



Evaluating Marine Protected Areas

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The **P**artnership for **I**nterdisciplinary
Studies of **C**oastal **O**ceans



Evaluating MPAs



Why



Where



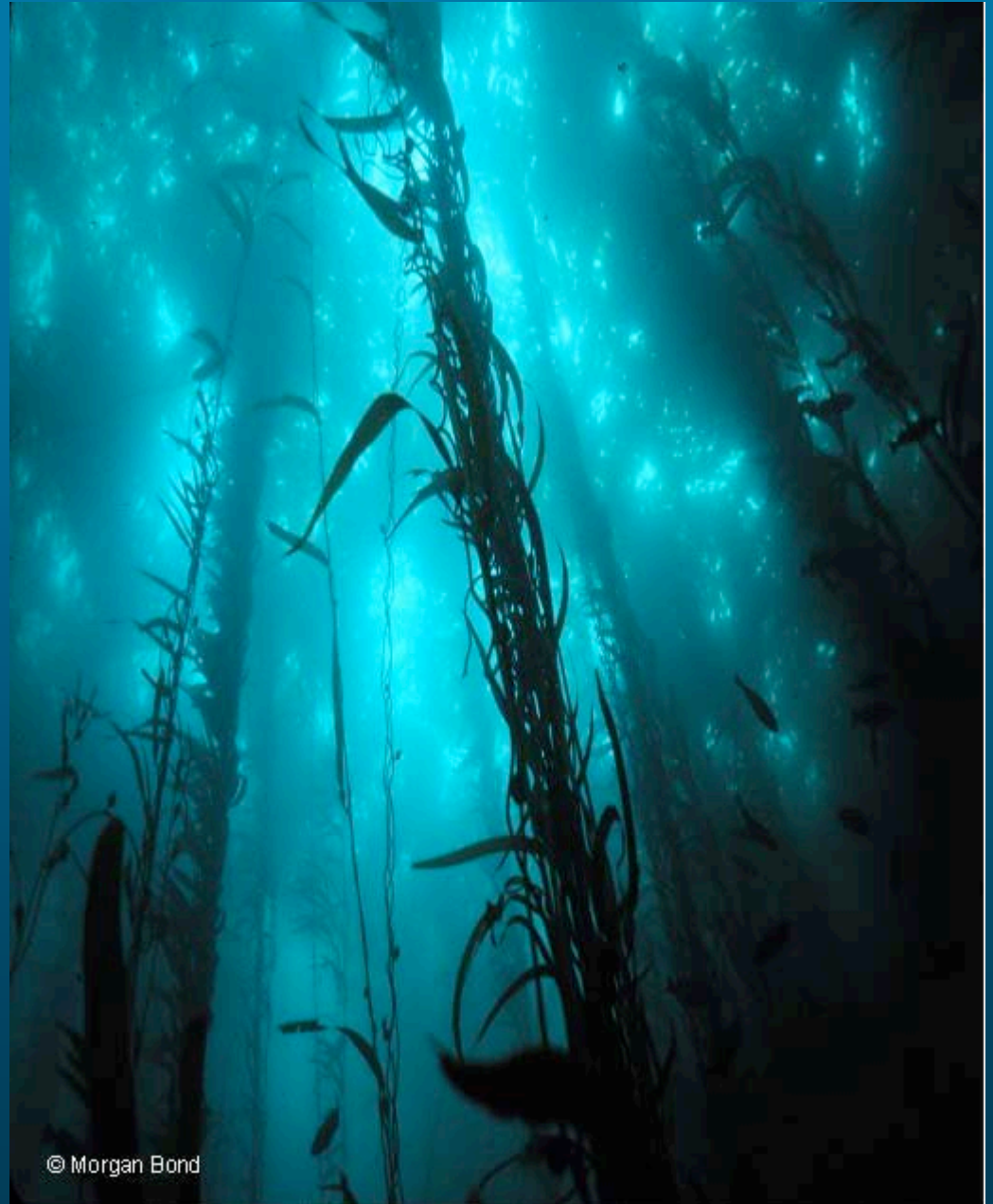
How



What



When



Why Evaluate MPAs?

1. Required by MLPA

The law requires that the master plan include “[R]ecommendations for **monitoring**, research, and **evaluation**...to assist in adaptive management of the MPA network...” (FGC Section 2856(a)2(H))

2. Adopted Goals of the Central Coast Regional Stakeholder Group

Goal 5 - 2. ...develop objectives, **a long-term monitoring plan** that includes standardized biological and socioeconomic monitoring protocols, and a strategy for **MPA evaluation**...

3. Given limited resources, any management approach comes with costs:

- detracts from alternative approaches
- redirects resources (financial and human)

Why Evaluate MPAs?



4. If ineffective and without evaluation, provides false sense of security

- jeopardizes resource, especially if other existing regulations are relaxed

5. Critical to refining design and adaptive management:

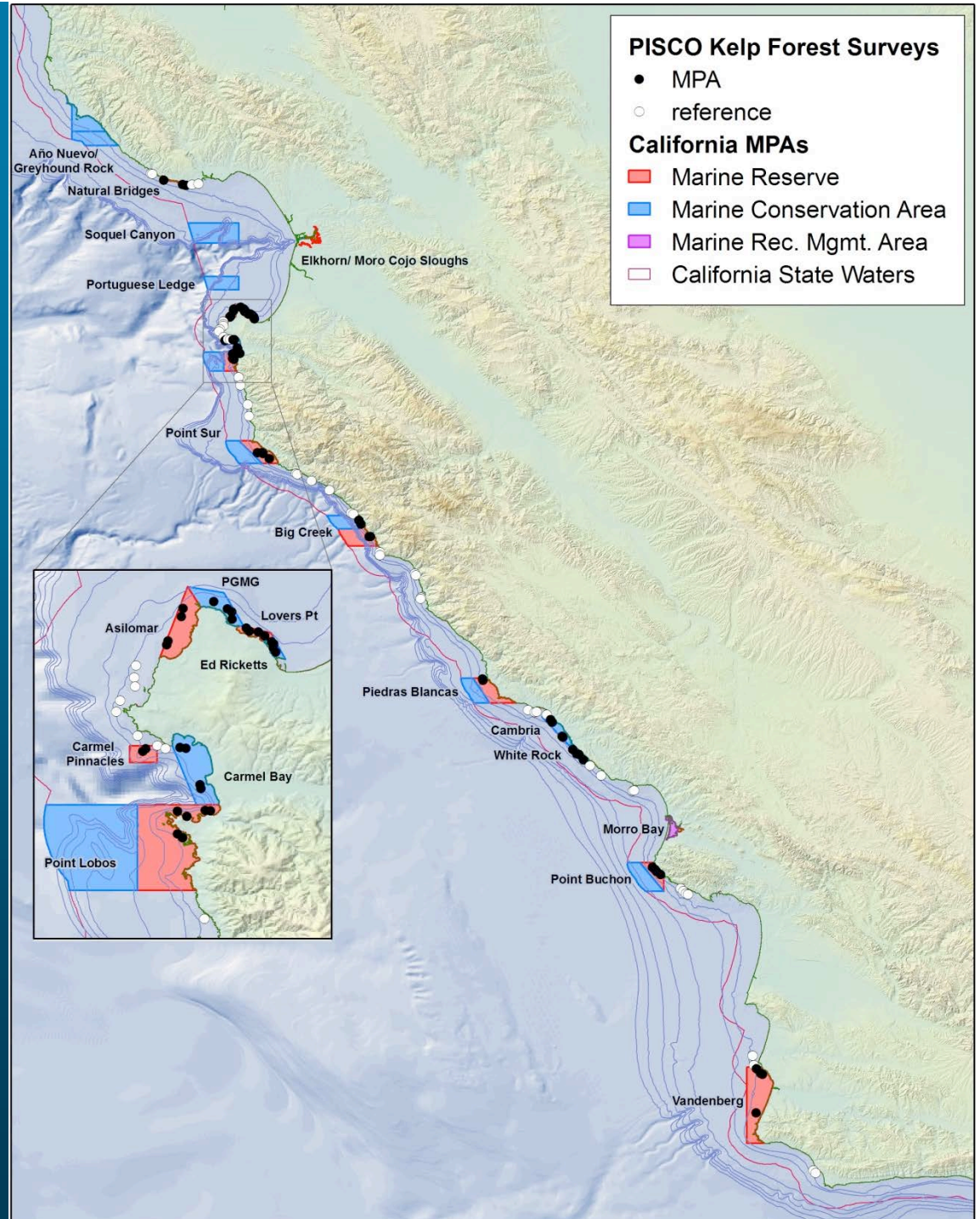
- the sooner benefits/costs determined, the more rapidly aspects of design can be refined

6. Goals common to evaluation and application

- e.g., EBM and fisheries application

Where do you Evaluate?

Diving surveys
2007-2008



Where do you evaluate?



Inside MPAs



Inside vs. Outside MPAs



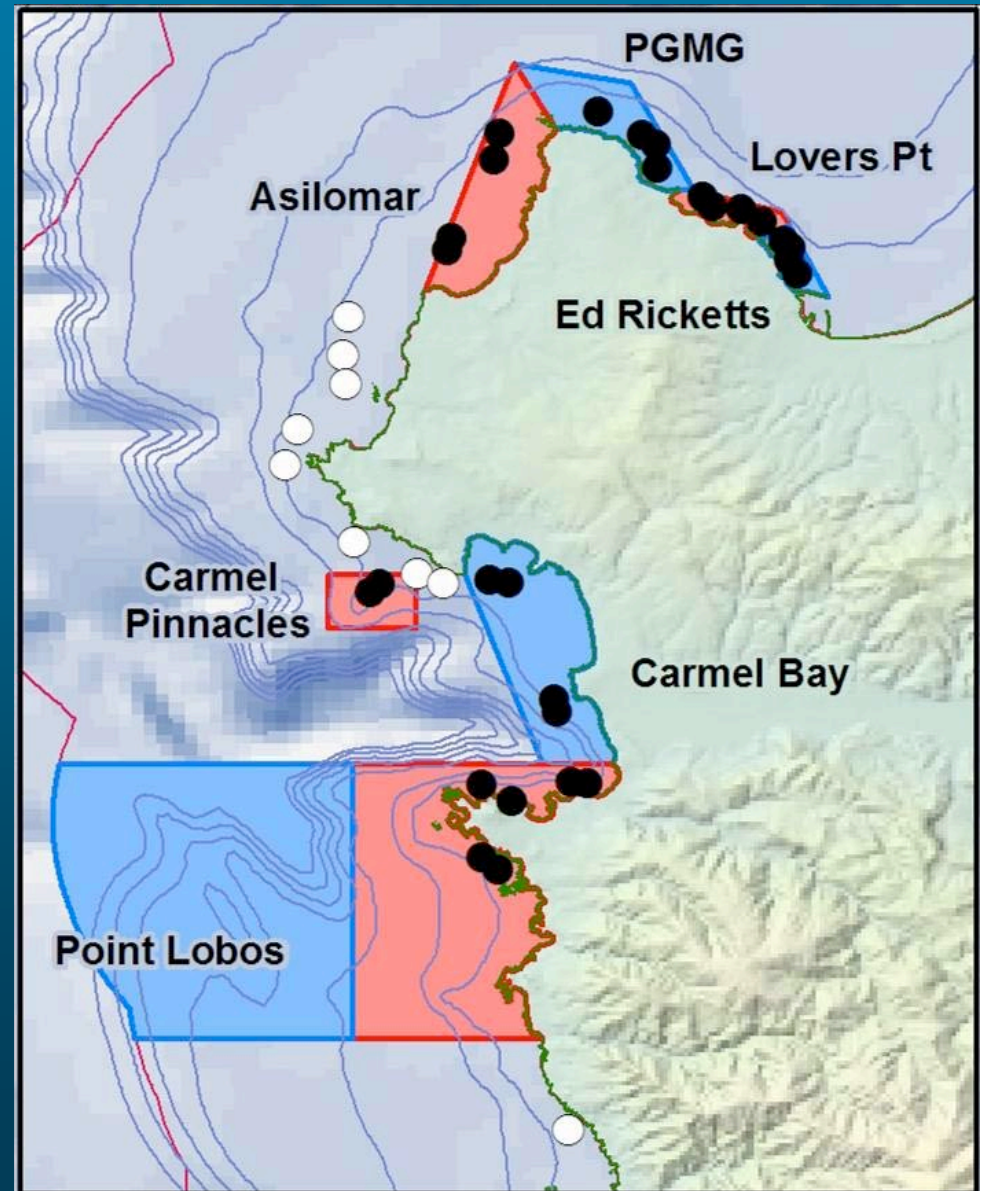
Among Multiple MPAs

PISCO Kelp Forest Surveys

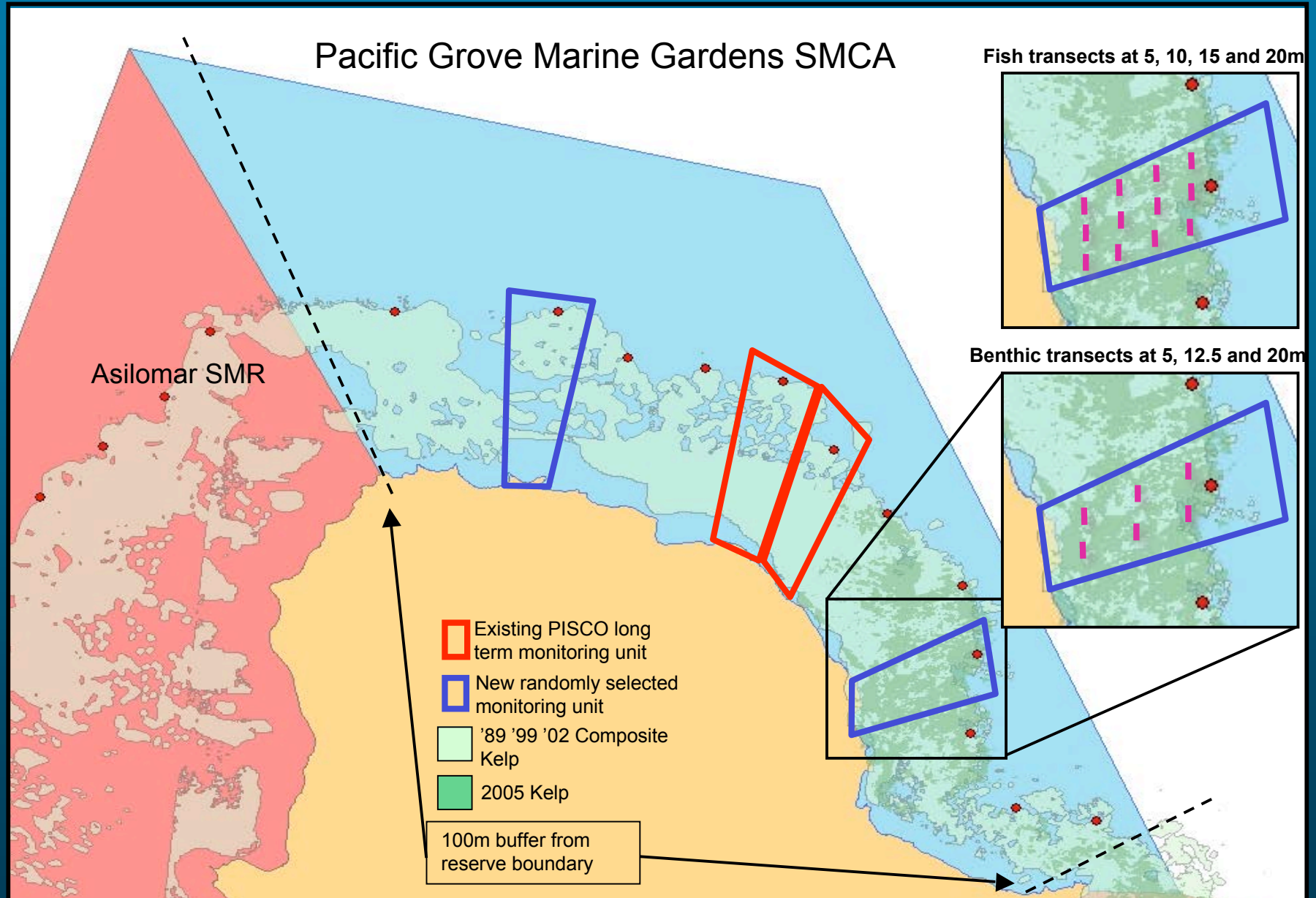
- MPA
- reference

California MPAs

- Marine Reserve
- Marine Conservation Area
- Marine Rec. Mgmt. Area
- California State Waters



Where do you evaluate?

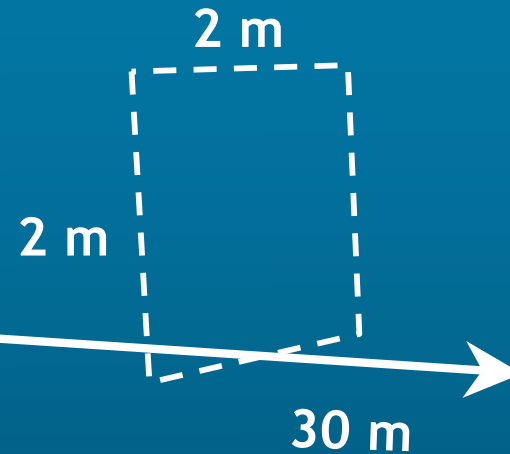


Example schematic diagram of stratified random permanent sampling design.

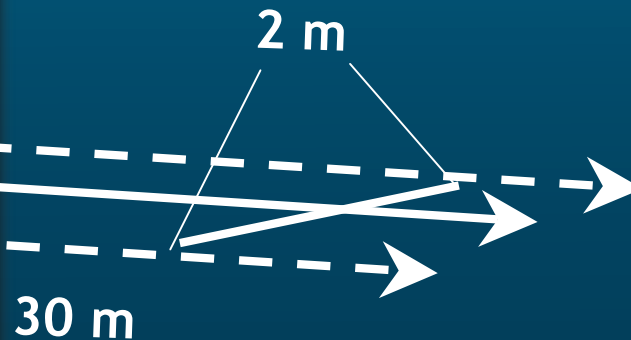
How do you evaluate?



Fish: density & sizes



Kelps & large mobile inverts:
density



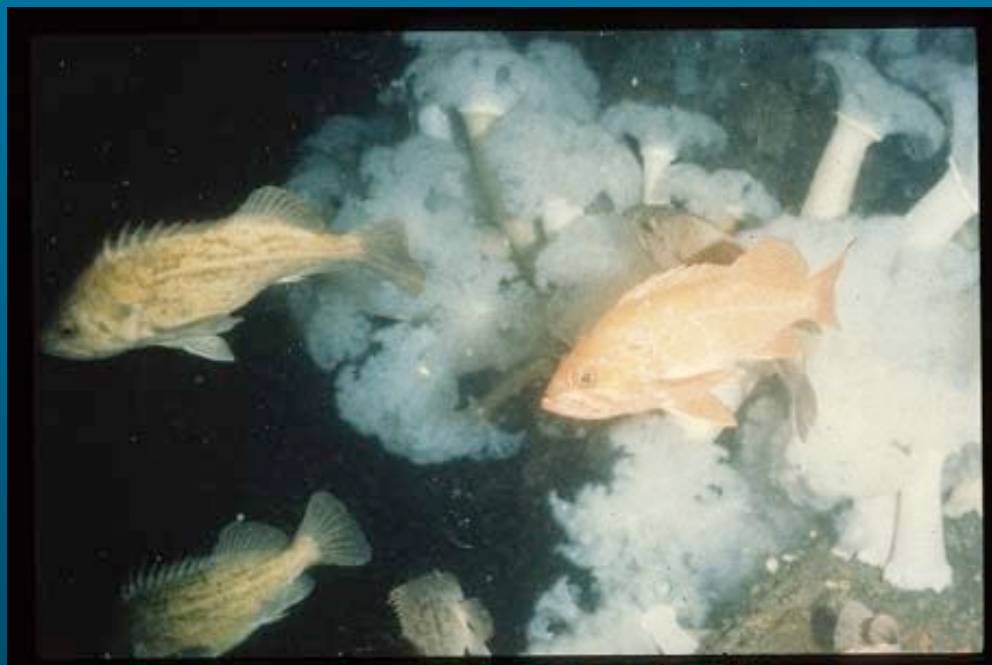
Algae & inverts: % cover

What do you evaluate?

Depends on **goals and objectives** of MPA:

conservation

- biodiversity
- structure and function of ecosystem



fisheries management

- buffer, spawning source (replenish unprotected populations)
- baseline, reference areas to distinguish human impacts from natural variation

What do you evaluate?

Ecological Parameters to estimate:



Population



Community



Ecosystem



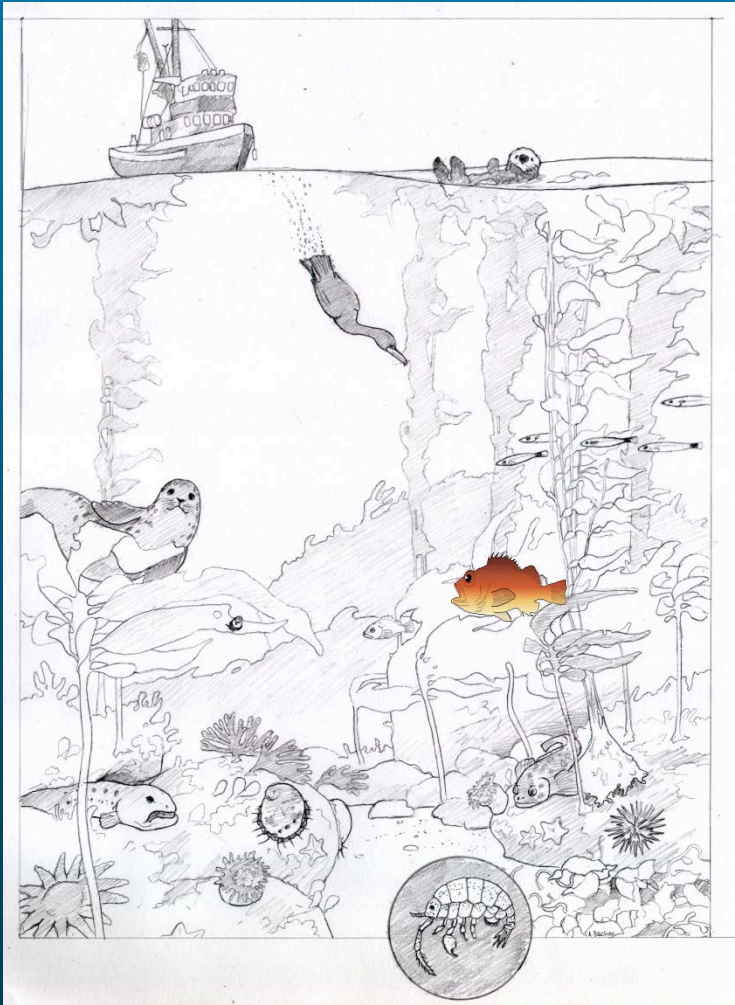
Structure



Function

What do you evaluate?

Parameters to estimate:



Population

- size / age structure
- larval production
- density (i.e. abundance)
- ecological role

Community

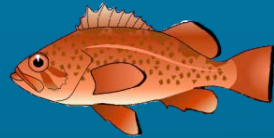
- structure: diversity, composition
focal species (threatened, indicator)
- function: keystone, trophic and other interactions, habitat engineers

Ecosystem

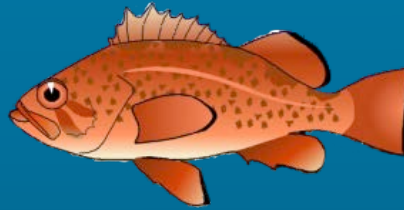
- productivity, connectivity

Why Measure size?

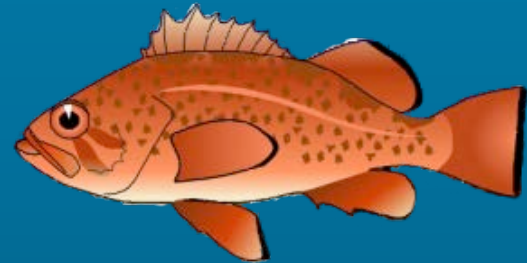
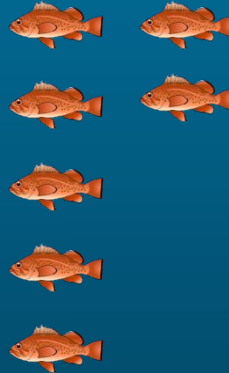
Vermilion Rockfish, *Sebastes miniatus*



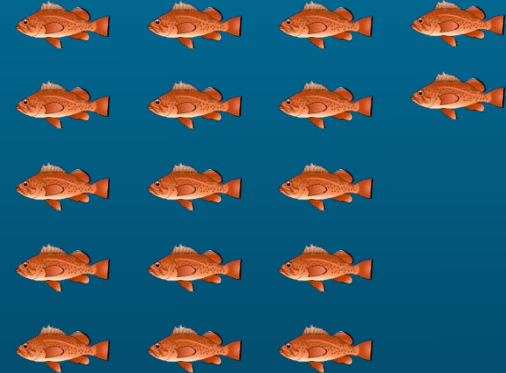
37 cm, 0.8 kg



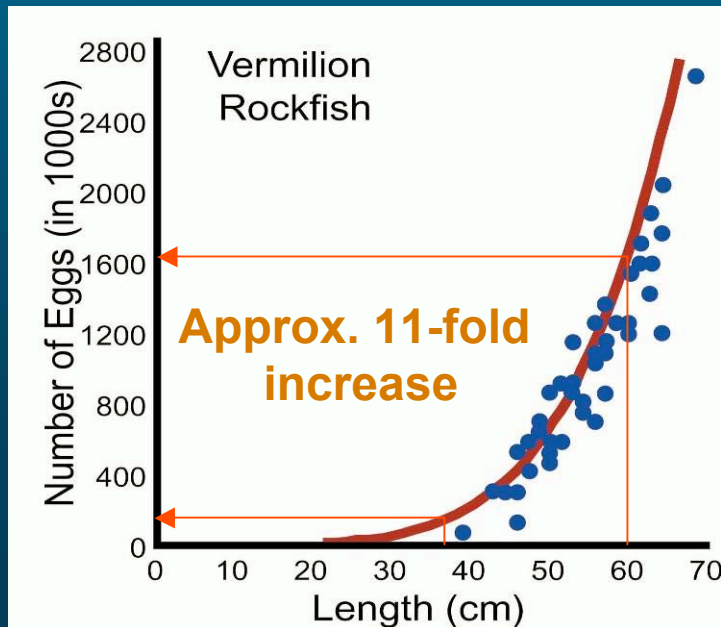
50 cm, 1.9 kg



60 cm, 3.3 kg



 = 100,000 babies

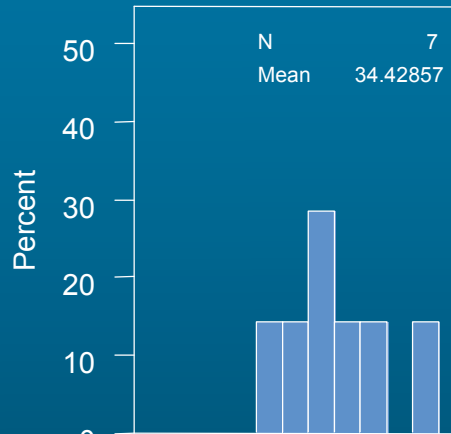


Love et. al. NOAA Tech. Rep. 1990

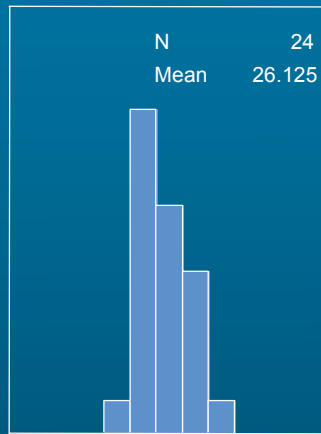
Size Frequency Comparisons

Carmel Bay State Marine Conservation Area

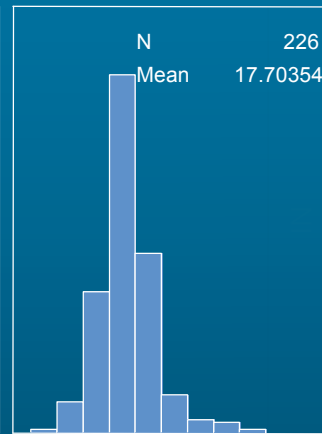
Kelp Greenling



Kelp Rockfish

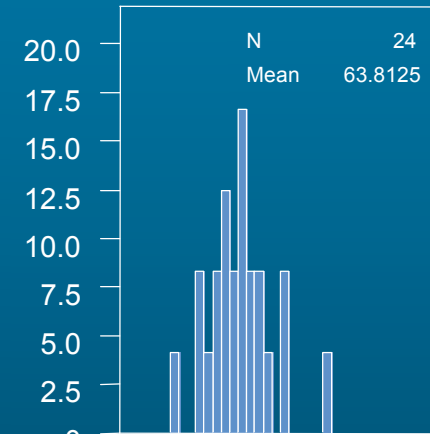


Blue Rockfish



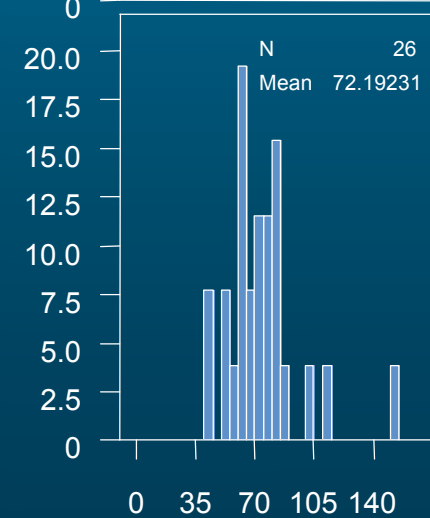
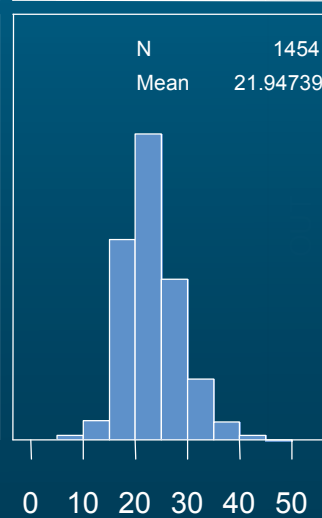
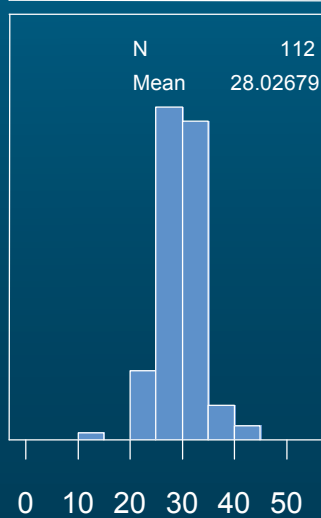
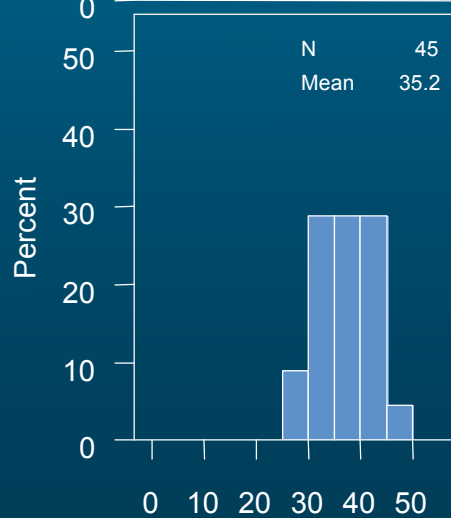
All CCSR Reserves

Lingcod



INSIDE RESERVE

OUTSIDE RESERVE

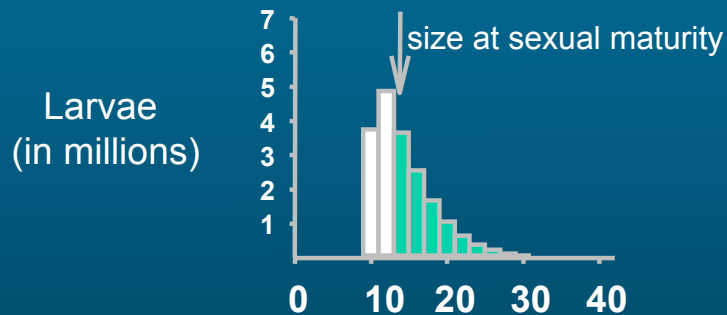
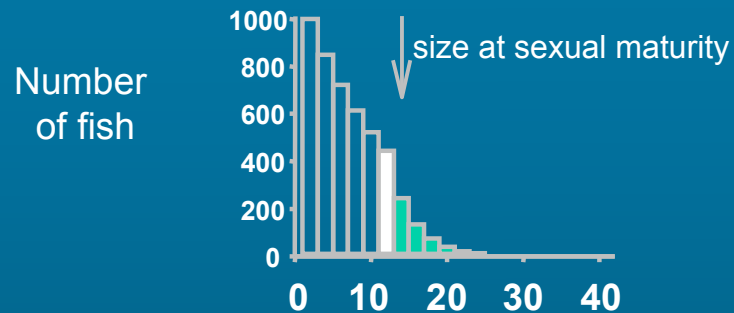


fish_tl

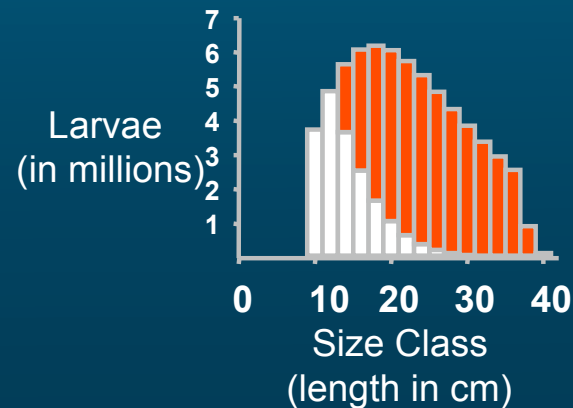
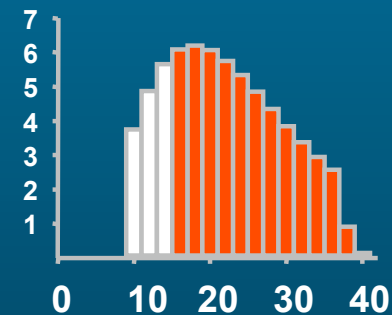
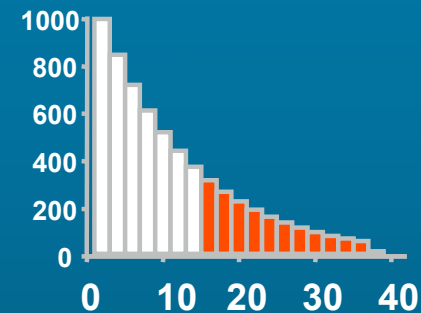
fish_tl

Size structure and larval production

Outside MPA

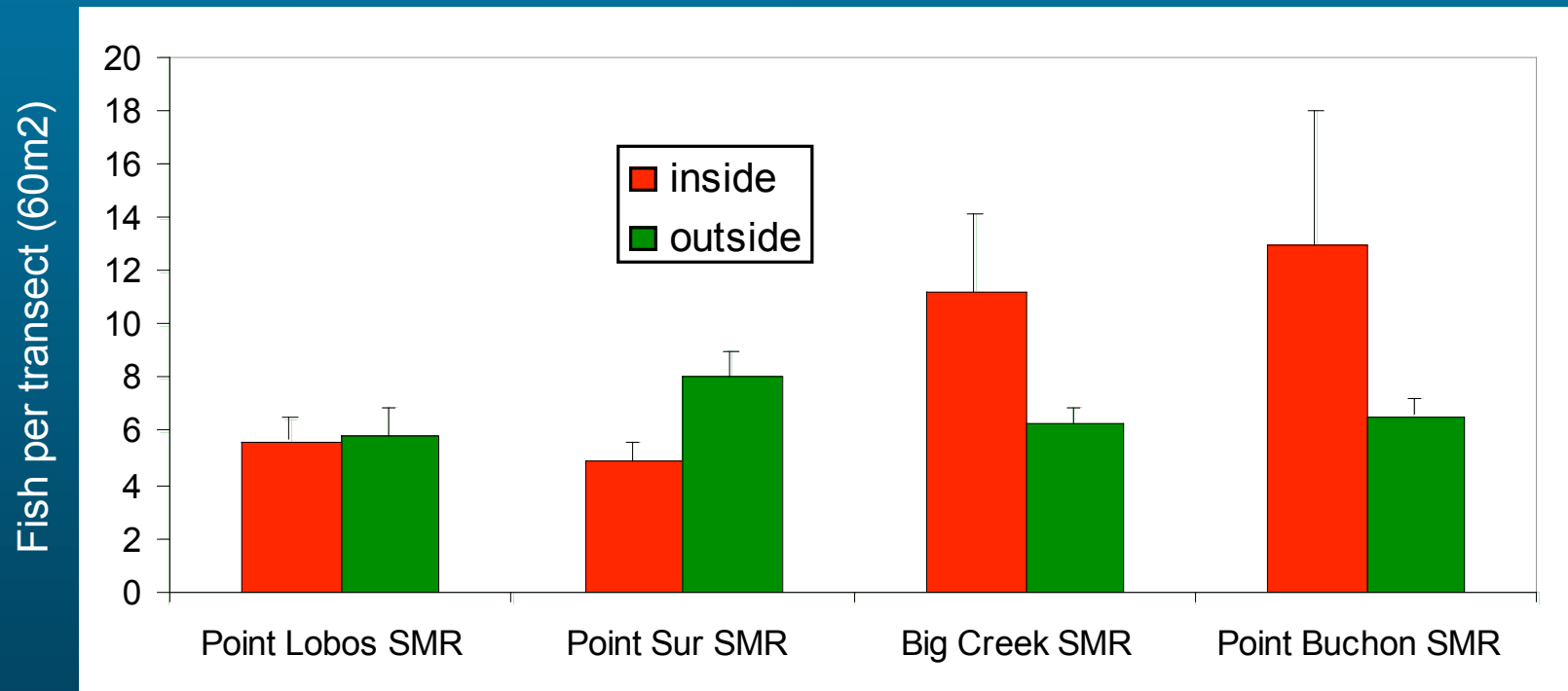


Inside MPA



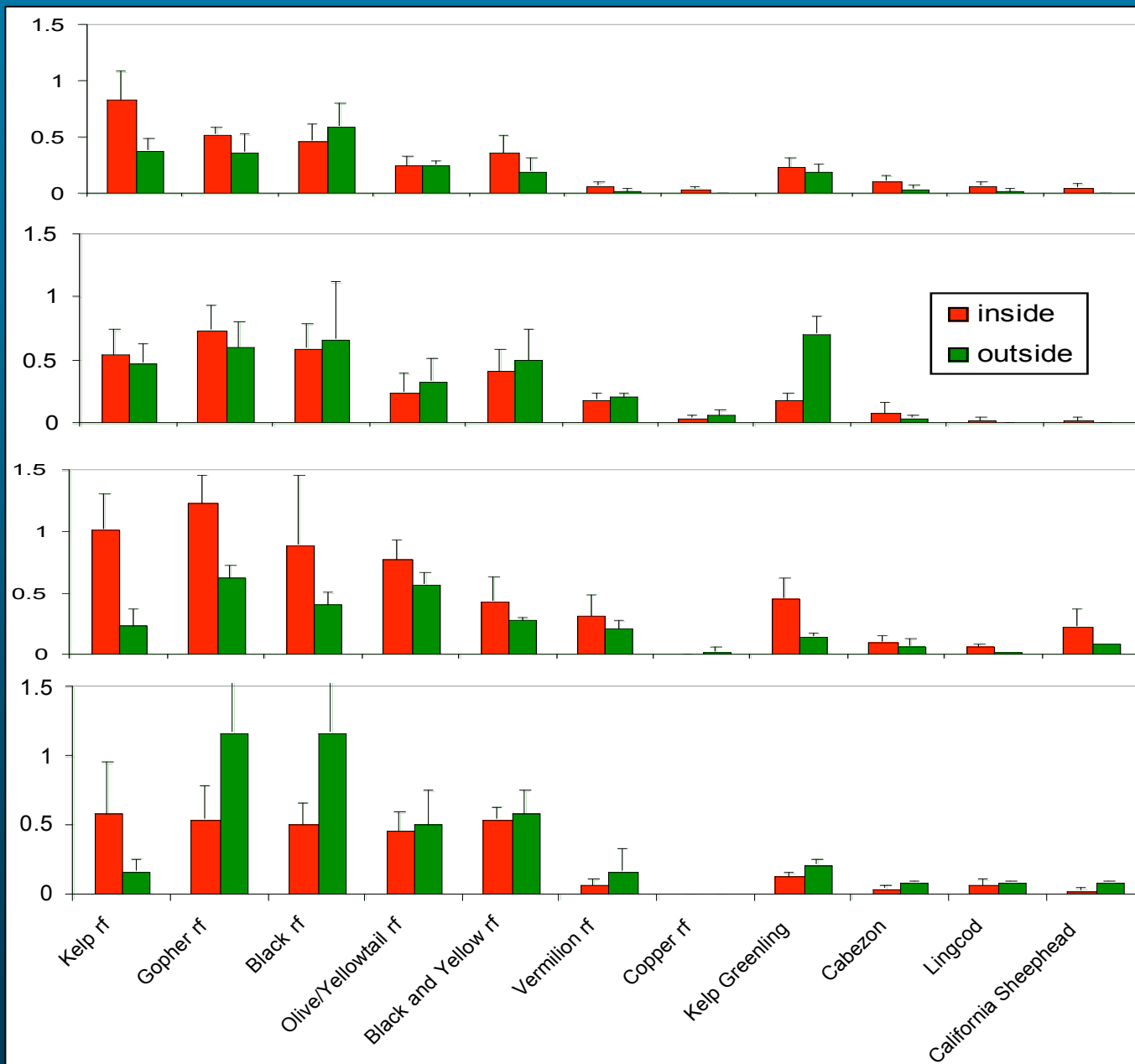
Fish Density Comparison

Blue Rockfish



Fish Density Comparison

Fish per transect (60m2)



Point
Lobos
SMR

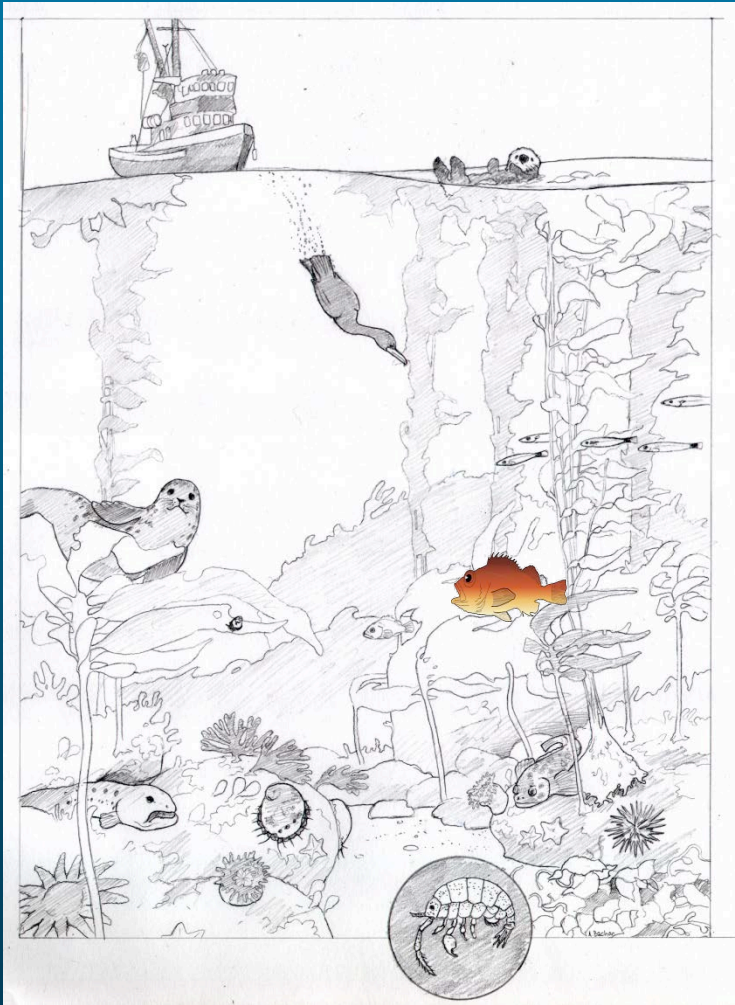
Big
Creek
SMR

Point
Sur
SMR

Point
Buchon
SMR

What do you evaluate?

Parameters to estimate:



Population

- size / age structure
- density (i.e. abundance)
- larval production
- ecological role

Community

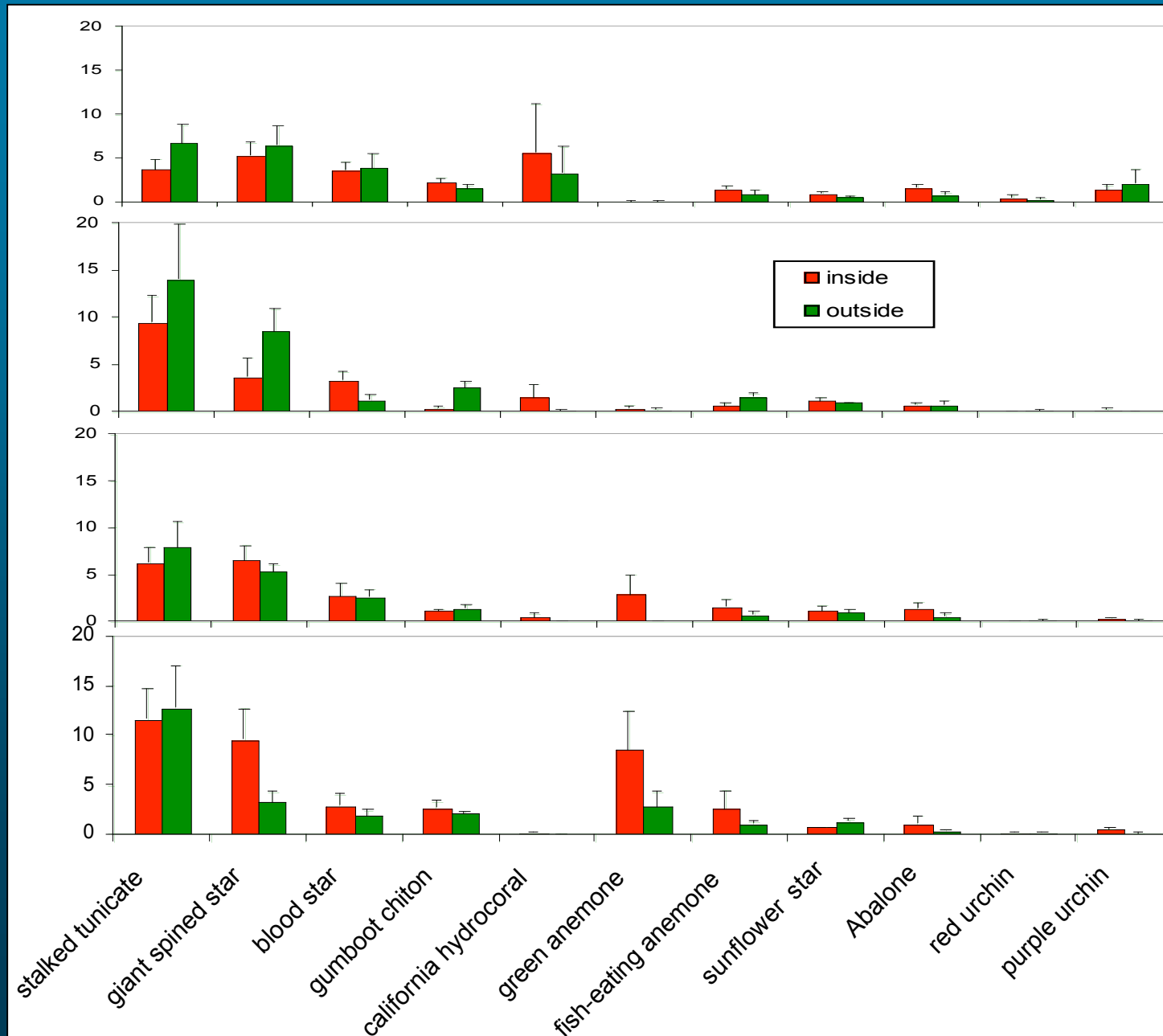
- structure: diversity, composition
focal species (threatened, indicator)
- function: keystone, trophic and other interactions, habitat engineers

Ecosystem

- productivity, connectivity

Invertebrate Community Comparison

Number per transect (60m²)



Point
Lobos
SMR

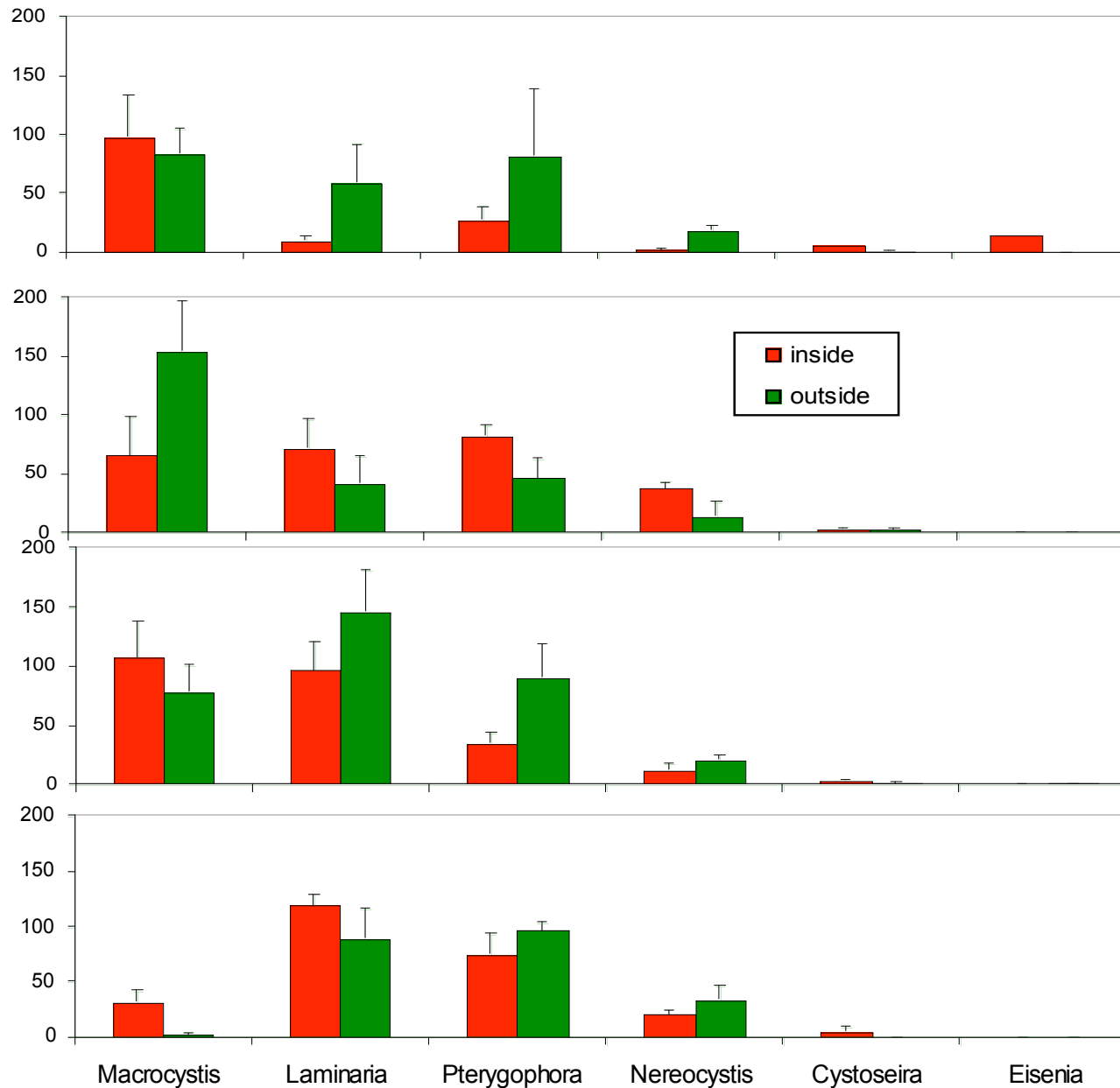
Big
Creek
SMR

Point
Sur
SMR

Point
Buchon
SMR

Kelp Community Comparison

Number per transect (60m²)



Point
Lobos
SMR

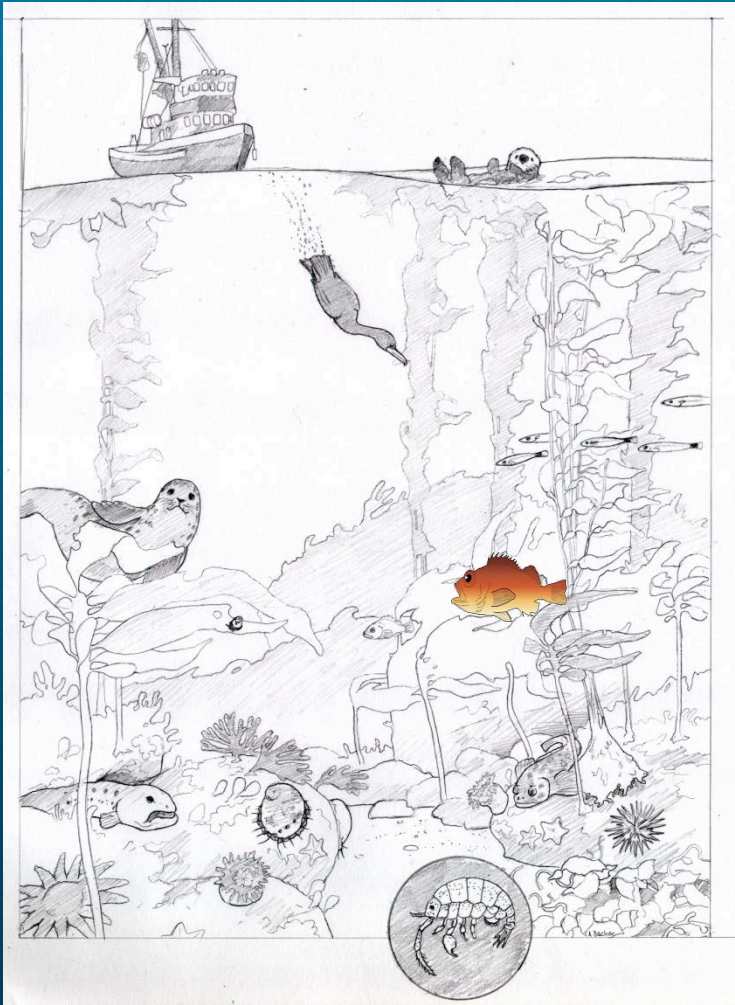
Big
Creek
SMR

Point
Sur
SMR

Point
Buchon
SMR

What do you evaluate?

Parameters to estimate:



Population

- density (i.e. abundance)
- size/age structure
- larval production
- trajectory of population size

Community

- structure: diversity, composition
focal species (threatened, indicator)
- function: keystone, trophic and other interactions, habitat engineers

Ecosystem

- productivity, connectivity

Attributes of Ecosystems - To Evaluate

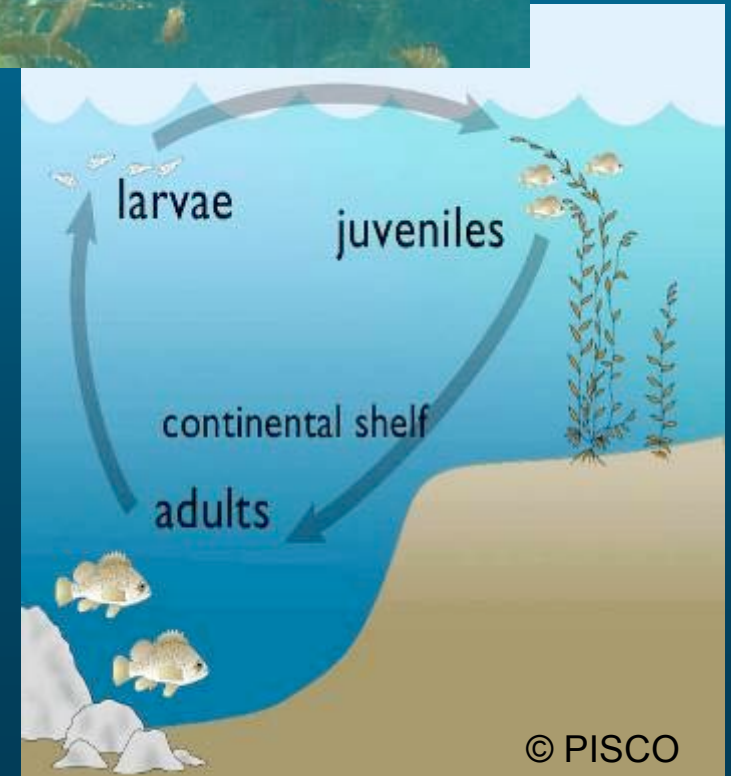
Structure

- Similar to community structure plus habitat structure



Functions

- Productivity
- Trophic interactions
- Other species interactions (e.g., kelp produces habitat)
- Nursery habitat
- Connectivity - larval production and export

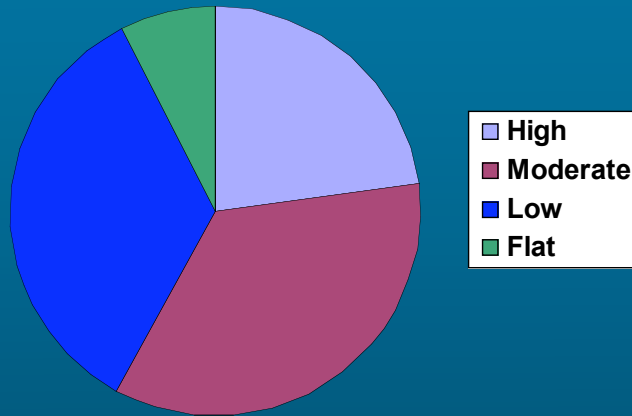


Habitat Comparison

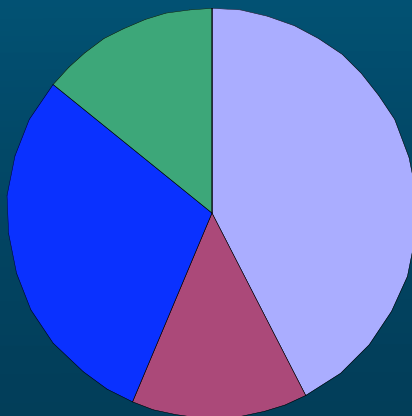
Point Lobos SMR

Vertical Relief

Inside

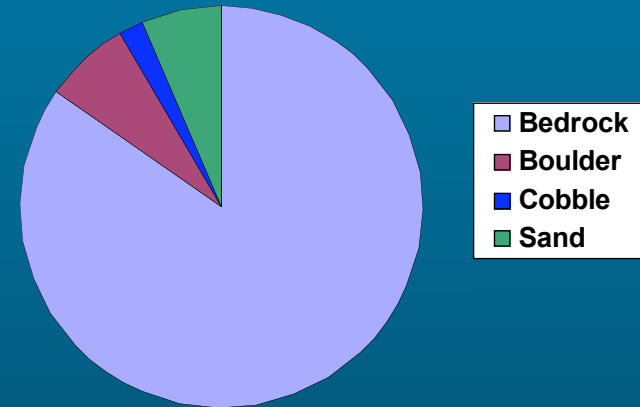


Outside

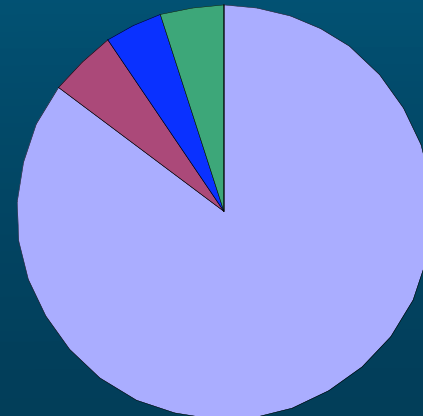


Substrate Type

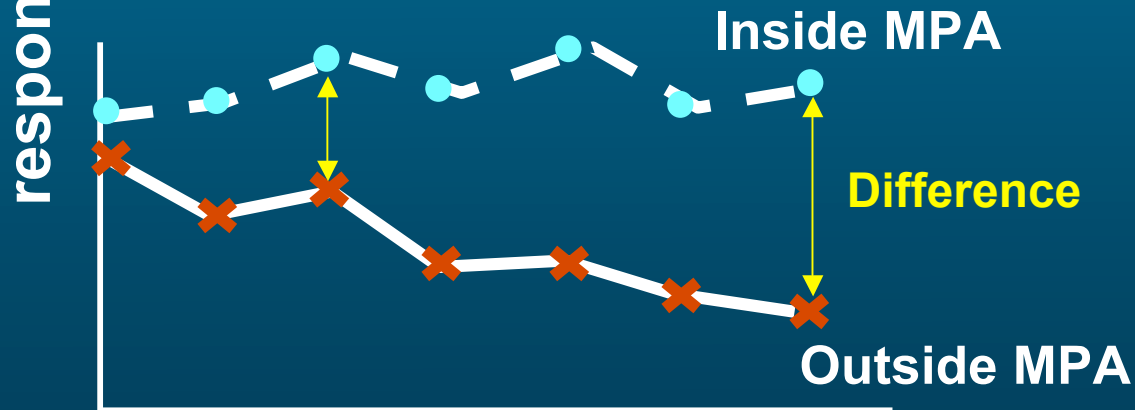
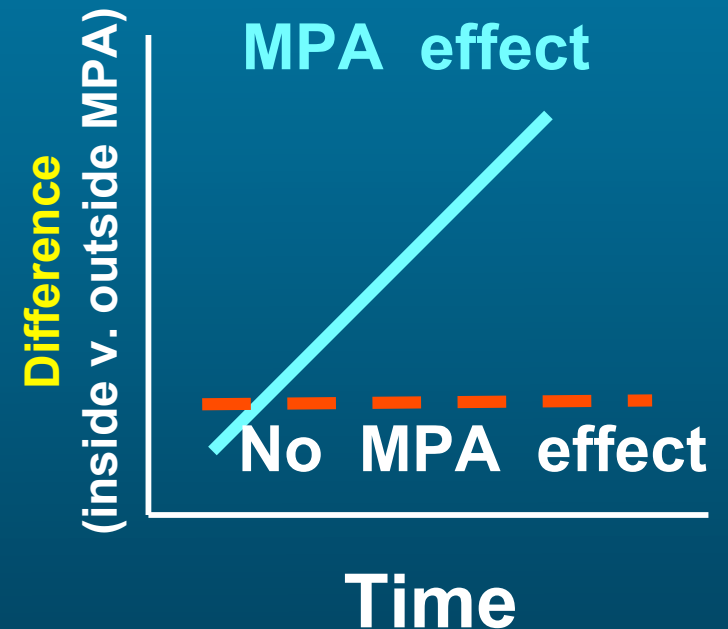
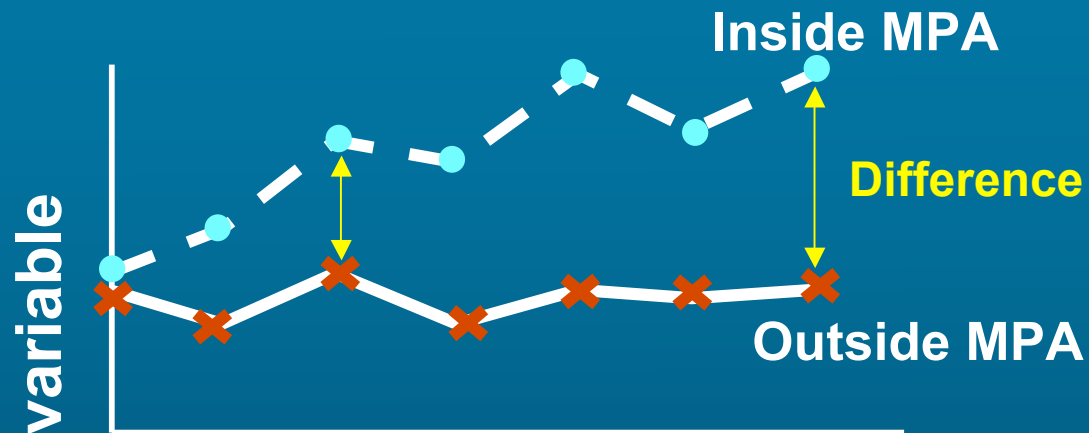
Inside



Outside



When do you evaluate?



Establish **and** start
monitoring MPA

Time

Evaluation - Conclusions

- Complex, costly, but these are relative and doable
- Must be initiated as quickly as possible
- Must have realistic expectations of rate, scale and magnitude of responses
- Multiple MPAs are better than one
- Must respond to feedback adaptively
- Requires multiple sampling approaches
- Requires collaboration among agency, academia, and user groups