South Coast Baseline Program Final Report: Integration

Jennifer E. Caselle and Carol A. Blanchette

Photo Credit: Carol Blanchette

Integrative Report

Jennifer E. Caselle and Carol A. Blanchette

November 30, 2015

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Executive Summary

The Marine Life Protection Act (MLPA) South Coast Study Region (SCSR) ranges from Point Conception in Santa Barbara County to the California/Mexico border and includes the state waters on the mainland coast as well as the Channel Islands. The southern California coastline is 1197.2 km in length, comprising about half of the entire coastline for the State and contains nearly half of the marine protected areas (MPAs) in the state (52 of 109 MPAs in California). The SCSR is characterized by high productivity, high biological and habitat diversity, and highly variable oceanographic conditions, creating unique challenges for long-term MPA monitoring. This region is also unique in the State in terms of population (17 million, US 2010 census). Due to the large human population, the Bight's size, and its mild climate, all factors enhancing accessibility, it is no surprise the SCB supports $41 billion in ocean-dependent tourism and over 800,000 jobs (NOEP 2008). However, there is also an enormous amount of pressure on nearshore resources in the region.

The MPAs of the SCSR went into effect January 1, 2012, and the baseline program was initiated shortly after. Most Baseline projects conducted field sampling between 2012 and 2014 and individual technical reports were submitted in 2015. The Integrative Project (this report) was initiated at the onset of the Baseline period to coordinate the individual projects. The integrative project goals included 1) provide a coordinated approach to monitoring across these ecosystem features, so that data can be easily shared and analyzed in a unified framework, 2) ensure a standards-based approach to data and metadata management across projects, 3) facilitate data analysis and synthesis through dedicated workshops and working groups, and 4) produce an integrated dataset and series of data-based products (papers, presentations, outreach materials) providing a baseline characterization of ecological and socioeconomic conditions of the entire south coast region across ecosystem features as well as an assessment of initial changes in these conditions within the initial period of baseline monitoring. Here we report on progress made in these areas including recommendations for the development of long-term monitoring in the south coast and integrative products.

All projects that were funded as part of the SCSR Baseline program were asked to make recommendations for the development of long term monitoring plans for the region. Principal Investigators were to take into account the learning that occurred during their baseline project. These recommendations were included in the individual technical reports and encompassed a diversity of topics relevant to each ecosystem. Here, we categorize and summarize those recommendations. Many recommendations were similar across projects representing different ecosystem features. For example, several projects identified biogeographic regions or distinct community types from their baseline data and recommended that long-term monitoring sites (especially for MPA monitoring) be established in each region, as results might not be transferrable across regions with different species and human usages. Recommendations regarding temporal design of monitoring were less specific, perhaps due to the short duration of most baseline datasets and the unknown scope (financial, temporal, spatial) of any future long-term monitoring program. It was mentioned in several reports that there are tradeoffs between spatial and temporal considerations in any monitoring program and suggested that these be evaluated as design for long-term monitoring proceeds. Indeed, spatial considerations were explored

further in a dedicated workshop. Many projects evaluated focal species lists (from the Baseline monitoring plans) but few went into detail about metrics and indicators beyond species or taxonomic groups (e.g. community or ecosystem level indicators or process indicators). Several projects used quantitative approaches to indicator evaluation.

To culminate the integrative project, we held a workshop together with Ocean Science Trust partners to apply the lessons learned in the baseline period to the development of long-term monitoring. In advance of this workshop, the MLPA Baseline Team developed a set of draft guiding questions for South Coast MPA monitoring that reflected conversations about monitoring priorities for the California Department of Fish and Wildlife (CDFW), California Fish and Game Commission (FGC), and California Ocean Protection Council (OPC). The workshop began with these guidelines and explored both spatial and temporal considerations for long-term monitoring in this large and complex region. Key conclusions from this workshop included:

- Consistency of monitoring across state regions is critical to assessing the performance of the MPAs as a network, and to detecting statewide patterns and trends.
- It is extremely difficult to proposing designs for a long-term monitoring program without information on the potential level of funding or scope of program.
- Spatial design (site selection) depends strongly on scale of a monitoring program. For very small programs, the best approach might be to control for variation in factors other than protected status. For larger programs, one can begin to stratify across those factors.
- Assessing MPA effectiveness and tracking long-term change are both important goals, and ideally a monitoring program will do both, however different ecosystems lend themselves to answering different types of questions and both may not be possible in all ecosystems.
- In general, an important criteria for site-selection in the south coast included biogeography, and there was a strong desire to spread out their long-term monitoring sites across bioregions to the degree possible. However, this desire was predicated on the assumption that any monitoring program is funded at some minimum level to allow a biogeographic approach.
- There is evidence that biogeography is an important criteria in designing a long-term monitoring program. The selection of only one MPA site per bioregion does not provide replication essential to statistically evaluating MPA effects. All participants cautioned strongly against this lack of replication.
- Spatial co-location of long-term monitoring sites across ecosystems is desirable to the extent possible, given that we may discover new information about connections between those ecosystems.
- The south coast region is the largest of all MLPA regions, containing as much coastline (~1200 km including islands) as the rest of the state and approximately half of all MPAs in the state. The size, biogeographic and oceanographic complexity, the very large human population and

the diversity of habitats must be accounted for when designing long-term monitoring for this region. For these reasons the South Coast will likely require a much greater level of investment in monitoring than other regions.

Finally, the results of the various integrated projects are currently being written as a Special Issue for the journal Marine Ecology. The papers are composed of studies of ecosystems and components ranging from kelp forests to beaches and from basic science to citizen science and socioeconomic analyses. These papers represent a suite of novel, integrative scientific products brought together under the broader goal of developing a path breaking MPA monitoring framework designed to inform adaptive management of marine ecosystems. The papers described in this special issue represent a rare integration and synthesis across a broad array of socioeconomic, physical and biological scientific information that has been collected across ecosystems in the southern California region. They seek to collectively enhance our understanding, and inform adaptive management of marine resources in a large and highly populated region. This is the first baseline region to integrate in this way.

Introduction

Background to South Coast Study Region

The Marine Life Protection Act (MLPA) South Coast Study Region (SCSR) ranges from Point Conception in Santa Barbara County to the California/Mexico border and includes the state waters on the mainland coast as well as the Channel Islands (Figure 1). The SCSR is located in the northern portion of the Southern California Bight (SCB), which extends from Point Conception to Baja California in Mexico. The southern California coastline is 1197.2 km in length with the eight Channel Islands coastlines extending 502.7 km and the mainland coastline measuring 694.5 km. This comprises about half of the entire coastline for the State. Consequently, there are large numbers of MPAs in the SCSR: 52 MPAs were designated in the SCSR making up nearly half of the MPAs in California (N = 109).

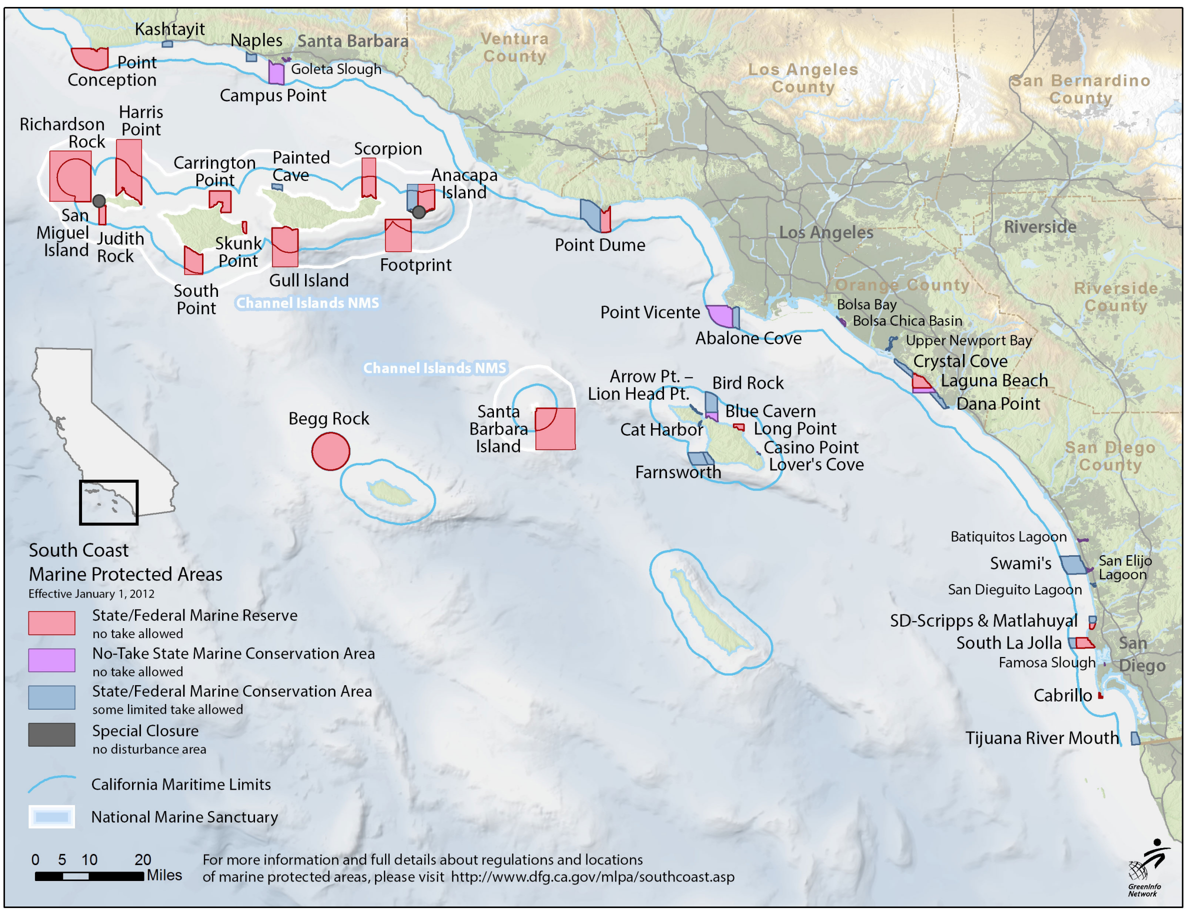

Figure 1 Map of South Coast Marine Protected Areas (www.californiampas.org)

The SCSR is characterized by high productivity, high biological and habitat diversity, and unique oceanographic conditions. The Southern California Bight is located within the greater context of the California Current Large Marine Ecosystem (LME), one of only four temperate upwelling systems in the world. The exceptionally high diversity of marine life in this region is largely due to the mixing of several major oceanographic current systems. Two major water masses meet at Point Conception, California—the cold, southward flowing California current, and the warm, westward flowing southern California countercurrent (Hickey 1998). This region is one of the most important biogeographic and oceanographic discontinuities on the west coast of North America (Valentine 1966; Doyle 1985; Burton 1998). The northern region is typified by consistently strong coastal upwelling bringing cold, nutrient-rich waters to the surface, resulting in both cold sea surface temperatures along the coast and high nutrient concentrations. The Santa Barbara Channel, immediately south/east of Point Conception, is typified by weak seasonal upwelling, which tends to occur in the winter months (Blanchette et al. 2002; Winant et al. 2003). The northern California Channel Islands are located just offshore from Point Conception and lie within this highly diverse oceanographic region. These oceanographic conditions exert a large influence on the species composition of biological communities across the region (Blanchette et al 2006, 2007, 2008, 2009, Pondella et al. 2005, Hamilton et al. 2010, Caselle et al. 2015).

Compared with other study regions in California, the SCSR is characterized by strong gradients in environmental conditions (e.g. water temperature). Figure 4 indicates a time-averaged long-term mean of sea surface temperature (SST) based on data available from MODIS satellite imagery at 1km resolution. The persistent spatial gradients in temperature across the SCSR have a strong influence on biological community structure and diversity, including a gradient of species abundances across the region. Some parts of the study region, such as the western-most Northern Channel Islands, contain biotic assemblages highly similar to those of central California while others support quite different species communities resembling those found in Mexican waters to the south.

Beyond the known physical and biological challenges for the Southern California Bight, this region is unique in the State in terms of population (17 million, US 2010 census). Due to the large human population, the Bight's size, and its mild climate, all factors enhancing accessibility, it is no surprise the SCB supports $41 billion in ocean-dependent tourism and over 800,000 jobs (NOEP 2008). This puts an enormous amount of pressure on nearshore resources, the immediate interface to the population. Many areas along the coastline of the SCSR support large human population centers and extensive development, with the largest urban centers occurring in the metropolitan areas of Los Angeles and San Diego. In addition to consumptive activities (fishing and harvesting of marine resources) a variety of non-consumptive activities are also popular within the SCSR, including diving, kayaking, surfing, beach-going, tidepooling, swimming, and a number of different shore and ship-based wildlife viewing activities.

Due to the high biological and oceanographic diversity across the SCSR, the MLPA Science Advisory team identified five biologically relevant subregions (bioregions) within the SCSR: (1) **North Mainland** – Point Conception to Marina del Ray, (2) **South Mainland** - Marina del Ray to the US/Mexico Border, (3) **West Channel Islands** – San Miguel, Santa Rosa and San Nicholas Islands, (4) **Mid Channel Islands** – Santa Cruz, Anacapa and Santa Barbara Islands, and (5) **East Channel Islands** – Santa Catalina and San Clemente Islands. Each of these five bioregions is characterized by a unique set environmental conditions and a distinct assemblage of marine organisms. This analysis was conducted with best available data at the time. Further refinement of these coarse bioregions was done during the Baseline period by research teams studying different ecosystem features. For example, the kelp forest and rocky reef program (Pondella et al. 2015) identified 17 geographically cohesive community clusters (later simplified to 14), each with distinct fish, invertebrate, and algal assemblages while the CA Reefcheck program identified 4 clusters of sites (Friewald et al. 2015) on the same habitat types. Similarly, the rocky intertidal group delineated 14 significant community groupings within the sessile taxa and 9 significant groupings for the mobile taxa (Blanchette et al. 2015). The integrative group of south coast PIs utilized these cluster to evaluate the cohesiveness of spatial variation in community structure analyses across the major habitat types in the SCSR (Claisse et al. in prep). This work will be the first time that biogeographic patterns across multiple ecosystems are compared in the southern California bight region. Early results indicate a moderate to high degree of overlap among the rocky intertidal, shallow subtidal, deep subtidal and deep sand ecosystems, largely driven spatial variation in temperature (Figure 2).

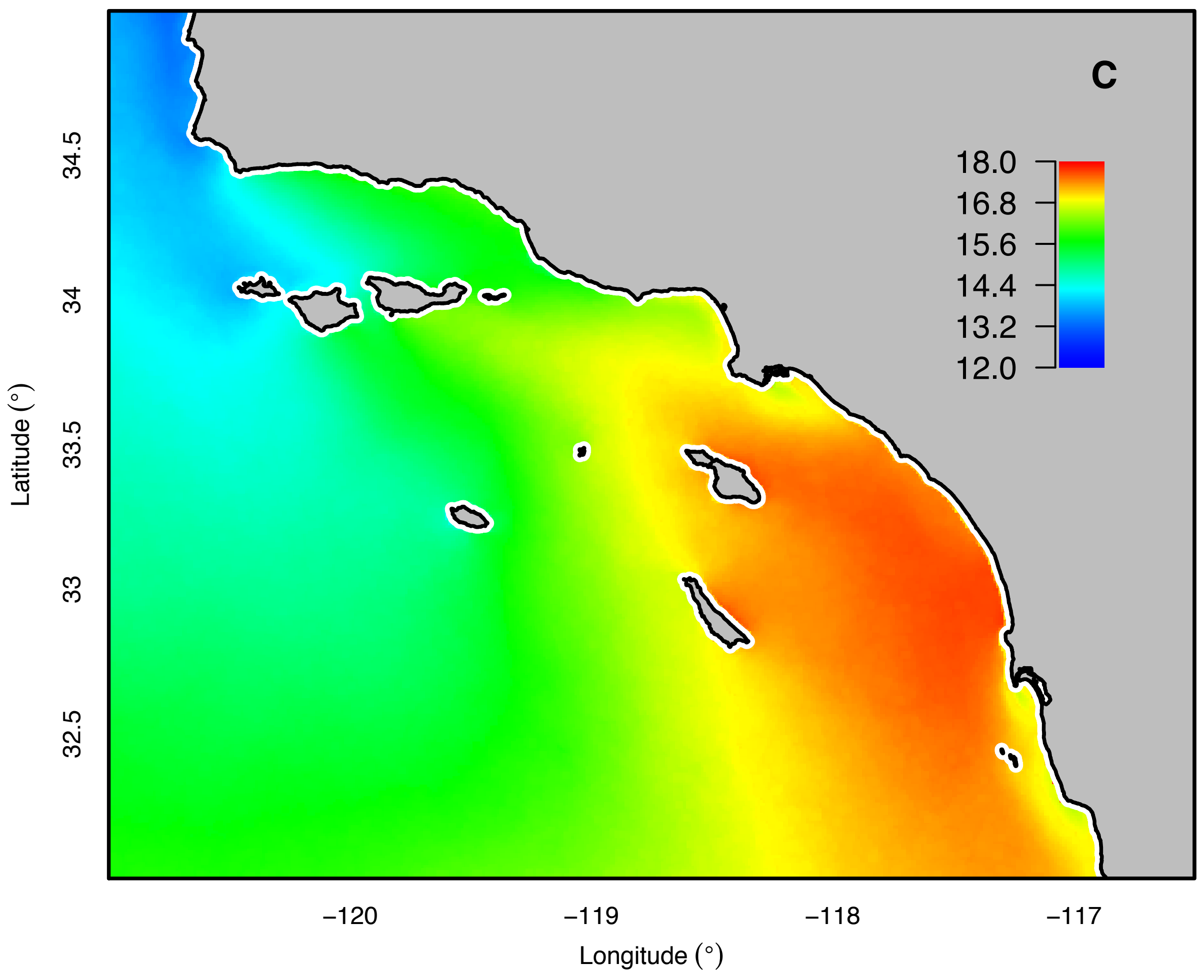

Figure 2 Spatial pattern of long-term mean SST from 2000-2012 across the SCSR

Physical and Anthropogenic Setting

The MPAs of the SCSR went into effect January 1, 2012, and the baseline program was initiated shortly after. Most Baseline projects conducted field sampling between 2012 and 2014. Since this period of time sets the stage for the baseline characterization, it is important to understand the environmental context in which this baseline characterization is based. Here we provide information on several climatic variables that are likely to influence biological data collected in the SCSR during the relatively short time of the baseline period, as well as in future monitoring. We follow this with presentation of other attributes of the system (data gathered by us and others) that we feel may be important to interpretations of future changes in MPAs in the SCSR. These analyses also provide additional context for future users of the MLPA monitoring data and we suggest that the results be considered in long-term monitoring plans.

PDO

The Pacific Decadal Oscillation (PDO) Index is defined as the leading principal component of North Pacific monthly sea surface temperature variability (poleward of 20N for the 1900-93 period). The Pacific Decadal Oscillation (PDO) is often described as a long-lived El Niño-like pattern of Pacific climate variability (Zhang et al. 1997). As seen with the better-known El Niño/Southern Oscillation (ENSO), extremes in the PDO pattern are marked by widespread variations in the Pacific Basin and the North American climate. In parallel with the ENSO phenomenon, the extreme phases of the PDO have been classified as being either warm or cool, as defined by ocean temperature anomalies in the northeast and tropical Pacific Ocean. When SSTs are anomalously cool in the interior North Pacific and warm along the Pacific Coast, and when sea level pressures are below average over the North Pacific, the PDO has a positive value. When the climate anomaly patterns are reversed, with warm SST anomalies in the interior and cool SST anomalies along the North American coast, or above average sea level pressures over the North Pacific, the PDO has a negative value (Mantua, 1999). Since the early 2000s, the PDO has been in a neutral to cool phase, however, based on previous cycles, we may expect the PDO to return to a warm phase in the near future (Figure 3).

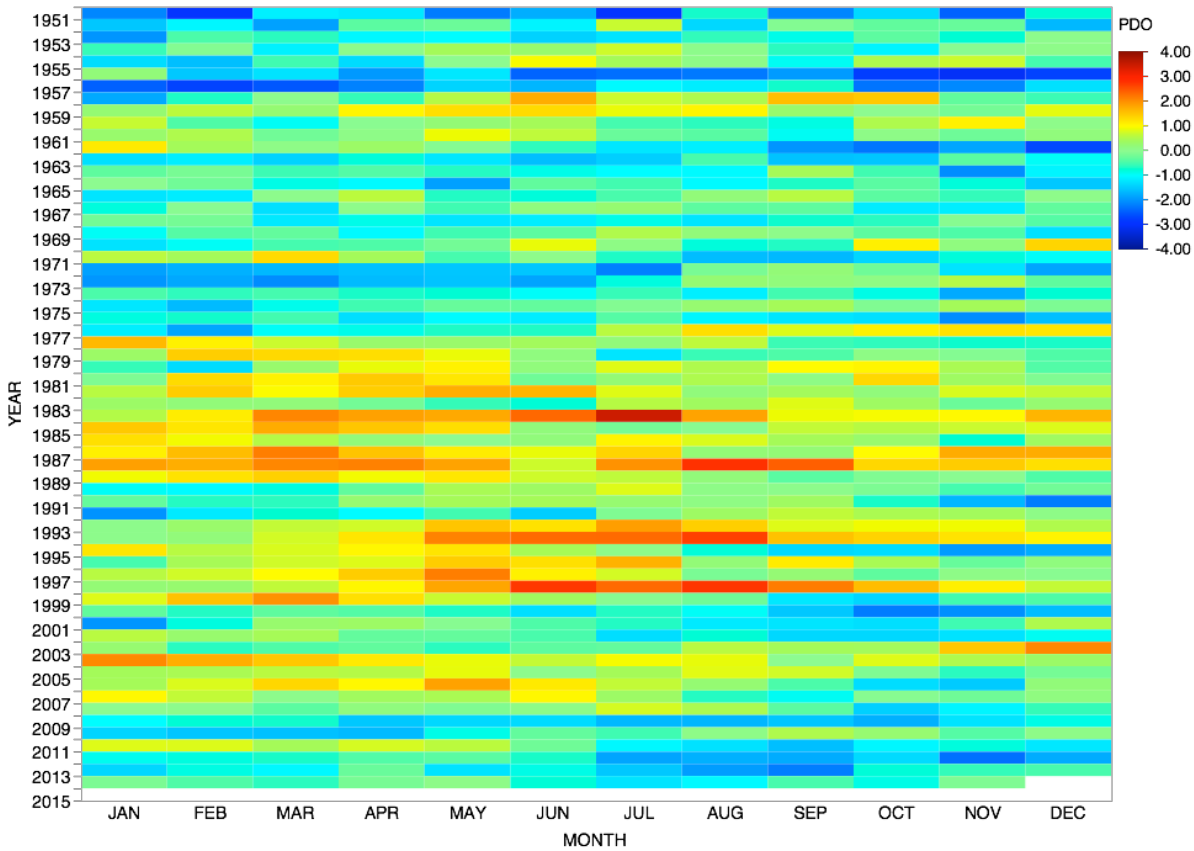

Figure 3 Monthly values of the PDO Index from 1950 to 2013

NPGO

The North Pacific Gyre Oscillation (NPGO) is a climate pattern that emerges as the 2nd dominant mode of sea surface height variability (2nd EOF SSH) in the Northeast Pacific (Di Lorenzo et al. 2008). Along the coast the atmospheric forcing associated with both the PDO and NPGO control decadal modulation of the upwelling cells, resulting in non-spatially-uniform responses of coastal upwelling. The PDO signal is strong north of 38N and the NPGO is strong south of 38N along the California Current System. The PDO and NPGO are the oceanic expression of the two dominant modes of North Pacific atmospheric variability -- the Aleutian Low (AL) and the North Pacific Oscillation (NPO), which are linked to the different phases of the ENSO cycle. This variability leads to changes in the strength and position of the winds that run along the California Coast and work to “pull” a current of water from the depths. The NPGO is significantly correlated with previously unexplained fluctuations of salinity, nutrients and chlorophyll-a measured in long-term observations in the California Current (CalCOFI) and Gulf of Alaska. Compared to negative NPGO years, average end of winter water conditions during positive NPGO years feature nitrate concentrations that are about 25 percent higher, chlorophyll concentrations about 15 percent higher and zooplankton numbers that are about 20 percent higher. These nutrients and zooplankton feed commercially important fish species and seabirds. The NPGO has been in a warm phase since around 2007, and a shift to a cooler phase is expected in the next few years (Figure 4).

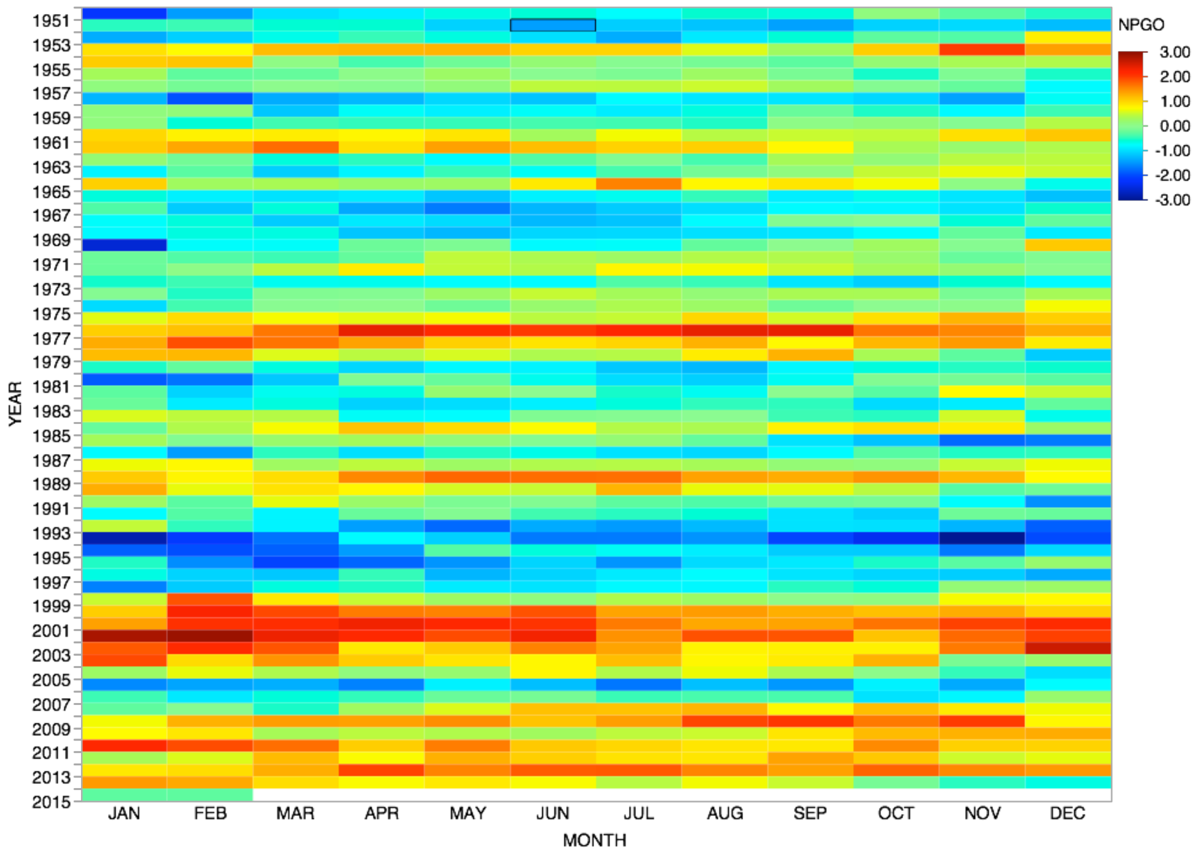

Figure 4 Monthly values of the NPGO from 1950 to 2014

MEI

The Multivariate ENSO Index (MEI) is probably the best-known climate index, and is particularly important in southern California, where El Niño and La Niña events have been shown to have significant impacts on coastal ecosystems. El Niño/Southern Oscillation (ENSO) is the most important coupled ocean-atmosphere phenomenon to cause global climate variability on interannual time scales. The Multivariate ENSO Index (MEI) is based on the first un-rotated Principal Component (PC) of six main observed variables over the tropical Pacific. These six variables are: sea-level pressure (P), zonal (U) and meridional (V) components of the surface wind, sea surface temperature (S), surface air temperature (A), and total cloudiness fraction of the sky (C). Positive phases of the MEI are associated with El Niño like conditions, and negative phases typify La Niña conditions. The baseline period of 2012-2014 has generally been characterized by neutral to weak ENSO conditions, with the prediction for a weak to moderate El Niño set to begin in fall 2014 (Figure 5).

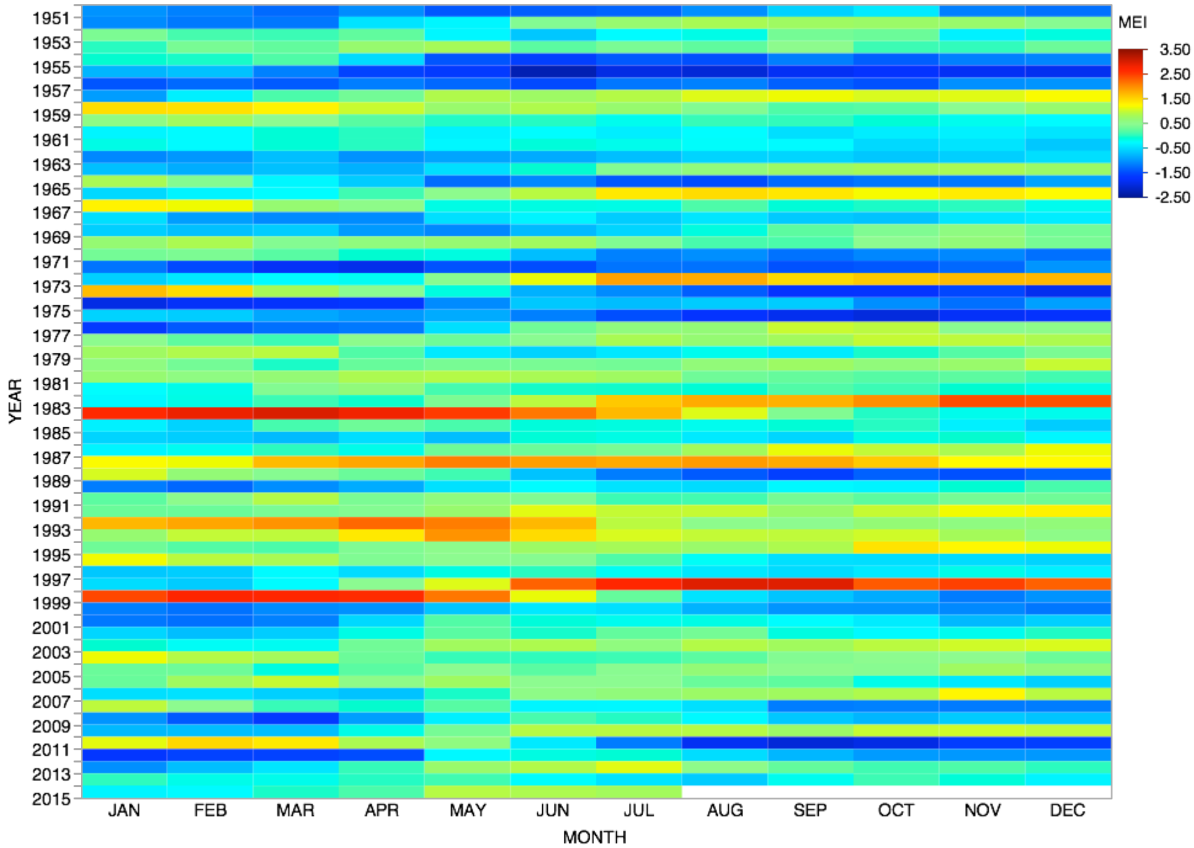

Figure 5 Monthly values of the MEI from 1950 to 2014

Upwelling Index

Upwelling is a dominant and important process along the California coast. Scientists at the Pacific Fisheries Environmental Laboratory (PFEL) generate monthly indices of the intensity of large-scale, wind-induced coastal upwelling at 15 standard locations along the west coast of North America. The indices are based on estimates of offshore Ekman transport driven by geostrophic wind stress. PFEL coastal upwelling indices are calculated based upon Ekman's theory of mass transport due to wind stress. Assuming homogeneity, uniform wind and steady state conditions, the mass transport of the surface water due to wind stress is 90° to the right of the wind direction in the Northern Hemisphere. Ekman mass transport is defined as the wind stress divided by the Coriolis parameter (a function of the earth's rotation and latitude). Ekman transports are resolved into components parallel and normal to the local coastline orientation. The magnitude of the offshore component is considered to be an index of the amount of water upwelled from the base of the Ekman layer. Positive values are, in general, the result of equatorward wind stress. Negative values imply downwelling, the onshore advection of surface waters accompanied by a downward displacement of water. The upwelling indices shown in Figure 60 are based on data for southern California from the 33 degrees N latitude station. The seasonal cycle of upwelling is apparent in Figure 6. The baseline period was characterized by a typical seasonal pattern of upwelling, with strong upwelling during May and June 2012.

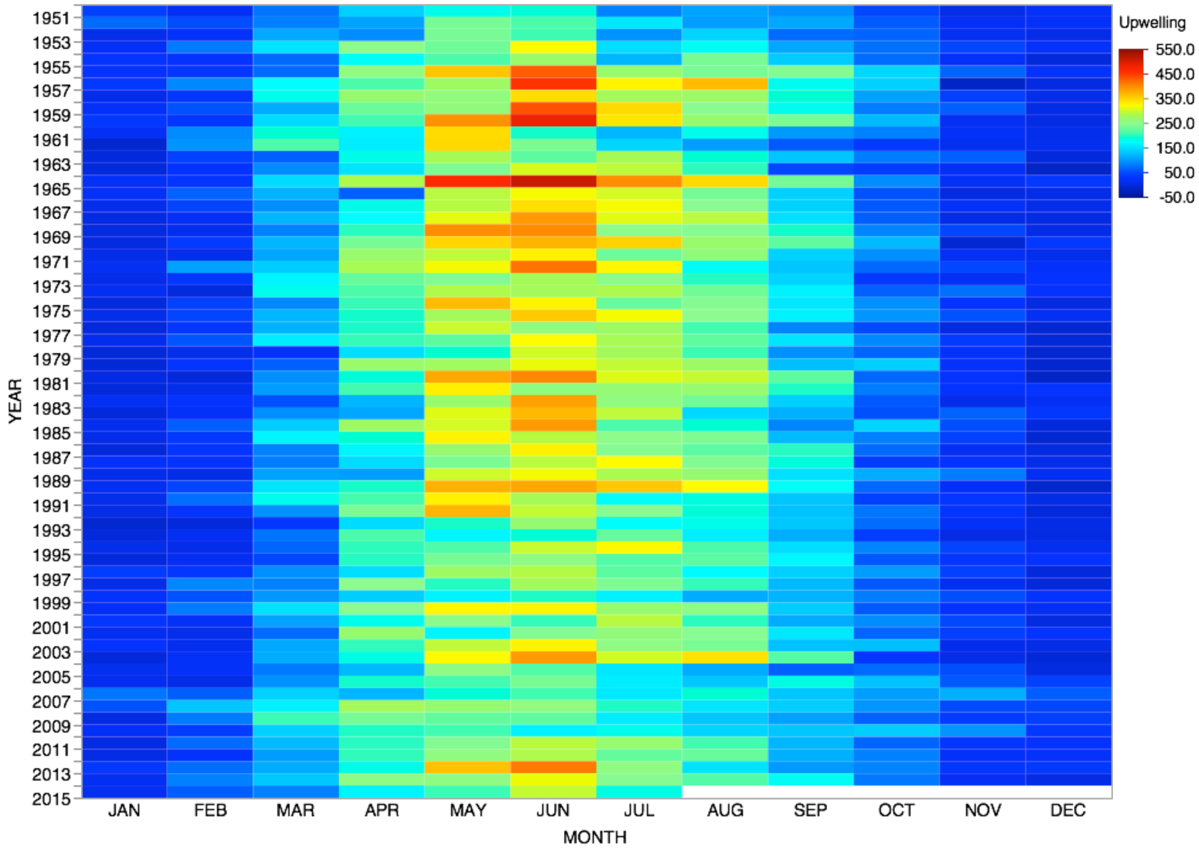

Figure 6 Monthly values of the PFEL Upwelling Index from 1950 to 2014

Water Quality

During the MLPA process, much of the mainland of the SCSR was classified as having impaired water quality caused by a variety of point and non-point source inputs (California MLPA Initiative 2009). As a parallel study to the kelp forest and rocky reef baseline assessment, two primary sources of anthropogenic pollutants, treated wastewater, released by publicly owned treatment works (POTWs) through ocean outfalls, and freshwater run-off contained in river plumes, were modeled for the mainland (Figure 7) by researchers at the Southern California Coastal Water Research Project as part of the Bight 13 project.

These investigators developed a geospatial tool in ArcGIS to calculate a Water Quality Index (WQI) across much of the SCSR. The WQI quantifies long-term exposure to potentially harmful pollutants emanating from these two sources. As a general overview, there is quite a bit of coastwide variation for these inputs, but the general pattern is a greater input and potential impact by the larger metropolitan areas (e.g., Los Angeles, Newport and San Diego) (Schaffner et al. 2014). While the effect of these inputs on nearshore ecosystems is a dynamic area of study, it has been established that sedimentation and associated processes (turbidity, scour and reef burial) are a significant deleterious factor for kelp forests and rocky intertidal systems (Pondella et al. 2012, Littler et al. 1983). The WQI has some significant data gaps; it currently incorporates only major point source pollution, large POTWs and rivers. Runoff and point source pollution from smaller plumes, such as storm drains or small POTWs are not included. The WQI will be incorporated into ongoing studies to examine relative risks posed to marine habitats by pollutants and fishing pressure, and subsequent products will provide additional data layers for future evaluations of MPA impacts in the SCSR.

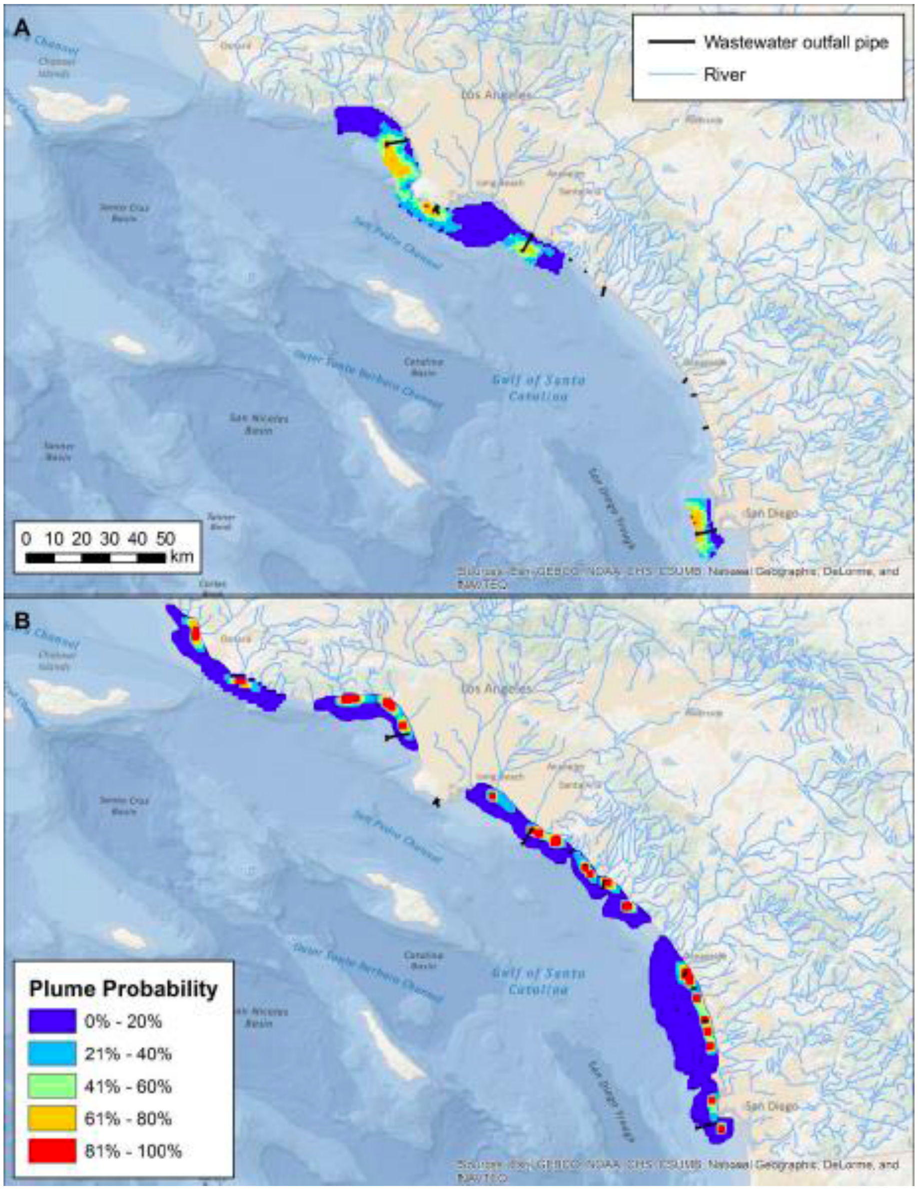

Figure 7 POTW plume probability (A) and river plume probability (B) for the mainland of the SCB (Schaffner et al. 2014)

Fishing Pressure

Using 29 years of landings records collected by the California Department of Fish and Wildlife (CDFW), investigators from the Vantuna Research group (VRG) quantified a multi-species spatial fishing pressure index to evaluate spatial distributions of commercial and recreational Commercial Passenger Fishing Vessel (CPFV) fisheries across shallow rocky reef habitat in the SCSR (Zellmer et al. in review). The SCSR is an area under intensive fishery pressure. Commercial fishing on rocky reefs in southern California has accounted for over $366 million US dollars' worth of harvested marine organisms, almost 10% of the total $4 billion dollars for the entire state of California (Perry et al. 2010) over the time period assessed (1980-2009) in the study (Zellmer et al. in review). Additionally, southern California hosts the largest recreational fishing market for the west coast of the contiguous US, accounting for almost 50% of the total harvest in this region at times (Gautam 1996). Results showed that fishing pressure is not uniformly distributed over this region by taxa, method nor industry (Zellmer et al. in review). The commercial fishery in this ecosystem is focused on extractions of invertebrates (e.g., Red Sea Urchin, Rock Crab, California Spiny Lobster) while the recreational CPFV fishery extracts primarily finfish (e.g., Barred Sand Bass, Kelp Bass, California Scorpionfish). With the exception of Red Sea Urchin, the largest commercial fishery in this habitat, there was no significant difference in the yearly extraction rates from shallow rocky reefs in the SCSR between the commercial fishery (866.53 MT/yr) and recreational CPFV fishery (826.30 MT/yr). Further details on the resource extraction by MPA and Fishing Block can be found in Pondella et al. (2015) and Zellmer et al. (in review). There was significant spatial partitioning, however, with the commercial fishers preferentially targeting the islands, while the recreational fishery is focused on the mainland (Zellmer et al. in review). Within those two general patterns, extraction among these reef systems varies significantly (Figure 8). Commercial fishing is correlated with the spatial extent of individual reefs, while recreational fishing is not. Certain areas of the coastline (Santa Monica Bay, Newport, Anacapa and Santa Catalina Islands) have particularly high pressure likely due to access (i.e., distance to port) in part caused by the recreational fishery continually targeting reefs systems that are close to port. This significant spatial variability and pressure adds an additional context for understanding this dynamic region. In future analyses of the impacts related to removing fishing effects from within the MPAs, these data may provide explanatory power with respect to why trajectories of change vary across different MPAs. Greater effects would be expected for species that are more heavily exploited in the local area (Lester et al. 2009; Hamilton et al. 2010).

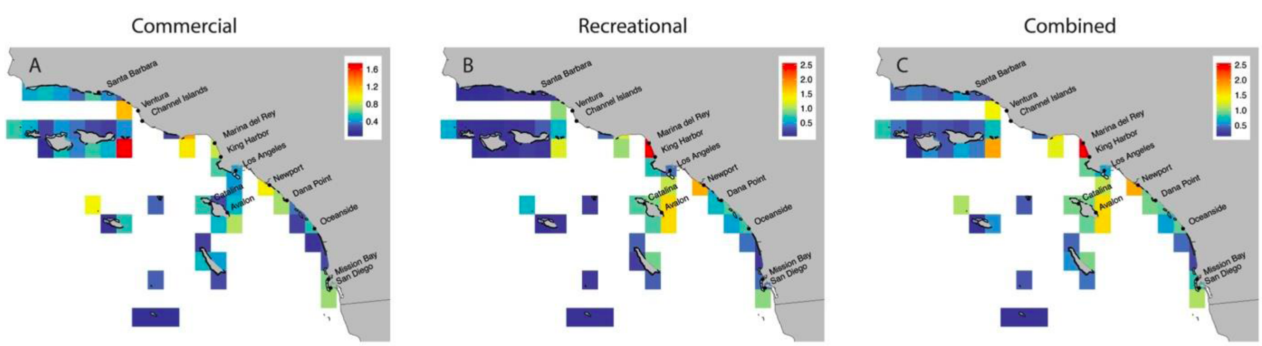

Figure 8 Spatial distribution of the fishing pressure index for A) commercial, B) recreational, and C) the combined fisheries for the multi-species dataset. The fishing pressure index was calculated as log10+1 tons per year harvest rates per amount of reef area in each block (MT/yr/km2). The colors indicate areas with high (red) versus low (blue) fishing harvest rates per km2 reef area. Only data for CDFW fishing blocks that contain shallow (<30m depth) rocky reefs are shown (Zellmer et al. in review).

Summary of Long-Term Monitoring Recommendations for the South Coast Region

A synthesis of key findings from South Coast Baseline Projects

All projects that were funded as part of the SCSR Baseline program were asked to make recommendations for the development of long term monitoring plans for the region. Principal Investigators were to take into account the learning that occurred during their baseline project. These recommendations were included in the individual technical reports and encompassed a diversity of topics relevant to each ecosystem. Here, we categorize and summarize those recommendations. Many recommendations were similar across projects representing different ecosystem features. For example, several projects identified biogeographic regions or distinct community types from their baseline data and recommended that long-term monitoring sites (especially for MPA monitoring) be established in each region, as results might not be transferrable across regions with different species and human usages. Recommendations regarding temporal design of monitoring were less specific, perhaps due to the short duration of most baseline datasets and the unknown scope (financial, temporal, spatial) of any future long-term monitoring program. It was mentioned in several reports that there are tradeoffs between spatial and temporal considerations in any monitoring program and suggested that these be evaluated as design for long-term monitoring proceeds. Indeed, spatial considerations were explored further in a dedicated workshop (see below for summary of that workshop). Many projects evaluated focal species lists (from the Baseline monitoring plans) but few went into detail about metrics and indicators beyond species or taxonomic groups (e.g. community or ecosystem level indicators or process indicators). Several projects used quantitative approaches to indicator evaluation (these approaches are described in detail below).

We organized the suite of recommendations provided in the individual technical reports into the following categories and summarized those recommendations in each category by ecosystem feature.

1) **Temporal Considerations** – Recommendations on timing (e.g. seasonal, diel) and/or frequency (e.g. annual, monthly) of surveys.
2) **Spatial Considerations** – Recommendations on particular sites or regions, biogeographic approaches, and evaluation of the adequacy of MPA and reference site pairing.
3) **Indicators/Metrics** - Recommendations on specific species or taxonomic groups to monitor, evaluation of species lists provided in the Baseline monitoring plan, and recommendations for 'process' metrics to measure for species or species groups (e.g. breeding, behavior, size structure).
4) **Technique/Protocol** – Recommendations on specific protocols, suggestions for changing or not changing existing or baseline protocols.
5) **Citizen science** – Suitability of monitoring particular ecosystem features using citizen science, recommendations for methods for citizen science programs.
6) **Other Recommendations** – Recommendations for key 'ancillary' data that would augment long-term monitoring of the Baseline ecosystem features, data for use in interpretation of long-term monitoring, recommendations about composition of research groups for long-term monitoring, and general suggestions for partnership approaches

This summary report is based on recommendations from each of the South Coast Baseline Program Projects as listed below. We refer to each of these projects by the bolded title in the list below:

- **Rocky Intertidal** – "South Coast Baseline Program Final Report: Rocky Intertidal Ecosystems" – Carol Blanchette, Pete Raimondi, Jayson Smith, Jennifer Burnaford, Julie Bursek, Rani Gaddam, Jessie Altstatt, Jenifer Dugan and David Hubbard
- **Sandy Beach** – "Baseline Characterization of Sandy Beach Ecosystems Along the South Coast of California" – Jenifer E. Dugan, David M. Hubbard, Karina J. Nielsen, Jessica Altstatt and Julie Bursek
- **Reef Check** - "Reef Check California: Citizen Scientist Monitoring of rocky reefs and kelp forests: Creating a Baseline for California's South Coast. Jan Freiwald and Colleen Wisniewski
- **Spiny Lobster** - "Baseline characterization of California spiny lobster (*Panulirus interruptus*) in South Coast marine protected areas" – Kevin A. Hovel, Douglas J. Neilson and Ed Parnell.
- **Mid-depth Rock** – "South Coast Marine Protected Areas Baseline Characterization and Monitoring of Mid-Depth Rocky and Soft-Bottom Ecosystems (20-350m)" – James Lindholm, Ashley Knight, Flower Moye, Alli N. Cramer, Heather Bolton, Michael Esgro, Sarah Finstad, Joshua Smith, Rhiannon McCollough, and Molly Fredle.
- **Kelp Forest** – "South Coast Baseline Program Final Report: Kelp and Shallow Rock Ecosystems" – Daniel J. Pondella, Jennifer E. Caselle, Jeremy T. Claisse, Jonathan P. Williams, Kathryn Davis, Chelsea M. Williams and Laurel A. Zahn
- **Seabirds** – "Use of Estuarine, Intertidal, and Subtidal Habitats by Seabirds Within the MLPA South Coast Study Region" – Dan P. Robinette, Julie Howar, Meredith L. Elliott, and Jaime Jahncke
- **Aerial Imaging** – "Nearshore Substrate Mapping Change Analysis Using Historical and Contemporary Multi-spectral Aerial Imagery" – Jan Svejkovsky

Temporal Considerations

Sandy Beach:

- Physical and ecological characteristics of sandy beach ecosystems are extremely dynamic on temporal scales ranging from hourly to decadal.
- Standardized, monthly observations of birds, fresh kelp plants, people and dogs on beaches along standardized alongshore transects should be a component of long term monitoring.
- Surveys of key, widely distributed taxa (i.e. sand crabs and talitrid amphipods) should be conducted at least once a year however conducting spring and fall surveys would yield much needed insights on the dynamics of recruitment, production and survival.
- Surveys revealed that a great number of endemic and rare intertidal invertebrates with restricted distributions inhabit SC beaches, including MPAs. For this reason, we recommend that the biodiversity of beaches should be evaluated with comprehensive surveys that are conducted every few years.

Rocky Intertidal:

- Observations suggested that the abundance of birds was often as high or higher during the falling phase of the tides, compared to during the lowest phase of the tides. Some of this variability appeared to be related to human use patterns with respect to tidal height at the rocky shore sites. We suggest that due to the small size of many of the rocky intertidal reef sites, future bird surveys should ideally be conducted independently of other rocky intertidal monitoring activities.

Spiny Lobster:

- Additional MPA monitoring (beyond Baseline) is critical for determining whether potential benefits of MPAs for lobsters and fisheries are realized at regional scales, or only at local scales. Such analyses should be accompanied by a detailed assessment of fishing pressure and changes to the fishery to enable a determination of the relative effects of harvest vs. protection in MPAs on lobster populations.

Kelp Forest:

- Considering the significant amount of effort that has been needed to properly understand MPA responses in the northern Channel Islands, at least annual monitoring of the 14 identified ecoregions is likely appropriate.
- The Northern Channel Islands dataset and analyses should be used as a guide for future monitoring decisions based on statistical power to detect reserve affects and to evaluate tradeoffs between spatial and temporal resolution in future monitoring programs

Spatial Considerations

Sandy Beach:

- Beaches in the SC region were physically and ecologically diverse. Only the proposed macroinvertebrate indicator taxa, sand crabs and talitrid amphipods, were observed on all 12 focal beaches, and a number of macroinvertebrate species were observed on only a few beaches

Reef Check:

- Surveys identified four spatially differentiated community types ('ecoregions'). Recommend that monitoring occur in each ecoregion.

Kelp Forest:

- Long-term monitoring of MPAs should be distributed across the 14 distinct Geographic Areas ('ecoregions') identified in this project. When considering the length of coastline in the South coast region and its statistically demonstrated complexity, this is essentially a recommendation of less monitoring than what is currently being done for an equivalent amount of coastline in the rest of the state.
- Tradeoffs between spatial and temporal resolution in future kelp forest MPA monitoring programs remain to be investigated, but this study (Baseline and Northern channel islands) shows that a high degree of spatial resolution will be necessary to make general conclusions about MPA performance.
- The observed geographic patterns of community structure and similar habitat characteristics suggest that the reference areas identified during this baseline project were generally well matched with associated MPAs. However, this assumes that temporal dynamics of a reference area and associated MPA are similar, that is, track together in time. The baseline data are insufficient to test that assumption but continued monitoring would allow that test.

Indicators/Metrics

Sandy Beach:

- Only the proposed macroinvertebrate indicator taxa, sand crabs and talitrid amphipods, were observed on all 12 focal beaches, and a number of macroinvertebrate species were observed on only a few beaches. These key taxa can be relatively quickly sampled, identified and quantified by trained observers.
- We recommend using the following suite of ecological indicators and metrics (identified and evaluated in this baseline study) for use in long-term monitoring of sandy beaches in the SC region.

Criteria used

- These indicators include shorebirds, macrophyte wrack and selected macroinvertebrates that represent the two main branches of the subsidized beach food web.

Specific indicators, metrics and key attributes:

Draft Metrics and Key Attributes		Draft Indicator/Focal Species or Taxa
Trophic Structure	Predatory Birds	Marine Birds – species richness, abundance Shorebirds, Seabirds, Gulls, Other birds, Terrestrial birds, including raptors and Belding's Savannah Sparrow
	Suspension Feeders	Macroinvertebrates - abundance, biomass, size structure Sand crabs, Pismo clams, Bean clams
	Wrack Consumers	Wrack invertebrate diversity, abundance, biomass
Productivity	Beach wrack	Macrophyte wrack composition, abundance, biomass
Diversity		Intertidal macroinvertebrate species richness
Non-consumptive Use		Human use - recreational activity, zone used
Consumptive Uses		Fishing, Clamming

Seabirds:

- The SCSR Monitoring Plan should be updated so that individual marine bird species are represented within the appropriate ecosystem feature. The current SCSR Monitoring Plan contains marine birds within some ecosystem features, but we feel many of these species can contribute to more ecosystem features. Specifically, most coastally breeding seabirds are dependent on prey from multiple ecosystem features.
- By monitoring both the breeding and foraging ecology of bird species (including shorebirds, waterfowl and other piscivorous birds), it is possible to gain information on multiple ecosystem features (e.g. intertidal and estuary/wetland ecosystems) without additional surveys.
- Seabird foraging rates should continue to be monitored inside and outside of MPAs in order to 1) better interpret annual variability in breeding population size and breeding productivity by documenting annual variability in prey distribution and 2) track where fish recruitment is likely occurring within nearshore habitats.

Reef Check:

The following species listed in the SCSR Monitoring Master Plan were identified as good candidates for long-term MPA monitoring indicators:

Criteria used:

- Abundance
- Economic importance
- Ease of field identification
- Found throughout other MLPA regions, allowing integration of monitoring across study regions

Fish species:

- Kelp bass
- Senorita
- Black perch
- California sheephead

Invertebrate species:

- Red urchin
- Purple urchin
- Turban snails
- Giant spined star
- Wavy and red turban snails

Mid-depth Rock:

Potential indicators provided here are intended as a point of departure for discussion as each of the MLPA regions moves beyond baseline characterization.

Criteria used:

- observed in numbers appropriate for particular statistical analyses
- capable of being identified with a high level of confidence from imagery alone

Fishes:

- Aurora/Splitnose Rockfish Complex
- California Sheephead
- Halfbanded Rockfish
- Lingcod
- Pink Surfperch
- Sanddabs (*Citharichthys* spp.)
- Squarespot Rockfish
- Vermilion/Canary/Yelloweye Rockfish Complex

Mobile Invertebrates

- Ridgeback Prawns
- Spot Prawns
- California Sea Cucumber

Structure-forming Invertebrates

Note**:** This category presents perhaps the greatest challenge. There are a great many species that could be included here, many of which have been observed serving as biogenic habitat for demersal fishes.

- California Hydrocoral
- Sea Pens and Whips
- Gorgonians

Kelp Forest:

Indicator species evaluation revealed that a handful of the candidate species might possess the wide spatial distribution and general statistical properties that would be characteristic of a good indicator for the entire SCSR.

Criteria used:

- Distribution across the 14 identified geographic areas
    - relatively high abundance and frequency of occurrence
    - relatively low spatial coefficient of variation

Fishes and Invertebrates

- Kelp Bass (*Paralabrax clathratus*)
- California Sheephead (*Semicossyphus pulcher*)
- red urchin (*Strongylocentrotus franciscanus*)
- Kellet's whelk (*Kelletia kelletii*)
- wavy turban snail (*Megastraea undosa*)
- giant key-hole limpet (*Megathura crenulata*)

- Other species evaluated, such as all individual rockfish species, with the exception of Kelp Rockfish (*Sebastes atrovirens*), were more limited in their spatial distribution and generally did not possess desirable statistical properties. Given the strong environmental gradients that occur across the SCSR and the high degree of kelp forest community structure, most of the other candidates will only be appropriate to consider as indicator species for specific Geographic Areas within the SCSR for more fine spatial scale analyses of particular MPAs.
- A single value of “Rockfish” abundance (i.e., aggregating data across all rockfish species observed), and especially size frequency, will likely have little utility as an indicator from a management or stakeholder perspective,
- **C**hoice of specific indicator species or groups *must* be linked to the management or policy questions at hand. Identification of these questions will allow a better match between properties of an indicator (i.e., what exactly does the indicator indicate) and ultimately drive an efficient and cost-effective monitoring program.

Rocky Intertidal:

The following species or taxonomic groups are currently monitored by the MARINe group in southern California for long-term (status and trends) monitoring.

Criteria used:

- most ‘iconic’ rocky intertidal organisms
- relatively easy to identify and census through time.
- dominant space occupiers (surfgrass, mussels, barnacles)

- changes in their abundance through time is likely to be linked to large community changes.
- The abundance of taxa such as owl limpets and abalone is likely to be linked to pressure from human harvesting.

Invertebrates and Algae

- *Anthopleura* (Anemones)
- *Chthamalus/Balanus* (Acorn Barnacles)
- *Tetraclita* (Pink Barnacle)
- *Pollicipes* (Goose Barnacle)
- *Mytilus* (California Mussel)
- *Hesperophycus* (Olive Rockweed)
- *Silvetia* (Golden Rockweed)
- *Endocladia* (Turfweed)
- *Mastocarpus* (Turkish Washcloth)
- *Egregia* (Feather Boa Kelp)
- *Phyllospadix* (Surfgrass)
- *Pisaster ochraceus* (Ochre Star)
- *Haliotis cracherodii* (Black Abalone)
- *Lottia gigantea* (Owl Limpet)

- The only ecosystem indicator that differed between MPAs and reference areas was richness/diversity. The effect was strong and results suggest that this indicator might be useful for characterizing the effects of MPAs and also for assessing changes in MPAs through time.
- For MPA analysis, there was also some evidence that the size distribution of owl limpets was affected by degree of human access (although not be MPA status). The suggestion that size distributions of this species could be affected by poaching has implications for MPA management.
- Before deciding on the selection of indicators for monitoring, it is important to establish the goals of a monitoring program and the desirable qualities of indicators.

Technique/Protocol

Sandy Beach:

- High mobility and dynamic distribution of sand beach organisms means that any protocol that relies on standardized length or placement of transects or sampling units is completely unsuitable for intertidal monitoring in sandy beach ecosystems. Protocols based on such standardize placement will result in major errors in estimates of population abundance on beaches

Spiny Lobster:

- We recommend that future monitoring involve a combination of techniques and analyses, including boat-based trapping (which can survey a substantial fraction of the lobster population, and provide the best estimates of trends in population size and lobster body size) and SCUBA-based surveys (which can establish lobster-habitat associations and assess behavioral shifts). Though these tools should form the backbone of a comprehensive monitoring program, modern technological tools will be very useful additions. This includes habitat mapping at high resolutions, particularly in shallow water, and assessments of lobster movement, home range size, and spillover using acoustic tracking.

- A useful integration could involve testing for correlations (positive or inverse) between lobster density and the density of urchins, algae, and potential lobster predators (large fishes). Visual surveys could be combined with more integrative techniques such as stable isotope analysis to develop a more comprehensive picture of the role that lobsters play in maintaining healthy coastal ecosystems

Aerial Imaging:

- Any future remotely-sensed derived databases to be used for comparison to the 2012 sub/intertidal and kelp databases generated as part of this study (ie. the Baseline study) should be as close as possible to the 2012 (baseline) data in regards to:
    1) the multispectral camera system used
    2) the time of year the data are acquired
    3) the tidal and environmental conditions at the time of data collection
    4) the processing techniques used to create the image mosaics
    5) the classification techniques utilized to create the thematic maps
- Even small differences in these factors can lead to diminished confidence in the analysis of the environmental/habitat change over the time period being studied. Any long term monitoring plan which aims to take advantage of the synoptic, comprehensive habitat map products generated from remotes sensing data should take this into serious consideration.

Rocky Intertidal:

- The ideal approach to monitoring would involve a combination of two methods currently used by the MARINe and PISCO programs (fixed plots and biodiversity surveys) to characterize the status and trends of as many of the key attributes as possible while maintaining a long time series of information on target species in fixed assemblages. Biodiversity surveys are essential to capturing site-wide diversity, and the abundance of species that are rare, invasive, or otherwise not well sampled by other methods.

Citizen science

Sandy Beach:

- With appropriate modifications, tiered structure, additional testing and validation, combined with considerable scientific oversight to ensure accuracy and consistency of the data collected, some of aspects of monitoring SC beaches may potentially be conducted in collaboration with trained and committed citizen scientists.
- Based on our evaluations and the results of the teacher workshop, the Sandy Beach group has developed a number of recommendations for modified protocols for surveys of sand crab populations on the California coast.
    - Use an adaptive sampling approach that is suitable for mobile beach invertebrates

- Modify Sampling grid to match the dynamic distribution of sand crabs on each sampling date and site. Alter location of highest and lowest cores, spacing of cores and width of zone surveyed with cores.
    - Develop decision tree for locating and setting up sampling grid and determining core spacing
    - Reduce disturbance of highly mobile reactive intertidal animals
    - Modify transect sampling, core collection and sieving process to reduce trampling and time spent in swash zone
    - Improve efficiency of population size structure measurement.
    - Eliminate use of calipers and adopt new method to measure carapace lengths with calibration to total length
    - Adopt a tiered sampling model based on observer training and skill

Rocky Intertidal:

- In terms of the two proposed monitoring methods for the rocky intertidal (Biodiversity Surveys, and status and trends monitoring), a citizen science component of participation in the status and trends monitoring has the potential to work well with consistent and well-trained citizen scientists. The Biodiversity surveys require a great deal of taxonomic expertise that is likely outside of the realm of most citizen scientists. We would advocate strongly for a rigorous training and validation program for citizen scientists willing to participate in the status and trends monitoring. Ideally the citizen scientists would work together with the scientists in the field as a component of the training.

Mid-depth Rock:

- In the deeper ecosystems off-shore, those generally below the effective depth of SCUBA sampling, the likelihood of a strong citizen-based monitoring program coming to the fore is probably very low; working in the deep water is costly, including vessel support, vehicle support (ROV, submersible, camera sled), and the personnel necessary to operate both.

Spiny Lobster:

- The contributions of the fishing community, in terms of local ecological knowledge (LEK), were invaluable in our research and can contribute substantially to future monitoring efforts.

Kelp Forest:

- Community group or 'Citizen Scientist' monitoring programs in the SCSR may consider revising their monitoring protocols, which typically survey a more limited species list, to focus more effort on quantifying the species with more desirable indicator characteristics.

Other Recommendations

Seabirds:

- The sources and rates of human-caused disturbance should continue to be documented inside and outside of MPAs.
    - use MPA Watch and similar groups.

    - can be used to document illegal fishing as well
- Measures of seabird breeding productivity should be integrated with indices of ocean climate and direct measures of ocean productivity.

Spiny Lobster:

- Future analyses should be accompanied by a detailed assessment of fishing pressure and changes to the fishery to enable a determination of the relative effects of harvest vs. protection in MPAs on lobster populations.
- Future monitoring for California spiny lobsters may be integrated with other forms of monitoring or datasets such as detailed maps of benthic habitats which can be used in conjunction with information on lobster density to create maps of suitable lobster habitat and to identify hotspots for abundance, growth, and catch.

Kelp Forest:

- Determining the relationship of fishing pressure on community structure and how it may change with reserve implementation will be critical for understanding how communities respond over time. We found that fishing impacts are variable in taxonomic composition and spatially explicit. Having this data establishes a unique experimental design, where variable types of extraction and their effects on reef health and resilience can be examined across reefs in the region.
- There is potential water quality stress along the mainland based upon major point source inputs of rivers and publicly owned treatment works, as well as localized problems with storm drain runoff and other sources of localized plumes. Another less well understood stressor is eutrophication. It will be helpful to expand pollution studies to include smaller point source and non-point source stressors.
- Future monitoring programs will almost certainly require partnerships and collaborations, from academic and agency scientists to citizen groups. To the extent possible, data management should be discussed from the beginning of any new program. In addition, adequate resources must be anticipated and budgeted for a partnership approach to result in high quality, defensible data. Merging datasets from multiple programs is challenging and takes time and expertise from researchers familiar with each dataset. This will especially be the case when merging data across ecosystem features and across Study Regions where even greater taxonomic and data structure differences will exist.
- Any MPA monitoring scheme should continue to coordinate with resource agencies to describe these problems (i.e. water quality, point source stressors and eutrophication) and develop solutions and recommendations (e.g., BMPs) for improving water quality.

Quantitative Evaluation of Indicators

One objective of the baseline programs was to assess candidate system indicators and examine potential new candidates. Ecological indicators are becoming mainstream tools for assessing impacts of human disturbance and general environmental 'quality' (Donnelly et al. 2007). There are hundreds to thousands of potential indicators of ecosystem status that can be used for management. They range in complexity from single-species indicators to 'emergent properties' of ecosystem models (Rice 2003). Indicators are useful when they condense composite biological information into single measures, which might be more understandable for the general public and easier to deal with for non-scientific users, such as decision makers involved in environmental management. As indicators are used for different purposes in ecology and conservation, many argue that their selection depends on the issue at stake, however, any good 'indicator' must ultimately be related to the phenomena of interest that the indicator reflects (Failing 2003; Heink and Kowarik 2010).

All baseline projects evaluated indicators for their ecosystems and recommendations on these indictors are summarized in the previous sections. Several baseline projects also conducted semi-quantitative (e.g. visual inspection of plots or patterns) or quantitative analyses to evaluate candidate indicator species or taxonomic groups. In particular, the Kelp Forest and the Rocky Intertidal groups conducted quantitative analyses to evaluate statistical properties of potential indicators against described criteria (Kelp Forest) and statistical analyses to reduce complexity by condensing long species lists into more manageable indicator lists (Rocky Intertidal). The approaches are detailed here.

Rocky Reef: Indicator Evaluation

While specific indicators will depend on the specific management or ecological objectives, at a minimum they should be:

(1) Easy to measure (e.g., cost-effective, readily observed/identified, relatively common)
(2) Suitable for statistical analyses or 'robust' (e.g., low random variation among samples)
(3) Indicate something:
    a. Sensitive to anthropogenic perturbations or a manageable human activity in a predictable way, and/or
    b. Strong ecological driver
(4) Applicable to a variety of temporal and spatial scales as well as habitats

In this Baseline project authors attempted to move the discussion forward with a quantitative evaluation of various identified and potential indicators. Specifically, they provided an evaluation of whether proposed indicators for the SCSR possess general characteristics that are desirable for good indicators (addressing aspects of number (1), (2) and (4) above). The analyses included species that likely "indicate something" (i.e., number (3) above), drawing from those listed in MLPA South Coast Monitoring Plan as "Draft Vital Signs" and "Draft Indicator/Focal Species. For each species they calculated multiple statistics, which describe elements of their spatial distribution and underlying statistical properties. These included:

- **Total number of Geographic Areas** (defined in the Baseline Characterization analyses) the species was observed on transects. Some species tend to show either northern or southern geographic patterns of distribution across the SCSR. Therefore, it is import to evaluate the extent of geographic applicability of an indicator across the SCSR.
- **Mean Density (No./100m^2)** to assess the relative abundance of a given species. In most cases, rare species would not be considered good candidates for indicators.
- **Mean Frequency of Occurrence** at sites in a given Geographic Area. It is important that indicators are commonly observed in both MPAs and Reference sites within a given Geographic Area.
- **Mean spatial Coefficient of Variation** (ratio of the standard deviation to the mean site specific density) across sites in a given Geographic Area during a given year. Ideally good indicators will have low variance in space (evaluated here) and this will be maintained over time.

This method succeeded in identifying several candidate fish and invertebrate species. While detailed results can be found in the individual project technical report (Pondella et al. 2015), here we highlight methods and conclusions of the approach. While this baseline group generally advocated the use of data driven approaches to indicator selection to the maximum extent possible, they recognized potential limitations that can be filled in part by expert knowledge of the environment and species or particular needs of managers. In particular, tracking recovery or detecting trends in species that are rare at the time of initiation of monitoring (e.g. protected, endangered or invasive species, species suffering periodic die-off events) will be challenging using a data-driven method where data may be limited in temporal scope. For example, Identification of invasive species as indicators of ecosystem health poses unique challenges as these species may be absent or occur infrequently until they invade, at which point they may increase dramatically and quickly.

Finally, this group reiterated that choice of specific indicator species or groups *must* be linked to the management or policy questions at hand. Identification of these questions will allow a better match between properties of an indicator (i.e., what exactly does the indicator indicate) and ultimately drive efficient and cost-effective monitoring.

Rocky Intertidal: Simplifying Complexity

The list of taxa identified in the Rocky Intertidal biodiversity surveys (Blanchette et al. 2015) was large (654 taxa). Many of these taxonomic groups are difficult to identify by anyone not having a great deal of experience and expertise in taxonomy. In order to simplify the complexity of this method, The Rocky Intertidal group followed the approach used in the NCCSR to develop a reduced list of sessile and mobile taxa that were >80% correlated with multivariate patterns produced by the full biodiversity dataset based on the full list of both sessile and mobile taxa. They carried out this analysis for both sessile and mobile taxa using the BEST routine in PRIMER to find a small subset of 'easily-identifiable' taxa which generated a multivariate pattern that was >80% correlated to that based on the full assemblage. Analyses were run using both random and fixed starts and they chose from among the resulting models those that had the fewest and easiest to identify taxa.

The analysis for the SCSR identified a reduced set of 8 sessile taxa and 6 mobile taxa produced matrices that were >80% correlated with the original (complete set of species) matrices. Upon evaluation, the PIs concluded that while the lists contain some common and easily identifiable taxa, most species on the lists would be greatly challenging for untrained observers to identify. While the same approach in the NCCSR yielded a smaller list of easily identifiable taxa, in the SCSR, the approach did not produce a result that would not be useful for implementation by citizen science. There are likely several reasons for these differences. The primary reason has to do with the much greater biodiversity and biogeographic differences among the bioregions of the south coast. Each of the bioregions is characterized by a relatively unique assemblage dominated by entirely different taxa. These taxa are generally the ones that drive separation across the bioregions, many of which are in the lists above. The Channel Islands is also a well-known biogeographic transition area, and the diversity of taxa across the islands is nearly as great as that along the entire west coast.

As a complementary approach to identifying a reduced subset of taxa, the rocky intertidal PIs also evaluated the degree of correlation among matrices that were produced using increasing degrees of taxonomic and functional aggregation. They evaluated the correlations across matrices produced using the full ‘species’ dataset, taxa identified to genus, order, phylum, functional group, common group, taxonomic group and trophic group. This was done using a second stage MDS approach using PRIMER to represent the correlations (Spearman) among matrices generated by increasing degrees of aggregation.

In general the PIs found that, not surprisingly, the matrix of taxa aggregated to genus was most closely correlated with the full ‘species’ matrix. Aggregation to Order was the next most similar, followed closely by aggregation to common and functional groups. These two groupings are very similar, and it probably would not matter much how they were categorized across these groupings. Also, some of the functional categorizations not entirely mutually exclusive (e.g. crustose coralline algae may be considered in the group coralline algae or crustose algae) and so development of these groupings requires some decision-making.

This approach to deciding among levels of classification may be useful for citizen science groups deciding on an appropriate level of lumping or aggregation. For example, the Rocky Intertidal collaboration with LiMPETS included a recommendation of providing a tiered approach to complexity for students of different grade or experience levels. This approach provides one way to develop and decide upon tiers that optimize the inclusion of easy to identify taxa, and maintains the closest possible correlation with the information provided by a full species list.

Planning for Long-term Monitoring in the South Coast Region

Summary of Workshop Background and Objectives

On August 20 and 21, 2015, scientists who participated in the South Coast Marine Protected Area (MPA) Baseline Program met to discuss sampling design for long-term MPA monitoring in the South Coast study region. Together with Ocean Science Trust (OST) staff, we convened this workshop to gather input from baseline program scientists on which MPAs to monitor (as paired inside-outside monitoring sites) and how often to monitor them for long-term monitoring in the South Coast. Workshop participants (represented four Ecosystem Features: 1) Rocky intertidal, 2) Sandy beach 3) Kelp and shallow rock, and 4) Mid-depth rock. The Kelp and shallow rock ecosystem was represented by a group of scientists from the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), Vantuna Research Group (VRG), and Reef Check California. In this report we have split this ecosystem into 2 groups to represent the scientific data collection efforts of PISCO and VRG (hereafter referred to as Kelp Forest throughout this report), and Reef Check, which is a citizen science effort. This chapter summarizes the results of the workshop. Appendix 1 includes the participant list, as well as a detailed agenda from the workshop.

In advance of the workshop, OST staff coordinated with PIs Caselle and Blanchette at the University of California, Santa Barbara (UCSB) to develop a series of layered maps that provided information about MPA boundaries, habitat types, upwelling, ASBS boundaries, locations of major discharges, and the presence of existing monitoring (both long-term and baseline) sites. PIs Caselle and Blanchette also prepared a draft list of criteria for consideration in the selection of sites for long-term monitoring (Table 1). These criteria were discussed and prioritized at the workshop and subsequently used in the discussions of ranking potential sites for long-term monitoring.

During the workshop, OST and California Department of Fish and Wildlife (CDFW) staff provided an overview of the process underway for planning the next five years of South Coast MPA monitoring. Participants also were brought up to date on the parallel process to develop a long-term monitoring plan for the Central coast. The full group then discussed the set of draft guiding questions for South Coast MPA monitoring before using the layered maps to consider the criteria used for site selection and the merits of various site selection plans. The draft guiding questions were developed by the baseline management team prior to the workshop.

The workshop had five objectives:

1. Discuss the priority monitoring questions that will guide the South Coast MPA monitoring program,
2. Identify and discuss the bio-regions in the South Coast region,
3. Identify and rank MPAs as potential monitoring sites for long-term South Coast MPA monitoring, based on characteristics and criteria developed in advance and refined by the participants
4. Discuss the spatial design that will address the questions guiding South Coast MPA monitoring (e.g., number of sites for each ecosystem)

5. Discuss the temporal design that will address the questions guiding South Coast MPA monitoring

In this report, we present a brief summary of the overall 'take home' messages of the workshop, and a structured discussion of each of the five main objectives identified above. Attached to the report is a table with a list of the site selection criteria, and how the criteria were ranked in terms of their relative importance among groups. Also included are appendices containing the participant list, agenda and series of layered maps.

Key Overall 'Take Home' Messages from the Workshop Discussions

- Consistency of monitoring across state regions is critical to assessing the performance of the MPAs as a network, and to detecting statewide patterns and trends. MLPA regions are 'artificial designations' in that they generally do represent breaks of biological significance. If long-term data are not collected in consistent ways across regions, they will ultimately be incompatible for detecting large-scale trends and MPA network effectiveness.
- All of the groups had difficulty proposing designs for a long-term monitoring program without information on the potential level of funding, given that the selection of sites strongly depends on the size of the program, and there are economies of scale to be gained as programs expand.
- Site selection and the criteria used to prioritize sites depend strongly on the size of a monitoring program. For very small programs, the best approach might be to control for variation in the criteria (for example, monitor multiple locations in only one bio-region or one type of MPA designation). For larger programs, one can begin to stratify across the criteria (e.g. multiple bio-regions or multiple MPA designations).
- Assessing MPA effectiveness and tracking long-term change are both important goals, and ideally a monitoring program will be able to both, however different ecosystems lend themselves to answering different types of questions and both may not be possible in all ecosystems. MPAs may also be ideal places to track long-term change in the absence of human impacts due to harvest pressure.
- All of the groups ranked biogeography highly as a criterion for site-selection, and there was a strong desire across groups to spread out their long-term monitoring sites across bioregions to the degree possible. However, this desire was predicated on the assumption that any monitoring program is funded at some minimum level to allow a biogeographic approach.
- There is evidence that biogeography is an important criteria in designing a long-term monitoring program. The selection of only one MPA site per bioregion does not provide replication essential to statistically evaluating MPA effects. All participants cautioned strongly against this lack of replication.
- Spatial co-location of long-term monitoring sites across ecosystems is desirable to the extent possible, given that we may discover new information about connections between those ecosystems (e.g. subsidies such as kelp wrack, larval connectivity, ontogenetic shifts).

- The south coast region is the largest of all MLPA regions, containing as much coastline (~1200 km including islands) as the rest of the state and approximately half of all MPAs in the state. The size, biogeographic and oceanographic complexity, the very large human population and the diversity of habitats must be accounted for when designing long-term monitoring for this region. For these reasons the South Coast will likely require a much greater level of investment in monitoring than other regions.

Discussion of the Priority Monitoring Questions

In advance of this workshop, the MLPA Baseline Team developed a set of draft guiding questions for South Coast MPA monitoring that reflected conversations about monitoring priorities for the California Department of Fish and Wildlife (CDFW), California Fish and Game Commission (FGC), and California Ocean Protection Council (OPC). The management team built the guiding questions for South Coast MPA monitoring off of previously developed guiding questions for Central Coast MPA monitoring.

Questions to Guide South Coast MPA Monitoring

The draft guiding questions were identified to focus this workshop for four Ecosystem Features (rocky intertidal, sandy beach kelp and shallow rock, and mid-depth rock), these questions were:

1. What is the current condition/state of communities associated with the target ecosystem, inside and outside MPAs and across the South Coast region as a whole? To get at this:

    a. Using focal species identified in the South Coast MPA Monitoring Plan, examine patterns of functional groups and targeted/non-targeted species.

    b. Examine patterns at an ecosystem level, including habitat, fishes, invertebrates, and algae.

2. How is condition/state changing over time inside and outside MPAs across the South Coast region? To get at this:

    a. Track change through time in ecological parameters/metrics identified in the South Coast MPA Monitoring Plan and physical parameters/metrics at multiple locations within the South Coast region

3. Are there changes in community-level dynamics over time inside and outside MPAs? For example, are fish assemblages exhibiting increasing/dampening variance/extremes?

Summary of Key Discussion Points

- Baseline characterization in the South Coast began at the time of MPA implementation, so discussing trends and responses is problematic from the baseline monitoring.
- With large temporal gaps between 'Baseline' and 'Long-term monitoring' periods, attributing change to MPA protection will be problematic, given large environmental changes in the interim (non-monitored) period.
- 'Cost-effective' best refers to cost per unit (or cost per system) of a programs ability to answer management or scientific questions of interest. 'Cost-effective' does not equate to 'low-cost' or 'high-cost'.

- Perhaps we should refer to "cost-appropriate" rather than "cost-effective" in relation to monitoring. Should ask if the allocation of effort was appropriate to the ecosystem feature that was proposed to be sampled?
- Overall these questions (guiding questions above) should give guidance to the sampling design. For example, it doesn't matter if sites are coupled or uncoupled spatially for tracking condition over time, but if you're asking about MPA performance then it does matter. In one case you're trying to assess 'REGION' and in other you're trying to assess 'PERFORMANCE'.
- Habitats across ecosystems are not uniformly distributed inside and out of MPAs, so figuring out how to track change relative to MPA status is challenging.
- A larger, and perhaps more relevant question related to Question 3 above might be "Do MPAs confer resilience upon ocean ecosystems?"
- MPAs are a 'treatment' – we want to have enough power to detect an MPA effect but we want to keep the other goals of the MLPA in mind.
- Tracking change through time might be in line with the larger question among many state partners, not about MPA effects explicitly, but about detecting long-term change.
- There may be places where you can track regional changes better in the absence of fishing, and use MPAs as bellwethers for tracking change in the region. Can we monitor within these MPAs to tell us how region is doing as a whole? Perhaps MPAs are then the best places to monitor long-term change.

Discussion of MPA effectiveness vs. Tracking long-term status and trends

Different ecosystems lend themselves to answering different types of questions. Ecosystems differ greatly in their ability to assess MPA effectiveness and assess climate-related changes for several reasons:

- Differences in harvest pressure, accessibility and other human impacts
- Differences in the importance of environmental and climate-related drivers
- Differences in the types of species (harvest vs. non-harvested)
- Differences in overall biodiversity and functional redundancy
- Differences in the availability of appropriate control areas similar in habitat

This discussion asked participants to evaluate their ecosystem in terms of the ability of monitoring to evaluate MPA effectiveness versus tracking long-term trends.

Kelp Forest

- The kelp forest ecosystem lends itself well to measuring MPA effectiveness because many of the species measured are targets of the types of fishing now prohibited in MPAs.
- Also very well poised to answer more general ecosystem health sorts of question – long-term monitoring for long-term change.
- The current monitoring design falls more toward measuring MPA effectiveness: using MPA monitoring data for traditional fisheries management, and understanding long-term effects.
- Across the state, SoCal is better suited for answering those questions than other regions because of the density of fishing pressure here that is greater, across the region, than other regions.

- For long-term change, sampling design may matter more than location – need bio-diversity monitoring and appropriate temporal resolution.

Rocky Intertidal

- One single poaching event can wipe out an entire population of harvested species at a site, so effectiveness of MPAs becomes difficult to measure.
- Difficult to measure MPA effects because of lack of knowledge of human activities and lack of enforcement.
- Conditions, status and trends and climate effects are things we can focus on in the intertidal. We know a lot of the species are already living at the edge of their physiological tolerances in a many ways.
- Rocky Intertidal ecosystem is ideally suited to tracking climate-related changes in biodiversity due to the large taxonomic diversity, and sensitivity of many species to environmental drivers and climate-related stresses.
- MPAs don't restrict human recreation, so if we had places that had a combination of MPA closures, and human exclusion, we could understand those effects better.

Mid-depth Rock

- There have been demonstrations of MPA effects in deeper waters, and it is subject to application of human use (for example, trawling).
- With respect to status and trends there is nothing that would preclude measurement of that. However, going offshore/deep is more challenging.
- In South Coast, there are sites that provide the opportunity to understand MPA effects – SMCA vs. SMR, and designation vs. no designation.
- There are technology opportunities in this field as well.

Sandy beaches

- Beach ecosystem features lend themselves to addressing both questions.
- There is potential to look at direct effects of fishing, and indirect effects (e.g. subsidies)
- Lots of human pressures on beaches: harvesting species, impacts of anglers in surf zone.
- A single poaching event can have a significant effect on the community.
- Any long-term monitoring you do on beaches is a huge plus to understand what's going on, due to the fact that there has been very little long-term monitoring in this ecosystem.

Discussion of the South Coast Bio-Regions

Due to high biological and oceanographic diversity across the SCSR, the MLPA Science Advisory team identified five biologically relevant sub-regions (bioregions) within the SCSR (Figure 9): (1) **North Mainland** – Point Conception to Marina del Ray, (2) **South Mainland** - Marina del Ray to the US/Mexico Border, (3) **Northern Islands** – San Miguel, Santa Rosa and San Nicholas Islands, (4) **Central/Mid Channel Islands** – Santa Cruz, Anacapa and Santa Barbara Islands, and (5) **South Islands** – Santa Catalina and San Clemente Islands (although San Clemente is excluded here, since it is under military restrictions). Each of these five bioregions is characterized by a unique set of environmental conditions, and supports distinct assemblages of marine organisms.

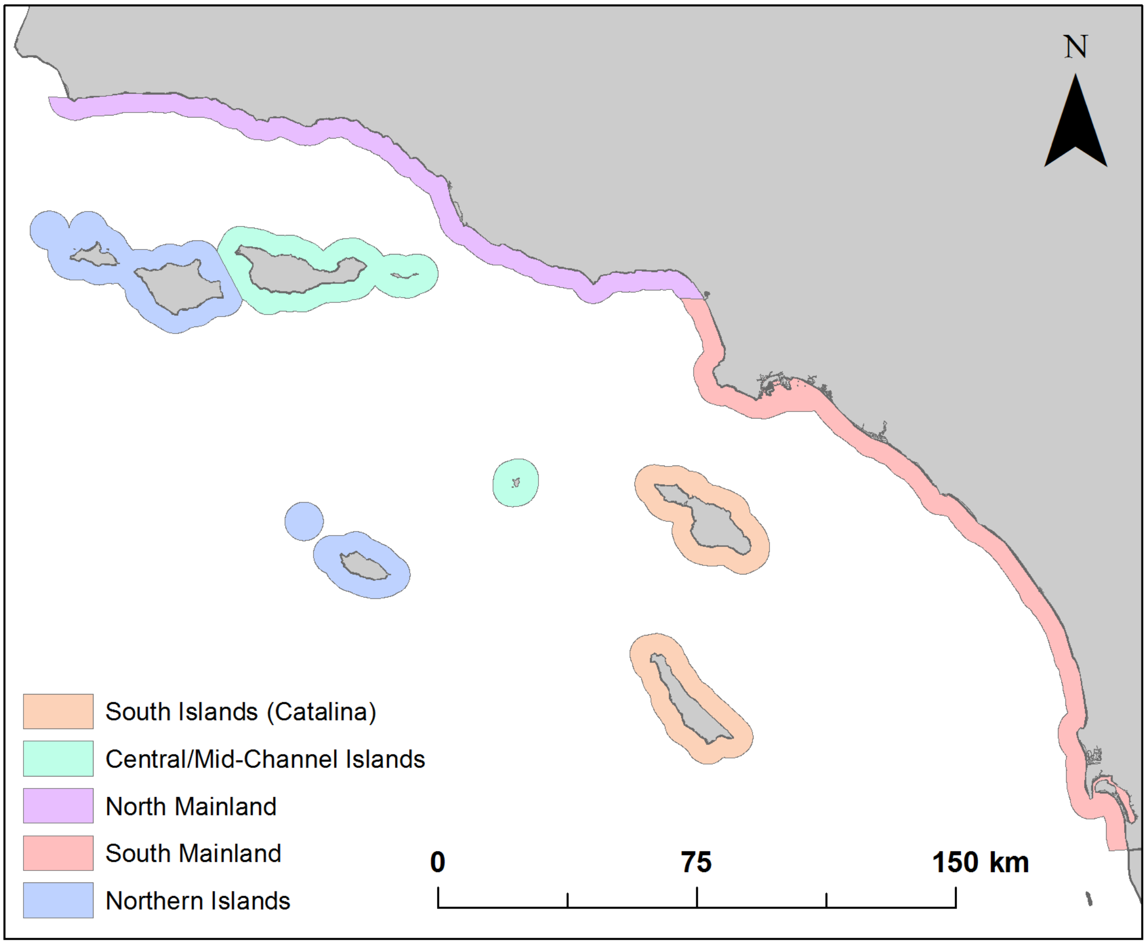

Figure 9 The five bioregions within the South Coast study region

The biogeographic complexity of the SCSR has implications for the spatial design of long-term monitoring in the South Coast. The discussion of biogeography raised important considerations ranging from the power to detect change in long-term monitoring, to the assessment of oceanographic conditions that might drive patterns of community structure.

Summary of Key Discussion Points

- The group questioned whether biogeographic representation should be an overarching criteria as a way of organizing site selection/design.
- In the Central Coast, biogeography defined the inferences that could be made across MPAs for each one that you sample.
- Biogeography is important for characterization, but the focus on long-term monitoring might be better focused on dynamics.
- Biogeography can be used to pare down and organize a program as a filter criteria.
- Biogeography is correlated with oceanography and habitat, along with many of the other physical variables, and provides an integrated way of addressing those.

- How you deal with biogeography will depend on the size of the program - if you have a small program, it might be best to control for biogeography by monitoring in one region only – if you have a larger program you can expand the scope of variation in biogeography (or any one of the criteria for site selection).
- Analyses in the south coast have shown that sea surface temperature has a role independent of geographic location.
- Results from kelp forest showed that the power to detect MPA difference was much stronger if you control for biogeography.
- How can you apply biogeography to MPA monitoring design?
    - There are tradeoffs:
        - Sampling within each community type but with fewer sites
        - Sampling in fewer community types but with more sites
        - Sampling fewer sites, more frequently, or more sites less frequently.
- If what we care about is management effectiveness – then it really doesn't matter what site it is, as long as there is representativeness. → But the choice of individual MPA may change the outcome of that answer.
- Goal is to balance our ability to say how the region is doing and be able to pick up any MPA effect. Participants questioned whether both are possible or will we end up doing a poor job at both? The size of the South coast region, in particular, makes this a challenge.

3. Identification and Ranking of MPA sites based on Criteria

It is important to understand how decisions regarding site selection are made and to make that information transparent. A draft list of criteria for consideration in the selection of sites for long-term monitoring was prepared in advance of the workshop. These criteria were discussed and refined during the workshop and were used in the discussions of ranking potential sites for long-term monitoring. As part of the workshop, participants from each of the main ecosystem features were asked to rank the importance of the individual criteria (low, moderate, high) that they felt would be important in the prioritization of sites for long term monitoring (Table 1). The exercise was meant to articulate the choices that would need to be made to select long-term monitoring sites across the ecosystem features.

Summary of criteria ranking exercise:

The criteria were divided into the general categories shown in Table 1 and representatives from the main ecosystem features were asked to rank the criteria as high, moderate or low in terms of the relative importance of the criteria in the selection of a particular site or MPA for long term monitoring. Note that some ecosystems had several representatives, and so there may be more than one ranking per ecosystem feature for any criteria. Additionally not all the criteria were ranked, typically only those that the participants chose to rank for their ecosystem.

Criteria that were ranked as High to Moderately-High by Several Groups:

- **Biogeographic Representation** was ranked as high by both kelp forest groups (Kelp Forest and Reef Check) and the Rocky Intertidal group.

- Both **length of existing time series** and **site accessibility (including cost)** were highly ranked by both the kelp forest and rocky intertidal groups, two of the groups with existing long time series
- **Monitoring site co-location potential** was ranked as high by both the Mid-depth Rock and Sandy Beach groups, moderate by Rocky Intertidal, but low for the Kelp Forest group.
- The Sandy Beach group also considered **trophic diversity** and **presence of harvested taxa** as high ranking criteria
- Several habitat criteria including **bioregional representation**, and **geomorphic variability** were highly ranked across most groups.
- **Unique habitat attributes** were of high importance to the Mid-depth Rock group and moderate importance for Reef Check and Sandy Beach.
- **Human impacts** in terms of both fishing pressure, numbers of visitors and other human impacts were highly ranked across most groups in addition to criteria.

Criteria that were ranked as Low to Moderately-Low by Several Groups:

- **Age, size, spacing, enforcement and location of MPAs** were generally ranked low by most groups, with the exception of **age of MPA** ranking as high with for the Reef Check group.

Criteria that were most variable in their ranking across groups:

- **MPA regulations** were ranked as low by both the Rocky Intertidal and Sandy Beach groups, but were ranked as high by the kelp forest group with the rationale that comparison of SMR and SMCA could help to understand the effects of recreational and commercial fishing.
- **Trophic diversity** was the most variable criteria across groups and ranked high by Sandy Beach, low by Kelp Forest and moderate by Rocky Intertidal.

Discussion of spatial design

During this portion of the workshop, scientists were asked to indicate which MPAs could be considered high priority monitoring sites for the ecosystem they represented. The conversation focused on spatial design and was split into two parts. In part one, scientists were asked to choose one MPA site in each of the five bioregions. We used the 5 bioregions identified during the south coast implementation phase as they roughly represent differences in community structure across multiple ecosystems (Fig. 3). In part two, scientists were asked to choose six MPAs throughout the south coast region independent of bioregion. Below we summarize the results of the two-part exercise, as well as the discussion regarding consideration of sites.

It must be noted that all participating scientists were uncomfortable with the site selection exercises. It was pointed out that site selection in this way is 'artificial' and not how a scientifically designed monitoring program is generally developed. In particular, there was serious concern at the arbitrariness of choosing a particular number of MPAs (e.g. five – constrained by bio-geography, six- unconstrained) as priorities without any information on the relative levels of funding of future monitoring programs. The selection of only one MPA site per bioregion provides no ability to evaluate bioregional effects on MPAs, which are known to be important. In addition, the equal choice of numbers of sites among ecosystems ignores the great differences in the biology, cost of monitoring, information gained, and and the extent of human influences across ecosystems.

Summary of exercise results – Part 1 – Selection of one MPA site per Bioregion:

In this exercise, scientists were asked to select one MPA site (along with a reference area) in each of the five bioregions and to articulate some of the criteria used to make that selection. This was done on an ecosystem-by-ecosystem basis with the exception of the Kelp and shallow rock ecosystem, which was divided into two groups - the Kelp Forest group represented by PISCO and VRG, and the Reef Check group (citizen science). The sites selected are represented for each ecosystem in Figures 10 a-e, and the narrative describing the selection of sites within each Bioregion, and the criteria and rationale for the selection of those sites for each ecosystem group is described below.

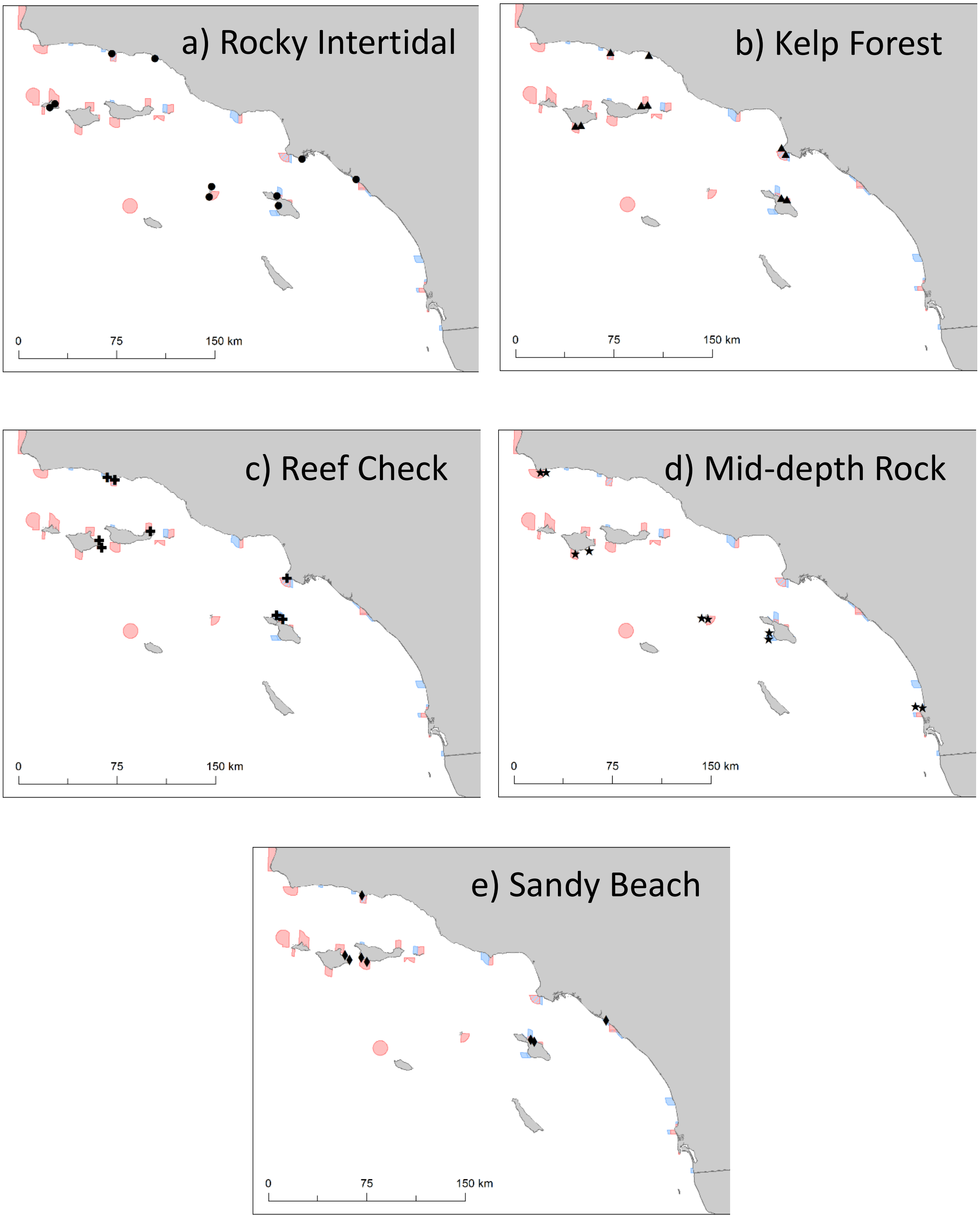

Figure 10 Site selection results for the selection of one MPA site (along with non-MPA) reference site per region for the following ecosystem groups; a) Rocky Intertidal, b) Kelp Forest, c) Reef Check, d) Mid-depth Rock, and e) Sandy Beach.

South Mainland Bioregion

- Rocky Intertidal
  - Crystal Cove (MPA) & Point Fermin (reference (REF)) – Reference has lots of human activity, – both have long-term data and biodiversity data that is relatively recent.
- Kelp Forest (PISCO/VRG)
  - Point Vicente (MPA and REF) – Right in the middle at the center of human use, high fishing effort, good habitat, and easy access, multiple projects going on there, long term data.
  - By only being able to pick 1 MPA in this bioregion, we overlook the San Diego MPAs which are adjacent to the 2nd largest population center in the entire SCSR (maybe the state) and monitoring needs to occur there as well.
  - *(If striving for co-location the Rocky Intertidal group would consider using Point Vicente as a Reference site)
- Kelp Forest (Reef Check)
  - Point Vicente (MPA and REF) – Right in the middle at the center of human use, high fishing effort, good habitat, and easy access, multiple projects going on there, long term data.
  - * Cabrillo MPA in Point Loma isn't good for monitoring kelp. All the good kelp forest is outside the MPA.
- Mid-depth Rock
  - San Diego Scripps & Matlahuyal – there are canyon heads in each of them and canyon heads are a good habitat and there is one in each. There are interesting habitats and can do SMR, SMCA comparison and there's really no deep rock anywhere else in that region for a reference site.
  - * There just isn't a lot of this type of habitat in that bioregion.
  - * These canyon heads rise to level of inclusion regardless of the fact that there isn't reference area.
- Sandy Beach
  - Crystal Cove MPA/ uncertain reference site: historical data, baseline data, all the zones present, minimally manipulated, it has kelp forest proximal, undisturbed birds – good bird signal, good sentinel site for looking at change. It's only place in littoral cell that has maintained assemblages of rare invertebrates. It could be representative of bioregion.
  - * We could go all the way down to Black's beach for a reference site that maintains all the zones.
  - * could look at Swami's instead of Crystal Cove because can get a reference site in Swami. N and W of Crystal Cove are groomed. For Crystal Cove the reference site would have to be in an MPA for it to be in the same littoral cell.

Discussion

  - For Rocky Intertidal, no good reference sites near MPAs in this bioregion, but for other ecosystems we can identify the priority MPAs – can we simplify the process and just focus on which MPAs are a priority

South Islands (Catalina)

- Rocky Intertidal
  - Blue Cavern (MPA)/Little Harbor (REF)– They both have long-term data sets. The only other site with long-term data is in a quarry, which has discharge. There are 2 sites that aren't in SMCA's, which is twin harbor, and then the only other one is in little harbor.
- Kelp Forest (PISCO/VRG)
  - Long Point (MPA)/Rippers (REF) – Habitat is good at Long point, and it's strange at West Cavern. Representativeness of habitat, availability of data, accessibility is easy. Long-term data exists.
- Kelp Forest (Reef Check)
  - Blue Cavern (MPA)/ Unidentified REF- Sites have good long-term data inside and outside.
- Mid-depth rock
  - Farnsworth SMCA/Reference site Unidentified- Offshore, there is some habitat across the border so there is a reference area. It's what passes for high relief rock in SoCal bite, was part of baseline program
- Sandy Beach
  - Blue Cavern (MPA) – only real long beach habitat within a reserve on Catalina Island
  - Isn't a high priority sandy beach site within an MPA within this bioregion.

Discussion

- We don't need to identify reference site by name, just need to know if there is a good ref site. If a good reference site exists then that's a reason why you would pick it.
- Sandy Beach - We don't want to prioritize Catalina, would instead prioritize multiple sites in different bioregion.

North Mainland

- Rocky Intertidal
  - Campus Point (SMCA)/Carp (REF) – good reference point with similar habitat and long-term data. Good reference for the bioregion and representative the region.
  - * Carp and Campus Point are similar
- Kelp Forest (PISCO/VRG)
  - Campus Point (MPA)/Carp (REF) – Easy to access, cheap, decent reference site, heavy sediment, gets inundated by sand. It's somewhat representative of the bioregion. Alternatives are Point Conception and Pt. Dume – both are hard to access with limited visibility, frequent bad conditions.
- Kelp Forest (Reef Check)
  - Campus Point (MPA)/Refugio (REF) - Same criteria as above, also Naples is just unique and Campus Pt. is more representative.
- Mid-depth rock
  - Point Conception (MPA) – was originally in the proposal and selected as northern most headland in the region, there is a relative paucity of sub-tidal hard bottom in this region. it provides opportunity for potential reference area adjacent to an MPA. When coupled

    - to other sites in entire So Cal bite its representative of north end of broader SoCal region which can afford comparisons as well.
- Sandy Beach
    - Campus Point (MPA)/Probable good REF site - Presence of habitat, easy access, it has high sand deposition, no manipulation, no grooming, lack of beach nourishment, dynamic site, long time series data on birds, it's in a UC reserve, some unique species, high biodiversity of birds (shorebirds), high trophic diversity.

Discussion

- Scale of southern California region is challenging for limited site selection.
- The workshop exercise is forcing people to choose a place in a bioregion when they might want to put funding toward somewhere else, but this exercise is about bioregional representation, so having a site for each one is important.
- Kelp forest group identified Pt. Dume as potentially good, as well as Campus point.

Central/Mid-Channel Islands

- Rocky Intertidal
    - Santa Barbara Island (MPA)/Good Ref available – Good MPA and a reference site, and they're side by side, long term data, sea lion rookery, representative of bioregion
- Kelp Forest (PISCO/VRG)
    - Scorpion (MPA)/ - long-term data set, involved in other MPA analyses, lots of fishing pressure, invasive species (*Sargassum*), accessibility relative to other side of the island, better references and easier to access.
    - * Anacapa doesn't have good reference area
- Kelp Forest (Reef Check)
    - Scorpion (MPA) – no good reference at Anacapa
- Mid-depth rock
    - Santa Barbara Island – Like conception we couldn't sample here because of funding. Good combination of hard bottom and some human pressure (existing)
    - * Not choosing other sites because ROV data has different protocol and sampling different species.
- Sandy Beach
    - Gull Island (MPA) – Most representative of region

Northern Islands Bioregion

- Rocky Intertidal
    - Harris Point (MPA) – The only place where they can get in the reserve and have sites that have Rocky Intertidal, Long-term data, representative of the region
- Kelp Forest (PISCO/VRG)
    - South Point (MPA)/Many choices for REF – long data set, good reference sites (unlike Harris Point), long time series, representative of bioregion
- Kelp Forest (Reef Check)

  - Skunk Point (MPA)/ – Availability of long-term data, accessibility, and that's the only site Reef check gets to on the distant islands on a regular basis
- Mid-depth rock
  - South Point (MPA) – Long term data (CDFW)
- Sandy Beach
  - Skunk Point (MPA) – Availability of habitat, historic data, Park Monitoring site for beaches, representative of region, it has all the zones and features for a sandy beach ecosystem, good shorebird use, and proximity to estuary makes it unique.

Summary of Key Discussion Points

- Participants questioned whether prioritizing by bioregion was appropriate. Should some bioregions be prioritized over other bioregions?
- The Southern mainland bioregion is large, and there is concern that perhaps it should be broken up. It contains two very large urban population centers and picking one site meant one of the centers was not chosen.
- It is unclear how many sites would be needed to say something about MPA effects in 10 years but it is unlikely that a single site in each bioregion would suffice.
- Most participants felt that the exercise of picking one site per bioregion was artificial, and highly unrealistic. It might be more likely to detect any MPA effects by focusing on more sites in a single/few region(s) than picking one site per bioregion.

Summary of exercise results – Part 2 – Selection of six sites independent of Bioregion:

In this exercise, scientists were asked to select six MPA sites (along with a reference area) throughout the south coast region, independent (unconstrained by) bioregion, and to articulate some of the criteria used to make that selection. This was done on an ecosystem-by-ecosystem basis with the exception of the Kelp and shallow rock ecosystem, which was divided into two groups - the Kelp Forest group represented by PISCO and VRG, and the Reef Check group (citizen science). The sites selected are represented for each ecosystem in Figures 11 a-e, and the narrative describing the selection of sites across the south coast, and the criteria and rationale for the selection of those sites for each ecosystem group is described below.

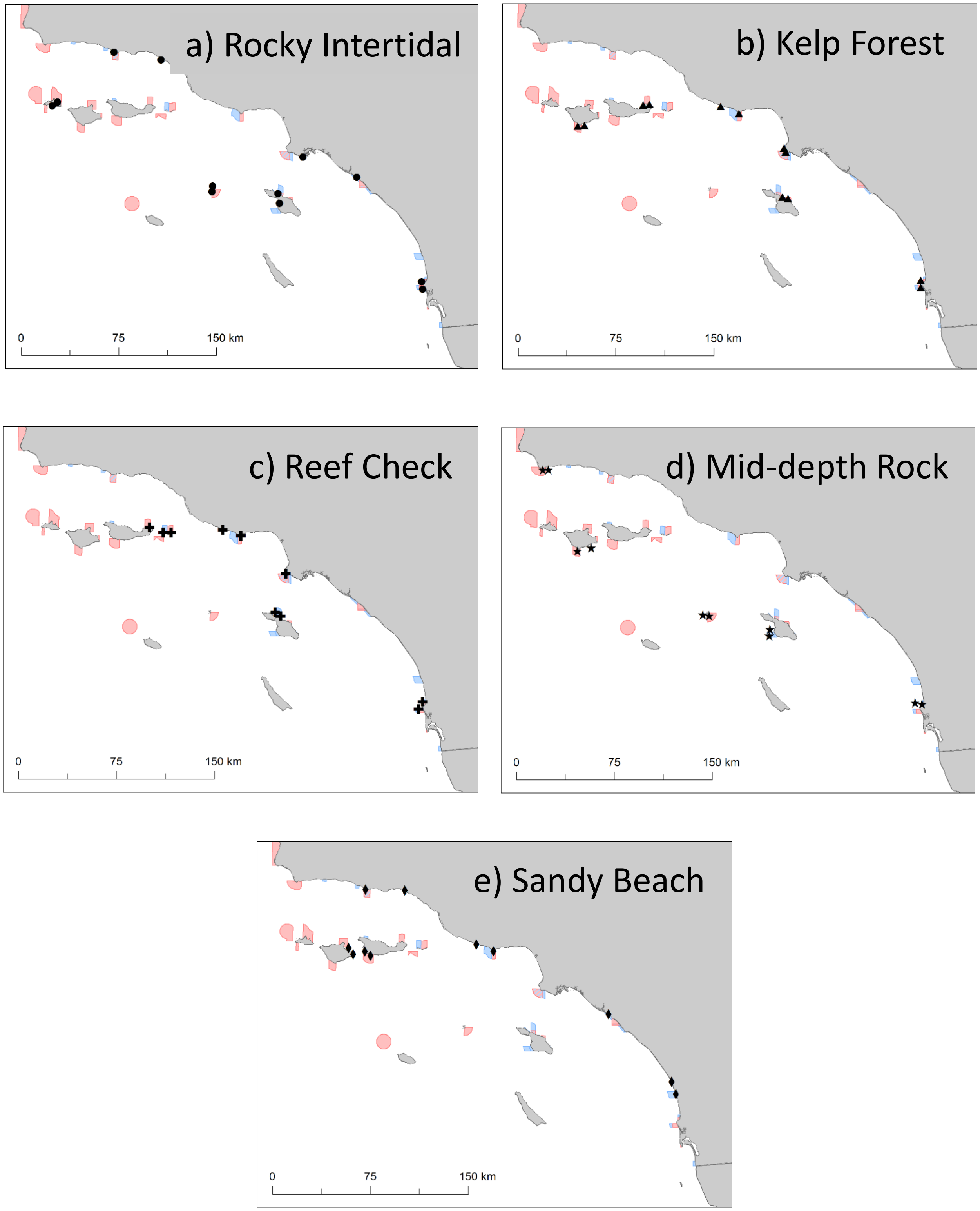

Figure 11 Site selection results for the selection of six MPA sites (along with non-MPA) reference sites across the south coast region for the following ecosystem groups; a) Rocky Intertidal, b) Kelp Forest, c) Reef Check, d) Mid-depth Rock, and e) Sandy Beach.

Rocky Intertidal

- Keep same sites as in exercise 1 but add South La Jolla site - Need to have a site in that part of the region, easy to access
- **Selection**:
    - Crystal Cove
    - Blue Cavern
    - Campus Point
    - Santa Barbara Island
    - Harris Point
    - South La Jolla site

Kelp Forest (PISCO/VRG)

- Keep sites as in exercise 1, but add another site to San Diego region, and consider Point Dume instead or in addition to Campus point
- Point Dume is more similar to PV.
- San Diego is second or third largest city in the state and there's a lot of fishing, huge urban area, and it's not represented currently in our site selection from exercise 1.
- Point Dume – Good reference habitat, the state needs to not let this go unmonitored. This was the most contested MPA in the region among stakeholders
- **Selection**:
    - South Point- Same reasons as exercise 1
    - Scorpion - Same reasons as exercise 1
    - Point Dume – See debate between Campus Point and Pt. Dume (above), lots of data
    - Point Vicente, Same reasons as exercise 1
    - Long Point, Same reasons as exercise 1
    - South La Jolla - Border influenced by cold vs. warm, Long-data set, Large MPA, New MPA

Kelp Forest (Reef Check)

- **Selection**
    - Scorpion - Long term data, more accessible than Catalina sites, old MPA
    - Anacapa - Have 2 sites on one side of the island because it's easier to get to.
    - Matahuyl - More long term data, Large site
    - Blue Cavern - More long term data
    - Point Vicente
    - Point Dume

Mid-depth Rock

- Keep sites as in exercise 1 because of lack of habitat, No additional sites identified
- **Selection**:
    - Scripps
    - Matlahuyal
    - Farnsworth
    - Point Conception

  - Santa Barbara Island
  - South Point

Sandy Beach

- Selection:
  - Keep sites as in exercise 1 with the following changes:
  - Add Swami's - Expanding coverage in that area, No dogs, Un-manipulated site in SD which is hard to find – baseline of what things could look like.
  - Add Point Dume (instead of Catalina) - Unique littoral cell, but representative of that littoral cell, Pocket Beach, Accessibility is ok, Part of baseline study, (existing data) and Proximity to kelp forests and other ecosystems – connectivity

Summary of Key Discussion Points

- In general, although Bioregion was not a required criteria for exercise 2, it tended to evolve as a way people organized their site selection. Most groups spread their site selection across bioregions.
- One major concern regarding Biogeography - With one point in a bioregion, but no replication, are we able to say anything about MPA effectiveness or long-term trends in that bioregion.

Exercise 3 – ranking/prioritizing each MPA

In this exercise participants were asked to rank each of the MPAs in the South Coast region in order of importance for their ecosystem. The idea of ranking is to flag the MPAs that are particularly important to monitor for a particular ecosystem or less important for a particular ecosystem --Which MPAs are particularly important from a scientific perspective.

- Participants universally felt uncomfortable with this exercise given that there is sensitivity in designating something as 'low' priority. Can be misinterpreted.
- What we really need to do is get at what is the minimum number of sites to say something about the big questions
  - Minimum number of sites is contingent on funding.
  - Ecosystem habitat isn't present at all MPAs
- Would we choose more sites or go to the same sites less often.

Discussion of temporal design

During this portion of the workshop scientists discussed the implications of temporal monitoring frequency for the design of long-term monitoring programs. The discussion of temporal frequency depends greatly on the interest in and level desired for detection of change. The initial points for discussion stemmed from the North central long-term monitoring workshop.

Key Points To Guide Discussion

- The frequency of monitoring will depend on the level of change that the program would like to detect over a given time frame.
- Monitoring an entire community rather than a single species may allow for more rapid

detection of significant change, assuming that a some species are slow to change (e.g., long-lived rockfishes), while others change more rapidly (e.g., annual algae or invertebrates).

- Smaller changes over time can be detected for species that are less mobile and more numerous. Because of this, monitoring of mobile species like fishes may need to be more frequent than monitoring of sessile organisms to detect the same percent change. Note that change can be detected with higher confidence for some fish species than others.
- If monitoring is reduced from annual to every-other-year, then the duration of monitoring must extend for twice as long to have the same power to detect change. Monitoring over different seasons does not necessarily increase power, because of seasonal variability. However, monitoring multiple times within a season across multiple years does reduce the effect of day-to-day variability and therefore increases the power to detect change.
- If monitoring occurs frequently at the beginning and end of a given time period, but not in the middle, change can be detected, but it will harder to attribute that change to a cause.
- Routine monitoring over a long time period can detect smaller changes because of the longer duration (this explains why existence of historical data should be a consideration in site selection).
- It can be difficult to ramp projects up and down for every other year monitoring, which can result in higher costs per trip than for annual monitoring.
- It is logistically challenging to maintain a program that samples infrequently, particularly because it requires training and maintaining skilled personnel, and appropriate supporting equipment (e.g., boats, dive gear, ROVs). One possible solution is to monitor many or all sites on a less frequent basis (e.g., every 3-5 years), with a subset of key sites monitored annually.

Discussion of Frequency of Monitoring for each Ecosystem feature

Kelp Forest

- Need annual monitoring for a core group of sites and that those would tend to be sites that are in the higher fishing pressure areas and relatively accessible.
- Would also want southern California Bight - wide sampling on scale approaching baseline characterization to get a larger scale look across the Bight to help answer other questions.
- Time frames vary - you want to do the Bight-wide surveys 2 years in a row at a minimum
- Sets of sites that alternated every year is possible. 1/3 one year, 1/3 the next. I.e. Hopscotch model. Programmatically that seems smart because you keep a team around, but statistically it's challenging because of strong inter-annual variability.
- Hopscotch model increases its viability with length of program but need many years to detect trends. The longer the gap between data points per site, the longer the time series must be to detect change.
- Year to year variability is high and you need to be able to track that to interpret more broadly what's going on across the Bight region.
- Could you track variability across a subset of sites?

- Annual monitoring would give you best shot at identifying a trend – annual monitoring of some set of sites that is cost effective as your team still has continuity and then scaling up to a big monitoring year is easy.

Rocky Intertidal

- Potential for having core sites that are done annually to look at annual variability and then hopscotch approach.
- Limited in habitat presence. Would err on side of covering as much space as possible, even if it meant having to do that on rotating schedule.
- Inter annual variability isn't that large
- One season only - limited to winter because of low tides.
- Depending on species groups (birds) you might have to go more than once/year.

Mid-depth Rock

- The priority sites that were identified in exercise 1 were a recommendation of where they would sample in locations where mid-depth rock is significantly different than what's being sampled by SCUBA– it's a unique addition.
- Incremental knowledge gained from going to northern Channel Islands would be scientifically interesting but return on investment based on cost might not be as high. So it's a value question.
- There is a gap from 25m to 100m - how important is that gap is for long-term monitoring?
- Harris Pt. and Gull Is are interesting, Scorpion, Anacapa south and north are also interesting
- You want to sample everything and you want to do it annually – what is the cost to not doing it annually is how we should be thinking about things.
- Offshore variability is considerable and you want to be able to understand that. You want to sample frequently to account for that variability.

Sandy Beach

- Annual wouldn't be sufficient for indicators we're using like birds and kelp – previous sampling was monthly over two years.
- There is high inter-annual variability, and very high seasonal variability.
- But some sampling methods are destructive - Could do frequent bird counts, kelp counts, and try to go back to once a year for invert sampling because it's destructive.
- Specific groups of species require different temporal sampling design
- It's about how different methods combine to get a condition assessment done.

Table 1 List of the criteria (along with some description) considered for site selection, and the ranking of the relative importance of those criteria (low, moderate and high) for each of the five ecosystem groups.

Criteria	Description	Kelp Forest	Reef Check	Rocky Intertidal	Mid-depth Rock	Sandy Beach
Biogeographic Region						
Biogeographic Representation	Selecting sites within each biogeographic region	high, high, medium	high	high, high		
Existing data/future feasibility						
Length of existing time series/amount of existing data or knowledge	Length' in combination with some level of rigor, can be any times series for that ecosystem	high	high			moderate
Accessibility of site for long-term monitoring, costs		high, high		high		
Ongoing or future monitoring planned (already funded)						
Future co-funding potential (e.g. Navy, NPS, ASBS, other agencies)						
MPA Characteristics						
Age of MPA			high	low		low
Spacing between MPAs		moderate		low		low
Size of MPA		low		low		low

Criteria	Description	Kelp Forest	Reef Check	Rocky Intertidal	Mid-depth Rock	Sandy Beach
MPA regulations (e.g. SMR vs. SMCA)	Comparing these two can tell you comparative effects of rec and commercial fishing.	high, high, moderate		low		low
Enforcement		low		low		low
Location relative to ASBS		low		low		
Location relative to interested/vested stakeholder community				low		
Connectedness of MPA (in the sense of oceanographic/larval connectivity)		moderate		high		
Biological criteria						
Biological hotspot/coldspot				moderate		moderate
Number of ecosystems represented (e.g. monitoring co-location potential)	Important for addressing connectivity - seeing change in condition over time Logistical value in co-monitoring/co-location of sites	low		moderate	high	high
Variation in biodiversity	Variation in biodiversity may explain differences and rates of change			moderate		

Criteria	Description	Kelp Forest	Reef Check	Rocky Intertidal	Mid-depth Rock	Sandy Beach
	in ecosystems					
Unique biodiversity		moderate	moderate	moderate		moderate
Trophic diversity	Trophic species	low		moderate		high
Presence of rare or threatened species			moderate	moderate		moderate
(Potential) presence of harvested taxa						high
Recruitment source/sink	Will vary by species, Sources and sinks for different species within a single site					
Habitat						
Unique habitat attributes	Represents future promise that you may want to monitor		moderate		high	moderate
Representative of the bioregion	Capturing one habitat or multiple habitats and ecosystem features - 'Habitat diversity'	high, high, high	high	high	high	
Min amount of habitat present.		high				

Criteria	Description	Kelp Forest	Reef Check	Rocky Intertidal	Mid-depth Rock	Sandy Beach
Geomorphic variability within ecosystem feature		high, high	high	high		high
Oceanographic variability including exposure						high
Representative of littoral cells						high
Other						
Fishing pressure/proximity to human center, human impact	Things we would expect the MPAs to exclude, as well as human impact	high, high, high		high, high	high	high
Adjacent management regime					high	high
Water quality		high		moderate	high	high
Other human impacts	might not be fishing pressure, can be other things			high	high	high
Potential for carbon sequestration				moderate		

Integrative Special Issue Papers

The concept of Ecosystem Based Management is rooted in this holistic view of ecosystems, and the idea that ecosystems should be adaptively managed, and decision-making should be informed by the best available scientific information. These ideas lie at the heart of the monitoring and management plans for the network of Marine Protected Areas (MPAs) across the state of California. Meeting the requirements of the MLPA means taking an ecosystems approach to monitoring in which ecosystems are the top level of the monitoring hierarchy and provide the umbrella that encompasses species, populations, habitats and humans. Although many marine habitats and their constituent communities have been extensively studied along the coast of California (e.g. kelp forest, rocky intertidal) studies of how these habitats are linked via species (e.g. birds, fish) that utilize multiple habitats within the ecosystem are rare. Information about the non-consumptive roles of humans in these coastal ecosystems is also relatively lacking, particularly in the context of how these systems might best be monitored in the future to meet a broad array of goals.

Here we provide a brief summary of the areas in which data from our South Coast Rocky Intertidal Baseline Project are being used to address integrative issues involving data collected across several South Coast MPA Baseline Projects. These papers are in draft form and have resulted from the combined efforts of south coast baseline PIs to integrate data from their individual projects to address larger issues. Our proposal to jointly publish these papers has been accepted by the journal "Marine Ecology", and most of these papers are in draft form, with an anticipated publication date of 2016.

Biogeographic patterns

Title of Proposed Paper: "Biogeographic patterns of communities across multiple marine ecosystems in southern California"

Authors: Jeremy Claisse, Carol Blanchette, Jennifer E. Caselle, Jenifer Dugan, Jonathan P. Williams, Daniel J. Pondella, Laurel A. Zahn, Chelsea M. Williams, James Lindholm, Ashley Knight, Dan Robinette, Meredith Elliott, Rani Gaddam, Katie Davis

Abstract: With the implementation of ecosystem based management approaches becoming more common, broad scale questions are increasingly dominant in conservation and management, requiring marine ecologists to examine linkages between patterns and processes operating at large spatial scales across ecosystems. The Southern California Bight is a complex biogeographic region as it is a transitional zone between the cold temperate fauna fueled by the California Current to the north and the warm temperate fauna from the south. A large scale sampling effort in 2011 and 2012 created a novel opportunity to compare patterns in community structure across multiple community and ecosystem types. Here we used non-metric multidimensional scaling analyses to quantify spatial patterns of community structures in eight different community types (rocky intertidal invertebrates, sandy beach invertebrates, shorebirds, kelp forest fishes, kelp forest invertebrates, deep water fishes, deep water benthic invertebrates, juvenile fishes indexed through Least Tern diet) which inhabit multiple marine ecosystems across this region. We found a high degree of spatial structure in the similarity within and

across these communities. Patterns related to the complex environmental gradients that occur across the region, but key differences were revealed among some community types which have important implications for the scales at which they are managed.

Coastal Recreation Valuation

Title of Proposed Paper: "Beachgoers of a Feather Flock Together: Ecosystem Service Valuation for Coastal Recreation in Southern California"

Authors: Noah Enelow, Mike Mertens, Cheryl Chen. Aaron McGregor, Taylor Hesselgrave, Matt Perry and Nick Lyman

Abstract: Coastal recreation is an important activity to residents in Southern California. Yet the very features that make coastal recreation attractive are often threatened by its popularity. Economic development and land use pressures have created significant impacts on key environmental attributes such as water quality and marine mammal, seabird and fish habitat. This study examines the preferences of the Southern California coastal recreation population for specific environmental attributes with relevance to the process of marine protected areas (MPA) planning, including mammal haulouts, seabird colonies, shoreline type and fishing access, while controlling for amenities and economic development variables. We use an innovative method of spatial clustering to define sites based on patterns of user behavior, thereby avoiding the Modifiable Areal Unit Problem (MAUP). Our results reveal that specific groups of recreational users are willing to pay (WTP) significant positive amounts for proximity to environmental attributes of interest to MPA planners and coastal managers.

Citizen Science

Title of Proposed Paper: "Citizen science monitoring of marine protected areas: case studies and recommendations for integration for among monitoring programs".

Authors: Jan Friewald, Jennifer Caselle, Ryan Meyer, Doug Neilson, Kevin Hovel, Dina Liebowitz, Carol Blanchette, Jenny Dugan, and Julie Bursek.

Ecosystem-based management and conservation approaches such as marine protected areas (MPAs) require large amounts of ecological data to be implemented, adaptively managed towards their goals and in order to evaluate their achievements or failures. Implementation of MPAs under the Marine Life Protection Act (MLPA) Initiative in southern California was followed by a monitoring program to establish a comprehensive baseline of marine ecosystems at the time of MPA implementation. The baseline monitoring consortium involved several citizen science monitoring programs alongside more traditional academic monitoring programs. We are investigating different citizen science models and their program goals with respect to their involvement in MPA baseline monitoring and examine their respective monitoring protocols and data quality assurance measures in light of the goals of the MLPA baseline monitoring program. We focus on three case studies: volunteer divers monitoring rocky reefs with the Reef Check California (RCCA) program, high school students monitoring rocky intertidal and sandy beach ecosystems with the LIMPETS program, and commercial fishermen and other volunteers collaborating with researchers to study the California spiny lobster. Through analysis of the experiences from each of these very different projects, and drawing on broader literature focused on citizen science, we elucidate capacities and potential of citizen science approaches for MPA baseline monitoring and for building capacity towards sustainable long-term monitoring of MPAs. In two of the three cases, comparison with academic monitoring programs surveying the same ecosystems, kelp forests and rocky intertidal, will inform recommendations for best practices for citizen science MPA monitoring and the creation of a framework of what types of monitoring questions can be addressed by citizen science. Results from this study will be relevant and timely as the monitoring of California's MPAs transitions from baseline to long-term monitoring, and as citizen science continues to becoming more prevalent in California and elsewhere in marine ecosystem monitoring.

Extensions, Invasions and Rarities

Title of Proposed Paper: "Where The Weird Things Are: A synthesis of range extensions, rarities, invasive species encounters, and unique occurrences in the Southern California Bight as a product of South Coast MPA Baseline Monitoring projects"

Authors: Jonathan Williams et al. TBD.

The Southern California Bight (SCB) spans a significant environmental gradient and is subject to the influx and removal of species based upon subtle regional changes as well as large-scale changes in climate and oceanographic conditions. Past reports of new or unusual species to the SCB were typically a product of large-scale oceanographic phenomena such as El Niño/Southern Oscillation events, increases in invasive species vectors through port expansion, new technologies, and stocking efforts, or simply a product of motive and opportunity. The opportunity to observe and document a unique or rare species across the entirety of the bight presented itself with the establishment of marine protected areas (MPAs) in southern California and the subsequent baseline monitoring program for those newly established MPAs. Here we describe range extensions and unique occurrences of several species of marine fish, invertebrates, algae and birds as observed during the 2011-2012 South Coast MPA Baseline Program as well as other recent monitoring efforts.

Distribution of Birds as a Higher Trophic level Indicators

Title of Proposed Paper: "Distribution of birds as high trophic level indicators"

Authors: Jenifer Dugan, Dave Hubbard, Dan Robinette and Carol Blanchette

Abstract: Higher trophic levels, as exemplified by shorebirds, can respond to prey resources in different ways depending on the foraging environment. Changes in the diversity, abundance and availability of key prey resources can strongly affect the composition and distribution of birds. Here we evaluate the responses of birds to variation in biodiversity, abundance and biomass of prey resources in two coastal ecosystems, sandy beaches and rocky shores, in southern California.

Foraging seabirds indicate fish recruitment

Title of Proposed paper: "Can nearshore foraging seabirds detect variability in juvenile fish distribution inside and outside of marine reserves?"

Authors: Daniel P. Robinette, Jennifer Caselle, Jeremy Claisse, and Julie Howar

California's Marine Life Protection Act established a network of marine protected areas (MPAs) throughout the state. As these MPAs mature, there will be a need not only to detect change in several levels of community structure, but to also establish efficiencies among monitoring programs to maximize coverage throughout the state. Juvenile recruitment is an important determinant of change within MPAs. Understanding spatio-temporal variability in recruitment rates will help managers set realistic expectations for individual MPAs and the network as a whole. Here we ask whether seabird foraging distributions can be used as a proxy for juvenile fish recruitment inside and outside of MPAs in southern California. We investigated the foraging distributions of five piscivorous seabirds during April-August of 2012 and 2013. We conducted weekly foraging surveys at plots inside and outside of three island and three coastal marine reserves. Additionally, we estimated juvenile fish abundance using data from diver surveys conducted at the same sites in the same years. We will integrate these data with regional measures of oceanographic productivity (e.g., upwelling, sea surface temperature) and larval fish abundance to assess seabird responses to spatio-temporal variability in fish recruitment. Past studies have shown that seabird diet, seabird foraging rates, and juvenile fish abundance respond to variability in regional upwelling and larval fish abundance, with localized effects influenced by coastal geographic features such as promontories that impact larval delivery to nearshore habitats. These results suggest that seabird studies can help resource managers understand local patterns of fish recruitment and establish realistic expectations for how quickly fish populations should change within individual MPAs.

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Appendix 1.

Timeline of PI calls and Integrative Workshops

Jan 14-15, 2013	Integrative Workshop 1
June 12, 2013	PI conference call
Sept. 25, 2013	PI conference call
Jan. 8, 2014	PI conference call
Jan. 30-31, 2014	Integrative Workshop 2
April 30, 2014	PI conference call
July 23, 2014	PI conference call
Oct. 13-15, 2014	Integrative Workshop 3
Dec. 8, 2014	PI conference call
Dec. 23, 2014	Data upload webinar
April 10, 2015	PI conference call
May 2, 2015	PI conference call
Aug. 20-21	Long-term monitoring Workshop

Integrative Workshop Agendas

South Coast MPA Data Integration Project Workshop 1

January 14-15, 2013 - Marine Science Institute, Room 2318

9 AM- 10:30 AM –Introductions, and discussion of workshop goals:

a) To define overarching research questions relating to the function of the entire SCSR
b) To identify analyses and syntheses to address the questions in part 'a' above
c) To determine the possibilities for data integration and synthesis
d) To agree upon common data and metadata standards to facilitate data integration

10:30 AM – 12 PM – Short, informal presentations (10 minutes or less) by each of the groups covering the current status of their project, the types of data being collected, and presentation of an example of a dataset typical of each project

12 PM – 1 PM LUNCH on the balcony

1PM – 2PM Presentation by Tony Hale of new data upload features of Oceanspaces

2PM – 3PM Presentation and discussion of metadata standards by Rani Gaddam and practical example of data package upload

3PM – 5PM Discussion of data integration challenges, and potential solutions to streamline data integration for synthesis, and determining the extent to which data integration is useful

Tuesday January 15

9 AM – 12 PM Discussion of potential analysis and synthesis projects based on current understanding of data from each group. Potential examples include:

1. Providing an overall baseline characterization of ecosystems inside and outside MPAs across the SCSR
2. Providing an assessment of initial changes in ecological and socioeconomic conditions across ecosystems inside and outside MPAs across the SCSR
3. Describing the scales of species similarity across ecosystems across the SCSR and accounting for this geographic variation in community structure while assessing the effects of protection (see Hamilton et al. 2010)
4. Describing trophic structure across ecosystems inside and outside MPAs across the SCSR
5. Evaluation of the strength of Consumptive/Nonconsumptive effects across ecosystems
6. Distribution of key taxa across ecosystem boundaries
7. Characterization of biodiversity and responses of biodiversity to protection across Ecosystems

12 PM – 1 PM LUNCH on the balcony

1 PM – 4 PM Further discussion of synthetic products, indicators and next steps

South Coast MPA Data Integration Project Workshop 2

January 30-31, 2014 - Marine Science Institute, Room 2318

Thursday 1/30/14 -- Meet at 2nd floor conference room – 2318 Marine Science Research Building

9:00 Welcome, Housekeeping, Introductions

9:15 Discussion of project timelines and grant/output extensions: Aaron and Ryan of the ME 10:15 Presentation and discussion of the goals and structure of workshop

- Potential goal: set of integrative projects each based on integration of one or more baseline projects
- Potential product: set of papers in a special issue or volume of a marine conservation oriented journal focused on the south coast region
- Discussion items: List of project ideas sent in by PIs

10:45 BREAK

11:00 Presentation and discussion of heatmaps for display of multiple datasets (James L and Ashley) 11:45 Discussion of integrative projects and structure of working groups for the afternoon (plenary)

12:30 LUNCH on the balcony

1:30 Working group session 1 (2 groups: 2nd and 3rd floor conf rooms)

3:00 BREAK

3:15 Working group session 2 (2 groups: 2nd and 3rd floor conf rooms) 4:45 'Gots and Needs' exercise – Carol will introduce

Friday 1/31/14 -- Meet at 2nd floor conference room -- 2318 Marine Science Research Building

9:00 Discuss/revise agenda in light of Gots and Needs (plenary) 9:30 Discussion of data, metadata and data uploading

10:00 Discuss, construct and finalize joint site and classification tables and common variables (e.g. biodiversity, indicator species, etc.)

10:30 BREAK

10:45 Working Group Session 3 (2 groups: 2nd and 3rd floor conf rooms)

12:00 LUNCH on the balcony

1:00 Meet back in plenary for report backs from each group (20 minutes each x 6 groups)

Reports to include:

--- feasibility of project idea
--- data needs to move forward
--- assignment of tasks/group leadership

3:00 BREAK
3:15 Next steps
4:30 Adjourn

South Coast MPA Data Integration Project Workshop 3

October 13-15, 2014 - Marine Science Institute, Room 2318

Note: The overarching goal of this workshop is to conduct joint data analyses and begin outlining integrative papers. The agenda is purposefully unstructured.

Monday October 13 2014

9AM-noon Room 1302 Marine Science Research Building

General announcements and group presentations of findings:

1 - Socioeconomics

2 - Rocky Intertidal 3 - Sandy Beach

- Kelp Forest Break

- Reefcheck 6 - Deep water

7 - Spiny Lobster 8 - Seabirds

9 - Aerial Imaging

Monday afternoon 1-5PM, Room 3322 Marine Science Research Building

Plenary group discussion:

1. Indicators

2. Recommendations for Monitoring

3. Integrative topics and how to make the best use of working goups in the next 2 days.

Tuesday October 14, and Wednesday October 15 - both days will be devoted to working groups to make progress on the integrative projects identified and outlined on

Monday. We have 2 rooms on both days (3322 and 4318) and details on how we will divide will be discussed on Monday afternoon.

Appendix 2.

Participants for Long-Term Planning Workshop

The workshop included the following participants:

- Carol Blanchette, Associate Research Biologist, Marine Science Institute, University of California, Santa Barbara
- Jennifer Caselle, Associate Research Biologist, Marine Science Institute, University of California, Santa Barbara
- Jenifer Dugan, Associate Research Biologist, Marine Science Institute, University of California, Santa Barbara
- Jeremy Claisse, Assistant Professor, Biological Sciences, California State Polytechnic University, Pomona
- Dan Pondella, Associate Professor of Biology, Occidental College
- Mark Carr, Professor, Department of Ecology and Evolutionary Biology, University of California Santa Cruz
- Jan Freiwald, Director, Reef Check California
- James Lindholm, James W. Rote Distinguished Professor of Marine Science & Policy and Director, Institute for Applied Marine Ecology (IfAME), California State University Monterey Bay
- Pete Raimondi, Professor and Chair, Department of Ecology and Evolutionary Biology, University of California Santa Cruz
- Benet Duncan, Ocean Science Trust
- Ryan Meyer, Ocean Science Trust
- Marissa Villareal, Ocean Science Trust
- Adam Frimodig, California Department of Fish and Wildlife
- Amanda Van Diggelin, California Department of Fish and Wildlife
- James Eckman, California Sea Grant

Agenda for Long Term Planning Workshop

Planning for Long-term Monitoring in the South Coast region

Date & Time:
Thursday Aug 20, 2015 from 9am – 5:00pm
Friday Aug 21, 2015 9am – 12:00 pm (noon)

Location:
2nd floor conference room, Marine Science Research Building
University of CA Santa Barbara

Goal:
Gather scientific input from South Coast baseline program scientists on which MPAs to monitor (as paired inside-outside monitoring sites) and how often to monitor them in sandy beach, rocky intertidal, kelp and shallow rock, and mid-depth rock ecosystems for long-term monitoring in the South Coast.

Objectives:

- Discuss the priority monitoring questions that will guide the South Coast MPA monitoring program
- Identify and discuss the bio-regions in the South Coast region
- Identify and rank MPAs as potential monitoring sites for long-term South Coast MPA monitoring, based on characteristics and criteria developed in advance and refined by the participants
- Discuss the spatial design that will address the questions guiding South Coast MPA monitoring (e.g., number of sites for each ecosystem)
- Discuss the temporal design that will address the questions guiding South Coast MPA monitoring

Agenda:

Day 1: Aug 20, 2015

9:00am – 9:30am	Welcome, refreshments provided (Carol Blanchette and Jenn Caselle) Review agenda, goals, and objectives
9:30am – 10:00am	Overview of the long-term monitoring planning effort at the state level and the Central Coast; what to expect with South Coast (OST & CDFW)
10:00am – 11:00am	Discussion of priority monitoring questions & the process of designing monitoring to answer those questions (OST). See Background Document: "Guiding Questions"
11:00am – 11:30am	Presentation and prioritization exercise discussion of criteria used to guide discussion of spatial monitoring design (Jenn). See Background Document: "Potential Criteria"
11:30am –	Presentation on biogeographic region results from Baseline (Jeremy Claisse)

12:00pm	
Noon – 1:00pm	Lunch (provided)
1:00pm -3:00pm	Rank potential monitoring sites for all ecosystem features (kelp & shallow rock, mid-depth rock, rocky intertidal, and sandy beach ecosystems). Discussion will proceed one biogeographic region at a time (starting in the South).
3:00 – 3:15pm	Break
3:15 – 3:45pm	Continue ranking potential monitoring sites.
3:45 – 4:45pm	Overview of statistical and other issues with designing temporal sampling strategies (Jenn)
4:45pm-5:00pm	Brief Recap of Day 1 and review of goals for Day 2
5:00pm	Adjourn for day
6:00pm	Dinner at Outpost at the Goodland Hotel

Day 2: Aug 21, 2015

9:00am – 9:15am	Welcome, refreshments provided (Carol and Jenn) Recap yesterday, Review agenda, goals, and objectives for the day
9:15 - 11:00	Continue ranking potential monitoring sites.
11:00 - 12:00	Discuss temporal resolution of monitoring for kelp & shallow rock, mid-depth rock, rocky intertidal, and sandy beach ecosystems (approx. 15 minutes each)
12:00-12:30	Summarize overarching recommendations, Next steps.