

Marine Life Protection Act Initiative



Marine Habitats, Ecosystems and Ecosystem Services in the North Coast Study Region

Presentation to the MLPA Blue Ribbon Task Force
January 14, 2010 • Crescent City, CA

Steve Rumrill, MLPA Master Plan Science Advisory Team
South Slough National Estuarine Research Reserve (Charleston, OR)



MLPA North Coast Study Region



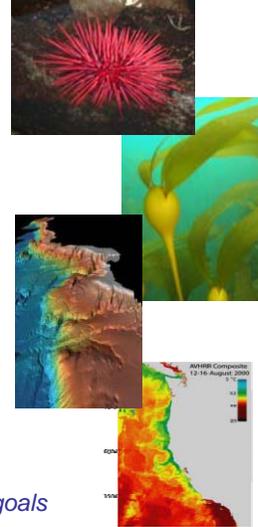
Outline

1. MLPA Goals for Habitats and Ecosystems
2. North Coast Study Region (NCSR)
3. Marine and Estuarine Habitats
4. NCSR Marine Ecosystem Functions
5. NCSR Marine Ecosystem Services



Marine Life Protection Act Goals

1. Protect **natural diversity** and **ecosystem functions**.
2. Sustain and restore marine life **populations**.
3. Improve recreational, educational, and study **opportunities**.
4. Protect representative and unique **habitats**.
5. Clear objectives, effective management, adequate enforcement, sound science.
6. Ensure that MPAs are designed and managed as a **network**.

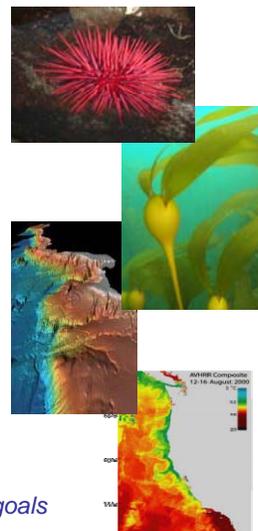


** Note: this language represents a summary of the MLPA goals*



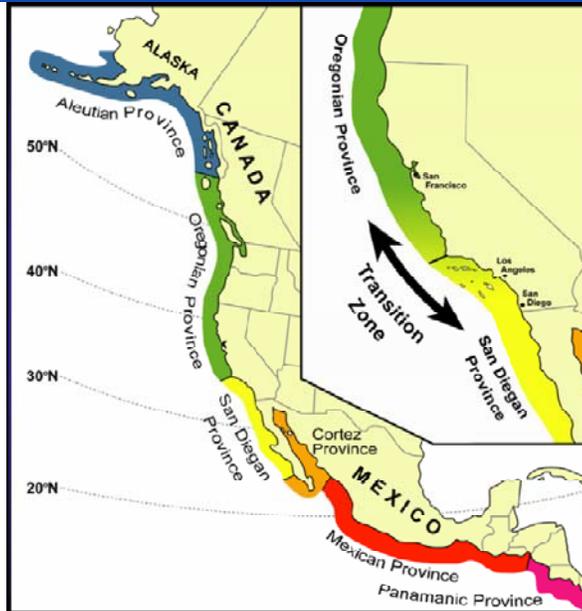
Goals for Habitats and Ecosystems

1. Protect **natural diversity** and **ecosystem functions**.
2. Sustain and restore marine life **populations**.
3. Improve recreational, educational, and study **opportunities**.
4. Protect representative and unique **habitats**.
5. Clear objectives, effective management, adequate enforcement, sound science.
6. Ensure that MPAs are designed and managed as a **network**.

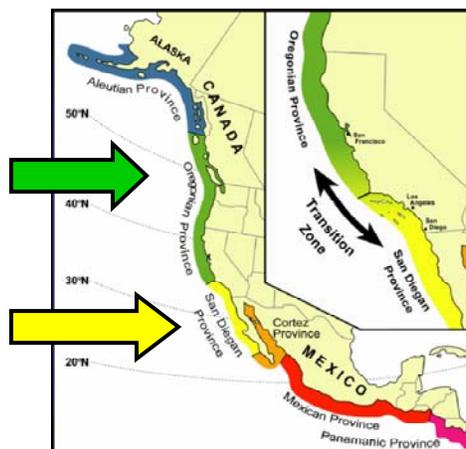
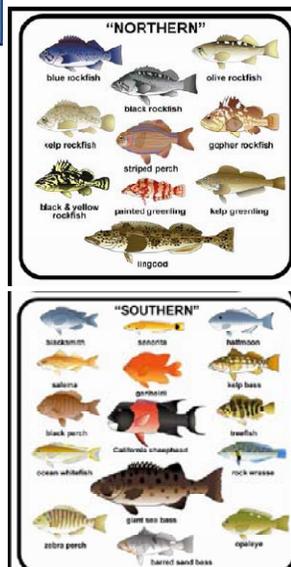


** Note: this language represents a summary of the MLPA goals*

Biogeographic Regions (Provinces)



Fish Assemblages by Biogeographic Regions





North Coast Study Region (NCSR)

Oregonian Province

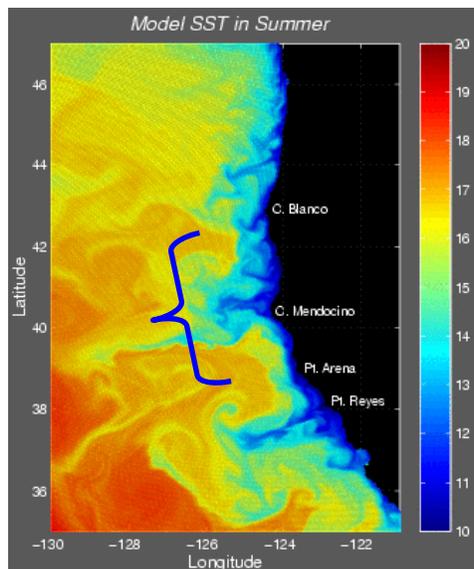
North Coast Study Region:

- California / Oregon border to Alder Creek near Point Arena



Nearshore Oceanography of NCSR

- Colder sea surface temperatures (SST) along the shore
- Intense upwelling regions and offshore jets in summer
- Upwelling center located at Cape Mendocino



Biogeographic Transition Zone



Hypomesus pretiosus
Adult



Atherinops affinis
Adult



Surf smelt

Estuary	Life Stage				
	A	S	J	L	E
Puget Sound	●	●	●	●	●
Hood Canal	●	●	●	●	●
Skagit Bay	●	●	●	●	●
Grays Harbor	○	○	○	○	○
Willapa Bay	○	○	○	○	○
Columbia River	○	○	○	○	○
Nahalem Bay	●	●	○	○	○
Tillamook Bay	●	●	○	○	○
Naselle Bay	○	○	○	○	○
Siletz River	○	○	○	○	○
Yaquina Bay	○	○	○	○	○
Alsea River	○	○	○	○	○
Siuslaw River	○	○	○	○	○
Umpqua River	○	○	○	○	○
Coos Bay	○	○	○	○	○
Rogue River	○	○	○	○	○
Klamath River	○	○	○	○	○
Humboldt Bay	○	○	○	○	○
Eel River	○	○	○	○	○
Tomales Bay	○	○	○	○	○
Cent. San Fran. Bay *	○	○	○	○	○
South San Fran. Bay	○	○	○	○	○
Elkhorn Slough	○	○	○	○	○
Moro Bay	○	○	○	○	○
Santa Monica Bay	○	○	○	○	○
San Pedro Bay	○	○	○	○	○
Azusa Bay	○	○	○	○	○
Anaheim Bay	○	○	○	○	○
Newport Bay	○	○	○	○	○
Mission Bay	○	○	○	○	○
San Diego Bay	○	○	○	○	○
Tijuana Estuary	○	○	○	○	○

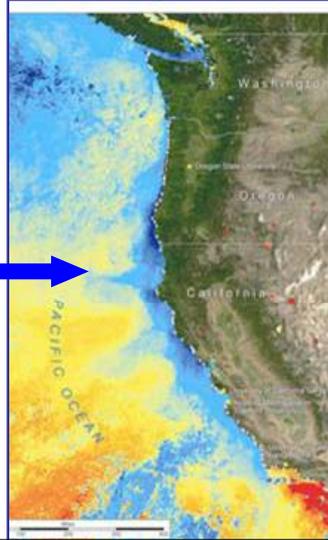
Topsmelt

Estuary	Life Stage				
	A	S	J	L	E
Puget Sound					
Hood Canal					
Skagit Bay					
Grays Harbor	○	○	○	○	○
Willapa Bay	○	○	○	○	○
Columbia River	○	○	○	○	○
Nahalem Bay	○	○	○	○	○
Tillamook Bay	○	○	○	○	○
Naselle Bay	○	○	○	○	○
Siletz River	○	○	○	○	○
Yaquina Bay	○	○	○	○	○
Alsea River	○	○	○	○	○
Siuslaw River	○	○	○	○	○
Umpqua River	○	○	○	○	○
Coos Bay	○	○	○	○	○
Rogue River	○	○	○	○	○
Klamath River	○	○	○	○	○
Humboldt Bay	○	○	○	○	○
Eel River	○	○	○	○	○
Tomales Bay	○	○	○	○	○
Cent. San Fran. Bay *	○	○	○	○	○
South San Fran. Bay	○	○	○	○	○
Elkhorn Slough	○	○	○	○	○
Moro Bay	○	○	○	○	○
Santa Monica Bay	○	○	○	○	○
San Pedro Bay	○	○	○	○	○
Azusa Bay	○	○	○	○	○
Anaheim Bay	○	○	○	○	○
Newport Bay	○	○	○	○	○
Mission Bay	○	○	○	○	○
San Diego Bay	○	○	○	○	○
Tijuana Estuary	○	○	○	○	○

Relative abundance:
 ● Highly abundant
 ○ Abundant
 ○ Common
 ○ Rare
 Blank Not present

Life stage:
 A - Adults
 S - Spawning adults
 J - Juveniles
 L - Larvae
 E - Eggs

* Includes Central San Francisco, Suisun, and San Pablo bays.



North Coast Bioregions



Bioregion Break Near Cape Mendocino

Mattole River Mouth

1. Divides two major reef systems
2. Different upwelling regimes
3. Barrier to population connectivity
4. Distinct geomorphology and hydrology





Key Marine Habitats for NCSR

Shoreline

- Rocky shores
- Sandy beaches
- Surfgrass

Rocky Reef

- Kelp / kelp beds
- Rocky reef 0-30 m
- Rocky reef 30-100 m
- Rocky reef 100-200 m
- Rocky reef >200 m
- Pinnacles

Soft Bottom

- Soft bottom 0-30 m
- Soft bottom 30-100 m
- Soft bottom 100-200 m
- Soft bottom >200m
- Submarine canyons

Estuarine

- Coastal marsh
- Tide flats
- Estuarine waters
- Eelgrass beds

Oceanographic Habitats

- Upwelling areas
- Retention zones
- River plumes
- Oceanographic fronts

Note: blue habitats have special data considerations or limitations



Unique Marine Habitats in NCSR

- Seastacks and offshore rocks/islands
- Sunken river estuaries
- Freshwater-influenced beaches



Trinidad Head



Albion



North Coast Marine Habitats

From: *Regional Profile of the North Coast Study Region* (2009) and MLPA staff (2010)

Habitat	Total Amount (linear or square miles)
Total Study Area	1026.5 square miles
Total shoreline	520 miles
Intertidal: Rocky shores	160 miles
Intertidal: Sandy beaches	180 miles
Intertidal: Coastal marsh	3.5 square miles
Intertidal: Tidal flats	65 miles
Estuary	43 square miles
Eelgrass	6.1 square miles
Kelp beds	52 miles

Note: blue habitats have special data considerations or limitations



North Coast Seafloor Habitats

From: *Regional Profile of the North Coast Study Region* (2009) and MLPA staff (2010)

Habitat (Bottom Type)	Total Amount (square miles)
Total Study Area	1026.5 square miles
Hard (0 - 30 meters)	23 square miles*
Hard (30 - 100 meters)	18 square miles*
Hard (100 - 200 meters)	0.2 square miles*
Soft (0 - 30 meters)	210 square miles*
Soft (30 - 100 meters)	320 square miles*
Soft (100 - 200 meters)	38 square miles*
Unknown (all depths)	420 square miles*

* high resolution substrate data not yet available for the entire study region area

Note: blue habitats have special data considerations or limitations



NCSR Intertidal Shoreline Habitats

- Sandy beaches / 35%
- Rocky shores / 31%
- Coastal marshes / 17%
- Tidal flats / 13%

Note: values indicate % of linear shoreline habitat in NCSR



Landforms and Features in NCSR

**Headlands,
Sandy Shores,
Boulder Fields,
and Creeks**





Landforms and Features in NCSR

**Terraces, Cliffs,
Coves, and Surge
Channels**



**Rocky
Intertidal
Benches and
Tidepools**



Rocky Intertidal Zone

- Occurs along 31% of the shoreline in NCSR
- Diverse communities of seaweeds, invertebrates, fish and shorebirds
- Scientific studies of zonation, predation, competition and other ecological processes





Estuaries and Lagoons

Transitional salinity zones between marine and freshwater environments

Productive habitats for invertebrates, fishes, shorebirds, seabirds and waterfowl

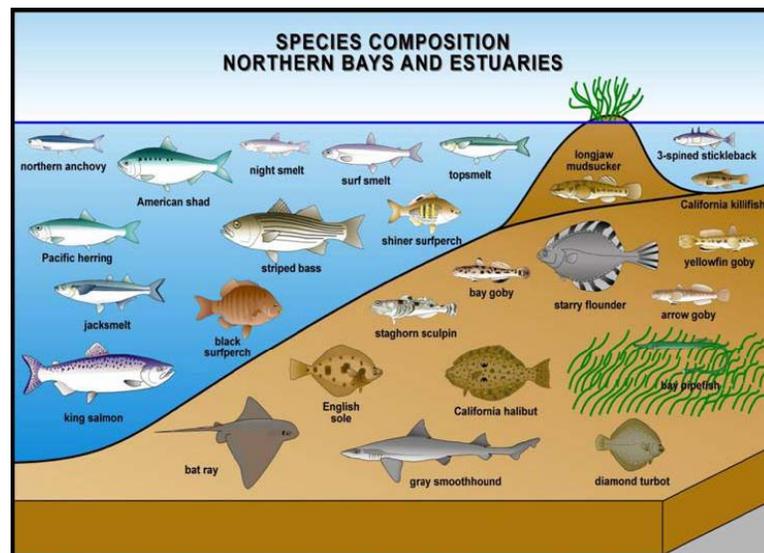
- Smith River Estuary
- Lake Earl
- Klamath River Estuary
- Redwood Creek Estuary
- Stone Lagoon
- Big Lagoon
- Little River Estuary
- Mad River Estuary
- Humboldt Bay
- Eel River Estuary
- Mattole River Estuary
- Ten Mile River Estuary
- Noyo River Estuary
- Big River Estuary
- Albion River Estuary
- Navarro River Estuary



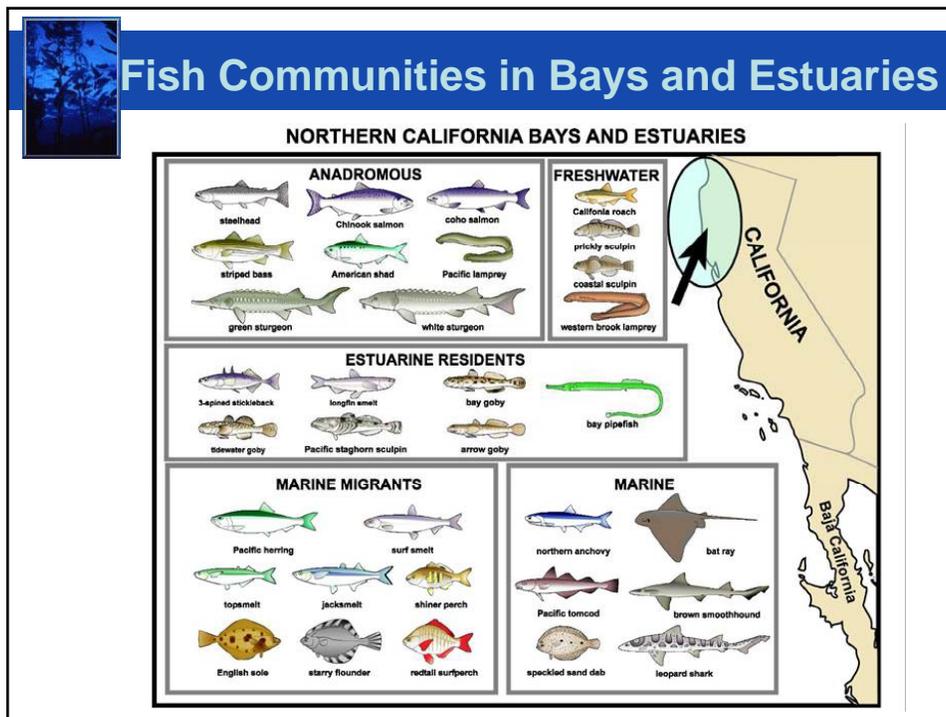
* Note that this is not a comprehensive list of estuaries and lagoons



Northern CA Bays and Estuaries



Fish Communities in Bays and Estuaries



Eelgrass and Surfgrass in the NCSR



- Surfgrass (*Phyllospadix* spp.) occurs along an unknown (< 31%) of the NCSR shoreline
 - Persistent patches and beds that fringe rocky coastline in shallow waters
 - Important habitat for a variety of fish, invertebrates, and algae



- Eelgrass (*Zostera* spp.) occupies 6.1 mi² (< 1%) of the NCSR shoreline but is not well mapped
 - Forms extensive beds in Humboldt Bay and also occurs in smaller estuaries
 - Stabilizes soft sediments, improves water quality, and provides refuge, foraging, breeding and nursery areas for invertebrates, fish and birds



Landforms and Features in the NCSR

**Offshore
Seastacks,
Promontories,
and Cliffs**



**River
Mouths and
Estuaries**



Shallow Sub-tidal Habitat in NCSR

**Bull
Kelp
Beds**



**Sub-
tidal
Bedrock
and
Reefs**





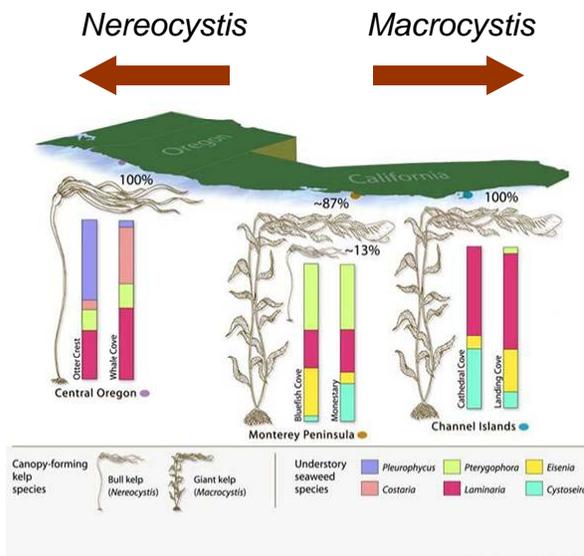
Bull Kelp Beds in the NCSR

- Bull kelp (*Nereocystis luetkeana*) is the dominant canopy-forming kelp in subtidal zone
- Dense-patchy beds occur at depths of 3 to 20 meters on bedrock, boulders and reefs
- Contribute to productivity of shallow coastal marine ecosystem
- Provides habitat, feeding grounds and nursery areas for fish, invertebrates, and marine mammals



Bull Kelp Beds in the NCSR

- Kelp beds in the NCSR occur in a latitudinal transition area
- Bull kelp (*Nereocystis*)
- Giant kelp (*Macrocystis*)



©PISCO; illustrations by Dana Steller



NCSR Marine Ecosystem Functions

Complex Food Web and Trophic Relationships in Northern California Bull Kelp Beds

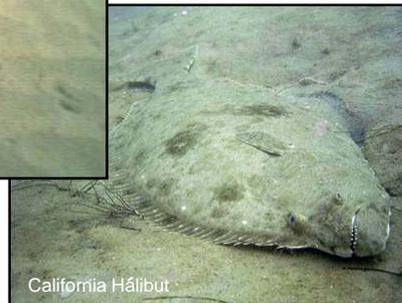


Landforms and Features in NCSR

Sub-tidal Sand, Sandy/Mud Soft-bottoms



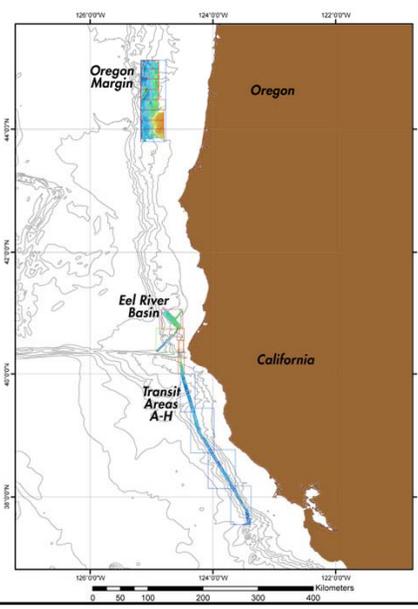
Dungeness crab



California Halibut



Deep-water Landforms in NCSR



Soft and Hard Bottom Habitats



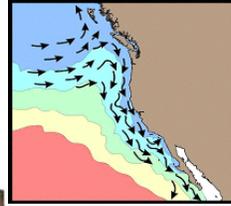
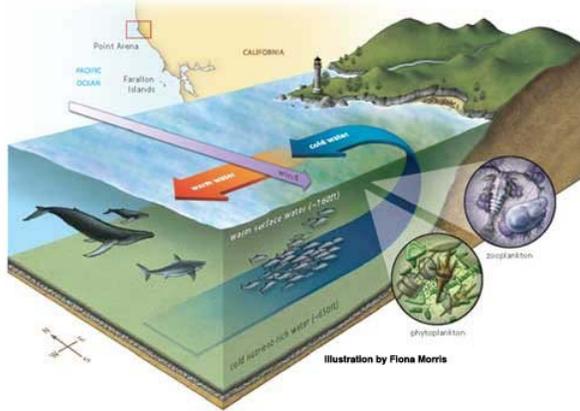
?

- Soft bottom, including sand and sandy-mud, constitutes 93% of the mapped seafloor within the NCSR
- Hard bottom, including rocky reef, bedrock and boulder, constitutes only about 7% of the mapped seafloor, but supports higher diversity of kelps, seaweeds, invertebrates, and fishes
- Mapping information has not yet been processed for a portion (41%) of the total bottom habitat in the NCSR



NCSR Marine Ecosystem Functions

California Current and Seasonal Upwelling



- Cold nutrient-rich water upwelled close to shore
- Fuel for marine ecosystem productivity



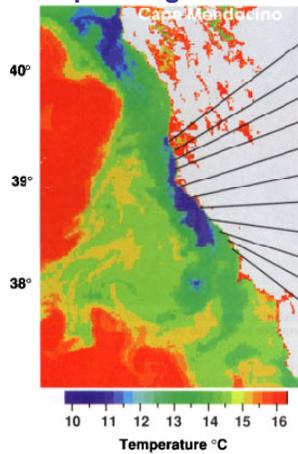
Ecosystem Functions

Latitudinal gradients and link between upwelling, temperature, and recruitment of red sea urchins

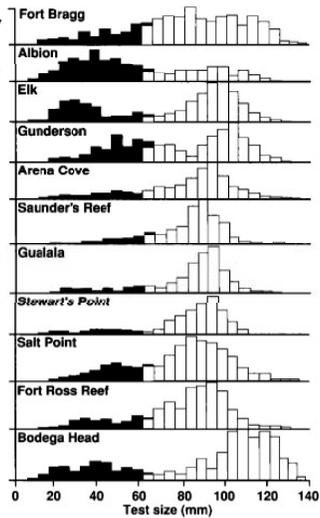


Sea Surface Temp

Poor urchin recruitment in upwelling zones



Sea Urchin Size





Marine Ecosystem Services

“marine resources and processes that are valued by humans”

Fisheries (commercial fisheries including crab, urchins, herring, halibut, tuna, rockfish, flatfish, shrimp, salmon)

Seaweed harvests (*Postelsia, Laminaria, Alaria, Porphyra*)

Aquaculture (shellfish in estuaries, potential offshore net-pens for finfish)

Nursery Habitat (rocky reefs, kelp forest, rocky intertidal, estuaries, marshes)

Coastal Protection (bluffs, kelp forest, rocky reef, estuaries, eelgrass, marshes)

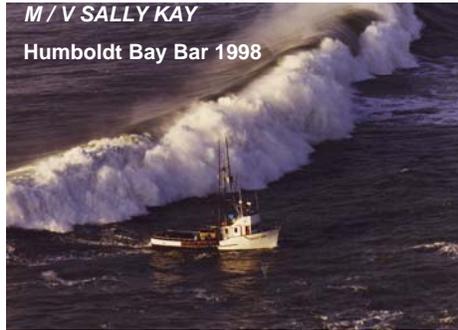
Ocean Wave Energy (highest potential on CA shoreline)

Tourism and Recreation (recreational fishing, sightseeing, surfing, hiking, camping, boating, cycling, kayaking, diving, etc.)



Ecosystem Services Trade-offs

Safe Bar Crossings, Estuary Hydrodynamics, and Tidal Wetlands



Metrics:

- Jetty repair \$
- Dredging \$
- Boater lives saved
- Eelgrass area
- Marsh area





Ecosystem Services Trade-offs

No-Take Marine Reserves and Recreational Fishing



Lingcod: *Ophiodon elongatus*



Metrics:

- Fish biomass (weight per area)
- Fish density (number per area)
- Fish population size & age structure

Metrics:

- Fish species & size
- Number of fish caught per trip
- Cost per hour & cost per fish



Ecosystem Services Trade-offs

Water Quality Protection / Nursery Habitat and Shellfish Mariculture



Metrics:

- Eelgrass area (% cover)
- Eelgrass density (number plants per area)
- Essential Fish Habitat (area)
- Oyster stocking density (# oysters per area)
- Mariculture production (quantity) (profit \$)



Applying Habitat Knowledge to MPAs

Given the *complexity and variability* of marine habitats, design MPAs to include:

- Key and unique marine habitats, characterized by seafloor type, depth, oceanographic properties and biogenic structure
- Multiple examples (replicates) of each habitat type within a network of MPAs
- A mixture of habitat types in each MPA to represent the greatest number of species



Marine Mammals in the NCSR

Pinnipeds: California sea lion, Steller sea lion, Northern Elephant seal, Harbor seal



Harbor seal



California sea lion

Cetaceans: Whales and Porpoises; Humpback, Gray, Fin, Sei, Blue, Sperm, Right, Baird's beaked, Orca, Harbor porpoise, Dall's porpoise



Orca



Humpback whale



Harbor porpoise



Seabirds and Shorebirds in the NCSR

Seabirds: Breeding success linked to nearshore ocean productivity



Brown Pelican



Pigeon Guillemot



Black Oystercatcher



Common Murre

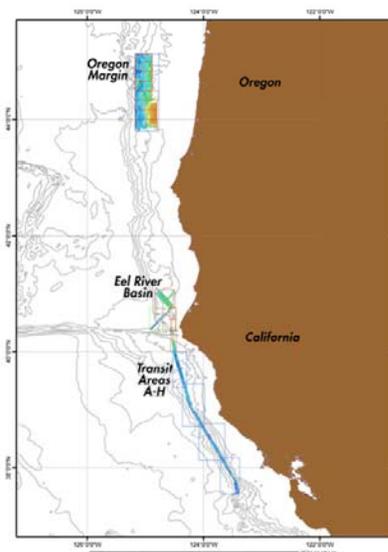
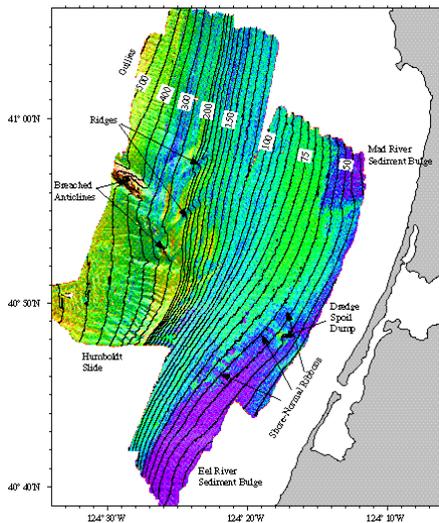


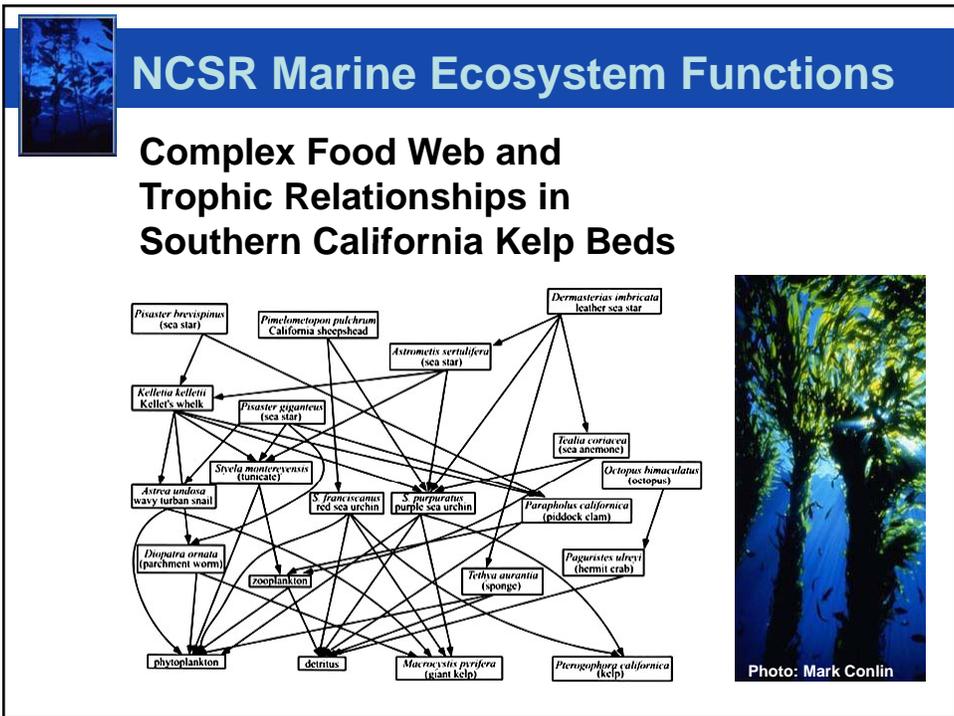
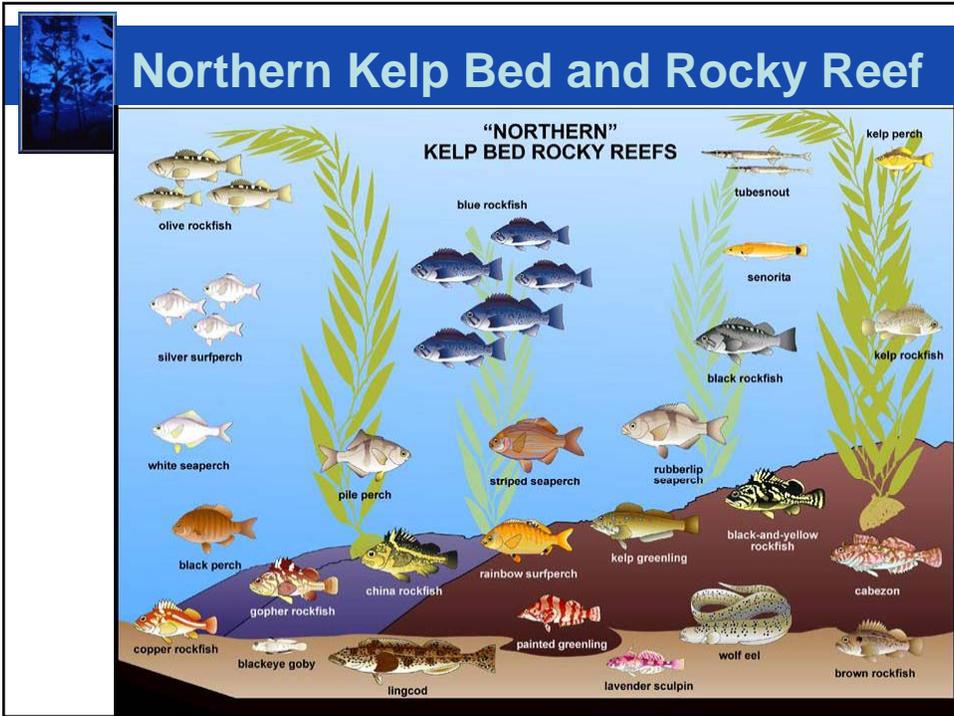
Sandpiper



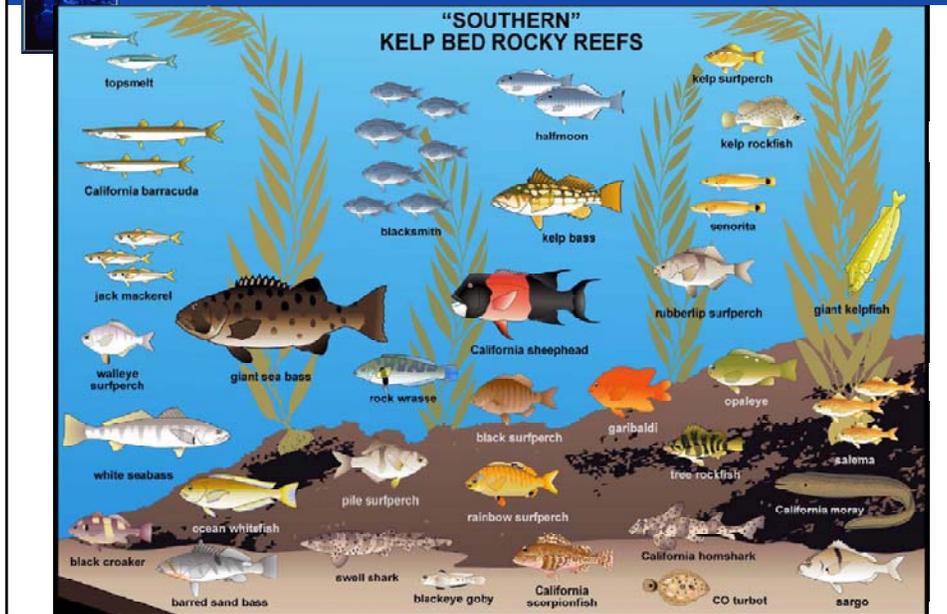
Landforms and Features in NCSR

Eel River Basin

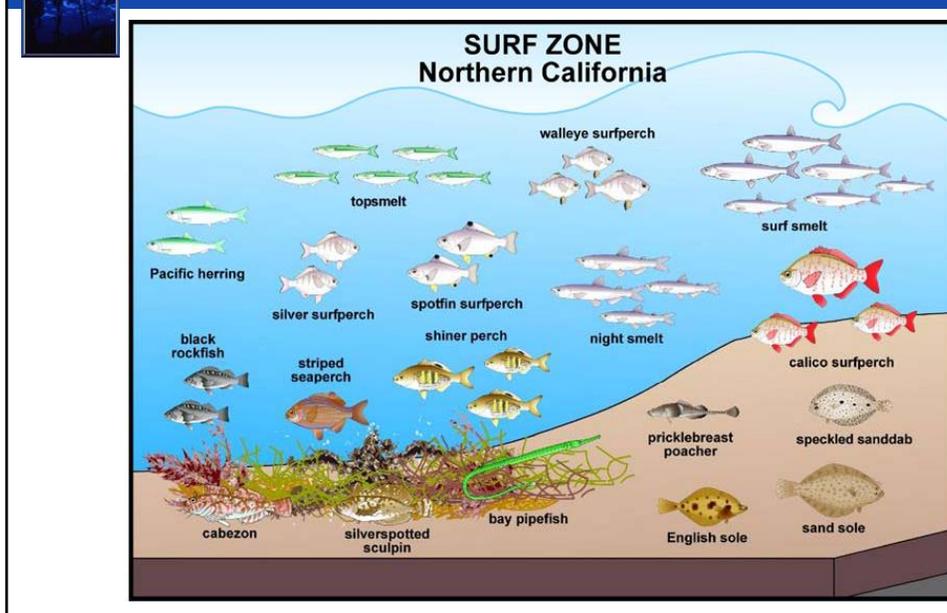




Southern Kelp Bed and Rocky Reef



Surf-zone Communities





Marine Ecosystem Services

M/V SALLY KAY

Humboldt Bay Bar Crossing 1998



Deep-water Fish Communities

