

Attachment 1: Summary of North Central Coast Draft MPA Monitoring Framework

The following pages provide a summary of aspects of the draft monitoring framework for on-going monitoring of the North Central Coast MPAs. This framework has been developed through consultations with scientists and stakeholders, including members of the former North Central Coast Regional Stakeholder Group and Science Advisory Team. This framework is still under development. It will form the core of the draft North Central Coast MPA Monitoring Plan, which is scheduled for release for public review and comment in October 2009.

The North Central Coast MPA Baseline Program (Baseline Program) responds to the most time-sensitive needs for collecting data to support monitoring: data to describe system conditions at or near the time of MPA implementation in order to provide one frame of reference for future comparisons; and identification and measurement of key socioeconomic and ecological changes in the first two to three years following MPA establishment. Thus, the Baseline Program is being launched before completion of the North Central Coast MPA Monitoring Plan, which focuses more on long-term monitoring and will take several additional months to complete.

The Baseline Program aligns with the North Central Coast MPA Monitoring Plan. It has been designed to complement the monitoring framework, thereby providing a robust foundation on which to implement long-term monitoring. As described in the RFP, the Baseline Program also offers the opportunity to collect data which can help refine this framework and inform long-term monitoring, for example by testing candidate metrics or informing selection of long-term monitoring sites. Priority will thus be given to proposals which are consistent with the draft monitoring framework, as described in the RFP.

Each of the following pages summarizes the current draft approach to monitoring the condition and trends of one of the identified Ecosystem Features. For each Feature, candidate monitoring metrics are presented. Candidates for inclusion in "Ecosystem Feature Checkup" are being developed to facilitate community-based monitoring. Candidates for use in "Ecosystem Feature Assessment" are being developed to provide a finer-grained evaluation of the specified ecosystem. Either or both of "Ecosystem Feature Checkup" and "Ecosystem Feature Assessment" approaches may be used in long-term monitoring to track the condition of the Ecosystem Features, inside and outside MPAs, and how conditions change over time. Possible monitoring configurations will be included in the draft North Central Coast MPA Monitoring Plan.

SUMMARY: KELP & SHALLOW ROCK ECOSYSTEMS

Kelp ecosystems and shallow rock ecosystems occur in areas of rocky substrate between mean lower low tide and 30m water depth. Kelp beds are highly dynamic and canopy extent, for example, may vary dramatically among seasons and years. Many of the same fish and invertebrate species, including economically important species, are found in shallow rock substrate habitats regardless of the presence of kelp. These habitats have therefore been combined into one ecosystem feature. Important drivers of these ecosystems include water temperature and geomorphological context, as well as salinity, nutrients, light, and turbidity.

CANDIDATE METRICS FOR ECOSYSTEM FEATURE CHECKUP

Vital Signs:

- Red sea urchin abundance
- Purple sea urchin abundance
- Red abalone abundance
- Average & maximum rockfish size
- Lingcod average size and abundance

CANDIDATE METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Biogenic Habitat: Macroalgae assemblage	Areal extent of surface kelp canopy (<i>Macrocystis pyrifera</i> & <i>Nereocystis leutkeana</i>) Kelp stipe density & size structure
Invertebrates	Purple sea urchin (<i>Strongylocentrotus purpuratus</i>) density & size structure Red sea urchin (<i>Strongylocentrotus franciscanus</i>) density & size structure Red abalone (<i>Haliotis rufescens</i>) density & size structure Sea star (<i>Pisaster/Pycnopodia</i> spp.) density & size structure
Piscivorous fishes	Black rockfish (<i>Sebastes melanops</i>) density & population size structure ¹ Lingcod (<i>Ophiodon elongatus</i>) density & population size structure ¹ Cabezon (<i>Scorpaenichthys marmoratus</i>) density & population size structure ¹

¹ Size structure includes young of the year rockfish where feasible.

POTENTIAL ADDITIONAL METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Biogenic Habitat: Macroalgae assemblage	Sub-canopy & turf algae cover Compound tunicate (multiple species) cover
Planktivorous fishes	Blue rockfish (<i>Sebastes mystinus</i>) density and population size structure ¹
Omnivorous fishes	Black & yellow rockfish (<i>Sebastes chrysomelas</i>) density & population size structure ¹ AND Gopher rockfish (<i>Sebastes carnatus</i>) density & population size structure ¹ Kelp rockfish (<i>Sebastes atrovirens</i>) density & population size structure ¹
Unfished fishes	Giant kelpfish (<i>Heterostichus rostratus</i>) abundance Painted greenling (<i>Oxylebius pictus</i>) abundance

¹ Size structure includes young of the year where feasible.

SUMMARY: DEEP ROCK ECOSYSTEMS

Deep rock ecosystems are defined as those areas of rock substrate occurring between depths of 30m and 116m, the maximum depth at which this ecosystem type is found within state waters in the North Central Coast. However most of the deep rock ecosystems in this region occur at depths of 30-50m and monitoring focuses on gathering information most appropriate for the habitats and species assemblages occurring in this depth range. Important physical drivers and contextual information for this ecosystem include geomorphological context and habitat characterization/complexity.

CANDIDATE METRICS FOR ECOSYSTEM FEATURE CHECKUP

Vital Signs:

- Dungeness crab abundance
- Average & maximum rockfish size
- Lingcod average size and density
- Total dwarf rockfish abundance

CANDIDATE METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Sessile Invertebrates	Density of structure forming invertebrates
	Cover of structure forming invertebrates
Mobile Invertebrates	Density of Dungeness crab (<i>Cancer magister</i>)
	Density of sheep (spider) crabs (<i>Loxorhynchus grandis</i>)
	Density of box crabs (<i>Lopholithodes foraminatusi</i>)
Piscivorous fishes	Bocaccio (<i>Sebastes paucispinis</i>) density and size structure
	Yelloweye rockfish (<i>Sebastes ruberrimus</i>) density and size structure ¹
	Vermilion rockfish (<i>Sebastes miniatus</i>) density and size structure ¹
	Lingcod (<i>Ophiodon elongatus</i>) density and size structure
Dwarf rockfish	Total dwarf rockfish abundance

¹ Size structure includes young of the year rockfish where feasible.

POTENTIAL ADDITIONAL METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Sessile Invertebrates	Cover of encrusting invertebrates
	<i>Metridium</i> spp. bed cover
	Hydrocoral density
Omnivorous fishes	China rockfish (<i>Sebastes nebulosus</i>) density and size structure ¹
	Gopher rockfish (<i>Sebastes carnatus</i>) density and size structure ¹

¹ Size structure includes young of the year rockfish where feasible.

SUMMARY: ROCKY INTERTIDAL ECOSYSTEMS

Rocky intertidal ecosystems are defined as areas of rock substrate occurring within the zone between mean high tide and mean lower low tide. In the North Central Coast region this includes exposed rocky cliffs, boulder rubble, exposed wave cut platforms and sheltered rocky shores. Important drivers of this ecosystem include geomorphology, temperature, swell, sediment flux, freshwater input, and disturbance (e.g., trampling).

CANDIDATE METRICS FOR ECOSYSTEM FEATURE CHECKUP

Vital Signs:

- Mussel bed cover
- Purple sea urchin abundance
- Owl limpet abundance
- Ochre sea star abundance
- Black abalone abundance
- Red abalone abundance
- Abundance of black oystercatchers

CANDIDATE METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Biogenic Habitat	Cover of turf algae
	Cover of foliose red algae
	Cover of Fucooids (fleshy brown algae)
	Cover of mussels (<i>Mytilus</i> spp.)
	Cover of feather boa kelp (<i>Egregia</i> sp.)
	Cover of surf grass (<i>Phyllospadix</i> spp.)
Invertebrates	Black abalone (<i>Haliotis cracherodii</i>) density and size structure
	Red abalone (<i>Haliotis rufescens</i>) density and size structure
	Sea star (<i>Pisaster ochraceous</i> , <i>Pycnopodia</i>) density
	Purple sea urchin (<i>Strongylocentrotus purpuratus</i>) density
	Giant/owl limpet (<i>Lottia gigantea</i>) density and size structure

POTENTIAL ADDITIONAL METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Predatory birds	Total abundance of piscivorous birds and shorebirds
	Diversity of piscivorous birds and shorebirds
	Abundance of black oystercatchers (<i>Haematopus bachmani</i>)
Intertidal fishes	Total YOY (young-of-the-year) rockfish abundance
	Monkeyface prickleback (<i>Cebidichthys violaceus</i>) density
	Rock prickleback (<i>Xiphister mucosus</i>) density

SUMMARY: SOFT-BOTTOM SUBTIDAL ECOSYSTEMS

Soft-bottom subtidal ecosystems are defined as areas of sediment substrate occurring between mean lower low tide and 100m depth. This ecosystem feature encompasses both nearshore and offshore environments, including sediment habitats in flat expanses and on slopes. This is the predominant habitat type on the continental shelf and slope throughout the region. Important drivers of this ecosystem include oceanographic features (e.g., subsurface currents), sediment supply and characteristics (e.g. grain size), and physical disturbance.

CANDIDATE METRICS FOR ECOSYSTEM FEATURE CHECKUP

Vital Signs:

- Sea star abundance and size structure
- Dungeness crab abundance
- Starry flounder abundance
- Halibut abundance and average size
- Total flatfish abundance

CANDIDATE METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Biogenic habitat	Total cover of biogenic habitat (multiple species)
	Biogenic habitat diversity
Benthic Infauna	Functional diversity of benthic infauna (feeding guilds)
	Sand dollar (<i>Dendraster excentricus</i>) abundance and size structure
Benthic Invertebrate Predators	Dungeness crab (<i>Cancer magister</i>) density and size structure
	Sea star (<i>Pycnopodia/Pisaster</i> spp.) abundance and size structure
Demersal Fish Predators	California halibut (<i>Paralichthys californicus</i>) density & size structure
	Starry flounder (<i>Platichthys stellatus</i>) density and size structure
	Sanddab (<i>Citharichthys</i> spp.) density and size structure

POTENTIAL ADDITIONAL METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

None currently.

SUMMARY: ESTUARINE ECOSYSTEMS

Estuarine ecosystems within the North Central Coast region encompass soft-sediment habitats, including coastal marsh, tidal mudflats and eelgrass beds, and areas of open water. The shoreward boundary of this ecosystem feature is drawn at the extent of tidal reach and salt water associated vegetation. Lagoons that are rarely open to the ocean and characterized by more freshwater species are not included. Important drivers of this ecosystem include freshwater regime (flow, sedimentation, nutrients), invasive species, contaminant loads, and geomorphology (grain size).

CANDIDATE METRICS FOR ECOSYSTEM FEATURE CHECKUP

Vital Signs:

- Areal extent of eel grass
- Ghost and mud shrimp abundance
- Clam abundance & size structure (Geoduck, gaper, littleneck clams)
- Starry flounder abundance
- Total diversity and abundance of piscivorous & shore birds
- Harbor seal abundance (colony size)

CANDIDATE METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Biogenic Habitat	Eelgrass (<i>Zostera marina</i>) areal extent
Infaunal Assemblage	Mud shrimp (<i>Upogebia pugettensis</i>) abundance
	Ghost shrimp (<i>Neotrypaea californiensis</i>) abundance
	Fat innkeeper worm (<i>Urechis caupo</i>) abundance
	Pacific gaper clam (<i>Tresus nuttalli</i>) abundance
	Littleneck clam (<i>Protothaca staminea</i>) abundance
Resident Fish	Shiner (<i>Cymatogaster aggregata</i>) and striped (<i>Embiotoca lateralis</i>) surfperch abundances
Predatory Birds	Total abundance and diversity of piscivorous birds and shorebirds
Predatory Fish	Leopard shark (<i>Triakis semifasciata</i>) abundance
	Bat ray (<i>Myliobatis californica</i>) abundance
Harbor seal haulout sites	Harbor seal (<i>Phoca vitulina richardsi</i>) abundance (colony size)

POTENTIAL ADDITIONAL METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Biogenic Habitat	Eelgrass (<i>Zostera marina</i>) shoot density
	Areal extent of common pickleweed (<i>Salicornia virginica</i>)
	Areal extent of sea lettuce (<i>Ulva</i> spp.)
	Native oyster abundance
Infaunal Assemblage	Abundance and foraging rates of shorebirds

SUMMARY: SOFT-BOTTOM INTERTIDAL & BEACH ECOSYSTEMS

Soft sediment intertidal and beach ecosystems are defined as wave-dominated areas of sand and gravel substrate occurring below the mean high tide and above mean lower low water. In the North Central Coast region this includes continuous expanses of sandy shores as well as enclosed or pocket beaches. Habitats with mud substrates, including tidal flats and coastal marsh, and barrier beaches forming at the mouths of rivers are included within the estuarine ecosystem feature for the purposes of identifying key attributes and indicators. Important drivers of this ecosystem include wave regime and nutrient inputs.

CANDIDATE METRICS FOR ECOSYSTEM FEATURE CHECKUP

Vital Signs:

- Abundance of sand crabs
- Total diversity and abundance of piscivorous & shore birds
- Harbor seal colony size

CANDIDATE METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Suspension feeders	Sand crab (<i>Emerita analoga</i>) abundance and size structure
	Razor clam (<i>Siliqua patula</i>) abundance and size structure
Surf zone fish assemblage	Surfperch abundance (Embiotocidae, multiple species)
	Surf smelt (<i>Hypomesus pretiosus</i>) abundance and size structure
Predatory birds	Total abundance of predatory birds
	Predatory birds species diversity

POTENTIAL ADDITIONAL METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

None currently.

SUMMARY: PELAGIC ECOSYSTEMS

The pelagic ecosystem feature is defined as the water column habitat occurring within state waters, and includes waters overlaying the continental shelf to 116m deep. This ecosystem feature includes oceanographic features such as upwelling and retention areas that affect the productivity and species assemblages within the pelagic environment and influence benthic habitats. During upwelling seasons, nutrient-rich waters fuel highly productive and diverse ecosystems linking pelagic and benthic habitats. Important drivers of this ecosystem include physical oceanography (PDO; temperature; multivariate ENSO index), water quality (oxygen; temperature; HAB occurrence; chlorophyll concentration; nutrients).

CANDIDATE METRICS FOR ECOSYSTEM FEATURE CHECKUP

Vital Signs:

- Pelagic/semi-pelagic rockfish average & maximum size
- Brandt's cormorant abundance (colony size)
- Pelagic cormorant abundance (colony size)
- Pigeon guillemot abundance (colony size)
- Cassin's Auklet breeding success

CANDIDATE METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Piscivorous Fishes	Widow rockfish (<i>Sebastes entomelas</i>) abundance and size structure
	Yellowtail rockfish (<i>Sebastes flavidus</i>) abundance and size structure
	Blue rockfish (<i>Sebastes mystinus</i>) abundance and size structure
	Shortbelly rockfish (<i>Sebastes jordani</i>) abundance and size structure
Seabirds	Brandt's cormorant (<i>Phalacrocorax penicillatus</i>) colony size (abundance) and fledgling rate
	Pelagic cormorant (<i>Phalacrocorax pelagicus</i>) colony size (abundance) and fledgling rate
	Pigeon Guillemot (<i>Cephus columba</i>) abundance and fledgling rate
	Common murre (<i>Uria aalge</i>) colony size (abundance) and fledgling rate

POTENTIAL ADDITIONAL METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

Candidate Attributes	Candidate Focal Species/Indicators
Ichthyoplankton	Total ichthyoplankton abundance
	Total abundance of rockfish larvae
	Ratio of fished species to unfished species

SUMMARY: CONSUMPTIVE USES

Consumptive uses include those activities involving extraction or consumption of living marine resources and reflect the activities discussed within the MLPA Initiative planning process. Important drivers of consumptive uses include changing fishing effort inside and outside MPAs, changes in fisheries regulations, climate and oceanographic shifts causing natural fluctuations in fish stocks, and the broader economic environment.

CANDIDATE METRICS FOR ECOSYSTEM FEATURE CHECKUP

[Under revision]

CANDIDATE METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

DRAFT INDICATOR FRAMEWORK

For each consumptive use or activity, indicators may follow a similar overarching structure:

1. **Number of people engaged in the activity**
2. **Level of activity** (e.g. number of trips, landings of key species per vessel/port/region, CPUE)
3. **Economic value or quality of activity** (e.g. landings value of key species per vessel/port/region, ex vessel value, net revenue)
4. **Knowledge, Attitudes and Perceptions (KAP) of participants**

DRAFT CONSUMPTIVE USES FOR MONITORING

For each consumptive use or activity, potential key fishery species for monitoring are noted. The indicator framework above can be applied to each consumptive use and associated fishery species.

- Commercial Fishing
 - Nearshore rockfish (*Sebastes* spp.)
 - Dungeness crab (*Cancer magister*)
 - California halibut (*Paralichthys californicus*)
 - Red sea urchin (*Strongylocentrotus franciscanus*)
- Recreational Fishing – Commercial passenger fishing vessels (CPFVs)
 - Rockfish (*Sebastes* spp.)
 - Lingcod (*Ophiodon elongates*)
 - California halibut (*Paralichthys californicus*)
- Recreational fishing – Abalone diving

DRAFT ADDITIONAL CONSUMPTIVE USES FOR MONITORING

- Recreational Fishing – Private vessels
- Recreational Fishing – Clamming
 - Pacific gaper clams (*Tresus nuttalli*)
 - Littleneck clams (*Prorothaca staminea*)

SUMMARY: NON-CONSUMPTIVE USES

Non-consumptive uses include activities that do not involve removal of marine resources. Both recreational and commercial aspects of non-consumptive uses are included within this ecosystem feature. Important divers include economic indicators (e.g., fuel costs, unemployment level, GDP, county income statistics), education & outreach activities, and ecological conditions.

CANDIDATE METRICS FOR ECOSYSTEM FEATURE CHECKUP

[Under revision]

CANDIDATE METRICS FOR ECOSYSTEM FEATURE ASSESSMENT

DRAFT INDICATOR FRAMEWORK

For each non-consumptive use or activity, indicators may follow a similar overarching structure:

1. **Level of activity** (spatial use and intensity)
2. **Knowledge, Attitudes and Perceptions (KAP) of participants**

DRAFT NON-CONSUMPTIVE USES FOR MONITORING

The indicator framework above can be applied to each non-consumptive use or activity. Draft non-consumptive uses for monitoring include:

- Scuba diving
- Wildlife viewing – boating and kayaking
- Wildlife viewing – shore based
- Tidepooling

DRAFT ADDITIONAL NON-CONSUMPTIVE USES FOR MONITORING

- Recreational beach use
- Educational opportunity