

The state of the west coast nearshore ecosystem: the importance of MARINe Multi-Agency Rocky Intertidal NEtwork



ter Raimondi, Department of Ecology and
olutionary Biology, UC Santa Cruz
www.pacificrockyintertidal.org

Impediments to Sound Management and Conservation

- Lack of understanding of coastal ecosystems, particularly
 - Long term dynamics
 - Geographic patterns
 - Current and potential threats
- Creates reactionary rather than informed policy





MARINe Program

General goal: To develop a long-term, spatially extensive, feasible and funded program providing baseline data in areas typically having none in order to assess the structure and function of ecological communities

Specific goals:

In order to inform policy and assess natural and anthropogenic disturbances create:

- **A network of monitoring sites that provide:**
 - A baseline from which to judge a change in ecological community or dynamics
 - Specific approaches for evaluation of questions of special interest (e.g. endangered species, disease, climate change, impacts of pollution, fisheries management, coastal resilience)
- **A common, query enabled database**
- **A set of web-based visualization tools for the public, managers, policy makers and other scientists**
- **A diverse and buffered funding model**

Funders

Primary Funding

Bureau of Ocean Energy Management



The [Bureau of Ocean Energy Management](#) is the bureau in the Department of the Interior responsible for managing development of the nation's offshore energy and mineral resources in an environmentally sound manner. These resources include offshore wave and wind energy, oil and gas, and marine minerals.

National Park Service



The fundamental purpose of the [National Park Service](#) is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of this and future generations.

The David & Lucile Packard Foundation



For more than 50 years, the [David and Lucile Packard Foundation](#) has worked with partners around the world to improve the lives of children, enable the creative pursuit of science, advance reproductive health, and conserve and restore the earth's natural systems.

State of California Ocean Protection Council



The [Ocean Protection Council](#) will ensure that California maintains healthy, resilient, and productive ocean and coastal ecosystems for the benefit of current and future generations. The OPC is committed to basing its decisions and actions on the best available science, and to promoting the use of science among all entities involved in the management of ocean resources.

United States Navy



Additional Support

[Cabrillo Marine Aquarium](#)

[Cabrillo National Monument](#)

[California Department of Fish and Wildlife](#)

[California Ocean Protection Council](#)

[California Sea Grant](#)

[California State Parks](#)

[Channel Islands National Park](#)

[Comunidad y Biodiversidad](#)

[Golden Gate National Parks](#)

[Gulf of the Farallones National Marine Sanctuary](#)

[Inventory and Monitoring Program of the National Park Service](#)

[Monterey Bay National Marine Sanctuary](#)

[Nature Conservancy](#)

[National Estuarine Research Reserve System](#)

[National Oceanic and Atmospheric Administration](#)

[NOAA Fisheries](#)

[North Pacific Research Board](#)

[Olympic Coast National Marine Sanctuary](#)

[Olympic National Park](#)

[Oregon State Parks](#)

[Point Reyes National Seashore](#)

[Quinalt Indian Nation](#)

[Redwood National and State Park](#)

[Resources Legacy Fund](#)

[Southern California Coastal Water Research Project](#)

[Tatman Foundation](#)

[University of California Institute for Mexico and the United States](#)

[University of California Natural Reserve System](#)

[Washington State Department of Ecology](#)

[Wrigley Institute for Environmental Studies, University of Southern California](#)

Research Groups

Lead Group

University of California Santa Cruz

Additional Groups

- Bureau of Ocean Energy Management
- Cabrillo National Monument
- Channel Islands National Park
- California State Polytechnic University, Pomona
- California State University at Long Beach
- California State University at Fullerton
- Feiro Marine Life Center
- Humboldt State University
- Navy Marine Ecology Consortium
- Olympic Coast National Marine Sanctuary
- Olympic National Park
- Padilla Bay National Estuarine Research Reserve
- Partnership for Interdisciplinary Studies of Coastal Oceans
- Quinault Indian Nation
- Redwood National and State Park
- San Francisco Bay Area Network - National Park Service
- Sitka Sound Science Center
- University of California Los Angeles
- University of California, Santa Barbara
- University of Washington
- Western Washington University

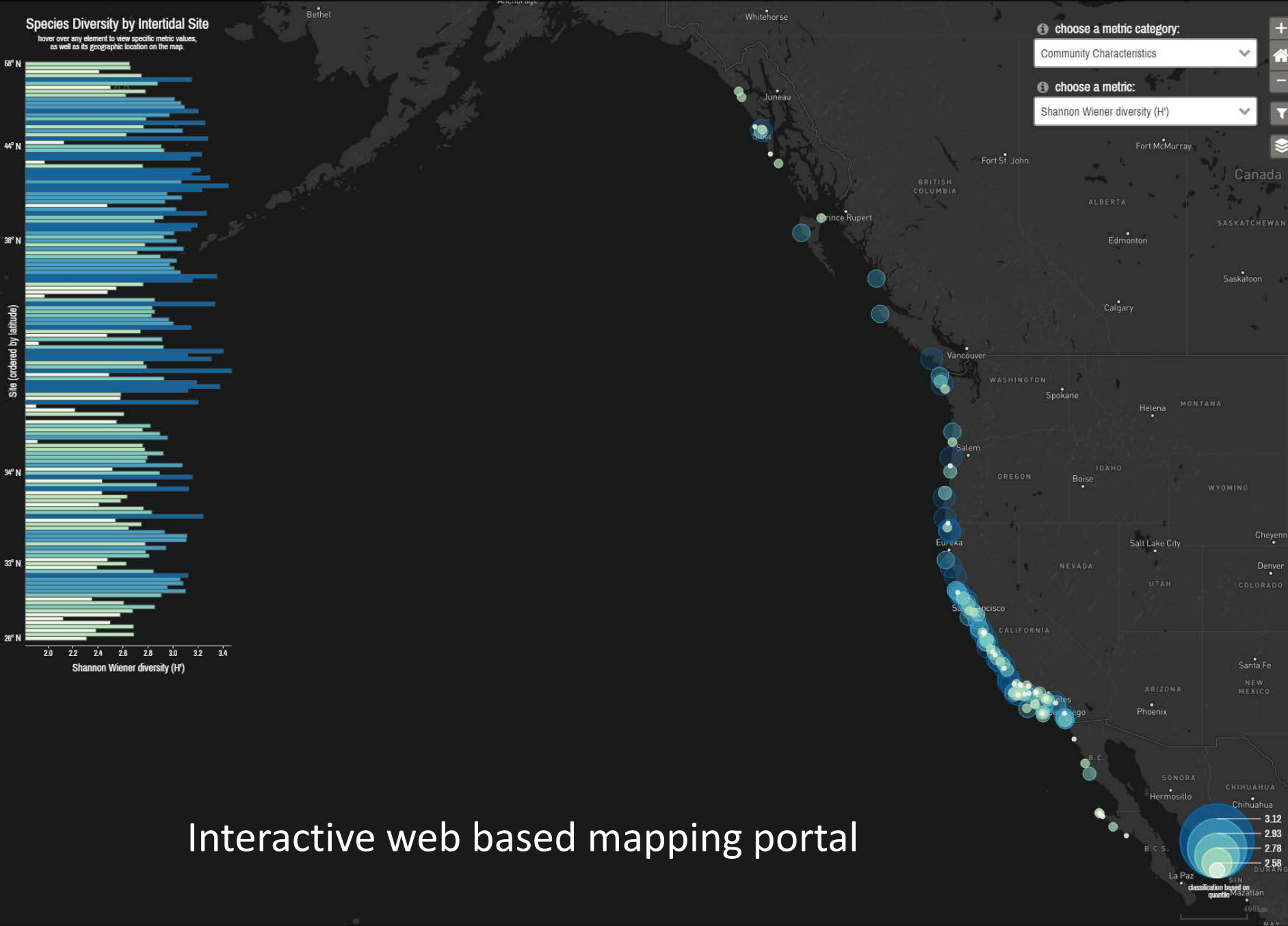




Three Part Approach

- Long-term “core” methods
 - Fixed plots that target “key” species
 - sampled annually – great temporal resolution
- Coastal Biodiversity Surveys
 - Large geo-spatial grid-style survey. Allows 3D mapping of species at all sites
 - Sampled periodically (3-5 yr. cycle)
- Environmental monitoring
 - Temperature, wave climate

Methods never change – ensures consistency, a usable comprehensive database and production of a web based graphics portal



Interactive web based mapping portal

Citizen Science data input and visualization

[seastarwasting.org home](#)

Sea Star Wasting Syndrome Observations

[SEA STAR WASTING MAP](#)

[JUVENILE OBSERVATION MAP](#)

[UPDATES AND NEWS](#)

[COLLECT DATA](#)

[CLICK HERE TO SUBMIT JUVENILE SEA STAR OBSERVATIONS](#)

Please use the link above to submit observations of juvenile sea stars. For a guide to identifying juvenile sea stars, see our [juvenile sea star identification guide](#). If you have disease observations as well as sightings of juveniles, please fill out both the [juvenile observation log](#) and the [disease observation log](#). If you have **photos** to send along with your observations, please send them [here](#).



Photo credits: Rani Gaddam (left) and Mark Nayer (right)

[CLICK HERE TO SUBMIT OBSERVATIONS OF HEALTHY AND/OR DISEASED SEA STARS](#)

Please remember to fill out a log even if you search and only find healthy sea stars, or no sea stars! This information is just as valuable as observations of diseased individuals. In addition to sea star disease observations, observations of disease in the purple sea urchin (*Strongylocentrotus purpuratus*) can now be reported (as of December, 2014). Note that prior to December 2014, there are no observations for *S. purpuratus* on the map. For species other than *S. purpuratus* observations should be recorded in the 'Additional Information' section of the [disease observation log](#). There is currently special interest in observations of *Leptasterias* spp. (healthy/sick/absent), which will be used by researchers at San Francisco State University and Santa Rosa Junior College to study potentially variable impacts of SSWD on sub-species of this star. See [Updates](#) page for more information.

Map Display Options

select site:

OR select [disease](#) presence:

AND select location type:

AND select species:

[Show All Sites](#)

[Clear](#)

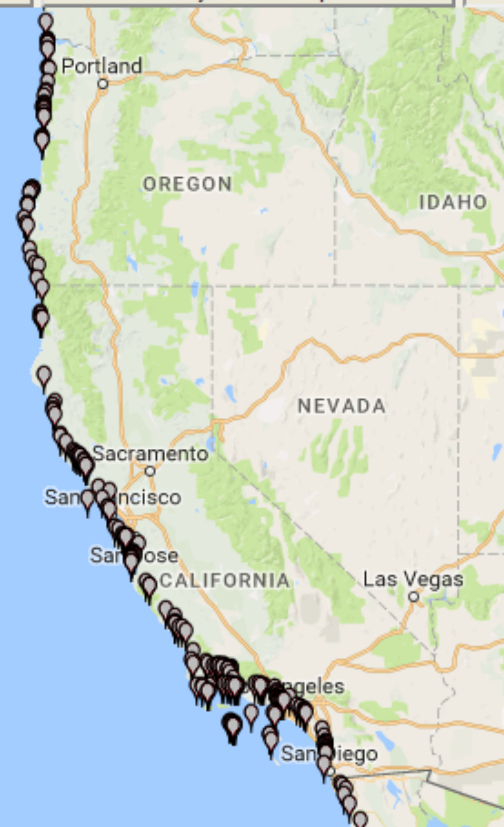
[Draw Polygon](#)

[Show Sites by Last Sampled Dates:](#)

201

[Map](#)

[Satellite](#)



Examples of diverse applications

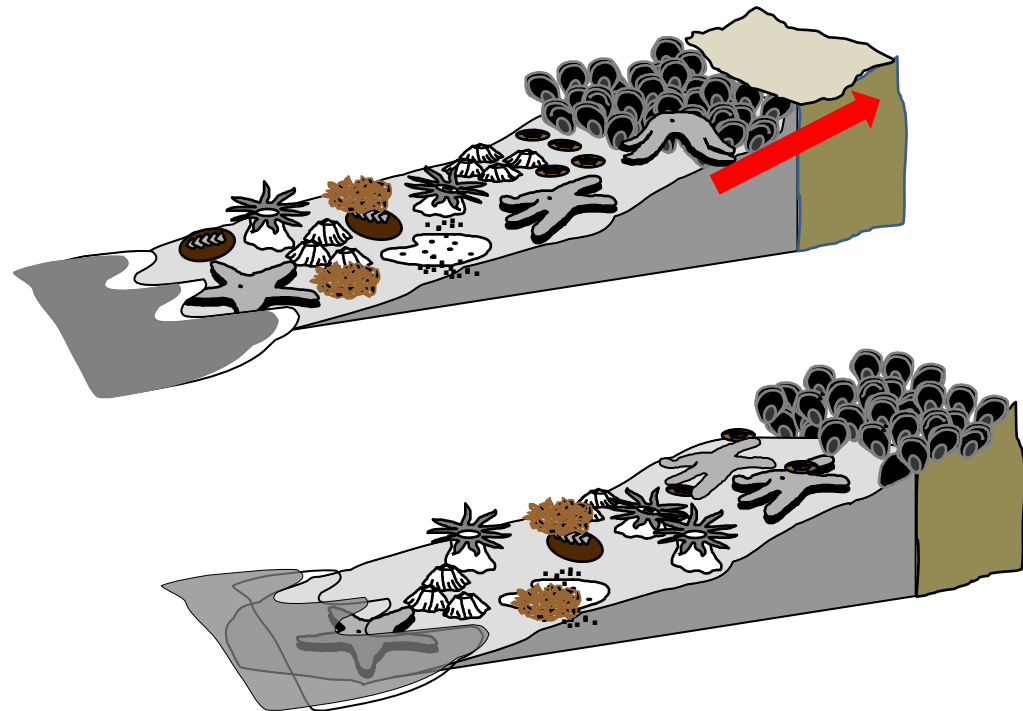
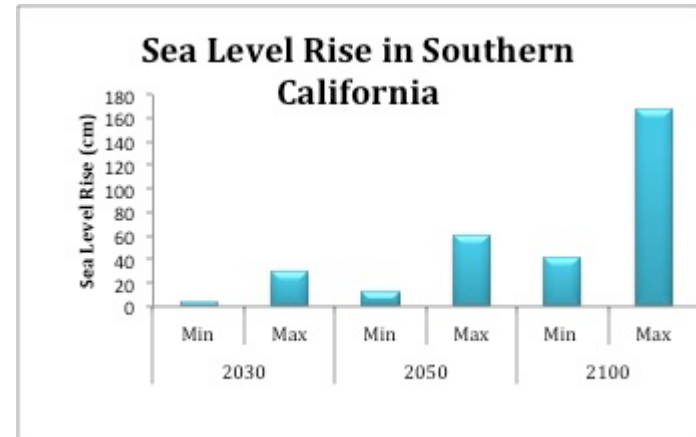
- **Climate change**
 - providing evidence
 - coastal vulnerability and climate adaptation
- Fisheries management
 - Red abalone
- Pollution
 - Oil Spills
 - Water quality (Areas of Special Biological Significance)
- Marine protected area networks
 - Design
 - Evaluation
- Emerging issues: Disease, wave energy, invasive species

Climate change

- Three predictions

1. Sea level rise will cause species to move up (more landward – if there is sufficient habitat)

MARINe monitoring of species' elevations allows detection of shifts in species distributions as small as 5 cm



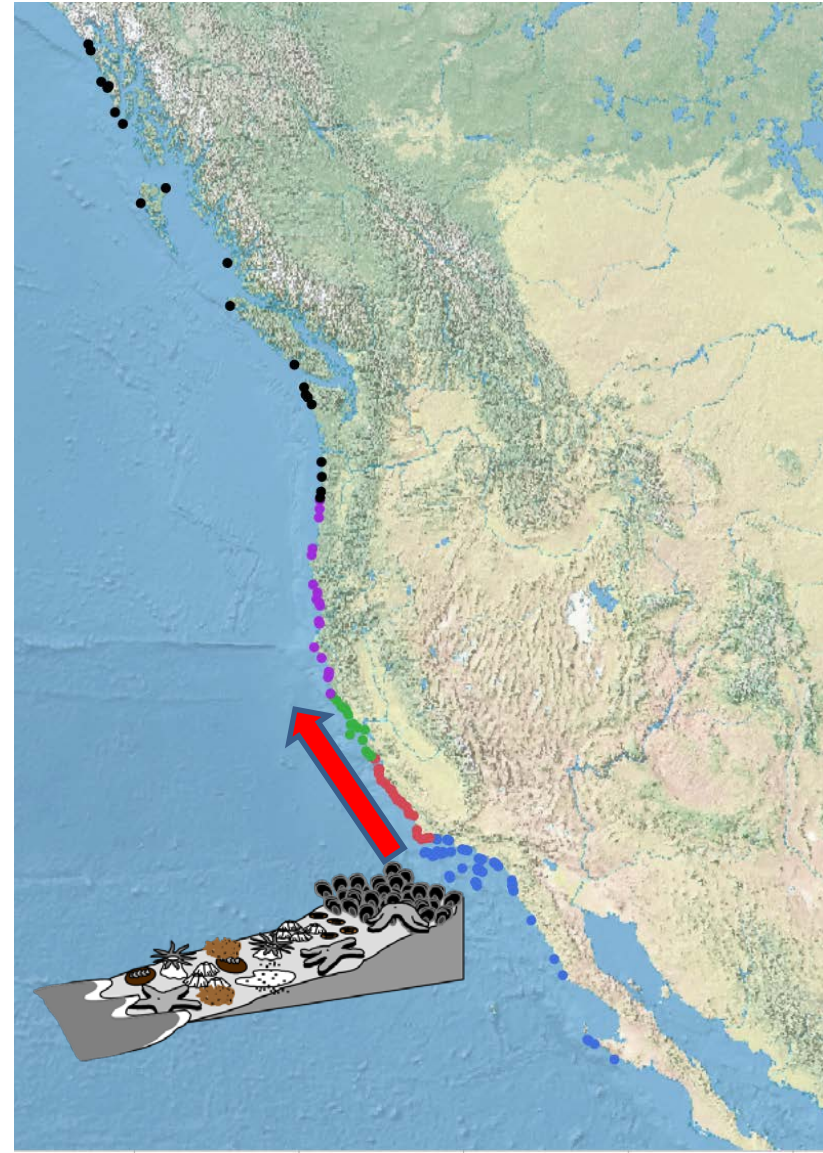
Climate change

- Three predictions

1. Sea level rise will cause species to move up (more landward – if there is sufficient habitat)
2. **Communities will shift geographically -predicted shift is to the north**

MARINE monitoring of >200 communities along the coast allows detection of shifts in the geographic distribution of as little as 3 KM/year

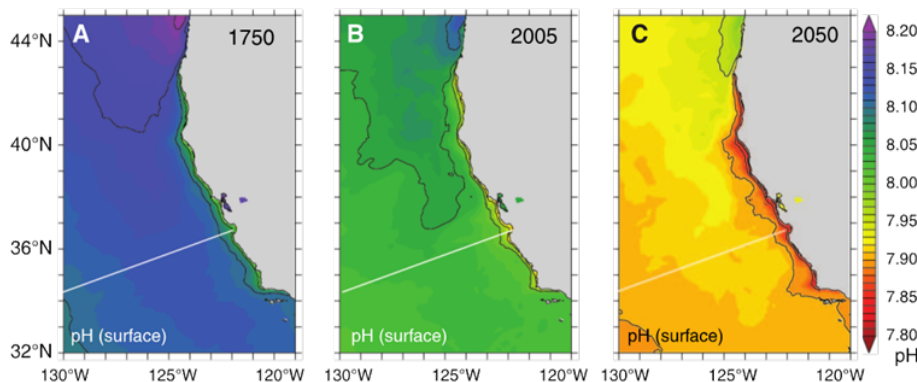
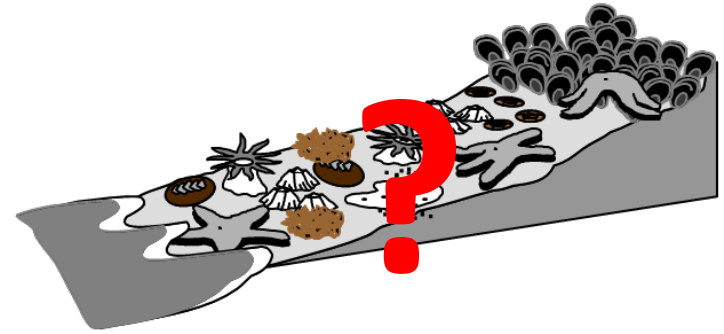
Currently we are seeing a shift of about 3-5 KM per year



Climate change

- Three predictions

- Sea level rise will cause species to move up (more landward – if there is sufficient habitat)
- Ecological communities will shift geographically -predicted shift is to the north
- **Climate change compromises the ability of ecological communities to respond in predictable ways. For example:**
 - Synergistic effects of multiple stressors (e.g. OA, storm frequency and rising sea level)
 - Stressors lead to reduced ability to resist disease.



Examples of diverse applications

- Climate change
 - providing evidence
 - coastal vulnerability and climate adaptation
- **Fisheries management**
 - **Red abalone**
- Pollution
 - Oil Spills
 - Water quality (Areas of Special Biological Significance)
- Marine protected area networks
 - Design
 - Evaluation
- Emerging issues: Disease, wave energy, invasive species

Fisheries management – Red abalone



- Stornetta Ranch (Sea Lion Cove) near Pt Arena
- Private access historically until 2004
- Opened to harvest in 2004-2005
- Closed in 2010 as part of MLPA as a State Marine Reserve
- Rapid recovery of exploited stock
- Rapid increase in Sub-legal recruits

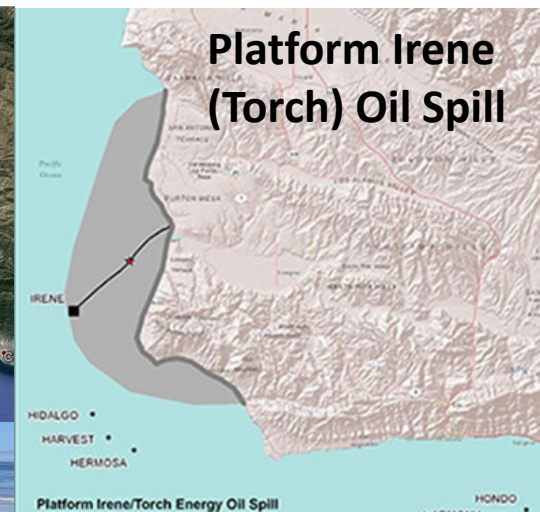


Examples of diverse applications

- Climate change
 - providing evidence
 - coastal vulnerability and climate adaptation
- Fisheries management
 - Red abalone
- **Pollution**
 - **Oil Spills**
 - **Water quality (Areas of Special Biological Significance)**
- Marine protected area networks
 - Design
 - Evaluation
- Emerging issues: Disease, wave energy, invasive species

Oil spills

- Initial (rapid) assessment
- Injury estimation (NRDA context)
- Mitigation activities
 - Habitat and species restoration

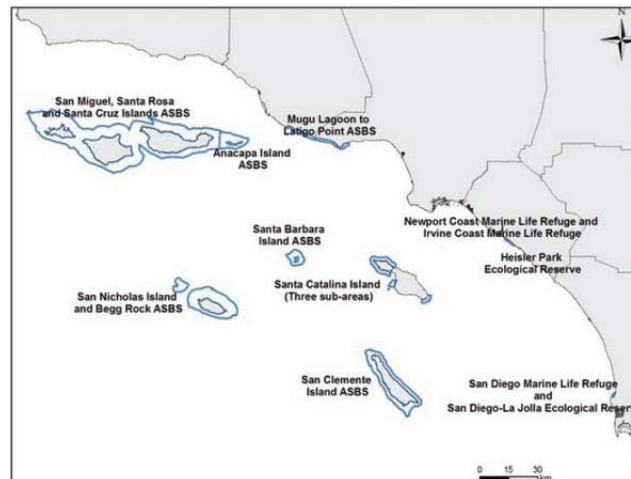
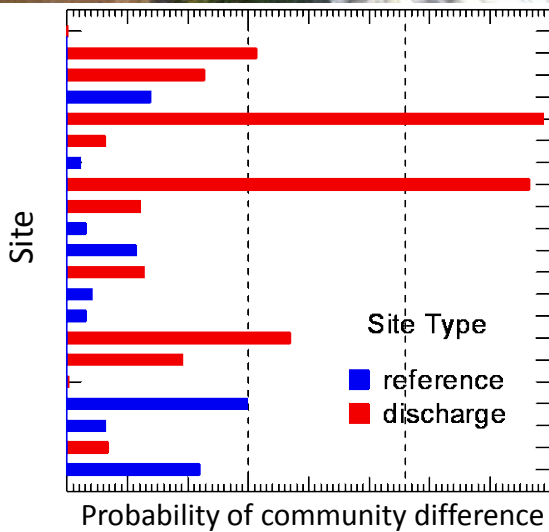




Water Quality – Areas of Special Biological Significance (ASBS)

Assessment of all ASBS in state

- Determination of potential for water quality effects on nearshore ecological communities
- Site specific problems identified

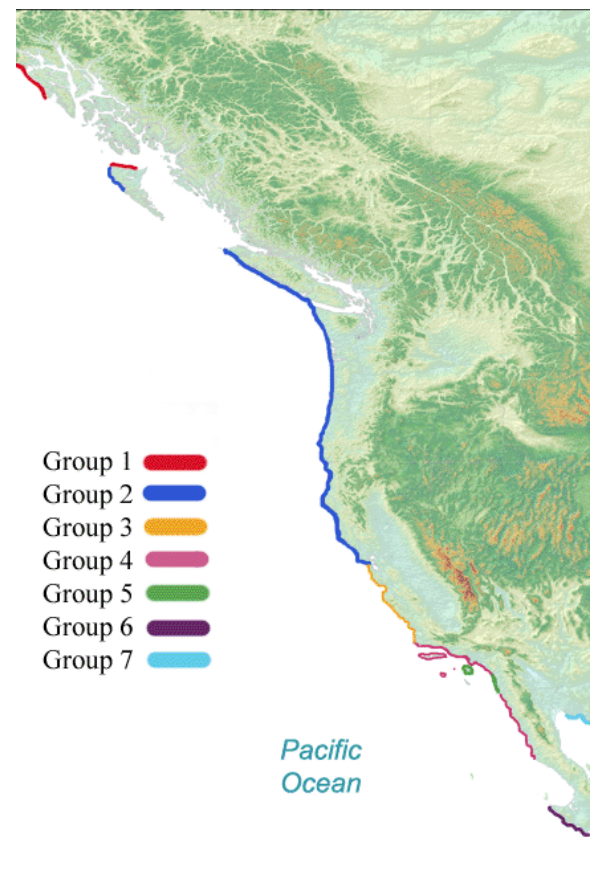


Examples of diverse applications

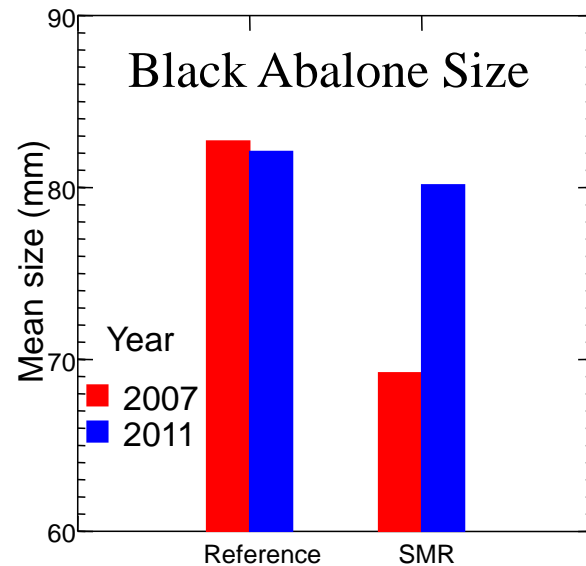
- Climate change
 - providing evidence
 - coastal vulnerability and climate adaptation
- Fisheries management
 - Red abalone
- Pollution
 - Oil Spills
 - Water quality (Areas of Special Biological Significance)
- **Marine protected area networks**
 - **Design**
 - **Evaluation**
- Emerging issues: Disease, wave energy, invasive species

Marine protected area networks

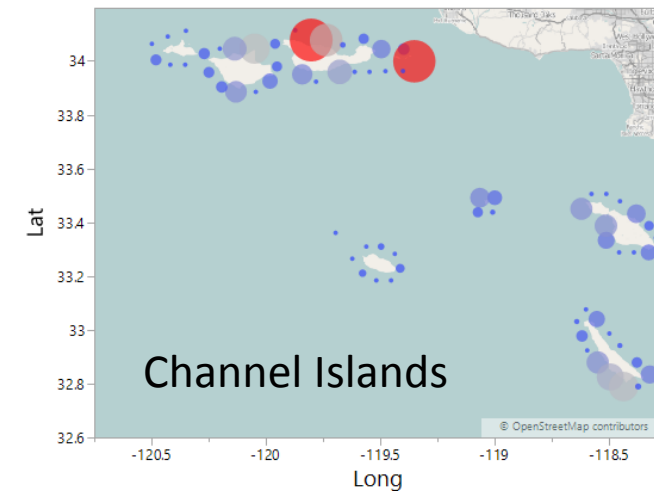
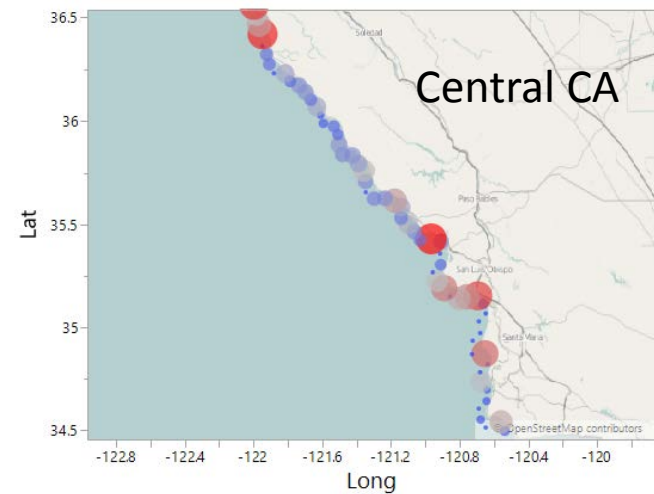
Bioregional design of network



Assessment of effectiveness



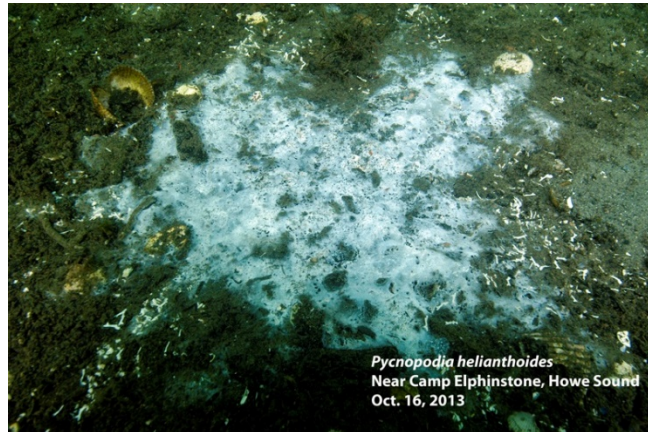
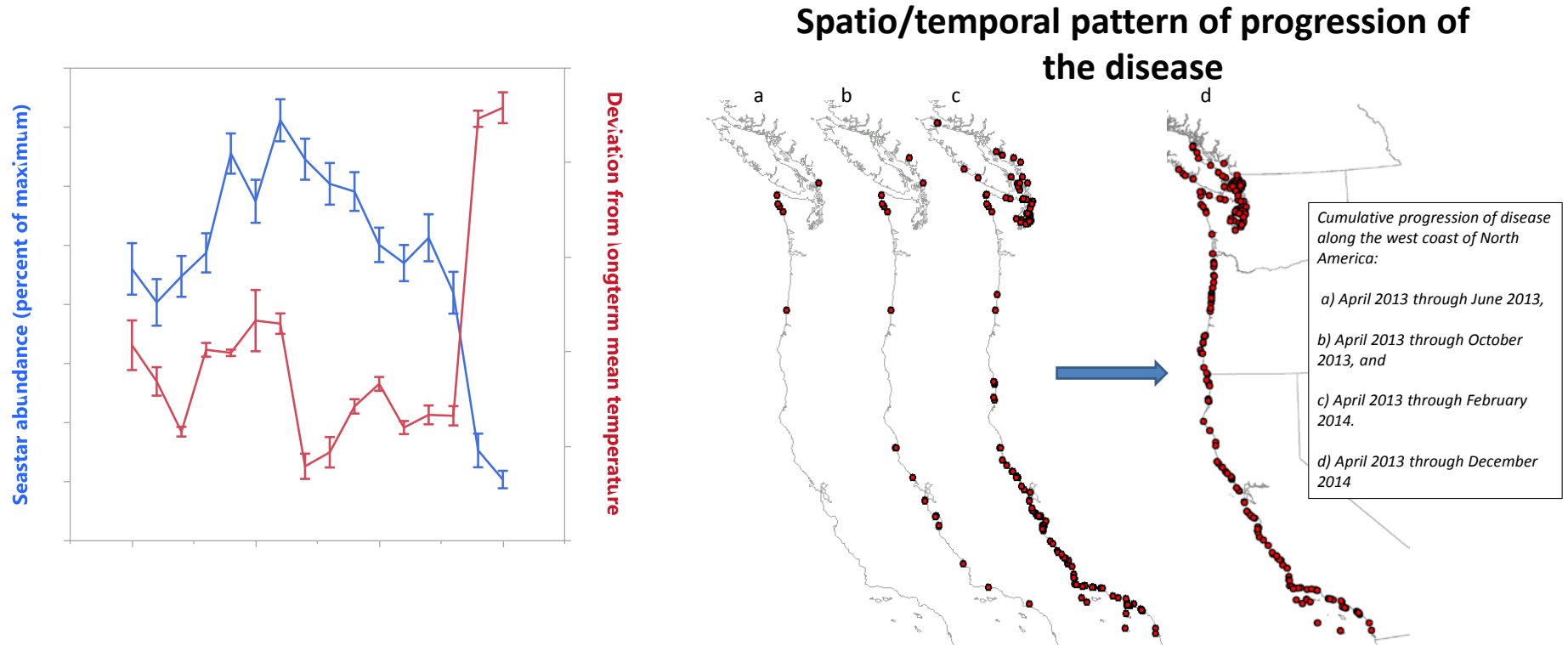
Importance to the network



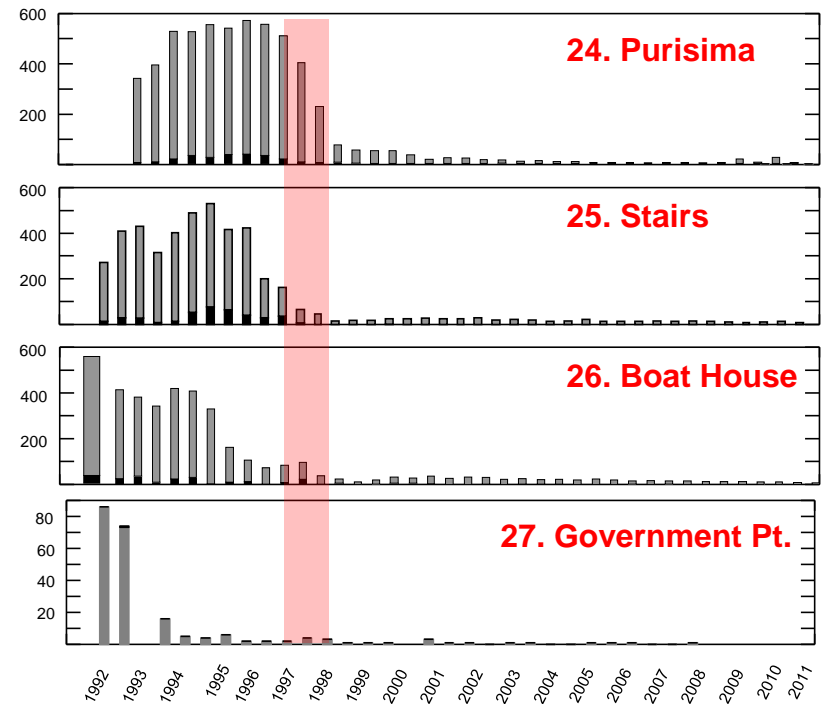
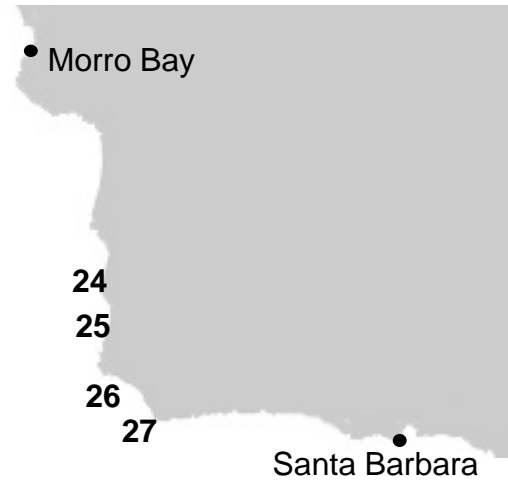
Examples of diverse applications

- Climate change
 - providing evidence
 - coastal vulnerability and climate adaptation
- Fisheries management
 - Red abalone
- Pollution
 - Oil Spills
 - Water quality (Areas of Special Biological Significance)
- Marine protected area networks
 - Design
 - Evaluation
- **Emerging issues: Disease, wave energy, invasive species**

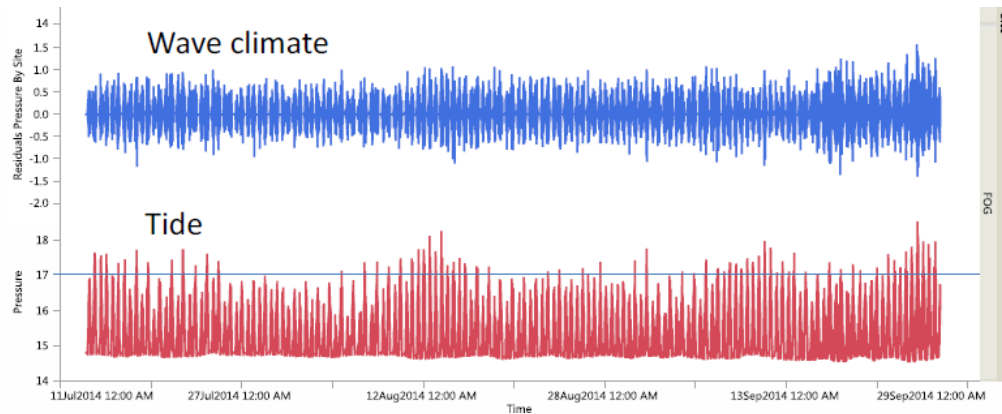
Disease – Sea Star Wasting



Disease – Black abalone Withering



More emerging issues – wave energy, invasive species



- Wave energy
- Invasive species





MARINe Program

General goal: To develop a long-term, spatially extensive, feasible and funded program providing baseline data in areas typically having none in order to assess the structure and function of ecological communities

Specific goals:

In order to inform policy and assess natural and anthropogenic disturbances create:

- **A network of monitoring sites**
- **A common, query enabled database**
- **A set of web-based visualization tools for the public, managers, policy makers and other scientists**
- **A diverse and buffered funding model**