

The California Current Large Marine Ecosystem (CCLME) Biological Observing Network

About the Network

The US West Coast Biological Observations Workshop convened on Nov. 7-9, 2018 and brought together a significant proportion of the scientific and observing communities working to understand the biological systems and observing needs within the California Current Large Marine Ecosystem (CCLME). During the workshop, a nascent vision for west coast biological observations network was presented. The proposed collaborative observing network would integrate the spectacular array of biology-focused scientific activities in the West Coast Region to better serve regional stakeholders. A key goal of network is to deliver more consistent observation and delivery of biology and ecosystem data, building on foundations in physical and biogeochemical work. A small steering team (Fig. 1) was established to continue the energy and enthusiasm developed at the workshop and to define the mechanism through which the west coast community will implement this community-driven effort.

Network Vision

A coordinated network of biological observations to deliver the information necessary to understand the ongoing changes in our marine ecosystems that are relevant to our extended coastal community.

Mission Statement

Build consensus and strengthen coordination among marine researchers and observing practitioners to develop and implement an operational biological ecosystem monitoring program that promotes understanding and management of marine ecosystems.

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Our Approach: An Ocean Health Indicator Network

We aim to deliver a suite of fit-for-purpose indicator products that incorporate near real-time data on an ongoing basis and encompass local-to-global perspectives on ecosystem assessment priorities (Fig. 2). This includes efforts to streamline the generation of National Marine Sanctuary Condition Reports and Integrated Ecosystem Assessment Status Reports for fisheries, protected areas, local, state, and federal managers, and other stakeholders. Automated indicator products that provide near real-time information on the dynamics of living marine resources in the coastal zone require updated interdisciplinary data and new public delivery services (e.g. THREDDS, ERDDAP). Coordination to create and use these products is needed to help ensure the best use of existing resources and meet the needs of people depending on the information.

- *Objective 1.* Synthesize stakeholder requirements for an integrated CCLME Biological Observing System (BOS).
- *Objective 2.* Build an inventory of high-priority CCLME biological datasets that serve multiple requirements.
- *Objective 3.* Develop ‘datastream plans’ and data pipelines for key biological datasets to streamline access (See figure 2)..
- *Objective 4.* Launch a West Coast Ecosystem Indicator Network to (1) provide consistent management tools for multiple purposes (2) deliver place-based management applications and (3) support a network of sentinel sites to safeguard our most productive places and valued marine resources.

Scientific Drivers for the Establishment of a CCLME BOS

The grand challenges and questions for the CCLME are related to the characteristic oceanography (i.e. upwelling), environmental variability and their interactions with society. The CCLME is one of the major Eastern Boundary Upwelling Ecosystems (EBUE) of our ocean. These EBUE have increased biological productivity, significant harvests of living marine resources (fish, squid and shellfish) and an abundance of charismatic/protected fauna (whales, seabirds, elephant seals, sharks, etc.). The animals are composed of resident species, those that spend their full life cycles in the CCLME, and highly migratory varieties, those that spend aspects of their life cycles outside of the CCLME.

Environmental change and climate variability impact on marine biology in the California Current Large Marine Ecosystem

- Will present day climate variability be maintained or will it increase in intensity or change in frequency (per the 'Blob', etc.)?
- Will species steadily shift geographically with continued warming (species expanding/contracting poleward/onshore)?
- Will ecosystems cross tipping points, where sudden jumps in state will occur?

Coastal ecosystems and interaction with offshore processes

- What drives fluctuations in nearshore ecosystems and how different are these from those in the open ocean?
- What are the key interactions between nearshore and open ocean ecosystems?
- How well are nearshore ecosystems monitored and what are the key missing elements?

Large predator-human interactions: assessing and predicting the future of living marine resources (LMRS)

- What drives the occurrence and timing of forage species and their predators?
- Why do these vary year-to-year?
- What information is required by a BOS to predict these sufficiently in advance to make corrective management decisions?

Harmful Algal Blooms (HABs)

- What are the time and space scales of HAB development needed to predict impacts throughout the food web?
- What are the requirements for a CCS BOS so that updated predictions, monitoring, and assessment for HABs can be realized?
- What BOS elements are required for an early warning system to track offshore seed populations that might trigger near shore blooms?
- How does the HAB toxin alter food web dynamics?

Aquaculture on the West Coast

- How can the aquaculture industry operate well and grow in the future?
- How do observation systems and modeling tools need to evolve in order to support this growth in a challenging ocean?
- What are examples of successful practices where observations and models are supporting growers and are there ways to maximize benefits or expand these successes?

Requirements for a CCLME Biological Observing System (BOS)

Our scientific drivers necessitate a cohesive, systematic, and sustained BOS to provide information for optimal management of the CCLME. The CCLME is uniquely positioned to be a world leader in biological observing and will become a model for future BOS development. The establishment of a BOS is required

to address emerging scientific and management needs and to keep pace with the rapidly changing ocean climate.

- **Requirement 1** Develop a suite of core biological observations needed to monitor ecosystem fluctuations in near-real-time to produce leading ecological indicators of climate-ecosystem interactions and to develop climate-resilient management tools to sustain ecosystem health.
- **Requirement 2** Connect nearshore ecosystems to the open-ocean processes for which they depend by developing integrated, multidimensional, dynamic monitoring systems.
- **Requirement 3** Provide real-time observations of offshore bloom initiation/evolution and model the relationship with inshore conditions to allow state and federal agencies to rapidly reacting to changing conditions.
- **Requirement 4** Integrate autonomous and animal-borne biological sensors and other biological observations to account for diversity and distribution of marine assemblages.

Ecosystem Indicator Priorities in the CCLME

The network will continue to engage other organizations to collaborate and strategize effective partnerships to maximize ongoing prioritization and indicator development activities. Strategic partnerships will become increasingly important as the network advances through leveraging and support. In addition to its many collaborators representing key federal, state, local, and regional interests, the network is working closely with the West Coast Ocean Alliance and Point Blue Conservation Science to maximize efforts to prioritize and understand ocean indicators.

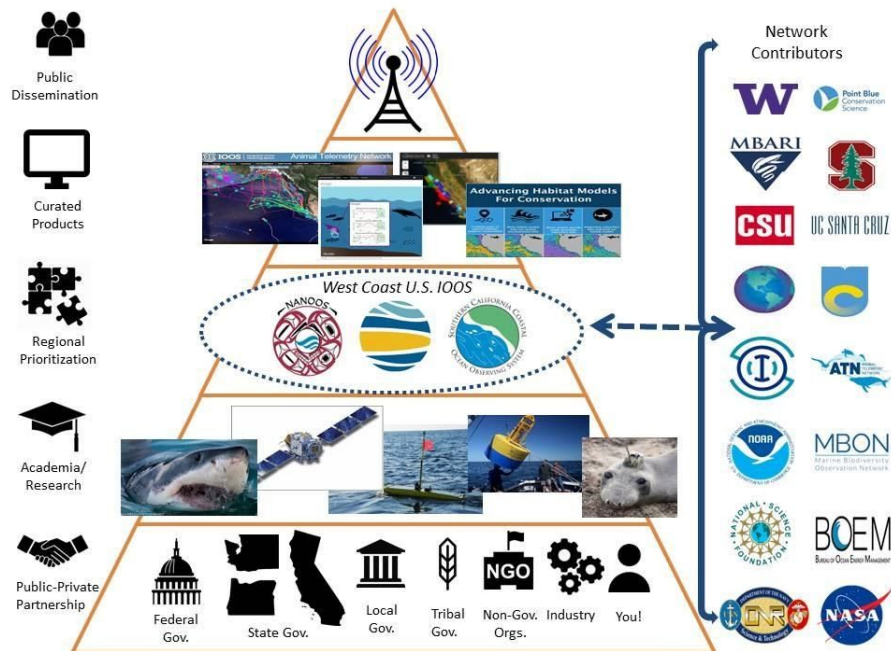


Figure 1. The Network is led by a small steering committee representing federal agencies, observing systems, researchers, and NGOs with shared expertise of biology, ocean observing, and regional stakeholder requirements.

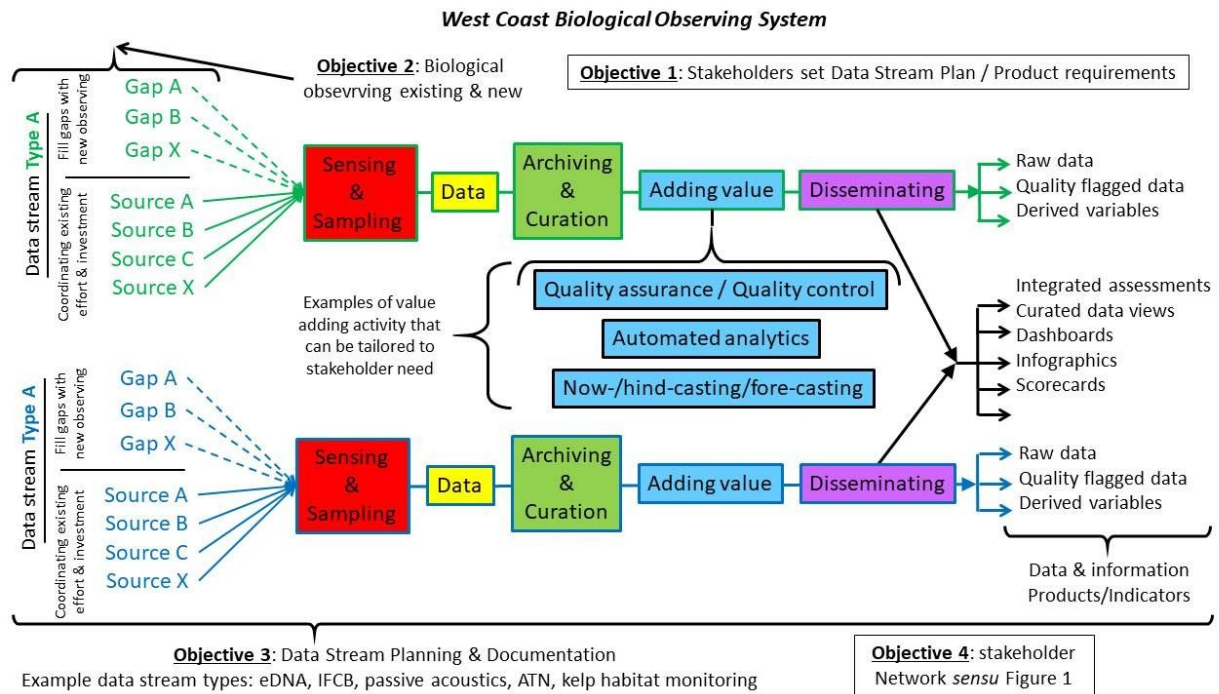


Figure 2. Data stream planning and documentation are a fundamental aspect of our west coast concepts. These have the benefit that they be divided up into tractable (sub)units, e.g. one for eDNA, one or more for ATN etc.