

Environmental Vital Signs

An Interagency Approach
To Monitoring the California Coast

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Channel Islands National Park

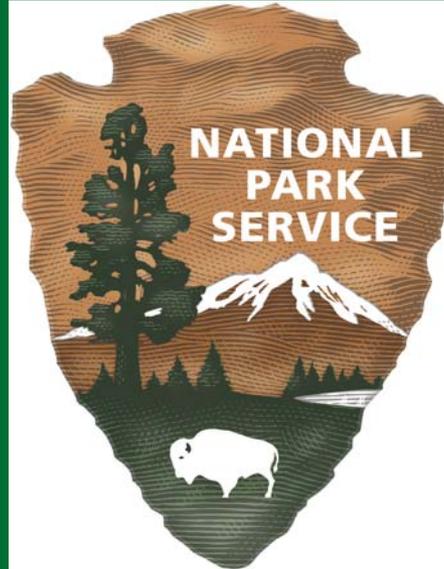
Ventura, California



Ecological Vital Signs Monitoring Presentation Objectives

- ✔ Why monitor environmental vital signs?
- ✔ Identify monitoring goals
- ✔ Describe a 4-step program design process
- ✔ Provide examples
 - Channel Islands National Park
 - Cabrillo National Monument

Natural Resources Stewardship



Program Structure and Function
in the
National Park Service



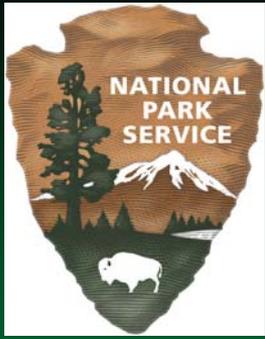
National Park Service Stewardship Mission

- ✓ Conserve the parks
- ✓ Provide for their enjoyment
- ✓ Leave them unimpaired for the enjoyment of future generations



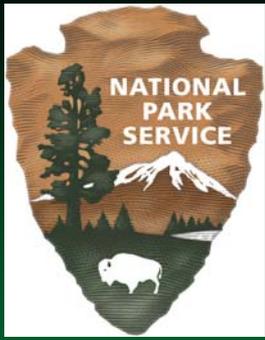
Stewardship Program Functions

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



Stewardship Program Structure

- ✓ FIELD OPERATIONS-Rangers, Interpreters, & Maintenance
- ✓ APPLIED SCIENCE-Resource Management
- ✓ RESEARCH SCIENCE-USGS, University



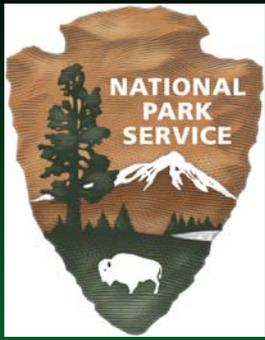
NPS Stewardship Program Structure & Function

	Research Science	Applied Science	Field Operations
KNOW	Design Protocols	Monitor Resources	Observe Conditions
RESTORE	Develop Techniques	Apply Techniques	Explain Needs
PROTECT	Evaluate Efficacy	Mitigate Impacts	Enforce Laws
CONNECT	Test Methods	Diagnose Issues	Describe Effects



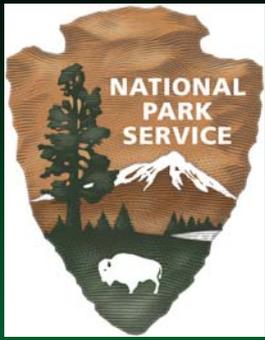
Vital Signs Monitoring Cornerstone of Stewardship

- ✓ Know resource conditions
- ✓ Understand how resources interact
- ✓ Predict ecosystem behavior
- ✓ Project consequences of intervention or lack of action



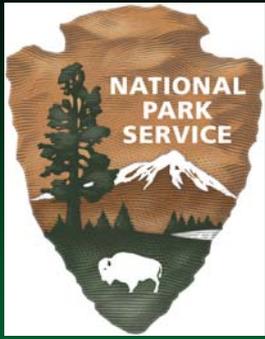
“You would be surprised at the number of years it took me to see clearly what some of the problems were which had to be solved...looking back, I think it was more difficult to see what the problems were than to solve them.”

Charles Darwin



Four-Step Design Process

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

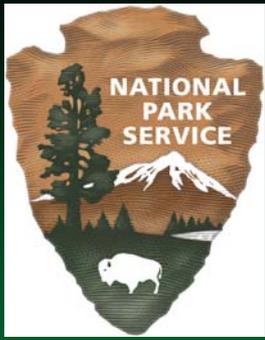


Why Monitor Natural Resources?

THE ANSWER DETERMINES:

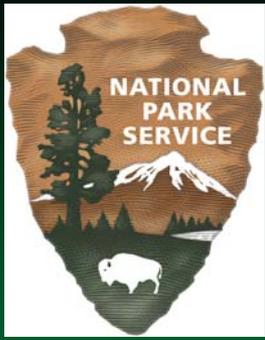
- ▼ What to measure
- ▼ When to measure
- ▼ Where to measure
- ▼ How to measure
- ▼ Accuracy and precision needed
- ▼ How to report results

Early National Park Managers Relied on Beliefs



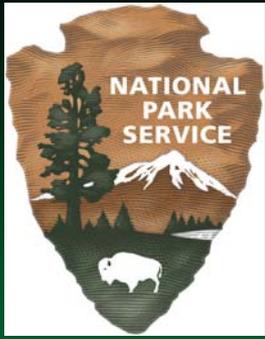
Fires were put out & predators killed
to 'save' the parks





Factors Driving the Need to Monitor–Stressors

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



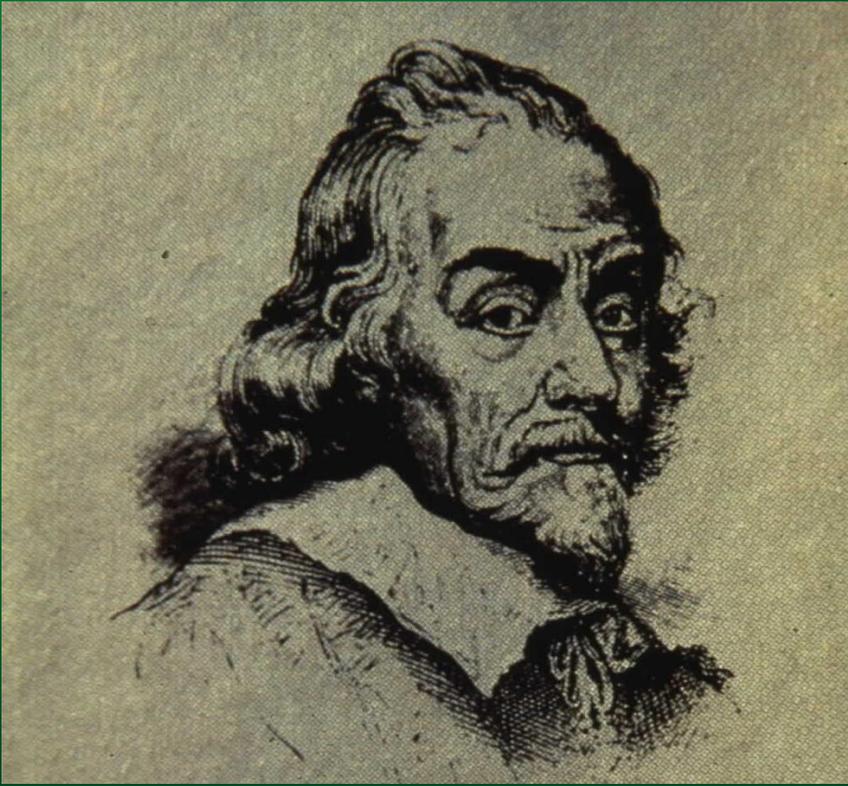
Goals of Monitoring Vital Signs

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



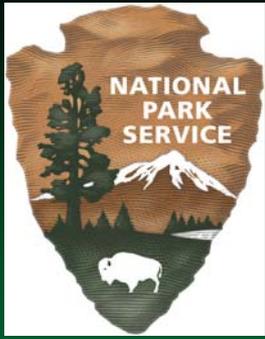
Conservation
Is Health Care
For The
Environment
and
Ecosystems





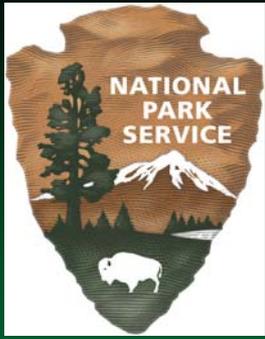
Ecology Is Still In The 17th Century Relative To Medicine

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



A Healthy Ecosystem

- ✓ Has all its parts
- ✓ Has no extra parts
- ✓ Responds normally to perturbation
- ✓ Is resilient, resists alien invasions



The Land Ethic

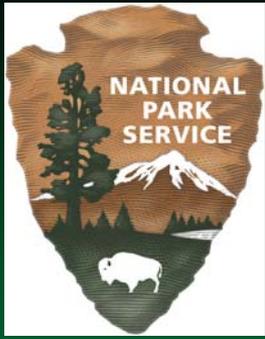
“A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.”

Aldo Leopold, 1949
A Sand County Almanac



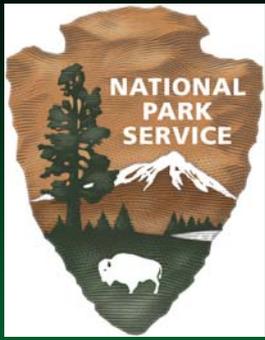
Approaches to Monitoring

- ✓ Energetics
- ✓ Nutrients or Constituents
- ✓ Biodiversity-repeated inventories
- ✓ Population Dynamics



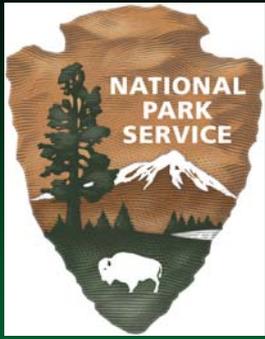
Population Dynamics

- ✓ Measures key species demographics
- ✓ Populations integrate effects of environment
- ✓ Easy to measure
- ✓ Projects future conditions, early warning
- ✓ Sensitive to sub-lethal chronic stress
- ✓ Interpretation and application direct



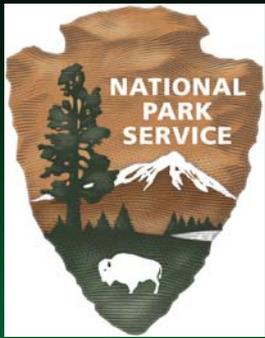
Population Dynamics Parameters

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



Vital Signs Monitoring Goals

- ✔ Identify status & trends in ecosystem health
- ✔ Define normal limits of variation
- ✔ Provide early warnings of situations that require intervention
- ✔ Suggest remedial treatments
- ✔ Frame research hypotheses
- ✔ Determine compliance with law/regulation



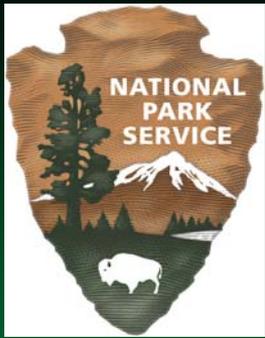
Step-down Plan Top Tier





Consult the Oracle at Delphi





Conceptual Model

Develop Conceptual Model

Set limits
(boundaries)
on system
to monitor

Inventory
resources

Make exhaustive
list of mutually
system components

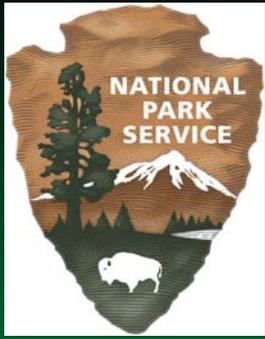
Identify relationships
among system
components
including stressors

Conduct field
surveys

Review literature
Survey collections

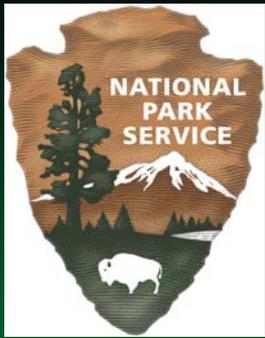
Define biogeographic
units, e.g.,
watersheds, islands,
ocean currents

Determine
appropriate taxa
and scales
of time & space



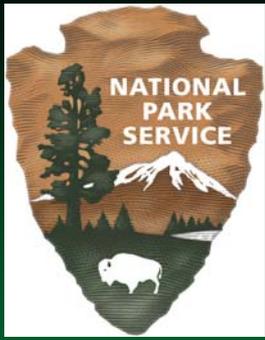
Use Stressors to:

- ✓ Cross-check comprehensive identification of potential vital signs
 - Will these measures detect alien species, habitat fragmentation, pollution, & unsustainable exploitation?
- ✓ Set priorities on which vital signs to develop and monitor first
 - Triage, first things first



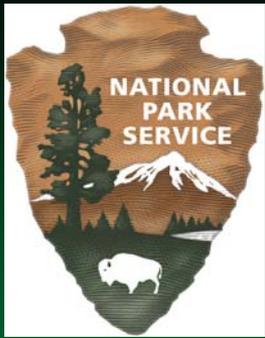
Conceptual Model vs. Stressors

Stress/ Ecosystem	Aliens	Pollute	Exploit	Fragment
Air		X		
Water		X	X	X
Plants	X	X	X	X
Wildlife	X	X	X	X
Aquatics	X	X	X	X
Soil		X	X	X

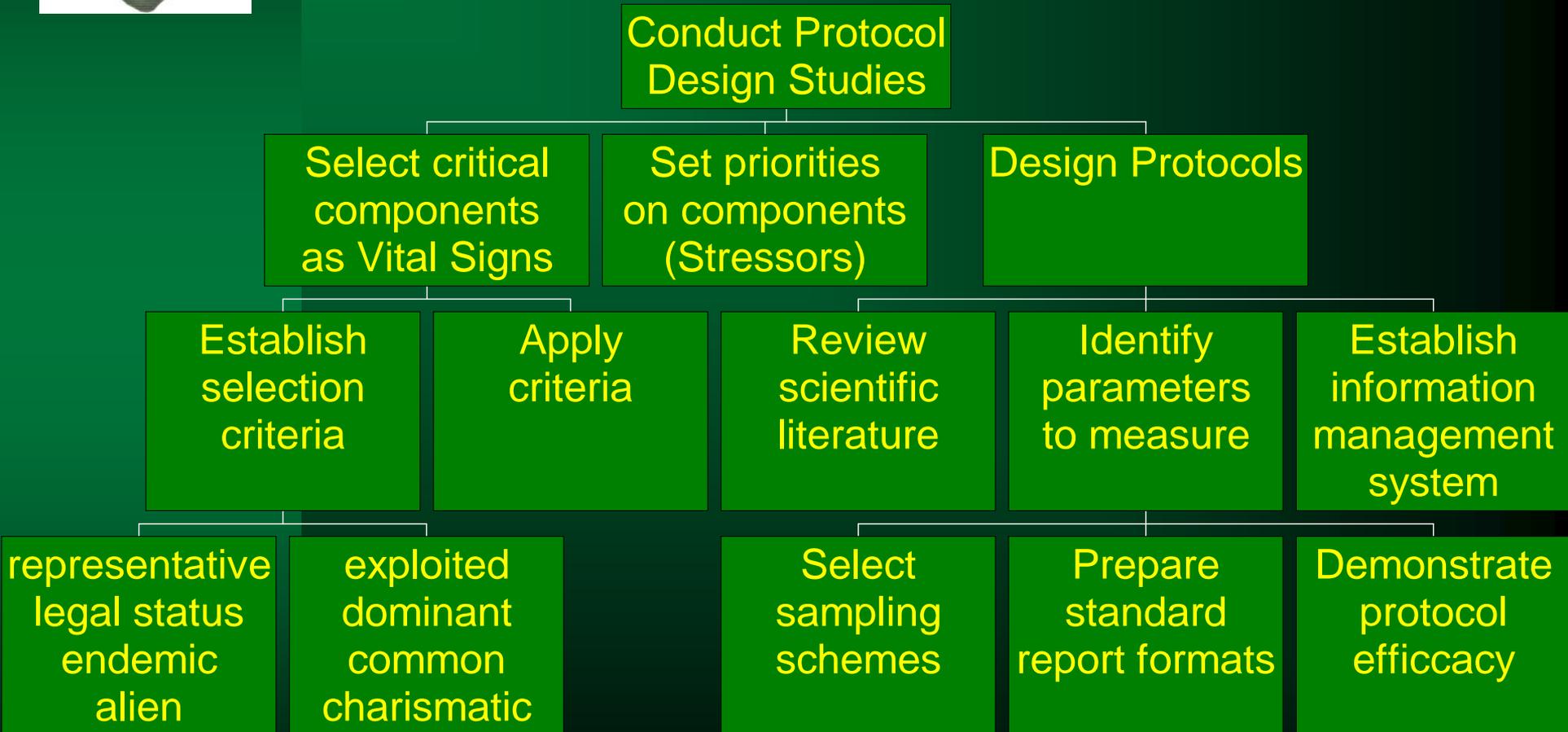


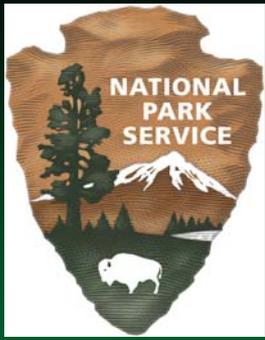
Protocol Design Study Objectives

- ✔ Select taxa & environmental factors
- ✔ Develop & test sampling techniques
- ✔ Develop & test analytical procedures
- ✔ Develop reporting formats-print & other
- ✔ Provide implementation recommendations



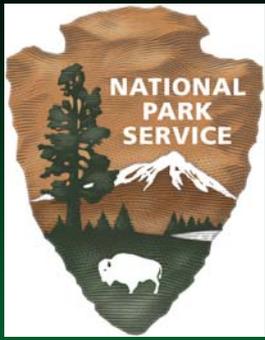
Protocol Design Studies





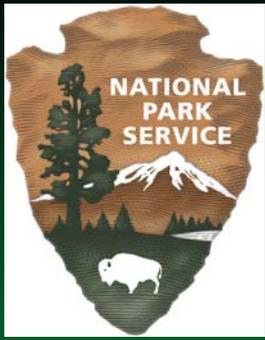
Protocol Design Objectives

- ✔ Select parameters of taxa & environmental factors 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

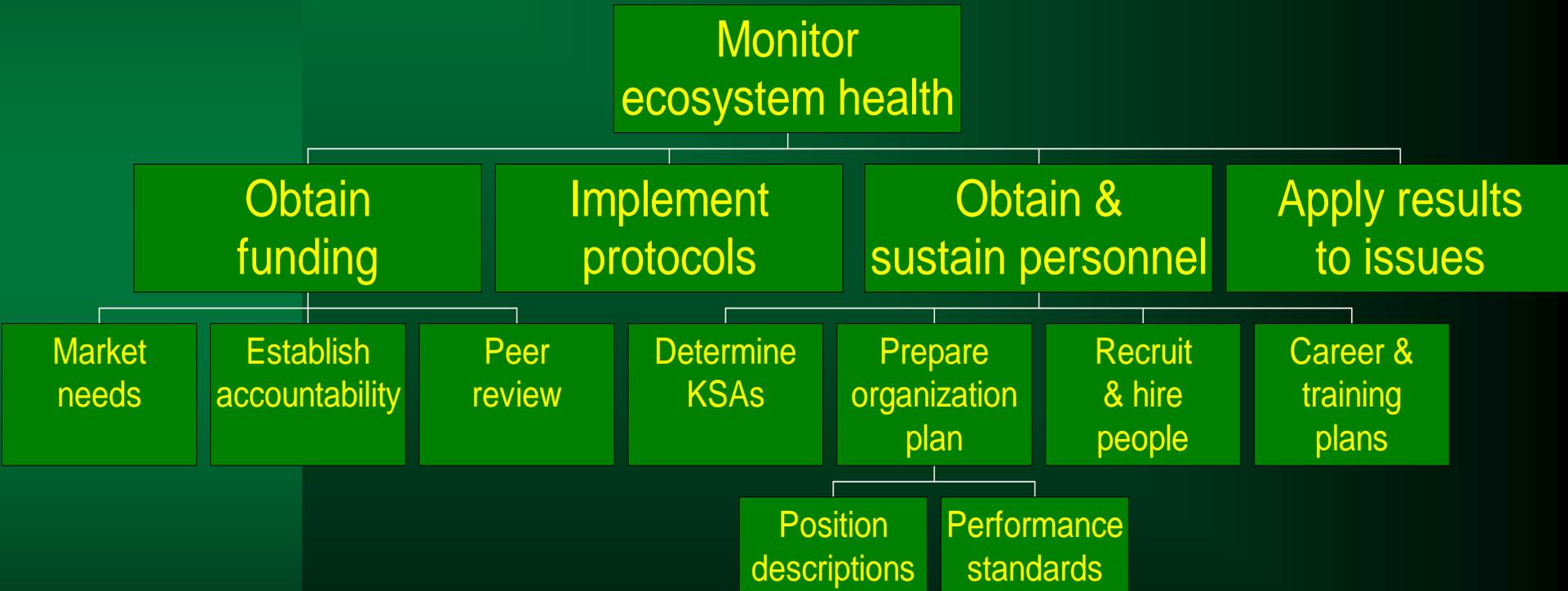


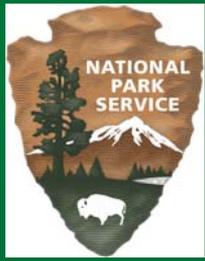
Biological Vital Signs Selection Criteria

- ✓ Representative, broad ecological array
- ✓ Common, dominant, structural element
- ✓ Special legal status
- ✓ Endemics
- ✓ Exploited
- ✓ Aliens
- ✓ Charismatic
- ✓ Practical



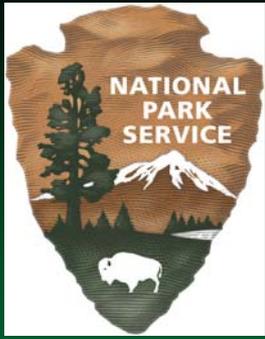
Implementation Plan





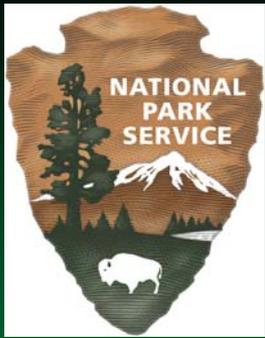
Many Agencies Contribute & Benefit

- California Fish & Game
- U. S. Geological Survey
- U. S. Fish & Wildlife Service
- University of California
- Minerals Management Service
- National Marine Fisheries Service
- National Marine Sanctuaries Office
- U. S. Forest Service
- California Coastal Commission
- County Air Quality Control Boards
- Regional Water Quality Control Boards

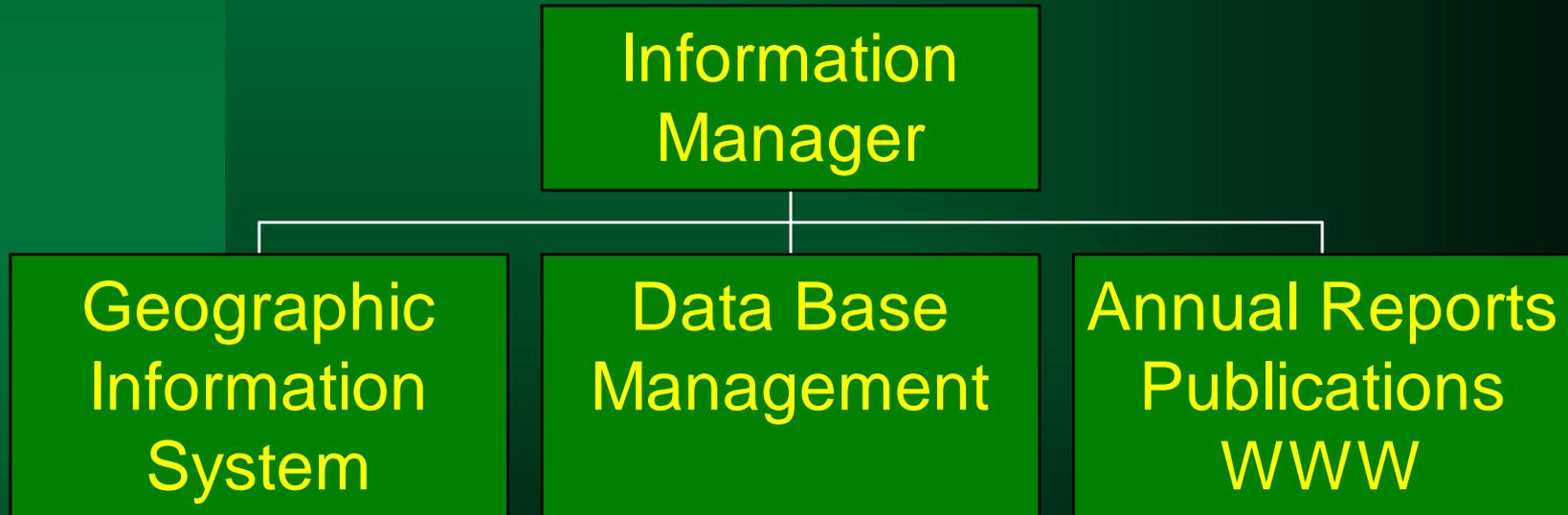


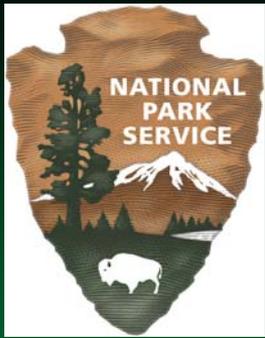
Channel Islands National Park Vital Signs Monitoring Program

- ✓ Structure follows function
- ✓ Integrated with other stewardship functions
- ✓ Three-legged stool
 - Information management
 - Island ecosystems
 - Marine ecosystems

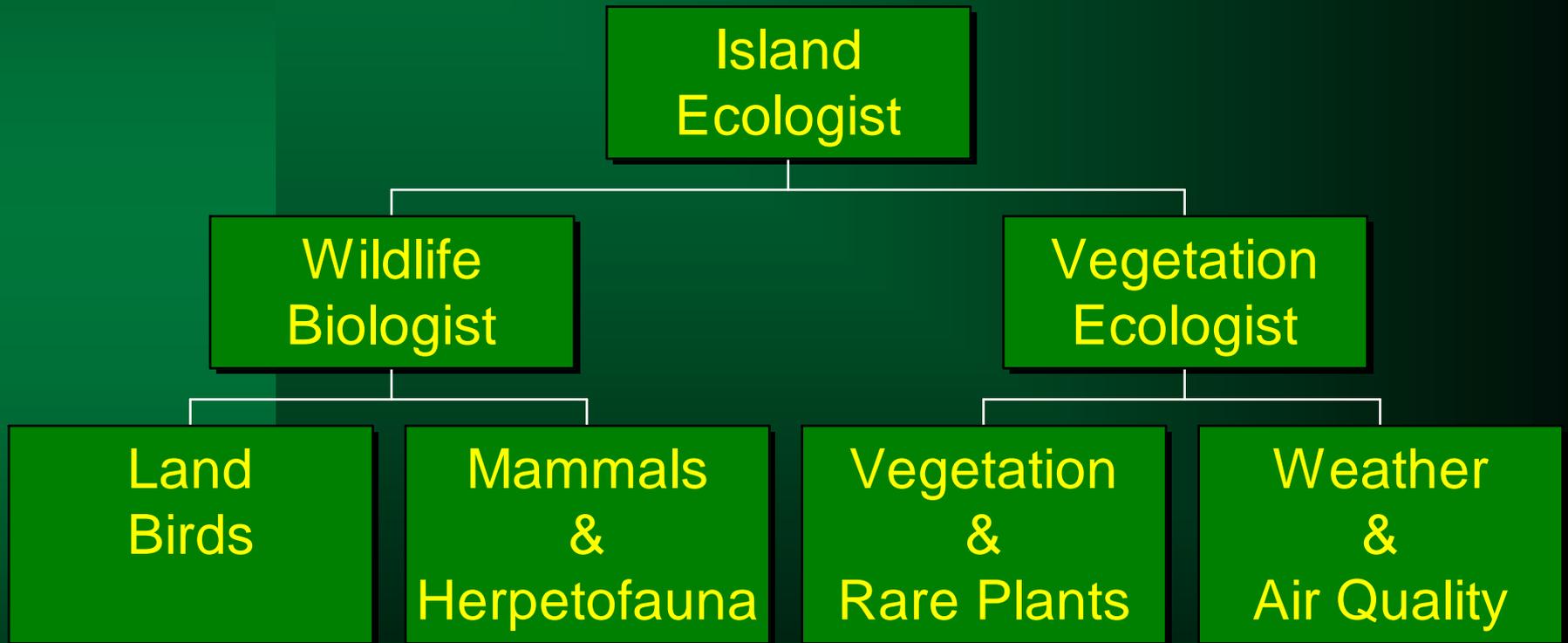


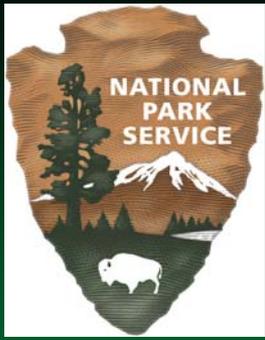
Information Management



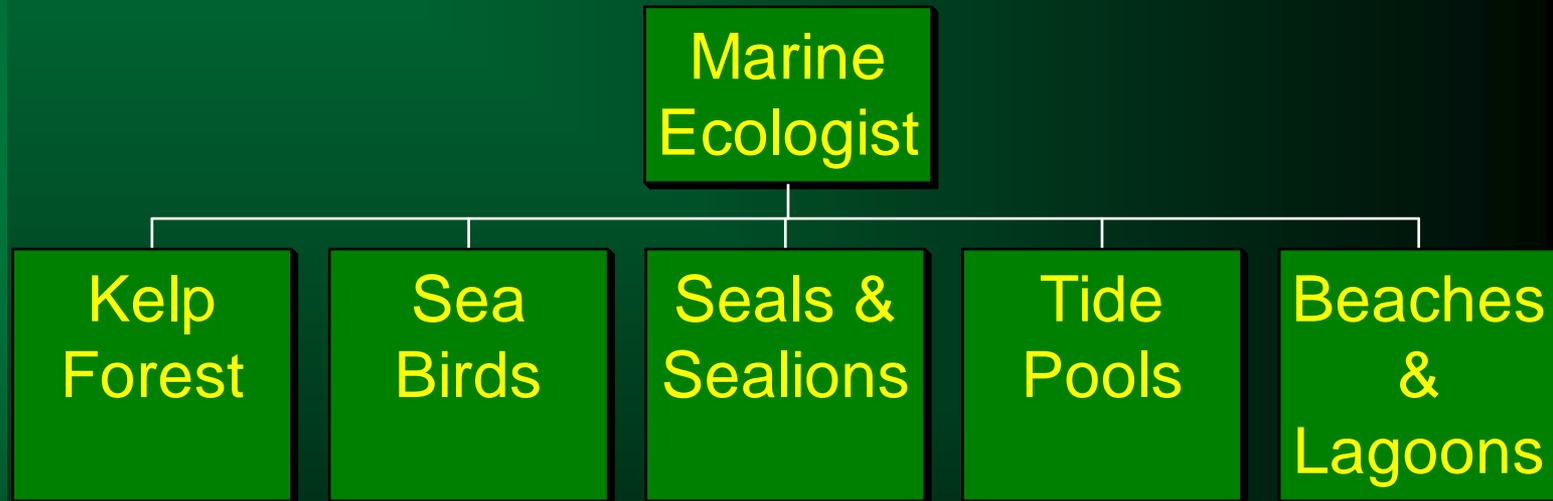


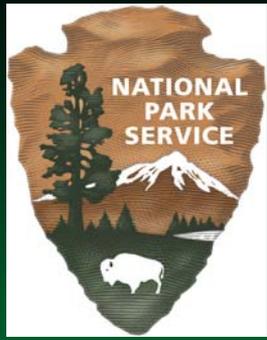
Island Ecosystems



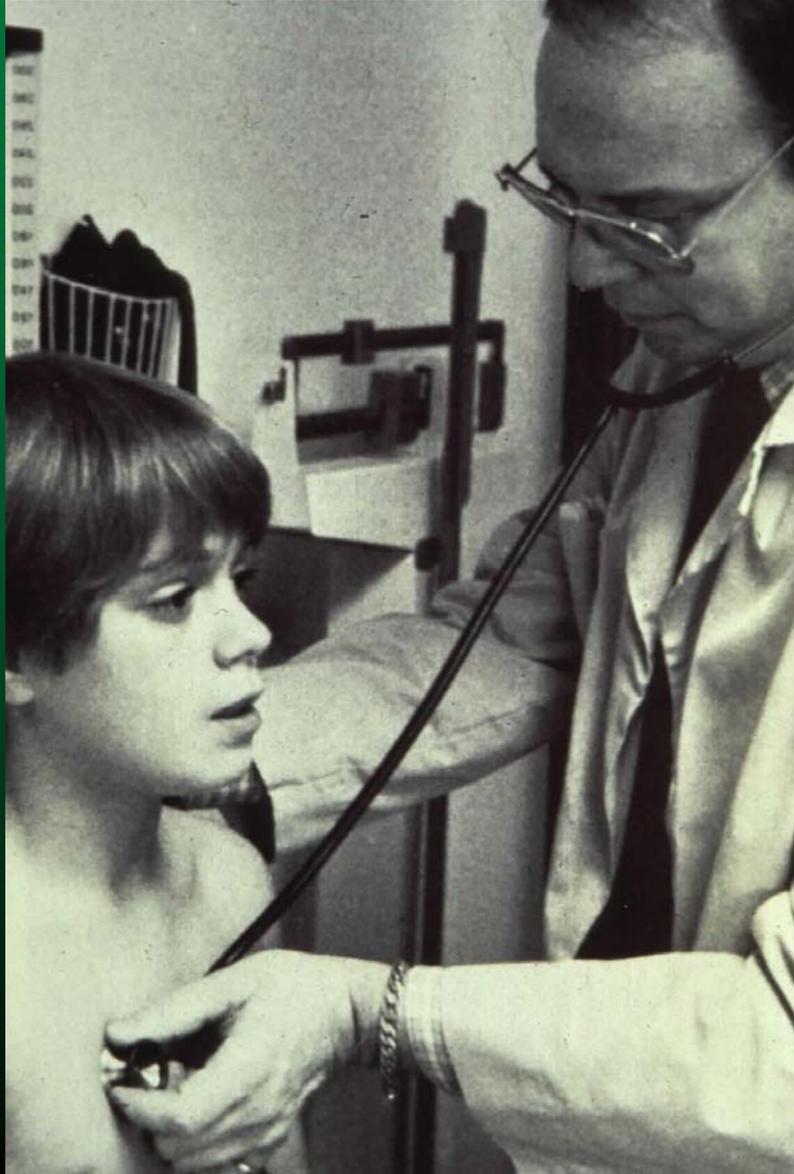


Marine Ecosystems





Ecological Vital Signs Monitoring



Health Care
for the
Environment

Using Monitoring Data to Resolve Conservation Issues

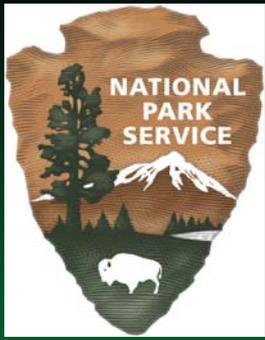


How Vital Signs Monitoring
Reduces
Uncertainty and Cost



Examples of How Monitoring Information Can Be Used To:

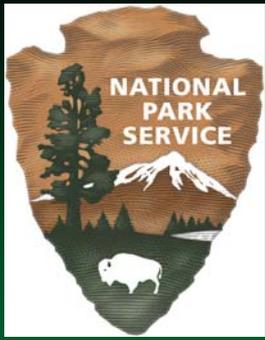
- ✔ Provide Early Warnings of Abnormal Changes
- ✔ Identify Possible Causes of Abnormal Changes
- ✔ Help Frame Research Questions to Resolve Environmental Issues
- ✔ Guide and Evaluate Management Actions



DDT contaminated marine food webs...

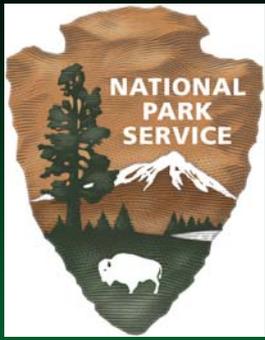
Reduced brown pelican, bald eagle, & peregrine falcon reproduction





SEWAGE CRISIS!

- ✔ Sewer pipe broke next to Cabrillo National Monument, San Diego, California
- ✔ 11 billion gallons treated effluent spilled
- ✔ Monument tide pools closed to visitors February-April 1992
- ✔ 63 days, \$15 million repair
- ✔ Damage to NPS resources?



Monitoring showed surprising effects:

Respite from visitor trampling, with nutrients and sediment from effluent, benefited intertidal ecosystem

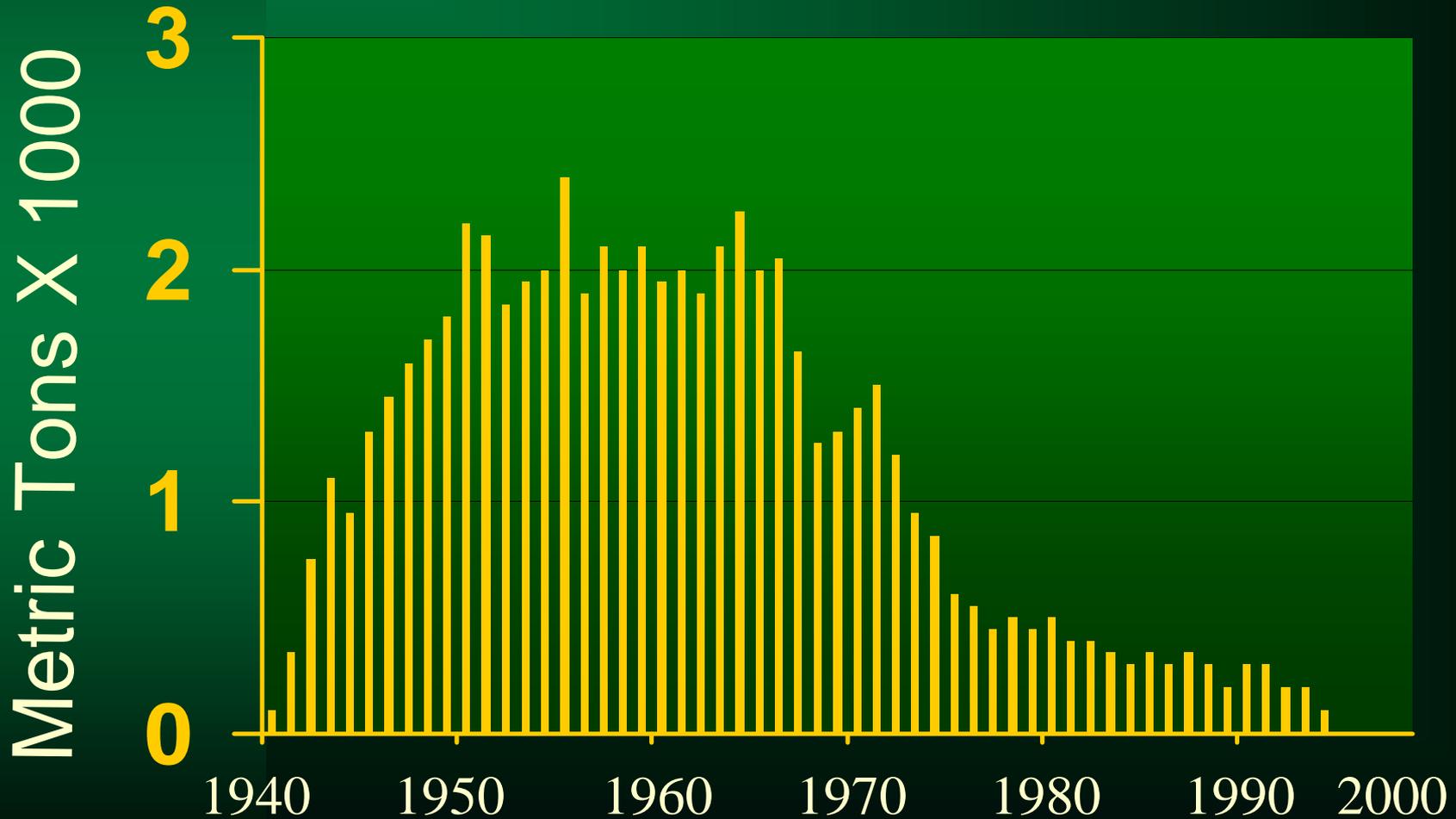
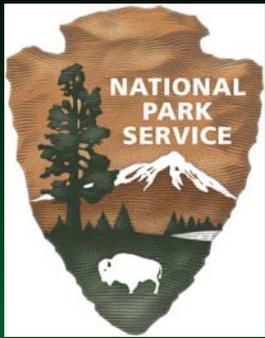




Unsustainable Exploitation

- ✦ Traditional fisheries monitoring is like recording checks written
- ✦ Vital signs monitoring examines account balance and deposits

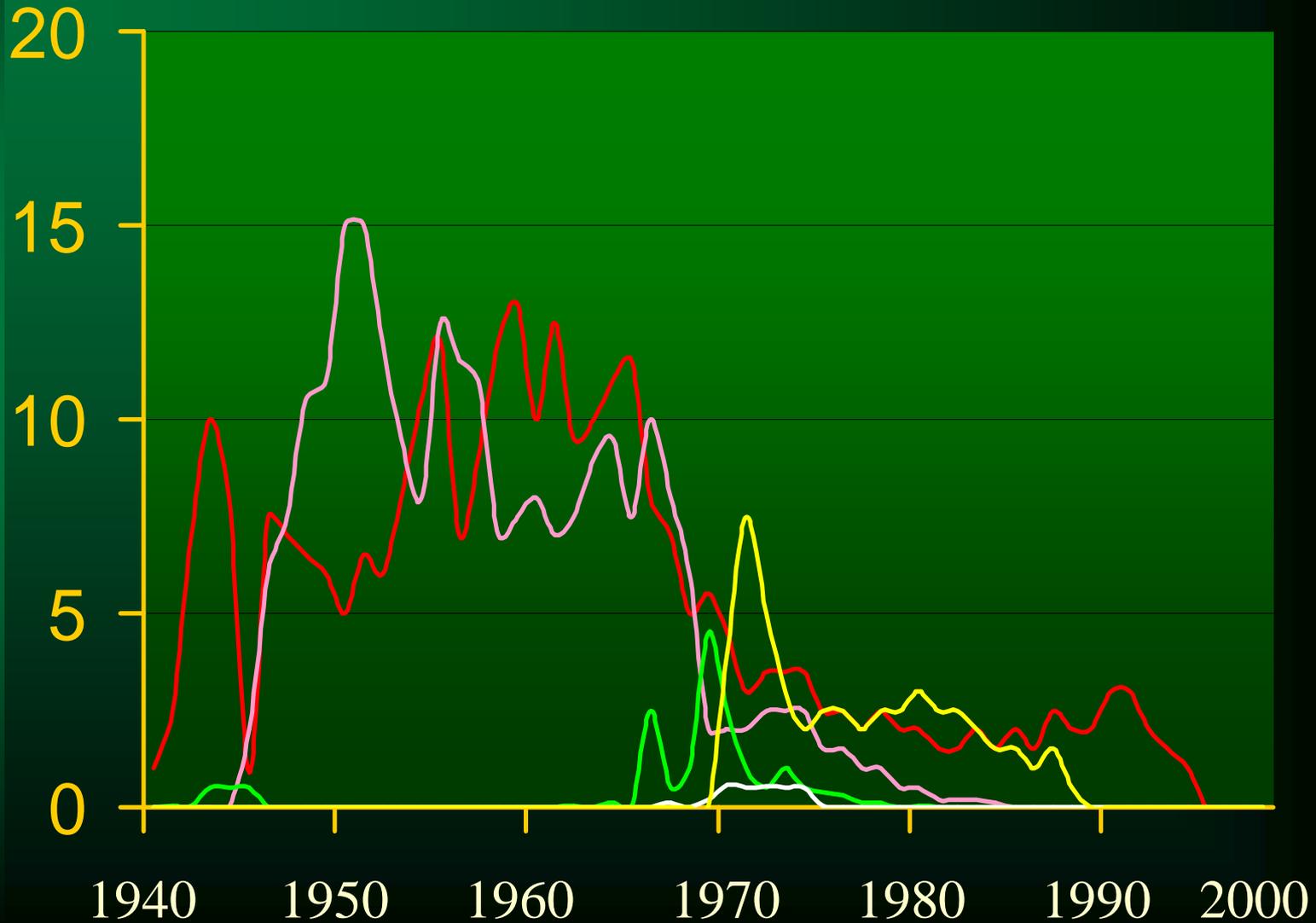
Commercial Landings California Abalone Fisheries





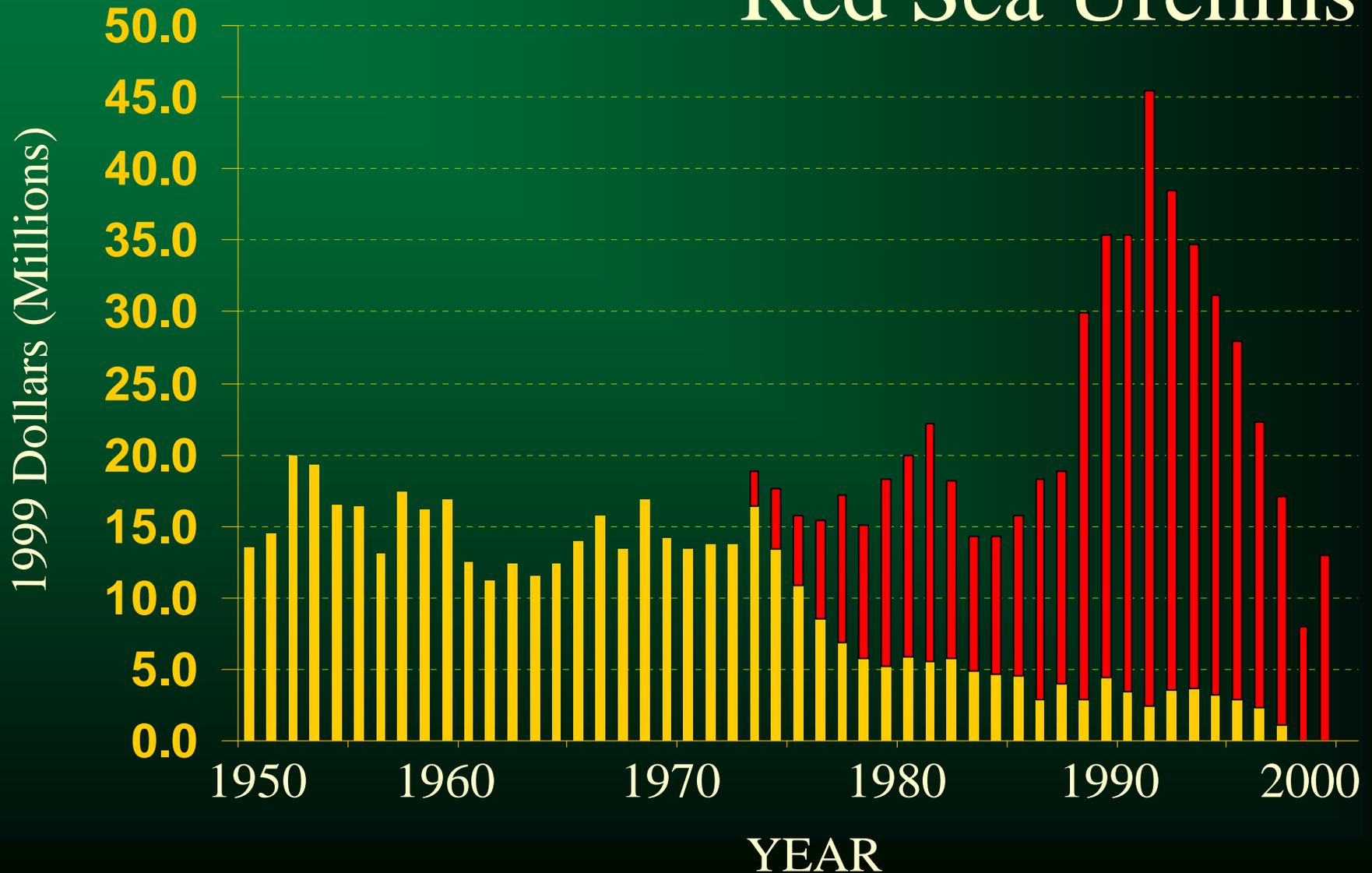
Serial Depletion

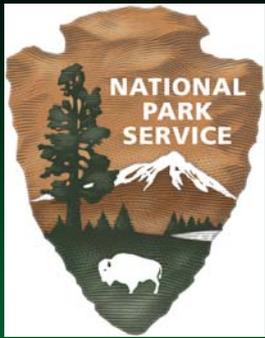
Metric Tons Abalone
X 100



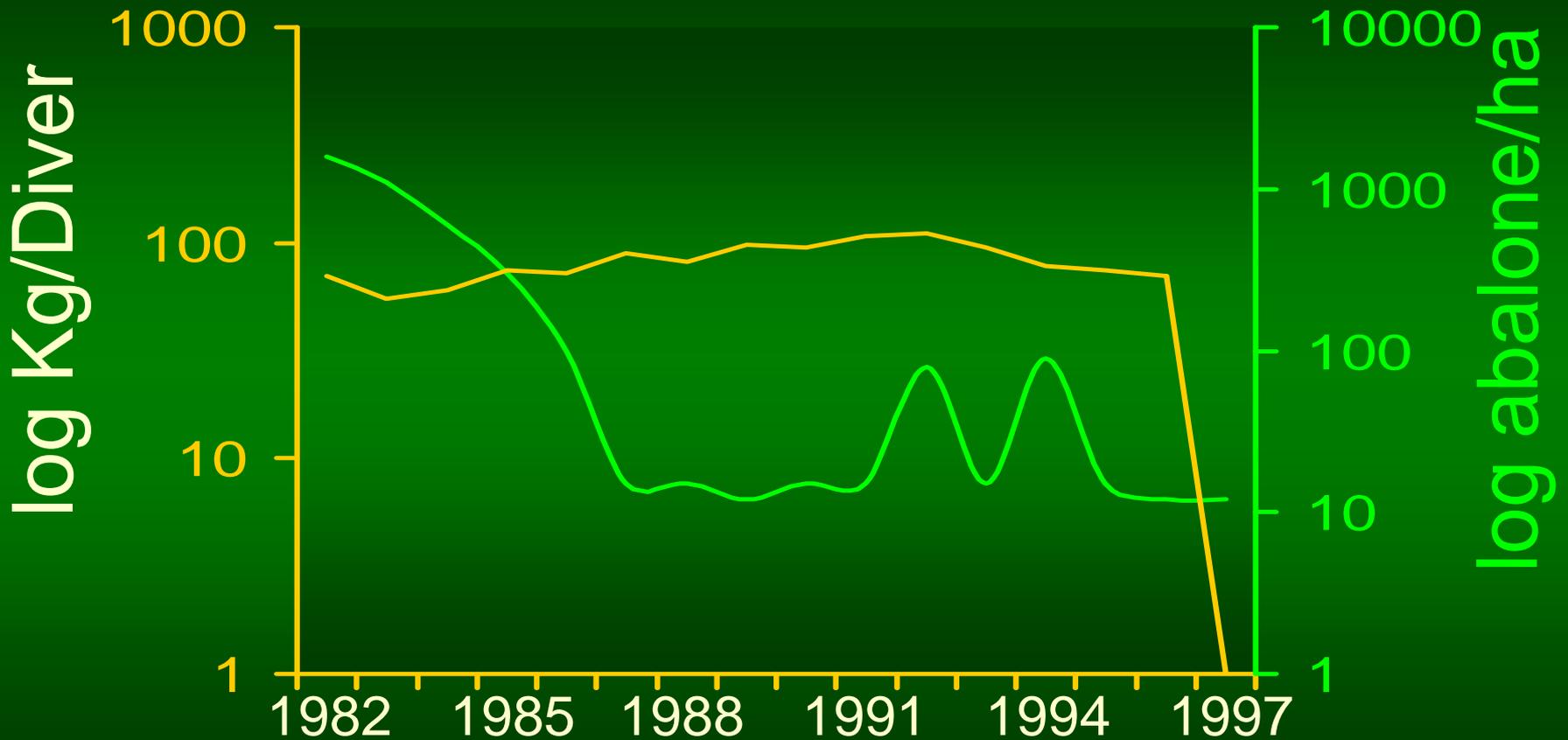
After Abalones...

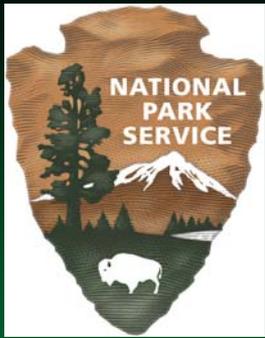
Red Sea Urchins





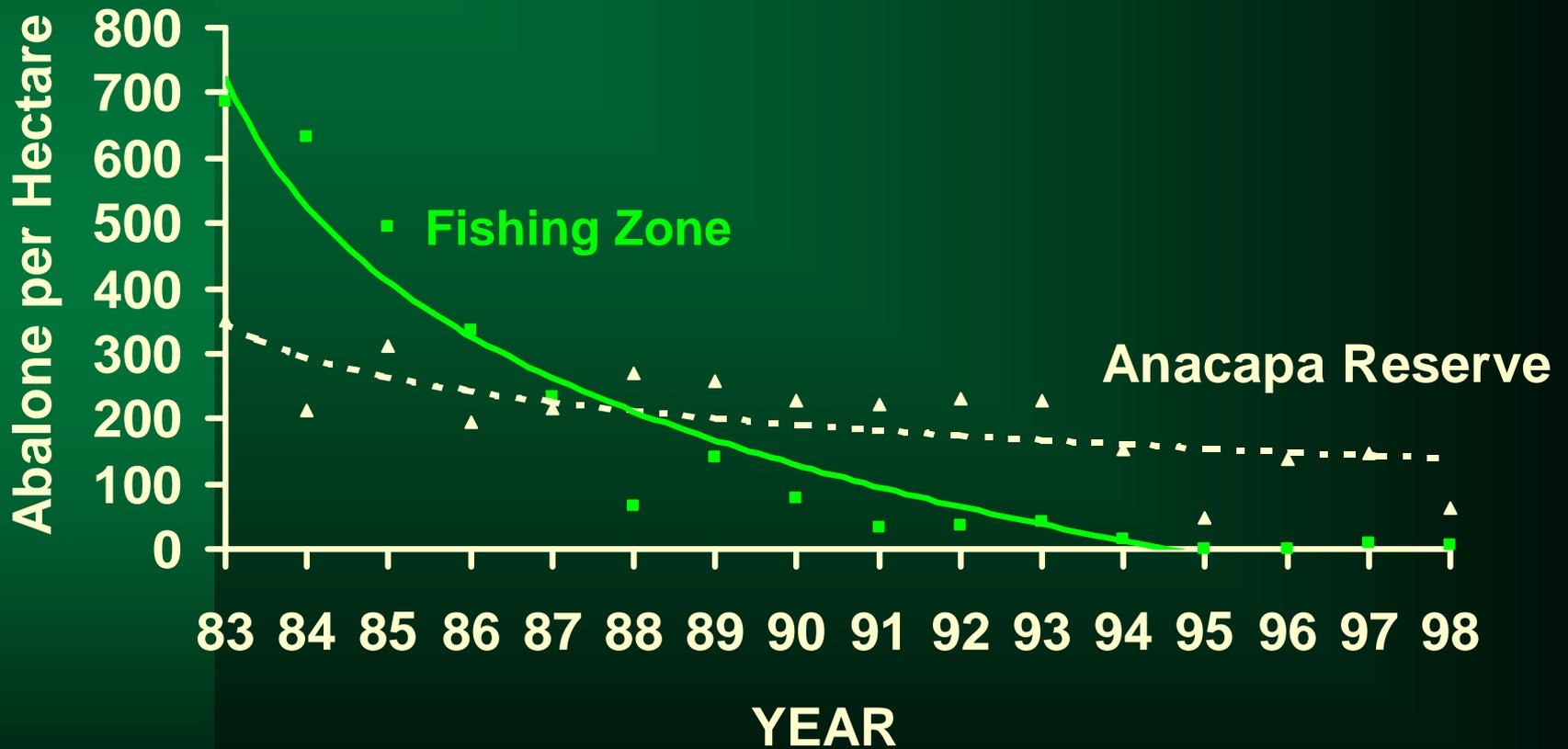
Catch Rate & Abundance

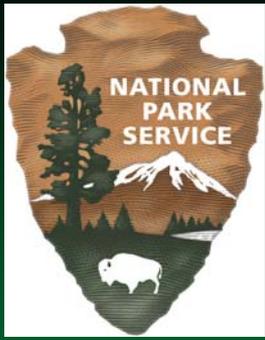




Pink Abalone

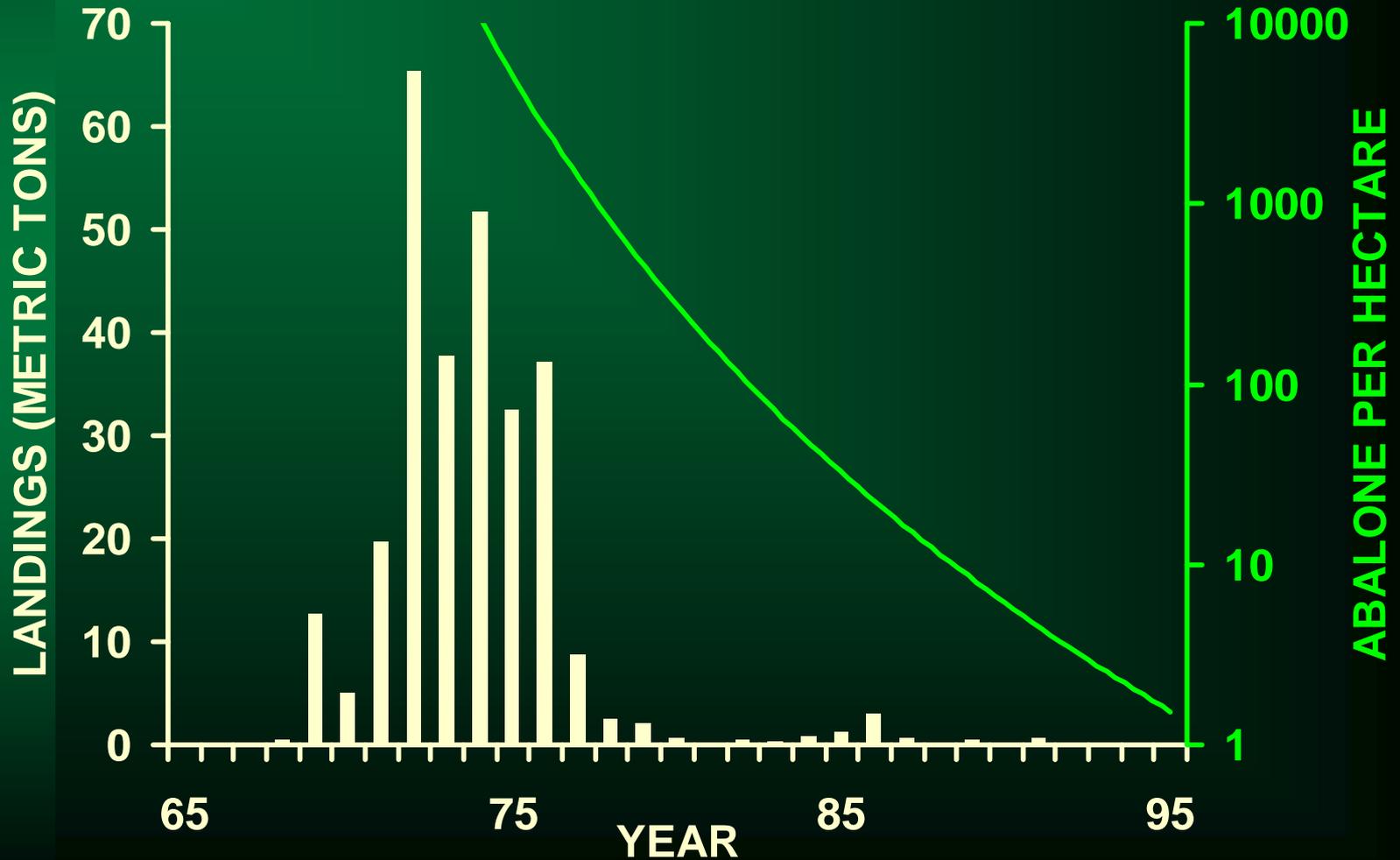
Haliotis corrugata

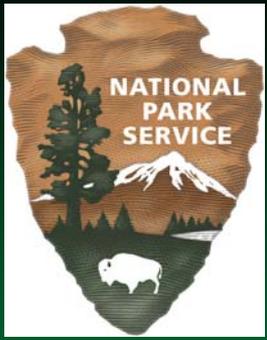




White Abalone

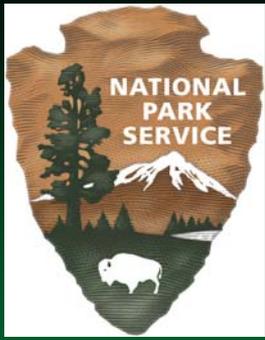
Haliotis sorenseni





Monitoring juvenile recruitment gives earliest indication of restoration success





Feral animals removed from Channel Islands National Park

Sheep & horses-
Santa Cruz

Cats-Anacapa

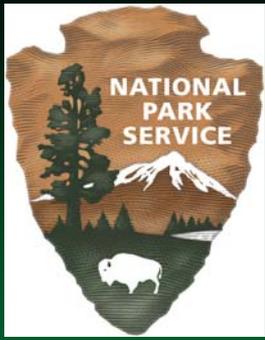
Rabbits-Santa Barbara



Burros-San Miguel



Pigs & cattle-
Santa Rosa



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'

“...there is nothing more difficult...than to initiate a new order of things.”



Niccolo
Machiavelli
1525