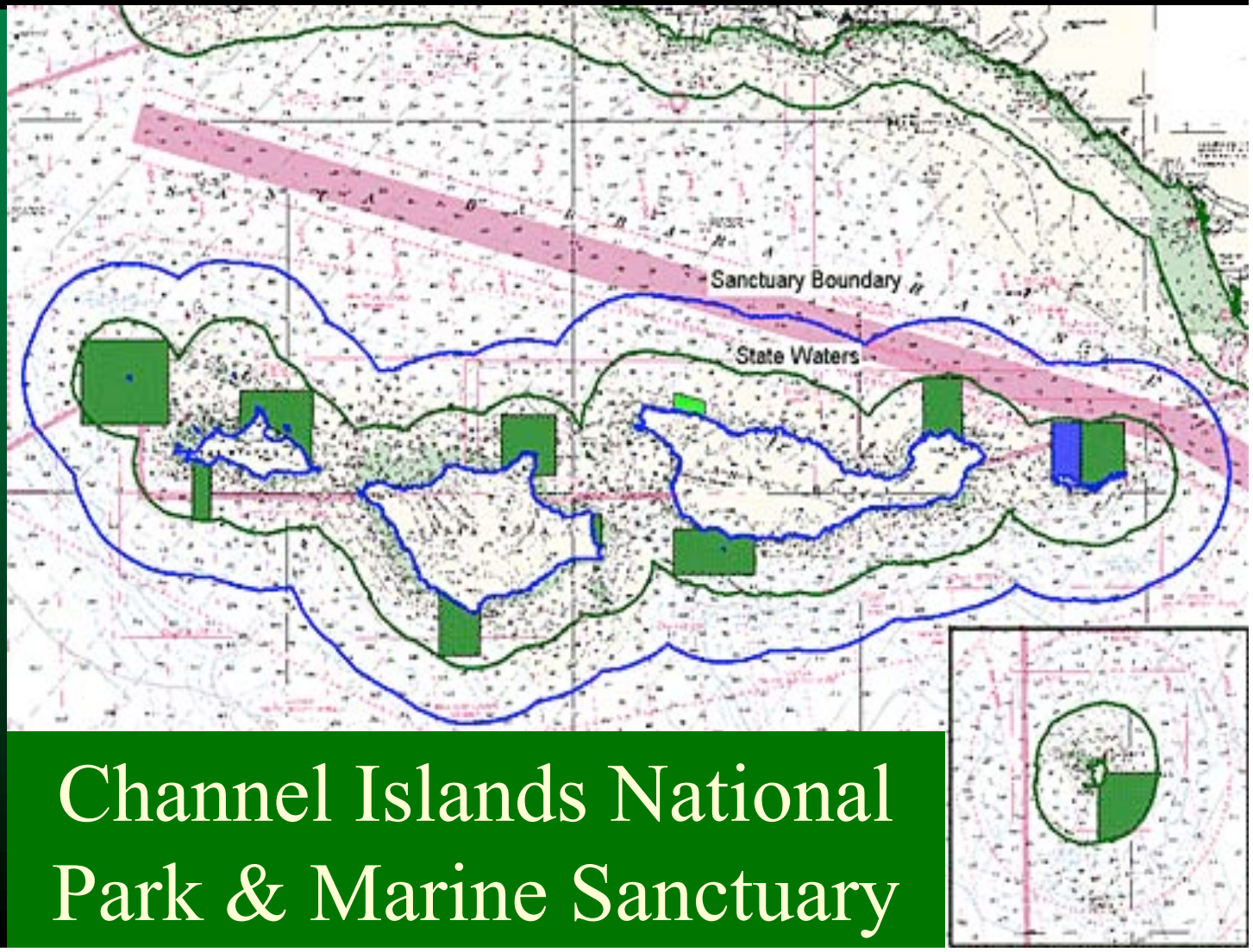
Unintended Consequences Cascade Through Ecosystems

Protecting Habitat Alone Was Not Sufficient

- Ecosystem integrity, stability and beauty were lost
- New conservation strategies were needed to protect old fat fish and provide capacity for self-renewal
- Ecosystem-based, adaptive management, marine reserves

Marine Reserve Network

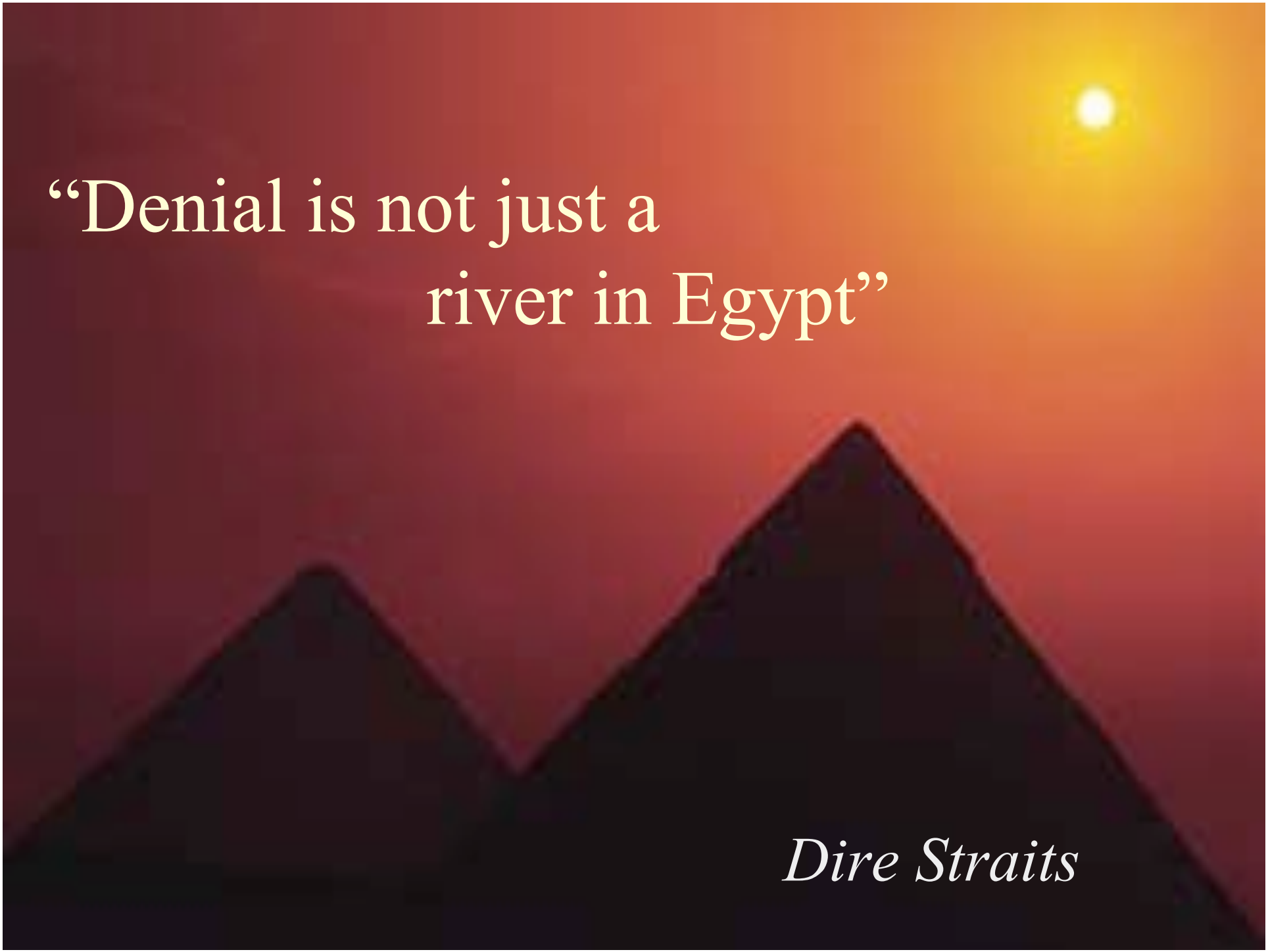
Ten Reserves Free of Fishing Effects (132 nm^2)

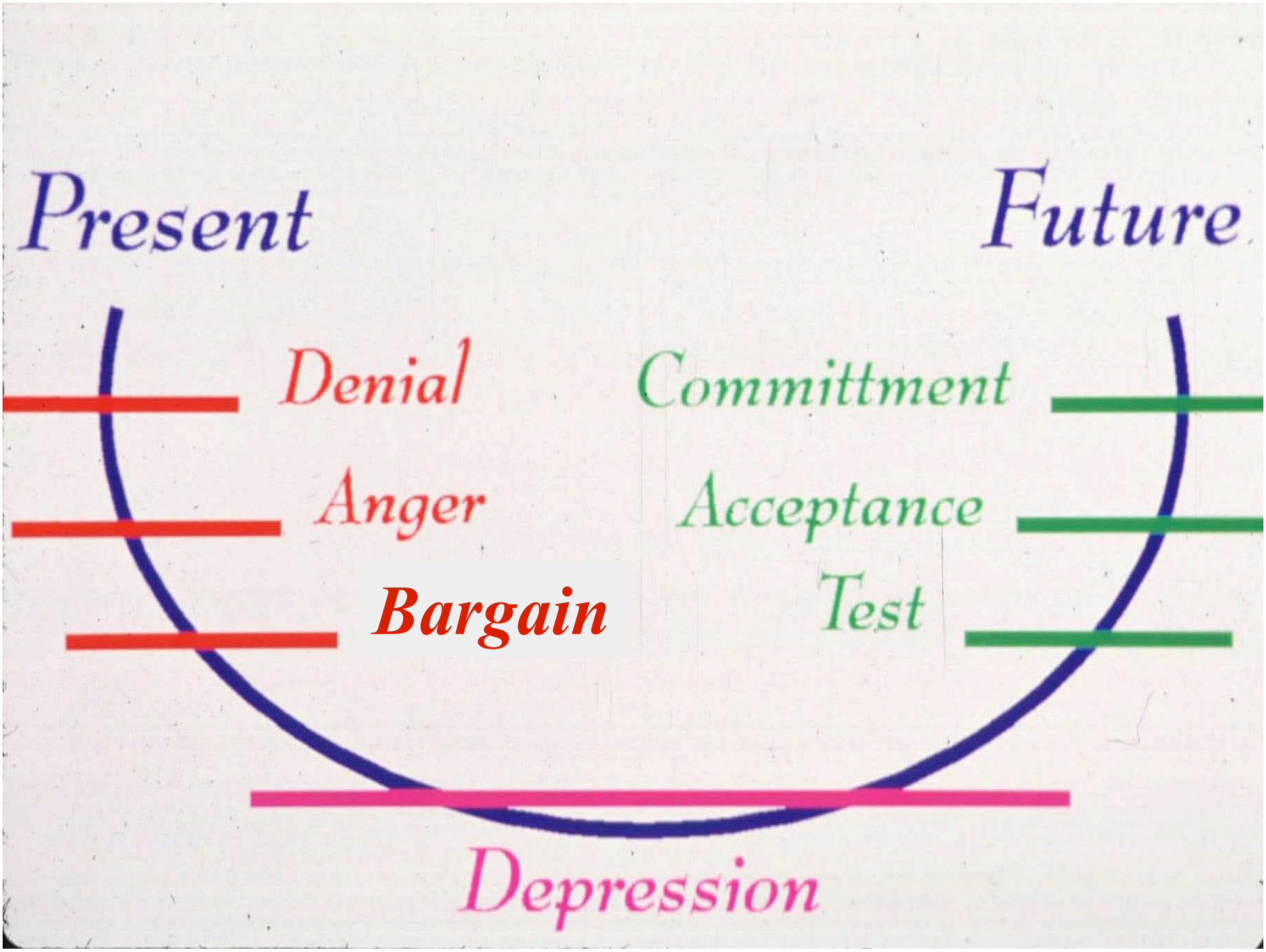


Channel Islands National Park & Marine Sanctuary

Biggest Impediments To Vital Signs Monitoring

- Denial that it's necessary
- Denial that it's cost effective
- It's different and requires change in established routines
- Requires sustained collaboration—investigators, practitioners, agencies
- Sustained commitment—some would rather fix things than identify more 'problems'


"Denial is not just a
river in Egypt"
Dire Straits


Present
Future
Denial
Anger
Bargain
Depression
Committment
Acceptance
Test


The Beginning of a New Era