LiMPETS
Long-term Monitoring Program and Experiential Training for Students


Photo: Jessie Altstatt, NOAA

LiMPETS Five-Year Strategic Plan 2017-2021

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 long-term regional baseline data on these habitats is essential.

The LiMPETS team has developed a monitoring program that involves teachers, students and local communities as citizen scientists in a network of long-term data collection of the sandy 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 contributing to 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 inspire the next generation to understand, value, and participate in science.

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 5,000 teachers, students and community members along the coast of California are already collecting data from rocky intertidal and sandy beach habitats in our national marine sanctuaries as part of the LiMPETS network.

Photo: Monica Krach, Greater Farallones Association

Teachers learn and practice sandy beach monitoring protocols during a LiMPETS professional development series for teachers.

Photo: Jessie Altstatt, NOAA

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

Photo: Abe Borker, UC Santa Cruz

Participating in LiMPETS rocky intertidal monitoring program, students lay out a transect at Fitzgerald Marine Reserve.

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 national marine sanctuaries in California are working together to engage teachers, students and the community to conduct real science and promote ocean stewardship.

The LiMPETS network aligns with many NOAA education strategies as listed below:

- Work with formal and informal education groups to develop and enhance ocean and Great Lakes stewardship. (NOAA Office of National Marine Sanctuaries Education Strategic Plan 2010-2020, Goal 2, Objective 3)
- Educators, students, and/or public collect and use ocean, coastal, Great Lakes, weather, and climate data and inquiry and evidence-based activities. (NOAA Education Strategic Plan 2009-2029, Outcome 1.3)
- Reduce threats to key species and important marine habitats. (Our Vision for America's Treasured Ocean Places in Goal 1, Objective 1.1)
- Increase sanctuary engagement. (Our Vision for America's Treasured Ocean Places in Goal 3, Objective 3.2)

The LiMPETS network was created in 2002 when the national marine sanctuaries of the West Coast Region worked together to streamline their student intertidal 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 Greater Farallones national marine sanctuaries, Greater Farallones Association, Marine Science Institute at the University of California at Santa Barbara, the University of California at Santa Cruz and the Pacific Grove Museum of Natural History.

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 teachers and students gather monitoring data against which future observations will be compared. Over the past 10 years, the scientific community's understanding of beach ecology and sand crab population trends has grown, and preferred sampling regimes have changed. LiMPETS continues to maintain the scientific validity and relevance of our program by adopting recommendations from top coastal scientists. Recent modifications based on these recommendations include the creation of new adaptive sandy beach monitoring protocols, quality assurance measures and a Quality Assurance Project Plan. These changes will enhance the scientific credibility of the program and allow resource managers and scientists to leverage LiMPETS data for future management decisions.

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 the 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;
- 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) affected by ocean acidfication;
- assess how sea level rise related to climate change may cause vertical zonation shifts; and
- better meet the science needs and resource protection issues of California's national marine sanctuaries.

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 *Emerita analoga* in response to environmental conditions (*e.g.*, El Niño, Pacific Decadal Oscillation);
- provide a long-term dataset to inform damage assessment following oil spills; and
- better meet the science needs and resource protection issues of California's national marine sanctuaries.

Photo: Jessie Alstatt, NOAA

Rocky intertidal monitoring in one of our national marine sanctuaries.

LiMPETS Monitoring Sites in California

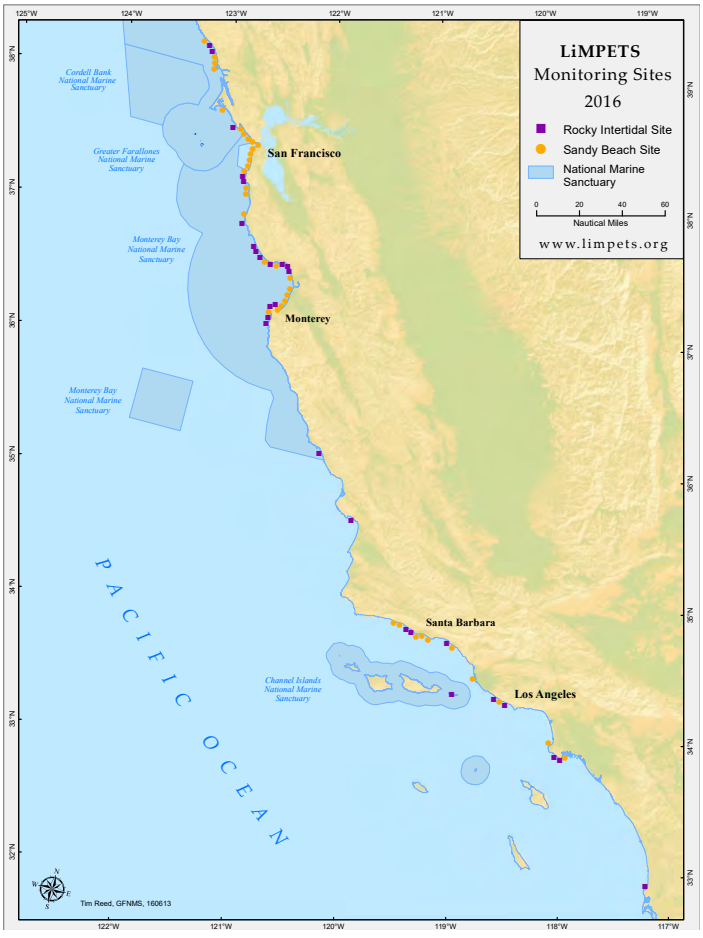

Photo: John Pearse

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

Photo: Claire Fackler, NOAA

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

Photo: NOAA National Marine Sanctuaries

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

VISION

Inspire the next generation to understand, value, and participate in science.

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
Standardize network-wide data collection and recording methods.

MEANS AND STRATEGIES

- Develop and follow a Quality Assurance Project Plan (QAPP)
- Develop and follow implementation standards that outline protocol
- Standardize and collect meta-data about participating groups

OBJECTIVE 2
Evaluate quality control and accuracy of data.

MEANS AND STRATEGIES

- Complete data checks twice yearly
- Reassess QAPP on an annual basis
- Conduct internal analysis and create report of how we have met Data Quality Objectives
- Seek feedback on Data Quality Objectives from external scientists

OBJECTIVE 3
Promote use of LiMPETS data and research.

MEANS AND STRATEGIES

- Encourage student use of data (*e.g.*, classroom data analysis, science fairs, posters)
- Perform data analysis to produce results in digestable form for external clients (*e.g.*, NOAA Office of National Marine Sanctuaries, SiMON)
- Publish in peer-reviewed journals (*e.g.*, Sanctuary Conservation Series)
- Present at conferences and meetings (*e.g.*, MARINe, MPA Collaborative groups, Citizen Science Association)

OBJECTIVE 4
Publicize LiMPETS data and research to an external audience.

MEANS AND STRATEGIES

- Publish LiMPETS data in broader public forum (*e.g.*, newspapers, social media, newsletters)

GOAL 2

Identify strategic funding sources.

OBJECTIVE 1
Establish introductory job descriptions and proposed funding levels for staff to support LiMPETS network.

MEANS AND STRATEGIES

- Identify network-wide costs of office, supplies, overhead, etc.
- Outline current operation
- Develop overhead standards and ranges

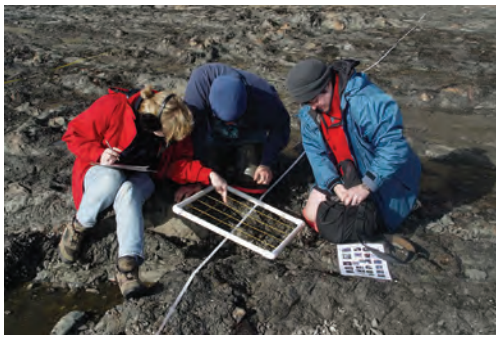

Photo: Kathy deWet-Oleson

Coastal monitoing 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.

Photo: Claire Fackler, NOAA

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

Photo: Abe Borker, UC Santa Cruz

Participating in LiMPETS rocky intertidal monitoring program, students lay out a transect at Fitzgerald Marine Reserve.

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.

OBJECTIVE 2
Identify strategic partners and funding opportunities to support the LiMPETS network.

MEANS AND STRATEGIES

- Develop story about entire network
  - Clarify how network is structured and implemented
  - Use common language and implementation standards network-wide
- Continue conversations with National Marine Sanctuary System about short-term and long-term funding
- Explore other federal funding opportunities (*e.g.*, NSF, NOAA)
- Develop funding plan for network
- Work with development professionals
- Create templates for implementing organizations to use in their grant proposals (*e.g.*, B-WET, NOAA Marine Debris)
- Develop a list of needs for one-time purchases (under $3,000) at end of the year

OBJECTIVE 3
Identify funding sources for immediate needs.

MEANS AND STRATEGIES

- Work to maintain Channel Islands National Marine Sanctuary's involvement in LiMPETS
- Continue to develop unique site-specific funding opportunities
- Track network-wide costs and effort as opposed to regional operations

GOAL 3

Build and maintain core staff.

OBJECTIVE 1
Define scope of work for current staff.

MEANS AND STRATEGIES

- Create outline of current LiMPETS staff members' duties and time spent supporting LiMPETS

OBJECTIVE 2
Develop a plan and priorities for additional support staff.

MEANS AND STRATEGIES

- Priority positions include:
  - Two full-time staff per network site
  - Network Coordinator
  - Database Coordinator
  - Science Coordinator
  - Education and Evaluation Coordinator

GOAL 4

Cultivate strategic and effective partnerships.

OBJECTIVE 1
Define roles and relationships to formalize LiMPETS network entry process for partners.

MEANS AND STRATEGIES

- *Network Partners* will provide teacher workshops, act as decision-making body and manage implementing organizations
- Create agreement for *Implementing Organizations* (delineated by data entry and non-data entry level partner) that will follow implementation standards and support network through coordinated funding
- Identify *Advisors* who can be available to *Network Partners* for subject matter expertise (*e.g.*, students evaluations, development, data analysis)
- Begin a mentor program (for volunteers, students, and other agency staff) to provide oversight of data

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.

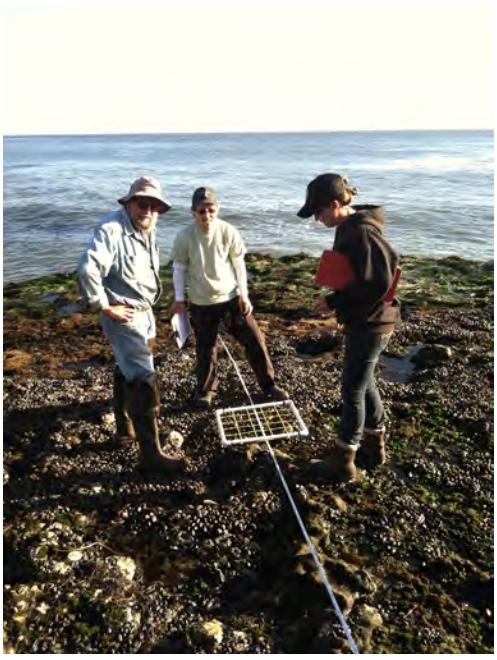

Photo: NOAA

Community members can get involved in the LiMPETS network to contribute long-term data.

Photo: Jessie Altstatt, NOAA

Students have fun getting a bit wet during the adaptive sampling protocols of LiMPETS monitoring.

Photo: Jessie Altstatt, NOAA

Students monitor the rocky intertidal habitat off Campus Point in Santa Barbara.

Photo: Claire Fackler, NOAA

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

- Create agreement for *Teaching Partners* who participate in coordinator-facilitated LiMPETS with their students

OBJECTIVE 2
Utilize LiMPETS network effectively through focused discussions.

MEANS AND STRATEGIES

- Conduct monthly LiMPETS coordinator calls and set up a topic list and calendar
- Conduct six yearly LiMPETS network calls with agendas that rotate through strategic plan action items or special topics
- Hold annual face-to-face network meeting

OBJECTIVE 3
Promote the LiMPETS network through strategic partners.

MEANS AND STRATEGIES

- Create branding, messaging and publicity plan that includes all partner levels (*e.g.*, style guide, boilerplate langauge, consistent messaging to teacers)

GOAL 5

Augment education content and standardize implementation of LiMPETS.

OBJECTIVE 1
Formalize different levels of involvement in LiMPETS

MEANS AND STRATEGIES

- Determine and utilize implementation standards for all levels
- Use consistent branding on materials for all levels
- Create standardized implementation agreements for all levels

OBJECTIVE 2
Standardize and improve educational materials.

MEANS AND STRATEGIES

- Highlight Next Generation Science Standard connections in existing curriculum materials
- Increase inquiry and exploration opportunities for students and teachers
- Tie LiMPETS into context of Earth Systems Science
- Align education materials with evaluation tools

OBJECTIVE 3
Continue to develop innovative educational tools.

MEANS AND STRATEGIES

- Add new online tools (*e.g.*, search bar on website)
- Utilize teacher network for sharing resources
- Develop new materials mindful of multiple learning styles
- Ensure accessibility to new materials for students with limited internet access
- Make new educational tools bilingual as they are developed

OBJECTIVE 4
Provide consistent training and support for teachers, students and communities across network.

MEANS AND STRATEGIES

- Formalize student assessment processes
- Make resources outside of curriculum available
- Document management, implementation and QAPP procedures
- Emphasis teacher involvement and responsibilities during training
- Increase teacher comfort-level with subject matter by providing resources and support
- Provide opportunities for coordinator-facilitated or supported follow-up activities (*e.g.*, data analysis and science communication)
- Transition existing educational and training tools to be bilingual

Photo: Abe Borker, UC Santa Cruz

High school student from Sacred Heart Cathedral holds a Pacific mole crab she found while monitoring for LiMPETS at Ocean Beach.

Photo: Greater Farallones Association

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

Photo: Claire Fackler, NOAA

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

Photo: Jessie Altstatt, NOAA

A student shows the sand crab he caught before measuring and sexing the individual and then returning it to the swash zone.

Photo: Coke Smith

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

Photo: Claire Fackler, NOAA

Teachers test out the adaptive sampling protocols on Santa Rosa Island in the Channel Islands National Marine Sanctuary and National Park.

GOAL 6

Implement a cohesive evaluation plan throughout the network.

OBJECTIVE 1
Perform an assessment on what LiMPETS evaluation tools are already in existence.

MEANS AND STRATEGIES

- Review current network evaluation tools from teacher workshops, student surveys, and end-of-year teacher surveys

OBJECTIVE 2
Develop a network evaluation plan that addresses all audiences.

MEANS AND STRATEGIES

- Address the following audiences:
  - Students
  - Teachers
  - Scientists
  - Leadership
  - Policy Makers
- Outline a timeline and implementation plan for network evaluations
- Define a plan to report evaluations
- Work with an evaluation advisor/consultant

OBJECTIVE 3
Implement a cohesive and comprehensive evaluation of LiMPETS participants.

MEANS AND STRATEGIES

- Provide incentives for students and teachers to complete evaluations.

OBJECTIVE 4
Share evaluation data broadly.

MEANS AND STRATEGIES

- Publish evaluation report on LiMPETS website and newsletter and share data at conferences.
- Update program advisors on evaluation results.
- Work with program advisors to co-publish evaluation data in peer-reviewed journals.

OBJECTIVE 5
Use evaluation results to inform program improvements.

MEANS AND STRATEGIES

- Review results annually and edit materials and resources as appropriate.

Photo: Anthony Fisher, Greater Farallones Association

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

Photo: Greater Farallones Association

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

Photo: Monika Krach, Greater Farallones Association

An AP Biology class celebrate after collecting baseline data at Pigeon Point, one of LiMPETS rocky intertidal monitoring sites.

GREATER
FARALLONES
ASSOCIATION