The following revised work plan reflects changes to our initial proposal that reflect a reduced funding level of $108,000. References listed below are included in the enclosed copy of the original proposal.

Data Sources

We will assemble data from a broad suite of sources, with a focus on the region extending from just north of Cape Blanco, Oregon to just south of Point Reyes, California thereby centering on the NCSR. In doing so, we will ensure that information on conditions affecting MPAs near the boundaries of the NCSR are not missed. Below, we identify the data we intend to integrate in our analyses and anticipate how these data will be used.

We will compile data that falls into three general classes:

I. *Regional Climate and Environmental Indices*

No change from previous statement of work. Note that wind stress curl is directly available from the ERD data servers, which should alleviate a reviewer's concern that it was something we would need to calculate directly.

II. *In situ environmental observations and indicators of local hydrographic conditions*

No change from previous statement of work.

III. *Remotely sensed surface currents and environmental conditions*

This section has been scaled down to reflect available support.

We will assemble and analyze data from shore-based HF radar to derive maps of surface currents for the NSCR and neighboring coastal regions (cf., Bjorkstedt et al 2011), and to extract indices of alongshore transport at key locations in the NCSR for comparison with analogous (but longer) time series in regions to the north (Cape Blanco) and south (Point Reyes, e.g., Bjorkstedt et al 2011). The HF radar data set includes historical time series data in select areas north and south of the NCSR (e.g., Kaplan et al 2005, Kosro 2005, Halle and Largier 2011), and more recently includes ongoing observations spanning much of the U.S. West Coast, including the NCSR (Bjorkstedt et al 2011; Kim et al 2011). These data will be obtained through collaboration with CeNCOOS (note that Largier is HF-radar lead for CeNCOOS). We will use HF radar data to distill indices of alongshore transport as an input to time-based indices (as in Sydeman et al 2013a).

We will acquire time series of satellite based remote sensing data for sea surface temperature (SST) and ocean color (OC) that extend at least as far back as the early- to mid-2000s ; these data are served by Coastwatch and the Environmental Research Division of NOAA's SWFSC (coastwatch.pfeg.noaa.gov/coastwatch/CWBrowser.jsp). Spatial fields of SST and estimated surface chlorophyll concentrations are available daily and as composite images (3- to 14-day averages) that sacrifice temporal resolution to offset the effects of cloud cover (Henson and

Thomas 2007a, b, c; Venegas et al. 2008; coastwatch.pfel.noaa.gov) and as blended, ground-truthed products (Kahru et al. 2012).

ANALYSIS AND PRODUCTS

From the suite of data identified above, we will distill a variety of data products and indices for interpreting biological or ecological patterns across the NSCR. We will provide information that allows researchers and managers to place current (and future) ecosystem observations in the context of temporal variability in oceanographic conditions that drive fluctuations in productivity and recruitment in marine systems at regional to subregional scales. We will make information on environmental parameters (e.g., temperature, salinity), ecosystem parameters (e.g., chlorophyll concentration), alongshore transport available in a coherent, readily accessible and interpretable form.

Our data synthesis will focus on the period from 1990 through 2014 for the main analysis and documentation, with an update into 2015 to span more of the baseline field work. Ongoing updates should be made easier by computational infrastructure developed in the course of our work, but will not be supported under this project.

Note that in the course of the analysis decribed below, we will pay attention statistical and analytical issues raised by the reviewers by, e.g., considering the potential for non-linear relationships among variables used in developing indices and applying standard methods to account for breaks in observational time series.

Scale and resolution of oceanographic information

We anticipate that our analysis will be able to produce information on environmental trends and variability at scales that span the NCSR as well as subregional nested within larger scale regions (e.g., north and south of Cape Mendocino, and possibly subdivisions within these regions). Resulting indices will support interpretation of data collected in MPAs in broader regional and coastwide contexts as well as broad-scale variability within the NCSR.

With respect to temporal resolution, we will focus on understanding how environmental conditions have shaped the current state of the ecosystem and the potential for biological responses to reduced fisheries mortality associated with the establishment of MPAs. Many of these biological responses are expected to take several years (or even decades) to manifest, although certain conditions (e.g., a year with strong recruitment) may substantially alter the trajectory of divergence between protected and non-protected areas. In this context, we will focus on quantifying interannual trends and fluctuations in the environment, although several of our analyses will focus on year-to-year variability in conditions during particular seasons or months (e.g., Garcia-Reyes and Largier 2012), or in the timing of events critical to the dynamics of focal populations or ecosystems (e,g. phenology of upwelling, see Bograd et al. 2009).

Note that the spatial resolution of oceanographic products will be limited to regional and subregional scales as above, and that the development and integration of high-resolution, spatially explicit indices from remote sensing data will not be supported by this project.

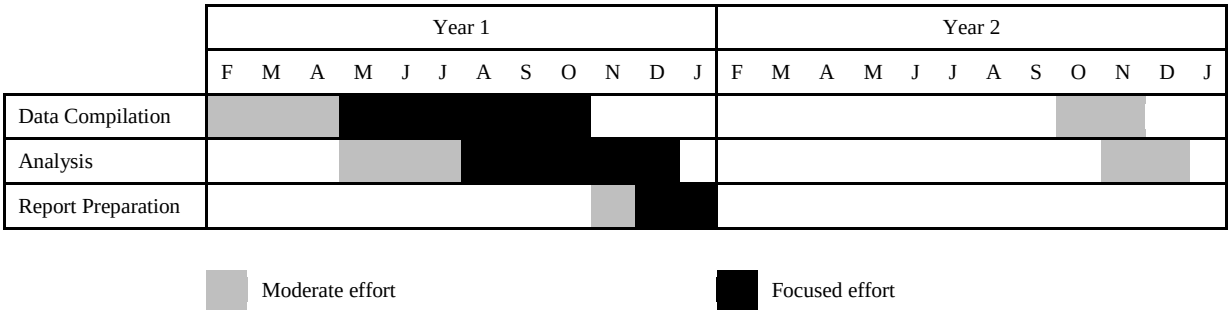
Specific products

We will conduct two distinct, yet complementary analyses to develop a suite of oceanographic data products to inform the baseline characterization in the NCSR.

I. *Time series of environmental conditions affecting coastal habitats*
We will extract from relevant *in situ* data sets time series of observations of temperature, salinity, and other parameters at specified points along the coast, and from remote sensing data sets time series of temporally and spatially aggregated (mean) conditions at regional and subregional scales (Figure Scale Schematic). From these data sets we will develop local climatologies and anomaly time series to characterize mean conditions and variability about those means, including resolution of seasonal dynamics. We will apply methods of univariate and multivariate time series analysis to characterize autocorrelation within (and covariance among) environmental time series, extract long-term and seasonal trends, and quantify interannual variability about these trends. We will also develop complementary analyses that characterize the effect of event-scale processes—emphasizing the potential importance of short-term variability, duration of exposures to 'extreme' conditions, and well-timed events relative to mean conditions in driving ecosystem dynamics.

II. *Regional and sub-regional multivariate oceanographic indicators*
Building on previous work (Sydeman et al. 2013), we will develop a comprehensive multivariate oceanographic indicator for the NCSR (and subregions within the NCSR) by compiling a broad suite of atmospheric and oceanographic indicators known to affect physical and biotic conditions in the CCS. We will apply principal component analysis (PCA) to identify coherent and independent modes of variability that drive the ecosystem, and how these aggregate indicators capture variability affecting the NCSR (e.g., Figure 2). We will then examine PCA loadings on individual contributory data time series to identify which variables are more critical for the region and to characterize differences among subregions. We will perform this analysis on seasonally-stratified time series to resolve the intra-seasonal structure of ocean variability as well as inter-annual variability within critical seasons. We will perform this analysis on discrete subsets of the time series to examine whether estimated relationships are robust at longer time scales.

We anticipate that our revised workplan will unfold as follows:



Project Deliverables

Compiled data sets and derivative products, including appropriate documentation and metadata will be made available through OceanSpaces (oceanspaces.org) in readily readable formats (e.g., ASCII or comma-separated-value (.csv) files). Appropriate metadata will be included, including documentation of methods and protocols used for extraction of data from their original sources and subsequent analysis.

We will produce a comprehensive annual report at the end of Year One, and update this report to produce the final technical report by the end of Year Two.