Habitat Replication in the MLPA North Coast Study Region

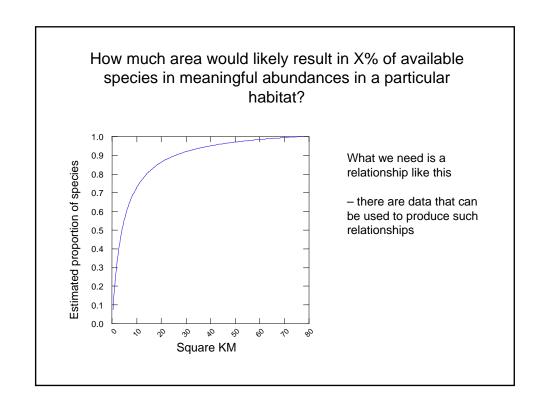
Presentation to the MLPA Master Plan Science Advisory Team
December 17, 2009 • Eureka, CA

Presented by Dr. Pete Raimondi, Member MLPA Master Plan Science Advisory Team

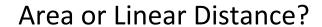
Valuation of habitat size

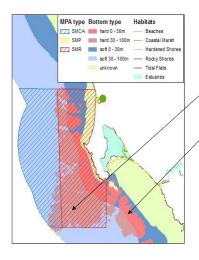
- Habitat size
 - Did not consider connectivity or adult movement
 - These are accounted for in MPA sizing and spacing guidelines
 - Based on conservation value
 - How much area or linear distance would likely result in X% of available species in meaningful abundances.

For example:



Habitat	Representation needed to encompass 90% of	Data Source
	biodiversity	
Rocky Intertidal		
Shallow Rocky Reefs/Kelp Forests (0-30 M)		
Deep Rocky Reefs (30-100 M)		
Deep Rocky Reefs (>100 M)		
Sandy Habitat (0-30 M)		
Sandy Habitat (30-100 M)		
Sandy Habitat (>100 M) - contiguous		
Sandy Habitat (>100 M) –non- contiguous		
Sandy Beaches		
Estuarine Habitats		





S. carnatus

- Habitats can be characterized as either
 - Two dimensional areas like
 Deep rocky reefs
 - Linear features, like Shallow rocky reefs

The key distinguishing characteristic is the effect of depth on the biological community

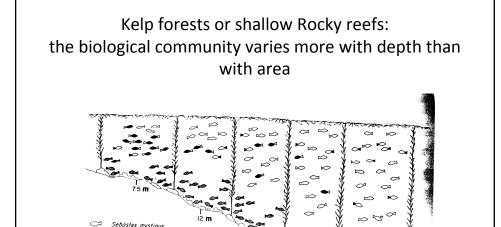
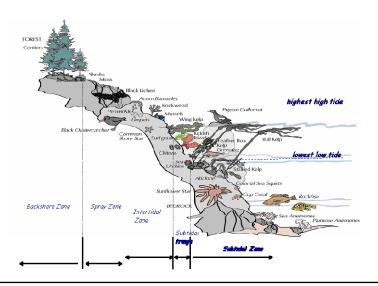


Fig. 3. Stylized depiction of the rockfish spatial regimes. Numbers of fish figures do not represent relative abundance of species on transects. Depth and vertical distributions are not drawn to scale.

Rocky Intertidal: the biological community varies more with vertical change than with area

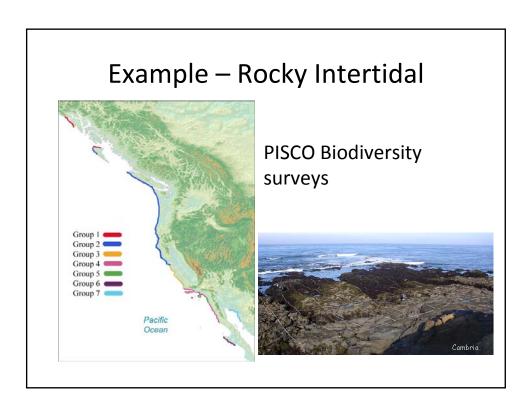


Area vs linear distance

- For habitats where the biological community varies more with depth than area, the key measurement is linear distance (distance along coastline). This assumes that the zone of protection extends from shoreline to the offshore edge of that habitat. Such habitats include:
 - Rocky Intertidal
 - Shallow rocky reefs
 - Kelp forests
 - Shallow sandy habitat
- For other habitats the key measurement is area. Such habitats include:
 - Deep rocky reefs
 - Deep sandy habitat
 - estuaries

Data considerations

- Need spatially explicit data for biogeographic area
 - Allows assembly of areas of varying sizes
 - Maintains a realistic set of species

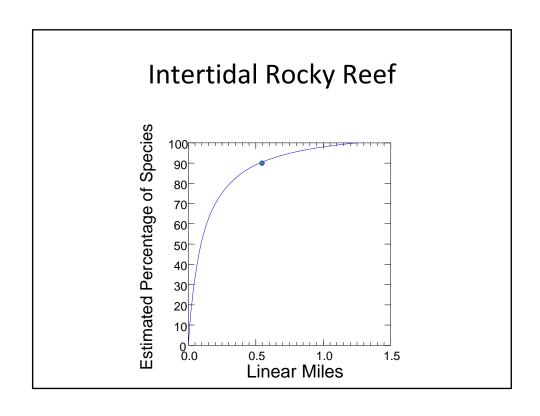


Analysis

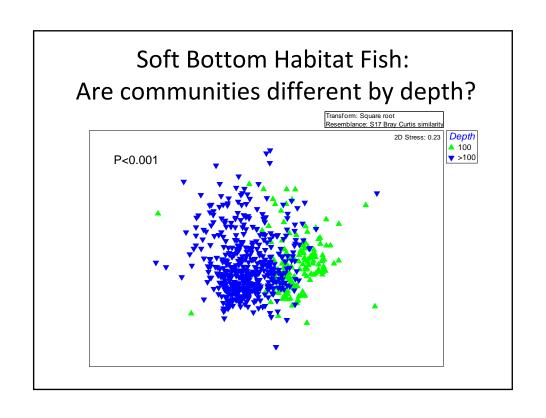
- Spatially explicit abundance data
- Resampling
 - Areas or distances of increasing sizes
 - Average number of species in 1000 iterations of size 1, 1000 of size 2, etc.
 - Likelihood of a species occurring increases with increasing abundances
- Fit curve to resampled data

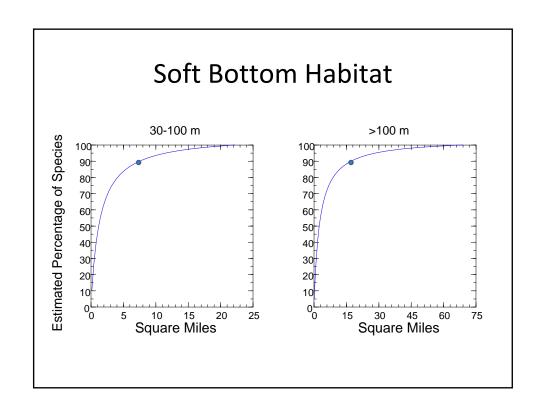
Model the relationship between linear distance or area and the likely proportion of species that would be found in an area or distance of that dimension. Many possible approaches:

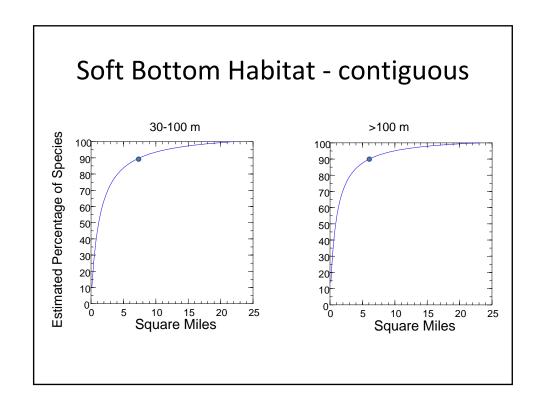
- S Curve of observed species counts.
- Chao 1 Chao's estimator based on number of rare species.
- Chao 2 Chao's estimator using just presence-absence data.
- Jacknife 1 Jacknife estimator based on species that only occur in one sample.
- Jacknife 2 Second order jacknife estimator
- Bootstrap Bootstrap estimator based on proportion of quadrats containing each species.
- Michaelis-Menton Curve fitted to observed S curve.
- UGE Calculated species accumulation curve (Ugland, Gray and Ellingsen (2003)

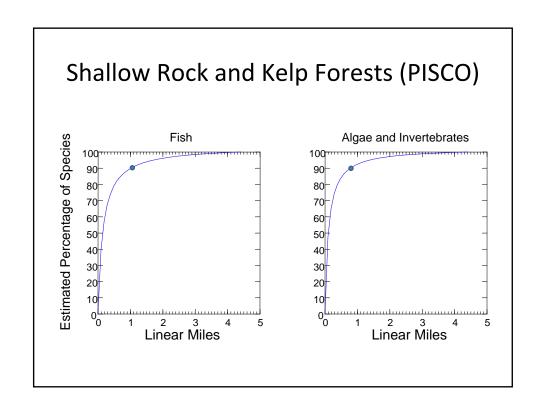


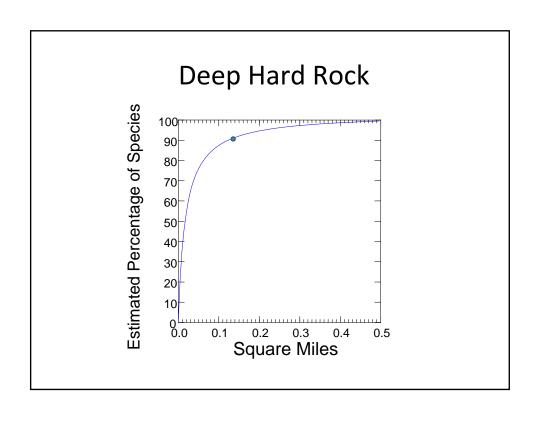
Habitat	Representation needed to encompass 90% of biodiversity	Data Source
Rocky Intertidal	~0.55 linear miles	PISCO Biodiversity
Shallow Rocky Reefs/Kelp Forests (0-30 M)		
Deep Rocky Reefs (30-100 M)		
Deep Rocky Reefs (>100 M)		
Sandy Habitat (0-30 M)		
Sandy Habitat (30-100 M)		
Sandy Habitat (>100 M) - contiguous		
Sandy Habitat (>100 M) –non- contiguous		
Sandy Beaches		
Estuarine Habitats		











Habitat representation			
Habitat	Representation needed to encompass 90% of biodiversity	Data Source	
Rocky Intertidal	~0.55 linear miles	PISCO Biodiversity	
Shallow Rocky Reefs/Kelp Forests (0-30 M)	~1.1 linear miles	PISCO Subtidal	
Deep Rocky Reefs (30-100 M)	~0.13 square miles	Starr surveys	
Deep Rocky Reefs (>100 M)	~0.13 square miles	Starr surveys	
Sandy Habitat (0-30 M)	~1.1 linear miles	Based on shallow rocky reefs	
Sandy Habitat (30-100 M)	~7.6 square miles	NMFS triennial trawl surveys 1977-2007	
Sandy Habitat (>100 M) - contiguous	~6 square miles ¹	NMFS triennial trawl surveys 1977-2007	
Sandy Habitat (>100 M) –non- contiguous	~17.2 square miles ¹	NMFS triennial trawl surveys 1977-2007	
Sandy Beaches	~ 1.1 linear mile	For discussion	
Estuarine Habitats	0.12 square miles (77 acres) ²	Primarily Southern CA data	
¹ Habitat is limited ²	² mixture of vegetated marsh, subtidal, and mudflats		

Habitat representation

Habitat	Northern California	North Central California	Southern California
Rocky Intertidal	~0.55 linear miles	~0.60 linear miles	~0.48 linear miles
Shallow Rocky Reefs/Kelp Forests (0-30 M)	~1.1 linear miles	~1.1 linear miles	~1.14 linear miles
Deep Rocky Reefs (30- 100 M)	~0.13 square miles	~0.20 square miles	~0.20 square miles
Deep Rocky Reefs (>100 M)	~0.13 square miles	Not done	~0.22 square miles
Sandy Habitat (0-30 M)	~1.1 linear miles	~1.1 linear miles	~1.14 linear miles ³
Sandy Habitat (30-100 M)	~7.6 square miles	~10 square miles	~2.24 square miles³
Sandy Habitat (>100 M) - contiguous	~6 square miles ¹	Not done ¹	~1.56 square miles ³
Sandy Habitat (>100 M) – non-contiguous	~17.2 square miles ¹	Not done	Not done
Sandy Beaches	~ 1.1 linear mile	~ 1.0 linear mile	~ 1.14 linear miles
Estuarine Habitats	0.12 square miles (77 acres) ²	0.12 square miles (77 acres) ²	0.12 square miles (77 acres) ²

¹Habitat is limited

Habitat representation

Habitat	Northern California	North Central California	Southern California
Rocky Intertidal	~0.55 linear miles	~0.60 linear miles	~0.48 linear miles
Shallow Rocky Reefs/Kelp Forests (0-30 M)	~1.1 linear miles	~1.1 linear miles	~1.14 linear miles
Deep Rocky Reefs (30- 100 M)	~0.13 square miles	~0.20 square miles	~0.20 square miles
Deep Rocky Reefs (>100 M)	~0.13 square miles	Not done	~0.22 square miles
Sandy Habitat (0-30 M)	~1.1 linear miles	~1.1 linear miles	~1.14 linear miles ³
Sandy Habitat (30-100 M)	~7.6 square miles	~10 square miles	~2.24 square miles³
Sandy Habitat (>100 M) - contiguous	~6 square miles¹	Not done ¹	~1.56 square miles ³
Sandy Habitat (>100 M) – non-contiguous	~17.2 square miles ¹	Not done	Not done
Sandy Beaches	~ 1.1 linear mile	~ 1.0 linear mile	~ 1.14 linear miles
Estuarine Habitats	0.12 square miles (77 acres) ²	0.12 square miles (77 acres) ²	0.12 square miles (77 acres) ²

¹Habitat is limited

²mixture of vegetated marsh, subtidal, and mudflats

³ preferred option was 8 sq miles across all habitats/ with at least 1.14 linear miles of sandy shoreline

²mixture of vegetated marsh, subtidal, and mudflats
³ preferred option was 8 sq miles across all habitats/ with at least 1.14 linear miles of sandy shoreline

Habitat representation

Habitat	Representation needed to encompass 90% of biodiversity
Rocky Intertidal	~0.55 linear miles
Shallow Rocky Reefs/Kelp Forests (0-30 M)	~1.1 linear miles
Deep Rocky Reefs (30-100 M)	~0.13 square miles
Deep Rocky Reefs (>100 M)	~0.13 square miles
Sandy Habitat from sandy beaches to sandy habitat >100 M (where >100 M is available). Question – how much of the habitat >100 M should be required?	10 square miles including at least 1.1 linear miles of sandy beach habitat
Estuarine Habitats	0.12 square miles (77 acres) ²

²mixture of vegetated marsh, subtidal, and mudflats