

Long-term Monitoring Program and Experiential Training for Students



Photo: Coke Smith

Teachers conduct LiMPETS monitoring at Frenchy's Cove in the Channel Islands National Marine Sanctuary.

LiMPETS Five-Year Strategic Plan 2010-2015

Introduction

The intertidal habitats of California's national marine sanctuaries are among the most diverse and productive of any region in the world. Despite their ecological significance and protected status, these habitats, along with sandy beaches, are being increasingly impacted by human activities—directly by harvesting and trampling, and indirectly through pollution and litter. In addition, there are dramatic geological and global climatic disruptions, such as earthquakes, severe storms, and El Niño events, that could impact intertidal life along our sanctuary shores. Collecting existing baseline data on their condition is essential.

We have developed a monitoring program that involves teachers, students, and local communities as citizen scientists in a network of long-term data collection of the sand beach and rocky intertidal communities. These citizen scientists gain knowledge about observing nature and doing science, as well as an appreciation about how gathering data can document changes and be used to protect our local marine ecosystems. Through this monitoring effort, these citizen scientists are establishing a web-linked database from which we can better address current and future impacts. The program, Long-term Monitoring Program and Experiential Training for Students, or simply the LiMPETS network, connects teachers, students, and the community to the ocean, involves them directly in a real scientific endeavor, and increases their awareness of, and interest in, the marine environment. The vision of the LiMPETS network is to be recognized and respected as one of the nation's premier student-based citizen science programs.

The LiMPETS network provides authentic, hands-on coastal monitoring experiences that empower teachers, students, and the community to conduct real science and serve as ocean stewards. Teachers participate in professional development to gain the necessary skills and confidence to engage their students in meaningful monitoring activities in the field. Approximately 3,500 teachers and students along the coast of California are already collecting data from rocky intertidal and sandy beach habitats as part of the LiMPETS network in our national marine sanctuaries.



Photo: Claire Fackler

LiMPETS workshops provide an opportunity for educators to gain experience and confidence in ecosystem monitoring.



Photo: Aelfric Wolf

Students gather around a teacher to experience scientific monitoring for Pacific mole crabs.



Photo: Coke Smith

A LiMPETS teacher learns the proper monitoring techniques along a transect line.

National marine sanctuaries are living classrooms where people can see, touch and learn about the nation's spectacular marine life. One of the National Oceanic and Atmospheric Administration's (NOAA) Office of National Marine Sanctuaries mandates is to "enhance public awareness, understanding and appreciation of national marine sanctuaries and the system." The LiMPETS network is one way that three sanctuaries in California are working together to engage teachers, students and the community to conduct real science and promote ocean stewardship.

This education and outreach program aligns with goal two, objective three of the NOAA Office of National Marine Sanctuaries Education Strategic Plan 2010-2020, which is to "enhance ocean and climate literacy through national marine sanctuaries," and "work with formal and informal education groups to develop and enhance ocean and Great Lakes stewardship." The LiMPETS network also fits under outcome 1.3 of the NOAA's Education Strategic Plan 2009-2029, which states that, "educators, students, and/or public collect and use ocean, coastal, Great Lakes, weather, and climate data and inquiry and evidence-based activities."

The LiMPETS network was created in 2002 when the national marine sanctuaries of the West Coast Region worked together to streamline their intertidal student monitoring programs. Student-friendly protocols for monitoring rocky intertidal and sandy beach ecosystems were developed with the expertise and guidance of Dr. John Pearse, Dr. Jennifer Salzman, and other scientists. The LiMPETS network is a collaborative effort among Channel Islands, Monterey Bay and Gulf of the Farallones national marine sanctuaries, Farallones Marine Sanctuary Association, Marine Science Institute at the University of California at Santa Barbara, and the University of California at Santa Cruz.

Addressing Resource Management Issues

Beyond the educational value of citizen science, the power of the LiMPETS network lies in the large quantity of data that is being collected for these California national marine sanctuaries at more than 60 sites and spanning 600 miles of California coastline. Annually, thousands of students gather monitoring data against which future observations will be compared. In the next five years, while the LiMPETS network works to enhance scientific credibility and the quality of datasets, it will also develop targeted research questions that will address some of the most important issues affecting California's sanctuaries: oil spills, water quality, wildlife/ecosystem health, introduced species and effects of climate change.

The LiMPETS dataset has already proven to be valuable to the sanctuary following oil and sewage spills, as demonstrated during the 2007 *Cosco Busan* oil spill. LiMPETS data have been used to assess damage to sandy beach and rocky intertidal ecosystems, and have the potential to address sanctuary resource management issues, such as identify long-term status and trends in intertidal regions, detect emerging issues, and inform resource management decisions.

In the rocky intertidal, LiMPETS data can be used to:

- identify potential changes in health of rocky intertidal areas by tracking variations in abundance of mussels, ochre sea stars, purple sea urchins and owl limpets;
- ascertain changes in communities associated with northward expansion of southern species (e.g. the sea anemone *Anthopleura sola*, and barnacle *Tetraclita rubescens*);
- identify changes in abundance of algal species sensitive to water pollution, oil, and human trampling;
- potentially discover the spread or arrival of introduced species into new territories, such as the green alga *Codium fragile* ssp. *tomentosoides*;
- provide a long-term dataset to inform damage assessment following oil spills;
- identify changes in abundance of calcified invertebrates (e.g. shell forming gastropods, urchin larvae) and algal species (e.g. coralline algae); and
- assess how sea level rise may cause vertical zonation shifts.

In the sandy beach ecosystem, LiMPETS data can be used to:

- identify potential changes in the health of coastal waters by tracking variations in abundance, size and structure of sand crab *Emerita analoga* populations, which depend on plankton for food;
- determine periods when sea otters and surf scoters are more vulnerable to disease by tracking acanthocephalan worm infection rate and load in *E. analoga*;
- track shifts in population densities of southern species in response to environmental conditions (e.g., El Niño, Pacific Decadal Oscillation); and
- provide a long-term dataset to inform damage assessment following oil spills.



Photo: Michelle Kinzel

Sandy beach monitoring in one of our national marine sanctuaries.

LiMPETS Sandy Beach Monitoring Sites in California





Photo: John Pearse

High school students collect data using randomly placed quadrats in a mussel bed at Natural Bridges in Santa Cruz.



Photo: Claire Fackler

Getting partially immersed during sandy beach monitoring is exciting for students.



Photo: NOAA National Marine Sanctuaries

A close-up view of a pregnant female Pacific mole crab, *Emerita analoga*, the species of interest in sandy beach monitoring.

VISION

To be recognized and respected as one of the nation's premier student-based citizen science programs.

MISSION

Provide authentic, hands-on coastal monitoring experiences that empower teachers, students and the community to conduct real science and serve as ocean stewards.

GOAL 1

Enhance scientific credibility.

OBJECTIVE 1

Establish a science advisory panel.

MEANS AND STRATEGIES

- Identify roles, responsibilities and structure of a science advisory panel.
- Appoint principal investigator(s) to lead science advisory panel.
- Select and recruit members of the science advisory panel, including national marine sanctuary scientists and research coordinators, as well as key outside partners

OBJECTIVE 2

Evaluate quality control and accuracy of data.

MEANS AND STRATEGIES

- Finalize the restructuring of the LiMPETS online database.
- Engage the science advisory panel in data assessment to ensure it is accurate and relevant.
- Elicit recommendations from science advisory panel for any procedural modifications to make data collection more robust.
- Work with science advisory panel to periodically review data collection for consistency and to address any issues.
- Create a simple quality assurance/quality control checklist for all LiMPETS coordinators.
- Hire a data management position.

OBJECTIVE 3

Promote credibility of LiMPETS data and research.

MEANS AND STRATEGIES

- Collaborate with members of the science advisory panel to co-author papers with staff for peer-reviewed scientific journals.
- Submit article(s) for inclusion in peer-reviewed scientific journal(s).
- Document which organizations are using LiMPETS data (e.g. *Cosco Busan* oil spill).
- Strategize with key sanctuary staff and researchers about resistance or lack of support for LiMPETS and identify solutions.

OBJECTIVE 4

Publicize LiMPETS data and research to an external audience.

MEANS AND STRATEGIES

- Integrate LiMPETS into the Sanctuary Integrated Monitoring Network (SIMoN) with major trends and data visualizations.
- Present LiMPETS research at scientific and education conferences (e.g. Southern California Academy of Sciences, California and the World Ocean, California Science Teachers Association).
- Make data accessible through MARINE.
- Establish a media plan to advertise information about the science of the LiMPETS network.
- Develop five-year report of LiMPETS data and research.

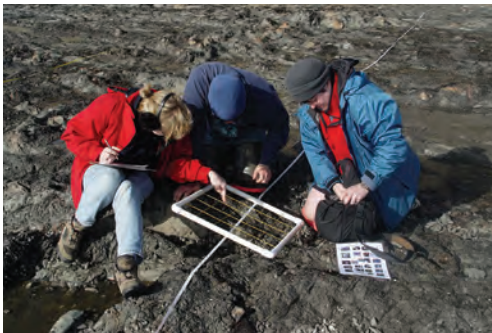


Photo: Kathy deWet-Oleson

Coastal monitoring experiences empower teachers and students to become ocean stewards.



Photo: Coke Smith

The starburst anemone, *Anthopleura sola*, is a southern species near its northern limit in central California that is monitored in LiMPETS.



First generation college-bound students participate in the LiMPETS network.

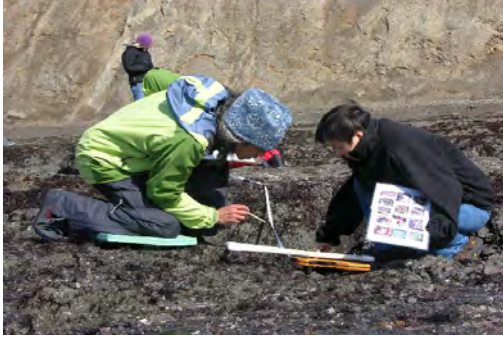


Photo: Amy Dean

Teachers conduct species identification and monitoring techniques at Duxbury reef in Marin County.



Photo: Coke Smith

Professional development workshops offer educators an opportunity to learn the monitoring techniques and gain confidence.



Photo: Kim Castagna

Middle school students from Carpinteria, California learn about the Pacific mole crab during their LiMPETS monitoring field trip.

GOAL 2

Identify strategic funding sources.

OBJECTIVE 1

Institute LiMPETS as a budget line item.

MEANS AND STRATEGIES

- Ascertain the amount needed for transportation, equipment, supplies, and workshops for each region on an annual basis.
- Enlist sanctuary field site superintendents and headquarters to support LiMPETS as a budget line item.
- Leverage B-WET grant recipient's proposals if they propose to conduct LiMPETS, and stipulate a minimum financial requirement as a budget line item in their proposal to support LiMPETS implementation.
- Work with the NOAA Office of National Marine Sanctuaries to get "additions to base" to each LiMPETS field site involved to build out staff.

OBJECTIVE 2

Identify strategic partners and funding opportunities to support the LiMPETS network.

MEANS AND STRATEGIES

- Approach strategic partners that have the potential to offer funds in support of teacher professional development, in-class support, transportation, symposium, etc.
- Identify strategic partners (i.e. Farallones Marine Sanctuary Association) to raise set amount of regional funds each year.
- Determine funding sources and write grants with partners to raise monies for staff support, such as interns, data manager, curriculum developer, evaluator, etc.
- Identify and approach potential donors (e.g. Packard Foundation) about the LiMPETS network as a funding opportunity.

GOAL 3

Build and maintain core staff.

OBJECTIVE 1

Define scope of work and hire new LiMPETS positions.

MEANS AND STRATEGIES

- Define scope of work for data manager to: a) conduct Web site maintenance; b) develop new, innovative online tools; and c) analyze LiMPETS data, including data summaries for peer-reviewed scientific journals, newspaper articles, etc.
- Employ a data manager.
- Develop scope of work for professional evaluator role to implement evaluation plan to assess program effectiveness.
- Retain a professional evaluator.
- Determine scope of work for curriculum developer to align all existing educational resources and curricular materials to the appropriate California state education standards.
- Hire a curriculum developer.
- Define the role and responsibilities for a West Coast Regional LiMPETS coordinator.

OBJECTIVE 2

Develop a plan for additional support staff.

MEANS AND STRATEGIES

- Outline a plan for additional staff support to ensure two full time (or equivalent) dedicated LiMPETS field staff.
- Hire support staff.
- Assess the opportunities to bring on interns and volunteers from local colleges, universities, and community groups.
- Define scope of work for interns and community groups.
- Retain interns and coordinate community groups.



Photo: Coke Smith

Teachers get practice identifying algal and invertebrate species while monitoring along a transect line.



Photo: John Pearse

Sea stars and sea anemones are two major predators in the intertidal that get monitored along the coast in the LiMPETS network.



Photo: Aelfric Wolf

Even young students and community members can get involved in the LiMPETS network to contribute long-term data.



Photo: Aelfric Wolf

Students get involved in the hands-on monitoring protocols of the LiMPETS network.



Photo: Amy Dean

Inner city students from Oakland, CA monitor mole crabs at Linda Mar beach in Pacifica.



Photo: Claire Fackler

LiMPETS workshops take educators out into the field to explore and connect with the environment.

- Identify and confirm a Sandy Beach Scientific Advisor and Rocky Intertidal Scientific Advisor.
- Coordinate with science advisory panel to contribute time and support LiMPETS in varying capacities.

OBJECTIVE 3

Dedicate a higher percentage of sanctuary staff time for LiMPETS.

MEANS AND STRATEGIES

- Incorporate LiMPETS into staff performance plans to increase percentage of staff time on the program.
- Collaborate with regional superintendents and headquarters to assign a West Coast LiMPETS coordinator to fully implement the LiMPETS strategic plan.

GOAL 4

Cultivate strategic and effective partnerships.

OBJECTIVE 1

Enhance capabilities of the LiMPETS network through partnership development.

MEANS AND STRATEGIES

- Develop baseline information of current partnerships within the program.
- Identify potential strategic partners and define their role (i.e. funding strategies, sharing volunteers, administrative oversight for specific sites, and promotion of the program).
- Define criteria for effective partners (for administrative support, grant opportunities, etc.).
- Conduct a meeting(s) with partners to outline the needs of the LiMPETS network.
- Discuss funding strategies with partners.
- Identify funding opportunities appropriate for partners.
- Host a “Train the Trainer” workshop(s) for individual partners.

- Begin a mentor program (for volunteers, students, and other agency staff) to provide oversight of data collection in the field.

OBJECTIVE 2

Promote the LiMPETS network through strategic partners.

MEANS AND STRATEGIES

- Coordinate with strategic partners on promotion of the LiMPETS network through their organization or facility (e.g. Cabrillo Marine Aquarium, Cal Academy of Sciences, Lawrence Hall of Science).
- Highlight these partnerships within the LiMPETS web site, on printed materials, and through the National Marine Sanctuary System and other organizations.

GOAL 5

Augment education content and standardize implementation of LiMPETS.

OBJECTIVE 1

Standardize and improve educational materials.

MEANS AND STRATEGIES

- Assess the status of current LiMPETS curriculum and resources and identify discrepancies.
- Delineate and strengthen alignment of existing educational materials and curriculum to California state education standards and ocean and climate literacy principles.
- Host a focus group to conduct a needs assessment on current curriculum and activities.
- Develop new, standards-aligned curriculum.
- Identify and develop multicultural resources for target audiences.

OBJECTIVE 2

Develop innovative online tools.

MEANS AND STRATEGIES

- Finalize the restructuring of the LiMPETS online database.
- Complete user-friendly web interface updates on new web site.
- Develop a plan for new online technology (e.g. virtual training).



Photo: Amy Dean

High school students from Daly City have been monitoring Ft. Funston beach in the spring and fall every year since 2002.



Photo: Farallones Marine Sanctuary Association

Students have fun monitoring mole crabs at an urban beach in San Francisco.



Photo: Claire Fackler

LiMPETS sandy beach monitoring protocols engage citizen scientists in real science activities.



Photo: Amy Dean

San Francisco State University students learn about ecological sampling techniques through their participation in the LiMPETS network.



Photo: Coke Smith

Teachers explore Frenzy's Cove on Anacapa Island before they set out to monitor the rocky intertidal site.

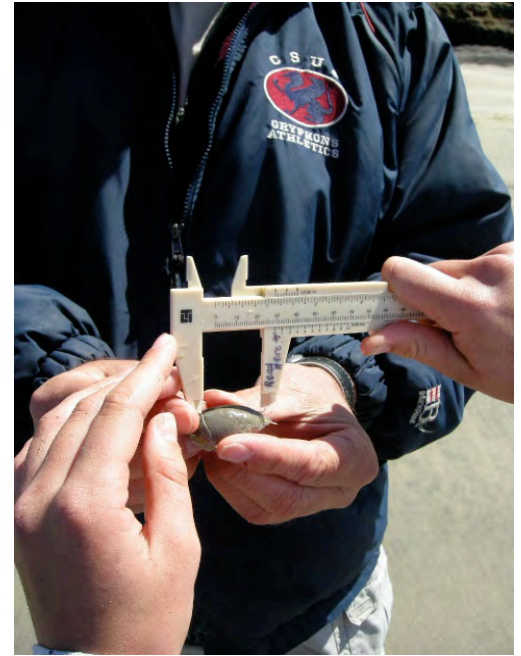


Photo: Amy Dean

Calipers are the primary tool used to measure Pacific mole crabs following the LiMPETS sandy beach monitoring protocols.

OBJECTIVE 3

Provide consistent training and support for teachers, students, and communities across the network.

MEANS AND STRATEGIES

- Assess current inventory of monitoring equipment.
- Plan for regional workshop(s) and seek funding to support travel and stipends.
- Conduct a regional workshop(s) to debut new standards-based curriculum and educational materials.
- Plan for a LiMPETS symposium and seek funding to support travel and stipends.

GOAL 6

Implement a cohesive evaluation plan throughout the region.

OBJECTIVE 1

Perform an assessment on what LiMPETS evaluation tools already in existence, including the Bay Watershed Education and Training (B-WET) grant recipients that are conducting LiMPETS.

MEANS AND STRATEGIES

- Coordinate with a professional evaluator.
- Assess all pre- and post-evaluations from past LiMPETS workshops.
- Review evaluation tools being used by B-WET grant recipients that are conducting LiMPETS.
- Determine what evaluation strategies and tools are most effective.
- Define what components of the LiMPETS network need to be evaluated (e.g. professional development opportunities, field experiences, educational content, accuracy of data, etc.).
- Elicit and present professional evaluator recommendations for first overall LiMPETS regional evaluation plan.

OBJECTIVE 2

Develop an evaluation plan.

MEANS AND STRATEGIES

- Work with the professional evaluator to develop a cohesive evaluation plan.
- Determine incentives for LiMPETS teachers who complete the evaluation.
- Establish all of the evaluation tools and strategies that will be used over the next five years.
- Build an online assessment tool that captures information about field experiences, retention of LiMPETS teachers, long-term student participation, and educational content (e.g. Web site, curriculum).
- Develop consistent pre- and post-evaluations for teacher workshops and other interactions with educators.
- Involve the scientific advisory panel in evaluation of the quality of data being collected by teachers, students and community groups.

OBJECTIVE 3

Implement the cohesive evaluation plan.

MEANS AND STRATEGIES

- Host an online assessment tool on web site and advertise incentives for teachers who complete the evaluation.
- Promote participation in our evaluation of the program through emails and letters to the LiMPETS network.
- Evaluate data quality annually and include input from the scientific advisory panel.

OBJECTIVE 4

Share evaluation data broadly.

MEANS AND STRATEGIES

- Publish evaluation data on web site, at LiMPETS symposium, and/or other conferences as appropriate.
- Collaborate with scientific advisory panel members to co-author papers on evaluation data.
- Share data with partners to promote the LiMPETS network.



Photo: Anthony Fisher, FMSA

An owl limpet, *Lottia gigantea*, on her "farm" is one of the key indicator species monitored by the LiMPETS network.



Photo: Farallones Marine Sanctuary Association

Teacher workshops train new educators to get involved and get them excited about monitoring at the beach.



Photo: Amy Dean

Young women from Branson High School monitor Duxbury Reef in Marin County.

L i M P E T S

Rocky Intertidal Monitoring Sites

2010

