Citizen Science Programs and Projects in NOAA

The following is a list of some of the citizen initiatives the National Oceanic and Atmospheric Administration (NOAA) supports. This list was compiled over a few days in January of 2013. It is not meant to be comprehensive, but does provide a general picture of the diversity and depth of initiatives that the Agency is involved with.

Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS)

- **Objectives/Goals:** CoCoRaHS is community-based network of volunteers to measure and map precipitation (rain, hail and snow). All volunteers are welcome: the only requirements are an enthusiasm for watching and reporting weather conditions. Each time a rain, hail or snow storm crosses an area, volunteers take measurements of precipitation from as many locations as possible. These precipitation reports are then recorded on line and data are displayed and organized for end users. The aim is to provide the highest quality data for natural resource, education and research applications by using low-cost measurement tools, stressing training and education, and utilizing an interactive Web-site. The NSF and NOAA are major sponsors of CoCoRaHS (CoCoRaHS is on the second of two Environmental Literacy Grants from NOAA's Office of Education).

    1. provide accurate high-quality precipitation data for our many end users on a timely basis;
    2. increasing the density of precipitation data available throughout the country by encouraging volunteer weather observing;
    3. encouraging citizens to have fun participating in meteorological science and heightening their awareness about weather;
    4. providing enrichment activities in water and weather resources for teachers, educators and the community at large.

- **Start Date:** The network originated with the Colorado Climate Center at Colorado State University in 1998 and has since expanded to become a nationwide organization. Also, they recently expanded to Mexico and Canda at the request of the NWS.
- **Scale/Size:** CoCoRaHS has a broad user community including the National Weather Service (NWS), other meteorologists, hydrologists, emergency managers, city utilities (water supply, water conservation, storm water), insurance adjusters, USDA, engineers, mosquito control, ranchers and farmers, and outdoor & recreation interests. They receive over 10,000 reports a day from volunteers.
- **Progress/Impact:** Many NWS offices link to their site and many NWS employees are CoCoRaHS trainers and/or state/regional coordinators. The data collected by these citizen scientists are also heavily relied upon by state climatologists throughout the US.

- CoCoRAHS provides environmental literacy messages to their volunteers, often linked to NOAA resources.
- The current NOAA OED grant will enhance partnerships within NOAA including the National Weather Service, the National Climatic Data Center, the Earth Systems Research Lab and the National Operational Hydrologic Remote Sensing Center, so that precipitation data quality and accessibility for professional users will be enhanced. The CoCoRaHS network will be constructing training, data entry and visualization tools utilizing Web 2.0 concepts, cyberlearning tools and hand-held device applications with a goal of increasing participation and expanding the current volunteer network into broader, younger, more diverse and more interactive audiences.
- They recently added drought impact reports (http://www.cocorahs.org/ViewData/ListDroughtImpactReports.aspx) and have put out information about the drought. They received over 950 drought reports in the summer of 2012 that helped detail that extreme period of time.

Precipitation Identification Near the Ground (PING)

- **Objectives/Goals**: Collect public reports of precipitation type (snow, rain, hail, sleet, freezing rain) to improve precipitation identification algorithms on NEXRAD. People can use the website interface or apps on their mobile devices.
- **Start Date**: PING project and website where volunteers could report, 2006; mobile apps, late 2012. The new mobile apps have made a huge difference in engaging the public.
- **Project Scale/Size**: Users include researchers, students and teachers, forecasters, TV meteorologists, members of the transportation industry including aviation, power utilities, city managers, law enforcement and the general public.
- **Progress/Impact**: Number of submissions is 23,500 reports so far. Goal is to have many tens of thousands of reports over a wide range of weather scenarios.

Marine Debris Tracker Mobile App

- **Objectives/Goals:** The Mobile App Marine Debris Tracker is a joint partnership of the NOAA Marine Debris Program and the Southeast Atlantic Marine Debris Initiative (SEA-MDI), located within the College of Engineering at the University of Georgia. A primary goal of SEA-MDI is to use innovative technologies and unique expertise to add culturally relevant outreach tools and information to the current NOAA Marine Debris Program. Marine Debris Tracker is the first product of this initiative. It is our hope that it will spread awareness of marine debris, as well as serve as an easy to use and simple tool for marine debris data collection. Marine Debris Tracker can be used by scientists, citizens and citizen scientists. The Marine Debris Tracker mobile application allows anyone to help make a difference by checking in when they find trash on our coastlines and waterways. It is available for both Android and iOS (iPhone, iPod, and iPad) platforms.
- **Start date of project:** SEA-MDI began September 1, 2010. Marine Debris Tracker was publically released on May 13, 2011 (NOAA press release).

- **Project scale/size:** The app is used throughout the world. See map of where data collected at right. The website has been viewed by people in 129 different countries (1.USA, 2.Canada, 3.UK) and every US state.

- **Progress/Impact:** The project met its goals of creating and releasing the app to collect data on marine debris throughout the world; and, use of the app and outreach continues to expand. Statistics are reported upon request (and minimally twice a year in progress reports to NOAA). The following statistics on outreach and use are current as of January 22, 2013. On Twitter, @DebrisTracker has 690 Followers, 777 Following, and has made 1,505 tweets. The website has had 10,248 unique visitors, 14,708 visits, and 74,383 page views. The Android app has been downloaded 3,217 times with 651 active apps, and 16 ratings for a total rating of 4.5 stars. The iPhone app has been downloaded 4,028 times. Total combined downloads of the app is 7,245. Marine debris data collected: 11,750 entries/location points; 134,402 total items logged. Press has included newspapers, Environmental Protection Magazine, New York Times Green Blog, Our Amazing Planet, Marine Protected Areas – Information for Educators, WTOC, Savannah, Treehugger.com, Smithsonian National Museum of Natural History Ocean Portal Blog, Teaching Your Students About Marine Debris: a Classroom Activity, and numerous other blog mentions. Examples of users (based upon communication to SEA-MDI): Georgia Sea Turtle Science Center, Clean Coast (GA), Madeira Beach Middle School (FL), Makah Fisheries Management (WA).

<u>National Weather Service SKYWARN</u>

- **Objectives/Goals:** NWS and partner groups set up SKYWARN, a volunteer program with trained severe weather spotters to obtain critical weather information from a variety of locations. SKYWARN volunteers help keep communities safe by sending NWS timely and accurate reports of severe weather and warning signs for earthquakes, landslides, avalanches, volcanic ashfall, and coastal hazards such as tsunamis, water spouts and rip currents where appropriate. SKYWARN storm spotters form the Nation's first line of defense against severe weather.
- **Start Date:** Since the program started in the 1970s, SKYWARN information, coupled with Doppler radar technology, improved satellite data and other resources, has enabled NWS to issue more timely and accurate warnings for tornadoes, severe thunderstorms and flash floods.
- **Scale/Size & Impact:** SKYWARN is a volunteer program with more than 230,000 trained severe weather spotters. Anyone with access to a telephone or HAM radio can join the SKYWARN program. Spotters can also submit reports through the internet on their local NWS Forecast Office web site. Spotters include police and fire personnel, dispatchers, EMS workers, public utility workers and other citizens interested in weather. NWS encourages staff at hospitals, schools, churches, nursing homes and other key locales to become a spotter. Training classes are free and typically are about 2 hours.

National Weather Service Marine Reporting Program (MAREP)

Objectives/Goals: MAREP is a program whereby mariners report current coastal weather conditions in the form of plain language reports to local Weather Forecast Offices producing Coastal Weather Forecasts. Unlike the SKYWARN program, pre-registration and training is not usually a prerequisite for participation. Available reporting methods and procedures include Cellular telephone, HF Marine radio, VHF Marine Radio, Ham Radio, Webforms and e-mail.

Website: The National Weather Service needs your help!!! If you spend any time out on the waters...you realize the importance of a timely and accurate weather forecast. Unfortunately, we do not have a lot of buoy data out in our coastal waters. Because so many mariners have cellular phone service today, you can help us provide better forecast service if you report Marine conditions to us via cell phone. The information that we are most interested is the location, sea height, visibility, wind speed and direction. http://www.nws.noaa.gov/om/marine/voluntary.htm

National Weather Service StormReporter

- **Objectives/Goals:** Continued population growth combined with sea level rise will raise the stakes for coastal flooding and erosion along the North Atlantic coastline. Efforts to improve coastal flood warnings and response depend upon the quality and thoroughness of historical data. For most locations, past accounts of coastal flooding are sketchy and incomplete. StormReporter is an online community reporting tool developed in cooperation with the Northeastern Regional Association of Coastal Ocean Observering Systems (NERACOOS), the National Weather Service, and the Massachusetts Office of Coastal Zone Management.
- **Start Date/Scale/Progress:** Began in 2010. Based on the successful deployment of Storm Reporter in New England, the tool has been refined and expanded to include the mid-Atlantic region. NOAA and state personnel in the mid-Atlantic region have begun to identify critical observation locations and plan training of government professionals and volunteers alike in observation procedures and Storm Reporter use. For example, 22 reporters submitted over 117 reports on the effects of an early June 2012 nor'easter that hit Massachusetts. Observations regarding flooding, erosion, storm damage/no damage was used to tweak coastal flood thresholds slightly for the communities of Gloucester and Chatham.
- **Website:** http://reporter.ma.stormsmart.org/

National Weather Service Cooperative Observer Program (Coop)

- **Objectives/Goals:** NWS Cooperative Observer Program (Coop) is the Nation's weather and climate observing network of, by and for the people. Its mission is two-fold:
  1. Provide observational meteorological data, usually consisting of daily maximum and minimum temperatures, snowfall, and 24-hour precipitation totals, needed to define U.S. climate and to help measure long-term climate changes.

2. Provide observational meteorological data in near real-time to support forecast, warning and other public service programs of the NWS.

- **Start Date:** The Coop program was created in 1890 under the Organic Act.
- **Scale/Size:** More than 11,000 volunteers take observations on farms, in urban and suburban areas, National Parks, seashores, and mountaintops. Observers are not required to take any tests. A cooperative station may be located with other types of observing equipment such as standard observations stations, Flight Service Stations, etc. In these cases, equipment supporting the cooperative program's mission is treated and documented separately.
- Most cooperative observers are volunteers, but some are paid where specific types of services are needed. Observers record temperature and precipitation daily and send those reports monthly to the NCDC or NWS office. Many Coop observers provide additional hydrological or meteorological data, such as evaporation. Data is transmitted via telephone, computer or mail. Equipment used at NWS cooperative stations may be owned by NWS, the observer, or by a company or other government agency, as long as it meets NWS equipment standards.

Office of Oceanic and Atmospheric Research Old Weather Arctic Project

- **Objectives/Goals:** NOAA, National Archives and Records Administration, Zooniverse — a citizen science web portal — and other partners are seeking volunteers to transcribe a newly digitized set of ship logs dating to 1850. The ship logs, preserved by NARA, are from U.S. Navy, Coast Guard and Revenue Cutter voyages in the Arctic between 1850 and the World War II era.
    - The principal aim of the project is to improve understanding of global climate, but the information recorded in these logbooks will also appeal to a wide array of scientists from other fields – historians of many specialties, genealogists, as well as current members and veterans of the U.S. Navy and Coast Guard.
- **Start Date/Scale/Progress:** The Old Weather project began in 2010. Since then, 16,400 volunteers have transcribed 1.6 million weather observations from British Royal Navy logbooks – work that would have taken one person many years to complete. Now, Old Weather is taking on the National Archives' extensive collection of logbooks, with an initial focus on ships that operated in the Arctic. Old Weather-Arctic will start off with roughly 100,000 logbook pages that include an estimated one million new-to-science observations.
- **Link to Oct 2012 press release:** *http://www.noaanews.noaa.gov/stories2012/20121022_oldweatherprojectlaunch.html*

Office of Oceanic and Atmospheric Research Historic Hurricanes - CycloneCenter.org

- **Objectives/Goals:** NCDC launched a new website that could help climate scientists estimate the historical intensities of hurricanes around the world faster than before—and the public is invited to help. The website, CycloneCenter.org, allows volunteers to examine color-enhanced images from 30 years of tropical cyclones taken from the archives of NCDC's Hurricane Satellite Data system. Then, the site will guide users through a process to analyze a specific hurricane image and answer questions, using a simplified technique for estimating the maximum surface wind speed of tropical cyclones.

- CycloneCenter.org was developed in partnership with the Citizen Science Alliance, the Cooperative Institute for Climate and Satellites, and the University of North Carolina at Asheville.

- The end product will be a new global tropical cyclone dataset that will provide 3-hourly tropical cyclone intensity estimates, confidence intervals, and a wealth of other metadata that could not be realistically obtained in any other fashion. Using citizen scientists could allow meteorologists to make more rapid progress on the analysis of historical tropical cyclone data. NOAA climate scientists and other researchers will use the new dataset in an attempt to better understand and research global tropical cyclone activity.

- **Start Date:** September 2012
- **Link to press release:** http://www.ncdc.noaa.gov/news/cyclonecenterorg-released

National Ocean Service Phytoplankton Monitoring Network

- **Objective/Goals:** The Phytoplankton Monitoring Network (PMN) was established to monitor marine phytoplankton and harmful algal blooms. PMN's goals include:
    - Monitor and maintain an extended survey area along coastal waters throughout the year
    - Create a comprehensive list of harmful algal species inhabiting coastal marine waters
    - Identify general trends where HABs are more likely to occur
    - Isolate areas prone to HABs for further study by Marine Biotoxins researchers in effort to assist state manager in mitigating the affects of HABs
    - Promote an increased awareness and education to the public on HABs
    - Create a working relationship between volunteers and Marin Biotoxins researchers
    - Increase the public's awareness of research conducted by federal workers on HABs
- **Start date:** 2001
- **Project scale/size:** Volunteers come from all across the coastal U.S. They sample local waters twice a month for at least one year. The program works well as a community group initiative or can be incorporated into classrooms.
- **Progress/Impact:** Since inception, more than 250 algal blooms and 15 toxic events have been reported by PNM volunteers. PMN volunteers are an asset to the community through the knowledge gained and shared about local waters and community public health.
- The following are examples of how volunteer collected data have been utilized.

    - 2009: Phytoplankton Monitoring Network volunteers efforts in the Alaska Kachemak Bay silver salmon mortality event, lead to the Alaska Department of Fish and Game changing its smolt release procedure to include phytoplankton observations. Discovery of a widespread *Pseudo-nitzschia* bloom by the Phytoplankton Monitoring Network and confirmation of domoic acid toxic shellfish by the NOAA Analytical Response Team helps alert resource managers of new threat to the northern Gulf of Mexico.
    - 2008: Identification of *Trichodesmium* bloom collected by Phytoplankton Monitoring Network volunteers in east coast of Florida provides layer of validation support to HAB forecasting.

Bioluminescent algal bloom observation by Texas Phytoplankton Monitoring Network volunteers provides coastal managers an opportunity to track movement of a harmful algal bloom (HAB).

- 2007: Phytoplankton Monitoring Network identification of harmful algal bloom leads to detection of neurotoxin in pygmy sperm whales. Observation of *Karenia brevis* by Alabama Phytoplankton Monitoring Network volunteers provides coastal managers a new layer of validation to HAB forecasting.
- 2006: First time identification of toxic *Pseudo-nitzschia* algal bloom in North Carolina alerts coastal managers to potential for human amnesic shellfish poisoning and domoic acid toxicity to marine animals.

Website: http://chbr.noaa.gov/pmn/about.aspx

<u>The GLOBE Program (www.globe.gov)</u>

- **Objectives/Goals:**
  - To improve student understanding of environmental and Earth system science across the curriculum;
  - contribute to scientific understanding of Earth as a system;
  - build and sustain a global community of students, teachers, scientists, and citizens;
  - and engage the next generation of scientists and global citizens in activities to benefit the environment.
- **Start date of project:** April 1994
- **Project scale/size**: There are 26,026 schools and 16,324 teachers from around the world involved with GLOBE. To date, over 1.5 million students have participated in GLOBE from 112 participating countries.
- **Progress/Impact:** To date, GLOBE schools have reported 95,971,012 measurements. This month, 499,280 measurements have been reported. This summer the program launched a new web site designed to foster online community building and created a new network of scientists involved with the program. An option for online training is going to be released this winter, and hundreds of teachers have already signed up to take advantage of this new capability. The program has been rapidly growing its social media presence with the following statistics for its Facebook page:
- **Visits:** 198,650 (6-month mark)
  - Unique Visitors: 140,776 -- (New People)
  - Page views: 637,864
  - Pages / Visit: 3.21
  - Bounce Rate: 60.55 percent
  - Percent New Visits: 69.65 percent

NOAA provides in-kind support to the program in close partnership with the primary funding agencies, NASA and NSF.

<u>Summer Science in New England: Ocean Education through Informal Science Centers</u>

- **Objectives/Goals:** The goals of Summer Science in New England are to increase: 1) teens' awareness of Ocean Literacy and Climate Literacy Principles; 2) Ocean and climate science grounding in

summer camp programs for teens; 3) Ocean scientists' awareness of and input to informal education; and 4) Regional capacity for cross-network information sharing and collaboration.

- **Start date of project:** December 2009
- **Project scale/size:** Each summer, campers ages 14 and up carry out intertidal monitoring according to the modified NaGISA protocol at camps throughout New England. Data are reviewed by a science advisor for quality assurance prior to uploading to the international Ocean Biogeographic Information System (OBIS). Approximately 750 campers have participated in the three summers of the project. Each summer there is a Teen Ocean Summit held at the New England Aquarium. This past summer participating teens learned more about how their data have been and will be used by scientists, through the Ocean Biogeographic Information System, and made final presentations based on the projects they did over the summer.
- **Progress/Impact**: This summer approximately 250 teens participated in collecting data. Campers (36), scientists (9), lead staff (9), educators (8) participated in this summer's Teen Ocean Summit. The project is its last year of funding from a NOAA Environmental Literacy Grant.

Chesapeake Watershed Education Scale-Up: A Partnership for Geographic and Environmental Science Literacy, Managed by the National Geographic Society

- **Objectives/Goals:** This is a project-based educational program that combines dynamic, geographic classroom learning activities with outdoor field experiences and technology-supported inquiry. It builds on existing National Geographic resources including FieldScope, a webbased GIS analysis and collaboration tool designed to support geographic investigations and engage citizen scientists in exploring real-world issues; and National Geographic's network of Alliances for Geographic Education, key partners in the work who will implement state-level customization and dissemination of the project. The project builds on an existing educational citizen science project launched in 2009 to study water quality. Specific outcomes include strengthened state-based partnerships, effective and engaging curriculum materials, high quality professional development, and student learning outcomes. The project has been designed to serve as a national model for the implementation of classroom and field-based learning
- **Start date of project:** 7/1/2012
- **Project scale/size:** They estimate 400 teachers and potentially 20,000 students in 8 states (MD, VA, WV, NJ, DC, PA, DE, NY) by the end of the first y ear of the project.
- **Progress/Impact:** This project just started less than a year ago, but they have spun it up quickly. The regional geography alliances have been conducting their first suite of teacher workshops this fall and winter that will enable the teachers to help their students carry out field observations during the spring this semester. So far 50 teachers in the state of Virginia have participated in workshops to prepare them to support up to 2500 students in citizen science projects this spring. Reports on other states are not available at this time.

SoundToxins partnership: a program for monitoring harmful algal blooms and Vibrio in Puget Sound (http://www.soundtoxins.org)

- **Objectives/Goals:** The overall goal of this cooperative partnership is to establish a cost-effective monitoring program that will be led by state managers, tribal harvesters, commercial fish and shellfish farmers, and community volunteers. The SoundToxins program aims to provide sufficient warning of HAB events to enable early or selective harvesting of seafood, thereby minimizing risks to human health and reducing economic losses to Puget Sound fisheries. The objectives of the

SoundToxins program are: 1. to determine which environmental conditions promote the onset and flourishing of HABs; and 2. to determine which combination of environmental factors can be used for early warning of these events. To accomplish this, seawater samples are collected weekly by the participants at 24 different sites throughout Puget Sound and are analyzed for salinity, temperature, nutrients, chlorophyll, (paralytic shellfish toxins and domoic acid) and phytoplankton species. Phytoplankton species diversity is described and the four target species specifically identified and enumerated are Pseudo-nitzschia species, Alexandrium catenella, Dinophysis species, and Heterosigma akashiwo.

- **Start date of project:** 2006, funded by the West Coast Center for Oceans and State University Extension), environmental learning centers (Port Townsend Marine Science Center, Feiro Marine Life Center), shellfish growers (Taylor Shellfish Farms, Seattle Shellfish, Penn Cove Shellfish, Coast Seafoods Company), fish farmers (Long Live the Kings Salmon Hatchery, America Gold Seafood, Clam Fresh LLC), native tribes (Jamestown K'lallam Tribe, Nisqually Tribe), state and county agencies (Washington State Department of Health, Tacoma-Pierce County Health Department), and private citizens. The SoundToxins partnership was conceived and initiated by the NWFSC, and is now co-directed by Washington Sea Grant.
- **Project scale/size:**

  SoundToxins has partners throughout the Puget Sound region including universities (University of Washington, Evergreen State College, Washington
- **Progress/Impact:** SoundToxins has grown from four partners in 2007 to approximately 20 partners today. A recent poisoning event involving three people who gathered shellfish in north Puget Sound in the summer of 2011, resulted in the need for the State Department of Health to increase their shellfish testing to include a new toxin (diarrhetic shellfish toxins).
- They did not yet have the equipment to do this testing, but rather had to rely on NOAA and the Food and Drug Administration for regulatory testing of shellfish. The SoundToxins partnership, through its weekly monitoring of phytoplankton at sites around Puget Sound, allowed the State to target its shellfish monitoring to those sites that had the greatest risk of toxicity. SoundToxins is creating one of the most comprehensive long-term dataset of phytoplankton in Puget Sound. Human Health (funding ended in 2011).

<u>Citizens Weather Observer Program (CWOP)</u>

- **Objectives/Goals**: CWOP is made up of ham radio operators and private citizens with home weather stations and Internet or Ham Radio digital connections to participate with NOAA in monitoring the environment. Thus, CWOP supports NOAA's Local Forecast and Warning, Surface Transportation, Environmental Modeling, Coast/Estuaries, Hydrology, and Climate/Observation, NOAA Education and Outreach, and GEOSS Programs. CWOP is a private-public partnership with three main goals: 1) to collect weather data contributed by citizens; 2) to make these data available for weather services and homeland security; 3) to provide feedback to the data contributors so that they have the tools to check and improve their data quality. CWOP provides these citizens with on-line tools which help members determine station latitude and longitude to within 20 meters. CWOP observations are quality controlled (QC) by NOAA's Meteorological Assimilation Data Ingest System (MADIS), and these QC data are available to members along with suggestions on steps to improve the quality of

their weather data. Also, CWOP provides station operators with the tool to submit digital images of station sensor siting; these images allow NOAA personnel to better understand how to use the data.

- **Start Date**: CWOP was started in January 2000 leveraging the Automatic Position Reporting System™ (APRS™). APRS™ is a part of ham radio that provides an ideal way for weather station operators to distribute their weather data much further than the regions within their transmitter range. APRS™ was originally intended for position information data but actually provides a means for automatic transmission of all sorts of digital data. This is especially true now that the original APRS™ packet radio concept has been enhanced to include the capabilities of the Internet. The reporting of citizen weather .data is a particularly useful application of the APRS™ Internet Service (APRS™-IS).
- **Project Scale/Size**: CWOP currently has approximately 26,000 participants worldwide, 14,000 of which are actively sending over 42,000 reports per hour to MADIS. The CWOP reports contain temperature, pressure, wind speed/direction/gust, dew point temperature, relative humidity, precipitation rate/accumulation, and solar radiation data. CWOP data has a broad user community including, but not limited to, the list below.
    - NWS Weather Forecast Offices
    - National Center for Environmental Prediction
    - National Ocean Service
    - National Transportation Safety Board
    - National Center for Atmospheric Research
    - Department of Homeland Security
    - Denver Urban Drainage and Flood Control District
    - Colorado Avalanche Information Center
    - Kennedy Space Center
    - NASA Marshall Space Flight Center
    - University Corporation for Atmospheric Research
    - Embry-Riddle Aeronautical University
    - MIT Lincoln Laboratories
    - University of Utah
    - Penn State University
    - Mississippi State University
    - University of Alaska
    - University of North Dakota
    - Hampton University
    - Texas A&M University
    - University of Hawaii
    - Florida State University
    - Weather Underground
- **Progress/Impact**: CWOP continues to grow at a rate of around 40 new contributors per week. The CWOP data is integrated into MADIS which is currently being transitioned from research to operations within the National Weather Service (NWS). CWOP is the biggest unique contributor of observational mesonet data to MADIS, which means that it provides a backup source of information when other MADIS contributors are unavailable. CWOP observations are used operationally at NWS by forecasters and in the data assimilation/analysis phase in the NWS forecast modeling efforts. CWOP data has been archived as part of the MADIS system since July 2001, now providing a source for 13 years of climate history.

Project Limulus (Sea Grant)

- **Objectives/Goals**: Community citizen volunteers of all ages receive training to help tag horseshoe crabs for monitoring their movements and mating habits, to help scientists and resource managers assemble information used for conservation of this important organism.
- **Start Date**: 2003.
- **Progress/Impact**: Volunteers learn about the ecology, biology, and importance of Limulus polyphemus populations. Sacred Heart University researchers lead the effort, supported by Connecticut Sea Grant.

Citizen Monitoring Program

- **Objectives/Goals**: Delaware Sea Grant supports dedicated corps of Citizen Monitoring volunteers who have been taking water samples on a regular basis throughout Delaware's coastal watershed to measure a broad range of important water quality characteristics.
- **Start Date**: 1991.
- **Project Scale/Size**:
- **Progress/Impact**: The data they gather provides scientists and resource managers with a clearer picture of the estuary's health and the trend information needed to understand and manage the ecosystem.

ReefWatchers Big Island

- **Objectives/Goals**: ReefWatchers are volunteer coastal and near shore observers. The University of Hawai'i Sea Grant College Program, with the help of some dedicated volunteers and the Hawaii Division of Aquatic Resources, started Big Island ReefWatchers in 1998-2000. The goal of ReefWatchers is to provide long term data from specific areas by observing and recording the information.
- **Start Date**: 1998-2000.
- **Project Scale/Size**:
- **Progress/Impact**: Observations are entered into a master database and are available for use by state agencies and the University of Hawaii.

Hanauma Bay Education Program

- **Objectives/Goals**: The UH Sea Grant Hanauma Bay Education Program has a cadre of over 100 volunteers annually who promote stewardship of Hanauma Bay and minimize the impacts to the reef by educating visitors about proper reef etiquette and the value of marine resources.
- **Start Date**: 1990.
- **Project Scale/Size**: Over 100 annual volunteers.
- **Progress/Impact**: Approximately 800,000 annual visitors to Hanauma Bay are educated on the value of marine resources and reef etiquette. A strong team of volunteer docents make this significant education accomplishment possible. The Hanauma Bay Education Program also educates visiting schools and hosts marine and conservation related evening presentations for the public.

Beach Profile Monitoring

- **Objectives/Goals**: Coordinated by staff at Maine Sea Grant, volunteers monitor beaches on a monthly basis throughout the year. Over the years, the program has continued to expand and now includes 15 beaches between York and South Portland. Volunteers use a simple surveying technique to measure the contour of their beaches. An online data entry system has been established that allows volunteers to directly enter their own data to a Web page and then to graph the results. This allows volunteers to view changes in the beach face due to erosion and/or accretion.
- **Start Date**: 1999.
- **Project Scale/Size**: Over 150 community and school volunteers.
- **Progress/Impact**: Geologists use this data to identify seasonal and long-term trends that inform beach management planning.

Mobile Bay Oyster Gardening Program

- **Objectives/Goals**: The oyster gardening program is a volunteer-based program that focuses on education, restoration/enhancement, and research by bringing the reef to the people. Volunteers grow oysters in cages on their waterfront property.
- **Start Date**:
- **Project Scale/Size**:
- **Progress/Impact**: Oyster Gardeners have produced more than 400,000 oysters for restoration and enhancement efforts within Mobile Bay.

National Estuarine Research Reserve System (NERR)'s Alabama - Weeks Bay NERR Baldwin County Grasses in Classes Program (BCGIC)

- **Objectives/Goal:** The Grasses in Classes Program coordinates and sustains a network of teachers, students, restoration specialists, and other community members to plan and implement restoration of coastal environments in Baldwin County, Alabama. The Grasses in Classes Program is a partnership between the Baldwin County Public School System and Weeks Bay National Estuarine Research Reserve.
  The goal of this program is to promote individual stewardship and better understanding of coastal ecosystems through community-based restoration activities.
    - Help restore Baldwin County's coastal habitats while providing an educational resource for applying student learning to real world ecological practices.
    - Facilitate the establishment and maintenance of native plant nurseries on school campuses to provide plants and a volunteer base for restoration projects.
    - Provide students with meaningful hands-on activities which will provide investigative and problem solving experience.
    - Provide students an opportunity to learn about careers in science by working side by side with federal, state, and local environmental agency staff.
- **Start Date:** The BCGIC program was established in 2005 with three high schools participating and has since expanded to include all the high schools in the Baldwin County public school system.
- **Scale/Size:** Approximately 500 high school students have participated in the BCGIC Program since it began in 2005. Students, community volunteers and environmental agency staff have logged thousands of hours conducting restoration projects over the past 8 years.
- **Progress/Impact:** Students have planted more than 41,000 native plants at public access sites throughout Baldwin County. Restoration sites include: City of Gulf Shores Little Lagoon Boat Launch;

Fish River at Weeks Bay National Estuarine Research Reserve; Bon Secour Wildlife Refuge; Gulf State Park Beaches at Perdido Pass and the Pavilion; Alabama Dept. of Conservation and Natural Resources (ADCNR) Five Rivers Delta Center; Camp Beckwith on Weeks Bay; ADCNR Boggy Point Boat Launch; City of Foley Graham Creek Nature Preserve; Baldwin County Bicentennial Park. The BCGIC has allowed students to learn about careers in the environmental field while getting hands-on experience. BCGIC teachers have reported an increase in the number of students who have signed up for their classes because of the program. Students who had taken part in planting salt marsh plants along a shoreline in Orange Beach Alabama went to their teacher very concerned that "their plants" had been impacted by oil from the Deep Water Horizon Spill. The students were relieved to hear that their plants were fine but were angry that the oil spill had damaged critical salt marsh habitats along the northern gulf coast. Two college interns who had participated in the BCGIC program when in high school expressed to me the impact the program made on their decision to major in science. Each hopes to work in the environmental field in the future.

NERR's Alabama - Weeks Bay NERR Water Watch

- **Objectives:**
  - Elevate the level of citizen knowledge about water quality and water-related issues in the Weeks Bay watershed.
  - Monitor water quality of Weeks Bay, its tributaries and selected waterways draining to Mobile Bay.
  - Inspire citizens to use the knowledge, skills and data collected to increase involvement water and resource management issue in their community.
- **Start Date:** 1996
- **Scale/Size:** Citizens are trained using methods quality tested through the statewide Alabama Water Watch program at Auburn University. Funding for volunteer workshops and supplies come from the Weeks Bay Watershed Project and the Baldwin County Soil and Water Conservation District. Monitoring sites are located primarily within the approximately 200 sq mile drainage area of Weeks Bay. Several past and current testing location are located in adjacent watersheds on the waterways (Bon Secour River, Fly Creek and Rock Creek) that drain directly to Mobile Bay. Since 1996, approximately 100 sites have been monitored as part of Weeks Bay Water Watch. Water quality was tested at several locations for 5 and even 10 year durations. Currently, 7 individuals are testing 9 locations. Data collected by citizens reside on a database maintained by Auburn University (www.alabamawaterwatch.com) and are available to anyone to view and use.
- **Progress/Impact:** Citizens continue to monitor water quality in the project area and funders remain committed to supporting the project. Like many volunteer organizations, the number of participants fluctuates. The Watershed Coordinator at Weeks Bay NERR serves as a certified trainer and conducts workshops as demand warrants. In addition, supplies and reagents are housed at Weeks Bay NERR where again the Watershed Coordinator distributes to citizen monitors. Data collected by citizens has been valuable. The Town of Magnolia Springs used water quality data collected by citizens to help them achieve "Outstanding Alabama Water" classification for the Magnolia River. Bacteria data collected on Caney Creek in the Fish River watershed was used to document improvement resulting from best management practices for pathogen reduction. Ultimately, the creek was removed from

the Clean Water Act §303(d) list of impaired waters. Turbidity data collected by citizen monitors were used in separate occasions to bring about partnerships with agencies to resurface a dirt road and to fence cattle from a creek where they were causing the bank to erode. Keeping the cattle away from the creek reduced sediment runoff and improved water clarity. From 2008-2011, citizens monitored rainfall and bacteria in the upper reaches of Fish River as part of a bacterial source tracking project conducted by Weeks Bay NERR and the University of West Alabama with funding from the Mobile Bay National Estuary Program and the Weeks Bay Foundation. A volunteer collected a series of samples to determine cell counts as storm flow increased and subsided. Additional volunteers participated as rainfall monitors conducting daily rainfall measurements and serving as sentinels to inform project managers of qualifying rainfall events so that stormflow samples could be collected. Trend monitoring and recruitment of new citizen monitors continues as part of the Watershed Program at Weeks Bay NERR.

NERRS California - Elkhorn Slough NERR Oak woodland nest box study

- **Objectives/Goals:**
    - Understanding the health status of habitats in the Elkhorn Slough watershed is important for resource managers as they work to restore and maintain good water quality and healthy wetlands in the estuary. This project seeks to assess oak woodland health using nestbox activity and reproductive success as indicators. Monitoring these parameters serves as one way of keeping track of the health of oak woodland communities over time at the Slough. For instance, dramatic declines in nest box use or fledging rate would serve as a warning signal alerting managers to potential problems in these habitats, and would motivate a search by researchers for new negative environmental influences in the area.
    - The long term data may help to detect changes brought on by the recent spread of Sudden Oak Death (*Phytophthora ramorum)* in the coast live oak forests of California, possible impacts of restoration projects in the uplands of the watershed, and impacts of global warming on coastal habitats and species.
- **Start Date:** 1997
- **Scale/Size:** Each spring and summer, under the direction of Kerstin Wasson, the ESNERR research coordinator, volunteer Shirley Murphy has led a team of 10-15 volunteers who venture out weekly to monitor 150 nest boxes in the oak woodlands around the Elkhorn Slough. By carefully checking the boxes from February through August, and consistently recording what they see, the volunteers are able to obtain data on nest box occupancy (which boxes are occupied, and by which species), phenology (timing of reproductive events), indicators of reproductive success (clutch size, hatching rate, fledging rate) and parasitism, specifically looking for blowflies (*Protocalliphora*) in nesting material.
  Data from ESNERR are also submitted to the Cornell Lab of Ornithology, which manages a national database of volunteer nest box records, and identifies large-scale trends using this information.
- **Progress/Impact:** We observed changes in the timing of reproduction among years, suggesting that nesting may vary in response to environmental differences. While these short-term trends may simply reflect non-directional year-to-year variation, the sensitivity of this index suggests that it may

be useful for assessing long-term trends, such as climate warming or prey declines.
Our results revealed a significant difference among woodlots in nest box occupancy. In the future, we would like to attempt to understand the underpinnings of this pattern, by assessing ecological parameters (canopy density, understory composition, proximity to grassland, etc.) for each box site. Such an assessment would allow us to determine the factors that shape nest box choice at ESNERR. Moreover, we could look for correlations between these ecological parameters and reproductive success. Understanding what aspects of oak woodlands are valuable to their nesting bird communities might shape future restoration decisions.
Based on moderate to very high hatching rate and very high fledging rates observed and the absence of parasites, we conclude that the ESNERR oak woodlands are currently in good health, at least with regard to nesting cavity-nesting birds. Tracking reproductive success and parasitism in the future will be one good way of keeping our finger on the pulse of our oak woodlands.

NERR's California - Elkhorn Slough NERR marine mammal monitoring: Focus on the Southern Sea Otter

- **Objectives/Goals:** To track how the population of the endangered southern sea otter (*Enhydra lutris nereis)* changes over time in Elkhorn Slough, and to also record changes in its use of the estuary. Otters in this estuarine environment have not been studied extensively and their activities differ considerably from their kelp bed and open ocean counterparts. This study will seek to link observed patterns to invertebrate populations in the mudflats and saltmarsh, and water quality conditions in the estuary. This data will inform resource managers as they develop restoration strategies for the Elkhorn Slough.
- **Start Date:** 2007
- **Scale/Size:** Numerous volunteers have assisted in this monitoring, both from the Reserve volunteer team and from the public at large. They are trained in using a telescope to identify and record otter activities and conduct counts every half hour over a 5 hour observation period. Under the direction of Kerstin Wasson, the ESNERR research coordinator, volunteers Ron Eby and Robert Scoles have led the volunteer team in conducting weekly 5 hour observations of otters in Elkhorn Slough, specifically in the tidal creek called Yampah Island.
- **Progress/Impact:** Observations from these surveys have informed researchers interested in understanding the relationship between the foraging of the sea otters and the health of the eel grass beds in the estuary. Information learned from these observations has been shared with the public through numerous avenues, including news articles, presentations at the Elkhorn Slough Reserve, NOAA Coastal Discovery Center in Cambria, Friends of the Elephant Seals, the American Cetacean Society, NOAA Sanctuary Exploration Center in Santa Cruz and Moss Landing Marine Labs. In addition, a research poster was presented at the 2012 Monterey Bay National Marine Sanctuary Currents Symposium describing results from two years of observations.

California - Elkhorn Slough NERR volunteer water quality monitoring program

- **Name:** Elkhorn Slough NERR volunteer water quality monitoring program Objectives/Goals: To compare water quality under different land use and water management to understand benefits of

improved practices; track improvements due to restoration; detect sudden changes in water quality that may affect flora and fauna of the slough.

- **Start Date:** 1988
- **Scale/Size:** Elkhorn Slough National Estuarine Research Reserve (ESNERR), the Elkhorn Slough Foundation (ESF), and the Monterey County Water Resources Agency have been supporting a volunteer water monitoring program since 1988. Every month volunteers and staff visit 26 stations around the Elkhorn Slough and lower Salinas River watersheds gathering data in situ, and collecting water samples for analysis in the laboratory. Temperature, salinity, dissolved oxygen, pH, and turbidity are assessed using a sophisticated datasonde; water samples are collected for laboratory analysis of nitrate, ammonia and orthophosphate.
- **Progress/Impact:** For the first decade of this project the data were collected in the field by a singularly dedicated and reliable volunteer, Sue Shaw, with assistance from other volunteers. The project is continued by a team of staff and volunteers under the guidance of the ESNERR research coordinator.

  Some trends observed from this data include:

  - A significant increase in nitrate concentrations since the 1970s
  - extraordinarily high nitrate concentrations in the lower Salinas River which may be the highest recorded in scientific literature for a river or estuary
  - concentrations of ammonium that are an order of magnitude lower (or more) than nitrate
  - low concentrations of dissolved oxygen in some areas which have restricted circulation
  - opening of the Salinas River lagoon leads to rapid increases in salinity in the lower river even during the rainy season when river discharge is high.

  More recently, the Elkhorn Slough was awarded two different non-point source pollution monitoring grants to examine the water quality data in more detail. Starting in late 2005, a Quality Assurance Project Plan (QAPP) was developed for the acquisition and maintenance of all water quality data, made available to the Central Coast Regional Water Quality Control Board (CCRWQCB).

  Under the first of these two grants, the 18-year record of water quality data were analyzed for statistically observable changes in nutrient concentrations in the time periods before and after some concerted restoration efforts were completed in the Slough watershed by the Elkhorn Slough Foundation. ESNERR Environmental Chemist Alison Gee has written a manuscript summarizing those results. Also under this first grant, CSUMB environmental scientist Marc Los Huertos working in conjunction with several UCSC statisticians have produced detailed statistical analyses of the long-term trends in several water quality parameters measured in the Elkhorn Slough. These include temperature, dissolved oxygen, pH, salinity and dissolved inorganic nutrients.

  On the second grant, a baseline investigation of eutrophication symptoms throughout the 24 volunteer water quality monitoring stations is being undertaken. Parameters to be focused on for this study include night-time dissolved oxygen, chlorophyll and nutrient concentrations, macro-algal coverage estimates and light penetration depths.

More details and copies of publications related to this project are available at the Elkhorn Slough Reserve website, www.elkhorhslough.org.

NERR's Delaware - Delaware NERR Horseshoe Crab Spawning Survey

- **Objectives/Goals:** Over the past fourteen years hundreds of volunteers and coordinators have worked very hard to implement the Delaware Bay Horseshoe Crab Spawning Survey in a standardized manner throughout Delaware Bay during the main spawning period (May and June). The survey is a unique partnership of private and public efforts to monitor a vital indicator species of the Delaware Bay estuary.
  The Delaware Bay Horseshoe Crab Spawning Survey has several important objectives:
  - Provide a reliable index of spawning activity to monitor the temporal and spatial distribution of horseshoe crab spawning activity for comparing bay-wide spawning among years, beach-level spawning within Delaware Bay, and distributions of spawning horseshoe crabs and shorebirds;
  - Increase our understanding of the relationship between environmental factors (tidal height, wave height, and water temperature) and spawning activity; and
  - Promote public awareness of the central role of horseshoe crabs in shorebird population dynamics, Atlantic coast fisheries, and human health through the production of Limulus amebocyte lysate (LAL).
- **Start Date:** The bay-wide annual survey began in 1999. The Delaware NERR began coordinating efforts at three Delaware beaches in 2001.
- **Scale/Size:** The annual Horseshoe Crab Spawning Survey is conducted on 29 Delaware Bay beaches in Delaware and New Jersey in partnership with US Fish and Wildlife Service, US Geological Survey, Delaware Department of Natural Resources and Environmental Control (DNREC), New Jersey Fish and Game, Maryland Department of Natural Resources, and University of Delaware Sea Grant. The Delaware National Estuarine Research Reserve specifically coordinates the survey efforts for three beaches including Kitts Hummock, Ted Harvey, and North Bowers beaches in Delaware.
- **Progress/Impact:** Hundreds of volunteers participate in the Horseshoe Crab Spawning survey every year. The Delaware NERR requires all of its volunteers to participate in training and have very dedicated volunteers who return annually. The data collected during the survey is used by the Atlantic States Marine Fisheries Commission, Horseshoe Crab Technical Committee for policy decisions about the horseshoe crab fishery and the impact on the migrating shorebirds that rely on the horseshoe crab eggs for food to fuel their flights to their breeding grounds.

NERR's Maryland – Chesapeake Bay NERR (MD) Bioblitz

- **Objectives/Goals:** A Bioblitz is a brief, intensive survey of plants, animals and other organisms that is conducted in a coordinated way by scientists and amateurs working together in a well-defined study area. Bioblitzes are educational and fun, and can provide us with a greater understanding about local biological diversity. The new knowledge gained about the occurrence, distribution and relative abundance of plants and animals can be critical for protecting rare or unusual species, and for developing effective habitat management plans. Ecologists, resource

managers and students can use this information on the presence or absence of species in an area to initiate new studies or management plans. A Bioblitz can also attract scientists to a site which could lead to other projects in the future. Just as important, Bioblitzes are an excellent way to involve the public in an event that broadens their understanding of biological diversity, and gives them hands-on experience identifying organisms and recognizing the habitats where organisms live. Bioblitzes help citizens become citizen scientists.

BioBlitz events are held at 2 of the three component sites of the Chesapeake Bay National Estuarine Research Reserve in Maryland: Jug Bay, and Otter Point Creek. The goal of these surveys is to collect information on biological diversity and to add new sightings and records to those made in past BioBlitz surveys by concentrating on groups of organisms that were not surveyed then.

- **Start Date:** Since the program started in 2007, annual and bi-annual BioBlitzes have contributed a tremendous amount of scientific information about species or habitats that may need special care for protection or management.
- **Scale/Size & Impact:** Annually, approximately fifty searchers participate in each site BioBlitz. Comprised of teams of citizen volunteers, led by experts on a species, or classification, the teams work in stages during a 24 period. A typical team includes 5 searchers. Over 250 search-hours are devoted to the overall effort, with one search-hour equivalent to one person searching for one hour. Most teams search for 3-hour search periods.
  Volunteers and visitors can learn about how scientists find organisms to inventory. Biologists, ecologists, families, students, school groups, youth groups, teachers, community leaders, and all interested people help locate and identify the various species on the sites and learn interesting facts about them. The data collected during BioBlitz is an inventory of species and a description of habitats surveyed.
  By participating in BioBlitz, people can experience the biological diversity of the area first-hand. Volunteers and participants are truly needed to help collect data to make BioBlitz run smoothly. By participating in the sessions, people can recognize that they are helping to monitor the plants and animals of the Chesapeake Bay watershed. Citizen involvement, such as this, is a great way for people to make a difference in working to protect the bay and the lands that surround it.
  An example of the impact of a bioblitz is sited here in the report of the Jug Bay 2009 BioBlitz
    - *"A total of 334 species of plants and animals were identified during the 2009 Bioblitz, including 196 species that had not observed during the 2007 Bioblitz (Table 4). The total species diversity is considerably lower than the 501 species that were observed in 2007. The difference between the 2007 and 2009 surveys is due, in part, to our focus on different groups of organisms, some of which (for example, mosses and liverworts) required more time for collection and detailed inspection in the field. The "Moss" team surveyed the Sanctuary on Saturday and again on Sunday.*
    - *Observers recorded 112 "new" (species not been observed on the 2007 Bioblitz) plant species. Other groups with high numbers of "new" species were: ants (14 new species in 2009), beetles (14 species), and birds (11species). A total of 18 species of mosquito were identified by the research team working here throughout the month of June."*

- **Progress/Impact:** BioBlitz activity is planned at both component sites for 2013, and CBNERR is looking to expand BioBlitz and citizen science opportunities by developing BioBlitz events at the third CBNERR-MD component site at Monie Bay. Additionally, the program is exploring ways to make the data collected more available to the public, and richer in the story it tells about our reserve lands. Currently, CBNERR-MD is planning to partner with National Geographic Society, using their FieldScope online mapping software to catalog and showcase our BioBlitz data, making it easier to compare species between component sites, and gain a more comprehensive picture of species richness and diversity at our Reserve. Additionally, we would expand the project to include past data, to be able to specifically identify the effects of climate change on the biota (eg. Impact of invasive plants, or animals, decline of amphibians or nesting bird populations, extension of breeding range and migration duration of Osprey).

NERR's Maryland – Chesapeake Bay NERR (MD) Secretive Marsh Bird Surveys

- **Objectives/Goals:** The Secretive Marsh Bird Survey is part of the National Marsh Bird Monitoring Program. The specific goal of the National Marsh Bird Monitoring Program is to develop and field-test monitoring protocols that will eventually be used in a national monitoring effort. Because marsh birds are rarely seen by observers and are often less vocal than other birds, surveyors typically broadcast vocalizations of target species to improve detection probability. However, little is known about the pros and cons of call-broadcast surveys in a multi-species survey effort. Hence, we are currently examining the following aspects of this survey methodology:

    - comparing temporal variation in vocalization probability between passive (no broadcast) and call-broadcast surveys;
    - comparing observer bias between passive and call-broadcast surveys;
    - quantifying effects of broadcasting inter- and intra-specific calls on vocalization probability.

    The resultant protocols are being proposed for use in a continental marsh bird monitoring program for North America whereby survey routes will be chosen as part of a continental sampling design. Data collected from such a program will provide estimates of population trend at the regional, national, and continental scale.

    We conduct the Secretive Marsh Bird Survey at all three of the reserve sites of the Chesapeake Bay National Estuarine Research Reserve in Maryland: Jug Bay, Monie Bay and Otter Point Creek. The goal of these surveys is to collect information on biological distribution and relative abundance of several species for rails and bitterns.

o **Start Date:** The program began in all three Reserve site the spring of 2007. It has been conducted every year since except for 2009 in Jug Bay.
Scale/Size: Since the program started in 2007, we have had about a 15 volunteers involved in this survey. We contribute data colleted to the National Marsh Bird Monitoring Program.

o **Progress/Impact:** We will continue the Secretive Marsh Bird Survey into the foreseeable future and we are planning to start a second route at the Monie Bay Site if trained volunteers can be secured. The long term impact of this survey is another way to monitor wetlands by using secretive

marsh birds as an indicator of wetlands health and functionally. This project is determining the best technique to monitor secretive marsh birds to better understand them and the wetlands they live in.

NERR's New Jersey - Jacques Cousteau NERR Long-term ichthyoplankton sampling

- **Objectives/Goals:** The goal of the long term ichthyoplankton sampling program is to monitor seasonal and temporal changes in larval fish assemblages in the temperate estuarine system of Great Bay/Mullica River in New Jersey, located within the Jacques Cousteau National Estuarine Research Reserve (JC NERR). The program was designed to identify the timing of larval fish recruitment and temporal scales of variability in the abundance and occurrence of larval fish assemblages in the Great Bay/Mullica River estuary. Volunteers assist scientists with weekly sampling efforts to collect, sort and identify ichthyoplankton, and are an integral component in ensuring that sampling is completed in an efficient and timely manner.
- **Start Date:** Ichthyoplankton sampling began in November 1988 at the Rutgers University Marine Field Station (RUMFS) in Tuckerton, New Jersey. Volunteers have assisted with the project from the outset; with consistent volunteer participation from JC NERR volunteers beginning in 2000.
- **Scale/Size:** Volunteers from all walks of life participate in ichthyoplankton sampling. Volunteers include undergraduate and graduate students seeking more in depth experience in marine science as well as retirees and other members of the community interested in being involved with locally conducted scientific research. Data are used by a broad variety of user groups including RUMFS scientists, regional scientists, state and federal managers and undergraduate and graduate students. Data and findings from the project have been presented at local community venues such as fishing clubs and environmental organizations and through public programs offered at the Jacques Cousteau NERR.
- **Progress/Impact:** Ichthyoplankton data are used in conjunction with other long-term sampling data including trap and otter trawl data and, most recently, seining data, which target young-of-the-year, juvenile and adult fish. These data are used to determine if there is a relationship between larval recruitment and settlement and if there is a relationship between larval abundance and juvenile settlement/abundance. Data from the ichthyoplankton program have been the subject of numerous peer-reviewed publications with the occurrence of larval assemblages suggested to be driven, in part, by local environmental processes, most notably the annual temperature cycle. Having a 24 year data set provides unique opportunities to be able to compare data from the present to data collected over 2 decades ago. With this arsenal of data it is possible to assess temperature changes and subsequently possible changes in larval assemblages due to shifts in temperature, which is currently the subject of a graduate student's research at Rutgers University. Ichthyoplankton data collected is also used to complement similar sampling programs along the eastern seaboard including Duke Marine Laboratory in Beaufort, North Carolina and the Virginia Institute of Marine Science in Gloucester, Virginia.

NERR's New Jersey - Jacques Cousteau NERR Seine Sampling

- **Objectives/Goals:** The goal of this project is to provide a more detailed assessment of southern species of fish and crabs found in New Jersey. Data collected seining will supplement RUMFS' (Rutgers University Marine Field Station) long-term otter trawl sampling data.
- **Start Date:** Seine sampling began in August 2012 at two sites within the Jacques Cousteau National Estuarine Research Reserve (JC NERR) in Southern New Jersey.

- **Scale/Size/Progress:** JC NERR volunteers have conducted the majority of field work sampling for the project under the guidance of a RUMFS scientist and/or JC NERR volunteer coordinator to ensure proper sampling protocol and identification of fish and crabs. Through RUMFS' long-term ichthyoplankton data set, it has been possible to track changes in larval fish composition and water temperature for a period of over 20 years. A trend that has been shown in ichthyoplankton sampling is that an increasing number of larval fish of southern species have been collected, potentially correlated with warmer water temperatures. Seining previously took place in the JC NERR in the early 1990's with RUMFS collecting over 300 samples in shallow habitats. With these existing data, the expectation with the present sampling is to be able to compare seine data from 20 years ago to data collected today in order to ascertain possible patterns and changes in southern species composition and water temperatures. In addition to the data being used for research at RUMFS and peer-reviewed publications for the scientific community, there are also a number of user groups such local coastal decision makers, state and federal managers, and the recreational fishing community that can benefit from these data.

NERR's New York - Hudson River Eel Project – Hudson River NERR

- **Objectives/Goals:** Educators from the Hudson River National Estuarine Research Reserve, in partnership with New York State's Hudson River Estuary Program, designed a citizen-science program that trains volunteers to catch, count, and release juvenile American eels in the Hudson River estuary. The fascinating eel is born in the Sargasso Sea, then migrates to coasts and freshwater streams for decades before returning to the sea to spawn once and die. The Atlantic States Marine Fisheries Commission recently announced the stock as depleted and near historic lows likely due to overfishing, dams, and other environmental and cultural factors.
  The Hudson River Eel Project trains volunteers to study juvenile eel migrations in the estuary each spring under ASMFC research protocols, to assist Reserve experts in upstream studies each summer, and to help build and maintain eel "ladders" to get eels above dams that block their access to habitat. The project is not only of immense importance to eel conservation, but it gives citizens, from high-school students to retirees, the tools and opportunity to make a real difference in researching and restoring an imperiled species in their own neighborhoods.
- **Start Date of the Project:** The project began in Spring 2008. Each year since then, sampling of juvenile eels with nets in the estuary takes place from March to May. Upstream studies and the use of low-cost eel ladders to get eels above dams takes place from May to October.
- **Project size/scale:** We began the project on 2008 with three net sites and approximately 60 volunteers. The project currently has 12 sites with nets, and several more using other sampling gear. The sites span over 100 miles of estuary from the cityscapes of New York Harbor to the rural foothills of the Catskills. Approximately 500 volunteers are directly involved in the field, representing more than 35 different organizations, while another 2,000 students and citizens are educated through classroom and public presentations. The organizations that partner on this project include local high schools like Poughkeepsie High School, universities like Marist and Queens Colleges, local non-profits like Scenic Hudson and scout troops, and national entities like National Audubon and the Society for Wildlife Conservation.

- **Progress/Impact:** Since 2008, over 100,000 juvenile eels have been caught in estuary waters, counted, and released above barriers to migration. The information collected is reported to both state and coast-wide management councils. Some of the information assembled by citizen-scientists has been used to advise further efforts in eel passage and habitat conservation. Three different dams on the Hudson now have eel passage devices operating from May through October. Our stream surveys will serve as important benchmarks as further fisheries conservation projects take shape.

  The project has tremendous value to participants as well. In total we estimate more than 1000 volunteers have contributed nearly 5,000 hours of service. Annual evaluations indicate participants feel they gain knowledge, are more connected to their local environment, and have a better attitude towards conservation after being in this project.

  Many students and organizations use this project as more than a great way to get outside and practice good science. Students at Ossining High School compared the urbanization of two eel sites and won international acclaim from Intel and the US Navy. Volunteers on the Minisceongo and Hannacroix Creek host social "eel parties" before and after the sampling season.
  The project has garnered attention both regionally and nationally, including funding from TogetherGreen and media coverage from an array of local publications, the New York Times, Audubon Magazine, and a forthcoming book on citizen-stewardship projects. Professional presentations have been given to the American Fisheries Society, the National Marine Educators Association, and Restore America's Estuaries.

NERR's South Carolina North Inlet-Winyah Bay NERR Secretive Marsh Bird Surveys

- Details: The distribution of clapper rails in the North Inlet marsh is being examined using a standardized call-broadcast method and GIS and spatial analysis techniques. The effects of habitat type, distance from the marsh/upland edge and the presence of developed upland area are being studied. The results of this analysis will further our understanding of the habitat requirements of this species and be used to assess the potential effects of land use change and sea level rise on the population status of clapper rails.

NERR's Secretive Marsh Bird Monitoring at North Inlet Estuary

- **Objectives/Goals:** Better understanding of habitat requirements; potential impacts of land use change and sea level rise on population status of clapper rails
- **Start date of project:** March 2009
- **Project scale/size**, about 20 people including reserve staff and community volunteers over the 4 years
- **Progress/Impact,** They have recorded data for approximately 30 sites across North Inlet. The data has not been analyzed.

NERR's Texas - Citizen Science Blue Crab Monitoring Project - Mission-Aransas NERR

- **Objectives/Goals:** Historically, blue crabs have supported one of the largest commercial fisheries in Texas and they are a critically important food source for the endangered Whooping Cranes that winter on the Texas coast. Concern over recent declines in the abundance and commercial harvest of blue crabs led researchers at the Mission-Aransas National Estuarine Research Reserve (NERR) and University of Texas Marine Science Institute (UTMSI) to initiate a Citizen Science Blue Crab monitoring project. The goal of this volunteer monitoring project is to obtain information about the distribution, migration patterns, and population dynamics of larval blue crabs within the Mission-Aransas Estuary. Volunteers sample larval blue crabs from selected sites within the Estuary and prepare the samples for later analyses by NERR and UTMSI staff. The results of these analyses and of other NERR / UTMSI studies could help scientists understand why populations of blue crabs are declining in Texas estuaries.
- **Start Date:** The first volunteer training for this project was conducted at the Mission-Aransas NERR on 4/13/2012 and volunteers began sampling on 4/26/12.
- **Scale/Size:** Eighteen volunteers have participated in larval blue crab monitoring activities, from the project's inception to the present (4/26/12 – 1/18/13). Two of these volunteers have been specially trained to identify blue crab larvae and count the number of individual blue crabs in the samples. Anyone, 15 years of age and older, may volunteer to participate in the project. The current volunteers are adult certified Texas Master Naturalists, college students, and retired individuals with an interest in marine science.
- **Progress/Impact:** Volunteers have collected 807 larval blue crab samples and 232 of these samples have been processed. The data from these samples and future data collected in this project will be used by NERR / UTMSI and other researchers, including those from the Texas Parks and Wildlife Department, to enhance their understanding of larval blue crab migration patterns and population dynamics.

NERR's Alaska – Kachemak Bay NERR European Green Crab Monitoring

- **Objectives/Goals:** Early detection and rapid response
- **Start date of project:** 2007
- **Project scale/size:** 8 volunteers/groups including two school classes (grades 4 and 5)
- **Progress/Impact:** Volunteers have continued to return year after year, and the school classes have done this each year for four years. While we have never trapped a European green crab (thankfully!) we have found the data on crabs trapped to be of interest, and are beginning to look for population trends. The 4th grade class now plots graphs for us to use in our reports!

NERR's Harmful Algal Boom Monitoring

- **Objectives/Goals:** Early detection of algal blooms that may be toxic to humans or marine animals
- **Start date of project:** 2008
- **Project scale/size:** 13 monitors, of which, several are shellfish farmers
- **Progress/Impact:** Many of our HAB monitors return year after year. Some of them just take plankton tows and water dips and provide them to us to read under a scope, but others have learned to ID them, and provide us with completed data sheets.

NERR's KBNERR Science Collaborative

- Name: KBNERR Science Collaborative
- Objectives/Goals: the KBNERR Science collaborative has a citizen monitoring component whereby a trained group of volunteers were placed in four salt marshes around the Bay to identify the biotic diversity and community composition in these locations.
- Start date of project: 2011
- Project scale/size, i.e. how many people are involved, which user groups; 17 volunteers ranging in age from 12 to 70.
- Progress/Impact, basically, how are they doing: Three or four volunteers were paired with one Reserve staffer per plot and as a team they examined 24 meter-square plots per site to ID all plants, note evidence of animal life, and to collect invertebrate and insect samples. Everyone learned a great deal, amount of data collected were many-fold what Reserve staff could have collected without volunteer support, results were accurate and provide a concise snapshot of the biotic community on each of these salt marshes at the time of collection.

Florida Keys BleachWatch (http://isurus.mote.org/Keys/bleachwatch.phtml)

- **Objectives/Goals:** to train and coordinate volunteers to regularly report on the occurrence, or absence, of coral bleaching, as well as basic environmental conditions of the reef.
- **Start date of project:** 2005
- **Project scale/size:**
    - The Florida Keys BleachWatch program is designed to train and coordinate volunteers who regularly report on the occurrence, or absence, of coral bleaching, as well as basic environmental conditions of the reef. The observational data from BleachWatch volunteers is synthesized with existing NOAA's "Coral Reef Watch" and "Coral Health and Monitoring" programs which have developed remote sensing analysis and real-time monitoring data products for predicting when conditions are favorable for coral bleaching. This information is then provided to resource managers with NOAA, DOI and the State in the form of "Current Conditions" reports distributed throughout the warm summer months.
    - The project trains about 50 people a year, which includes local Marine Biology Camps and different Scouts camps. They have a total of around 350-400 people that have been trained to date.
    - In coordination with the FKNMS and Mote Marine Laboratory, a volunteer network was created in 2005 to collect, consolidate, and interpret observations collected from a team of trained divers, collectively called the BleachWatch program. The Florida Keys BleachWatch Program, modeled after Great Barrier Reef's BleachWatch, utilizes trained and coordinated volunteer divers and snorkelers to provide quantitative assessments and rapid reporting of coral bleaching conditions from reefs throughout the entire Florida Keys National Marine Sanctuary.

- **Progress/Impact**: Project is providing very useful information to resource managers and expanding range of coral reefs monitoring, both spatially and temporally.
  Each year, the Florida Keys BleachWatch program will provide training to individuals throughout the Florida Keys community through a series of public workshops, community presentations, and individual interactions. Anecdotal observations made in the past often did not distinguish between bleaching, partial bleaching, and paling, and often did not give specifics on the types, or even specific species, of corals affected. However, the training, information packets, and visual reporting aids provided to BleachWatch volunteers ensures a standardization of reporting, allowing for researchers to better utilize the data generated from volunteer observer reports. In addition, only through the continued training and coordination of an established volunteer network can researchers obtain this crucial information regarding not only bleaching, but equally importantly observations of no bleaching, year after year. By interpreting observations of coral condition from various areas within a geographic zone, additional insight will be gained toward determining natural resilience, both for habitat types, geographical location, and species of coral.

NOAA Climate Stewards Education Project

- **Objectives/Goal:** NOAA Climate Stewards Education Project (CSEP) provides opportunities for formal and informal educators to increase their understanding of essential climate concepts through direct interaction with scientists and education specialists. They are also supported through learning communities and grants to develop environmentally friendly action plans to reduce the "carbon footprint" in their own communities.
- **Project Outcomes:**
  - Direct Outcomes for CSEP Participants
    - Increase the content knowledge in climate-related STEM
    - Increase the use of NOAA, and NOAA Partner data resources.
    - Increase participation in active environmental stewardship

  - Indirect Outcomes for CSEP Stewardship Project Participants
    - Increase participation in active environmental stewardship
    - Increase knowledge about careers in STEM related to climate science
    - Increase ability to apply climate science STEM concepts and skills in meaningful ways
    - Intend to continue environmental stewardship activities in the future

  Start date of project: February, 2010
- **Project Scale/Size:** Formal and informal educators from all grade levels, college, and museums. 200 participants in 46 states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands.
  - Progress/Impact: Annual formal evaluation studies indicate that Overall, the program gets high marks from the participants, their knowledge increases and use of what they learned is impressive. Indicators of the success of the program are their increased confidence, changes in teaching practice, stewardship projects, and interest in continuing to participate in the

professional development. The evidence suggests it is working well and the number of successful community projects rise each year.

Marine Debris Monitoring and Assessment Project

- **Objectives/Goals:** MD-MAP is a network of shoreline marine debris monitoring teams coordinated by the NOAA Marine Debris Program. This project relies on partner organizations' capacity to recruit and manage teams of volunteers that apply NOAA's standardized protocols to survey set shoreline sites on a monthly basis. Regularly scheduled, standardized shoreline monitoring efforts provide essential baseline data and fill a gap in research to assess the impacts and risk posed by marine debris. On local and regional scales, these studies can address specific questions, for example sources and drivers of debris and potential targets for mitigation. Survey data is entered into an online database for analysis by the NOAA MDP and research community.

- **Start date of project:** MD-MAP was initiated on a large scale following the March 2011 earthquake and tsunami in Japan. Partners began monitoring as early as January 2012.

- **Project scale/size**: MD-MAP currently includes more than 30 partner organizations monitoring over 100 shoreline sites, with an estimate of about three volunteers per site. Partners include various members of the NGO community, academia, USFWS, NPS, and NOAA Sanctuaries. Sites are located in Alaska, Hawaii, and along the West Coast (including British Columbia). The project is expected to expand to other regions in FY13.

- **Progress/Impact**: Standardization of marine debris monitoring and assessment protocols has been an historic need. The launch and expansion of NOAA's MD-MAP is filling this gap by engaging various sectors of the community in support of monitoring efforts. An online database has been developed and launched and an initial data compilation and analysis is planned for March 2013. This project has extended the reach of the NOAA MDP, engaged new partners and citizen scientists, and facilitated the development of a nationally cohesive yet locally adaptable marine debris monitoring and assessment project.

Voluntary Observing Ship (VOS)

- **Objectives/Goals:** To engage cargo and cruise ships as well as other commercial and research vessels worldwide to collect and transmit weather observations to the many national meteorological services that have responsibility for marine weather forecasts. This data is archived for future use by climatologists and other scientists.
- **Start date of project:** According to *http://www.wmo.int/pages/prog/amp/mmop/JCOMM/OPA/SOT/vos.html* the VOS uses an "international scheme, first developed almost 150 years ago". Since 1999 the program is coordinated by the World Meteorological Organization (WMO) Intergovernmental Oceanographic Commission (IOC) Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM).
- **Project scale/size:** This program is an international effort currently involving about 4,000 vessels, from which NOAA/VOS services about one quarter, 1,200.. In the US NOAA maintains Port Meteorological Officers (PMOs) in almost 20 ports. PMOs are responsible for recruitment of new

vessels as observers, and also for ensuring the quality of observations from vessels actively participating in the program. In addition the program includes personnel to coordinate the operations and manage the data collected.

- **Progress/Impact:** From *http://www.vos.noaa.gov/vos_scheme.shtml*: "the contribution which VOS meteorological reports make to operational meteorology, to marine meteorological services and to global climate studies is unique and irreplaceable."

Ship Of Opportunity Program (SOOP)

- **Objectives/Goals:** The Ship Of Opportunity Program (SOOP) is an international effort that supports the implementation of a network of cargo vessels, cruise ships, and research vessels to deploy scientific instruments that collect oceanographic observations. The most important of these instruments is the Expendable Bathythermograph (XBT), used to measure the water temperature from the sea surface to a maximum depth of 850 m. XBT temperature measurements are used to monitor changes of key surface and subsurface currents, to study meridional heat transport in all ocean basins, and to supplement other observational platforms to assess the variability of the upper ocean heat content.
- **Start date of project:** Some of the XBT transects have been maintained for many years, for example AX32, which runs from Newark to Bermuda. This transect is geared towards investigating the variability of the Gulf Stream, and has been carried out for 31 consecutive years since 1981.
- **Project scale/size:** This program is an international effort. In the US there are more than 30 people involved in the SOOP, coordinating the operation and providing technical and operational support, equipment maintenance, software development, data management, and science support and applications. There are approximately 50 ships participating in the program. On average, approximately 20,000 XBTs are deployed per year, of which AOML is involved in some aspect of the logistics, operations, data processing, etc., of about 90% of them. AOML leads or co-leads with its international collaborators the implementation and operations of 12 Atlantic Ocean transects
- **Progress/Impact:** All XBT transects have been justified by their impact of our understanding of how the upper ocean dynamics and thermal structure may be linked to long-term climate signals, extreme weather events, ecosystem assessments, etc. Scientists using XBT data produce more than 25 publications annually in peer review scientific publications, in addition to presentations in scientific meetings, and a large number of other applications in which several products for ocean condition monitoring are created. Most of the data obtained though this project are distributed onto the Global Telecommunication System (GTS) within 24 hours of its acquisition, thereby providing critical input to weather and climate forecasts models and scientific applications. Additional scientific quality control is carried out at AOML to provide data with quality for climate studies. The SOOP project has developed and currently maintains the Shipboard Environmental Data Acquisition System (SEAS), a software used to collect and transmit observations from XBTs, ThermoSalinoGraphs (TSGs), and meteorological observations, which contribute to the largest source of marine meteorological observations used by the NOAA National Weather Service for

Marine forecast. In addition, this software provides regular reports to the US Coast Guard's Automated Mutual-Assistance Vessel Rescue System (AMVER), which aids in finding ships in the vicinity of vessels in distress, in order to save lives and property.

Note: the remaining programs with descriptions are from NOAA's National Marine Sanctuaries.

Project: Whale Watching Data Collection in Stellwagen Bank National Marine Sanctuary

Objectives/Goals: Data collection of vessel traffic and whale sightings in Stellwagen Bank NMS. This program gives the sanctuary a greater understanding of whale watching vessel use within the sanctuary. Whale watching vessel traffic has been a lacking component for proper site characterization throughout US waters, even though it is a chronic use of sanctuary waters. With their rigorous training, on-water experience and ability as uniformed Coast Guard Auxilarists to work on these private vessels and collect data has filled a data gap for all of NOAA.

Start date of project: 2004

Project scale/size: US Coast Guard Auxiliary and Stellwagen volunteers. About 300 hours per year by 10-15 volunteers.

Progress/Impact: This data has not only been used by Stellwagen Bank Sanctuary for numerous vessel use and acoustic impact analysis, it was also cited by the National Center for Ecological Analysis and Synthesis (NCEAS) and the White House Council on Environmental Quality (CEQ) as the only data on whale watching effects in eastern US waters. These data were used to build a robust Ecosystem Services Tradeoff analysis as tasked by the Presidents Ocean Policy Task Force for Comprehensive Marine Spatial Planning. A volunteer from this program was also named the National Marine Sanctuary Foundation Volunteer of the Year in 2012.

Project: Stellwagen Sanctuary Seabird Stewards

Objectives/Goals: Stellwagen Sanctuary Seabird Stewards (S4) sends volunteers out on the water to conduct bird surveys in partnership with National Audubon.

Start date of project: 2011

Project scale/size: 34 volunteer per year have completed 39 research trips on sanctuary or partner whale watch vessels for a total of over 2,000 hours per year.

Progress/Impact: The volunteer corps of experienced birders, who serve as citizen scientists, is providing the sanctuary with some of its most detailed information about avian species. This year's findings will be added to both the growing sanctuary and Audubon databases to help NOAA understand changes in the local seabird populations over time.

Project: Team Ocean Diver Corps – Gray's Reef NMS

Objectives/Goals: Assist with Gray's Reef NMS scientific dive operations

Start date of project: 2000

Project scale/size: 8 volunteers contributing about 450 hours yearly

Progress/Impact: Volunteer divers conduct fish counts, marine debris removal, and assist with sanctuary dive operations during the field season and on research cruises. Volunteers also assist in vessel maintenance and operations as well as U.S. Coast Guard overflights as mandated for Living Marine Resources protection.

Project: Channel Islands Naturalist Corps

Objectives/Goals: Channel Islands Naturalist Corps (CINC) are a group of specially trained volunteer ocean stewards dedicated to educating passengers on board vessels visiting the Channel Islands National Marine Sanctuary and Channel Islands National Park (CINP). Members provide education about the unique marine life found in sanctuary and Park waters to thousands of local residents, tourists, and school children annually. CINC volunteers also participate in numerous local outreach events and collect valuable research on marine mammals and other important sanctuary and Park resources. Each year CINC volunteers collect and enter marine mammal sightings data from the Santa Barbara Channel into the Marine Mammal Sightings Database. The database contains nearly 10,000 records from 1999-present. CINC volunteers also provide support for photo-ID of blue and humpback whales and killer whales – this citizen science data is included in Cascadia Research Collective's long-term research on humpback and blue whales both along the West Coast of the United States and the SPLASH (Structure of Populations, Levels of Abundance, and Status of Humpbacks) international study http://www.cascadiaresearch.org/splash/splash.htm.

Start date of project: 1996 - present

Project scale/size: Over 140 volunteers contribute almost 35,000 hours yearly. This program is made possible through a partnership with participating boat operators out of Santa Barbara Harbor, Ventura Harbor, and Channel Islands Harbor and is managed in partnership with Channel Islands National Park.

Progress/Impact: In 2012, data collected by CINC citizen science program was used by Channel Islands National Marine Sanctuary resource managers to map whale aggregations over time in relation to the shipping lanes in the sanctuary and inform the US Coast Guard's PARs study. These recommendations were influential in the IMO's December 2012 adoption of lane adjustments in the Santa Barbara Channel to reduce ship strikes of endangered whales. CINMS is currently testing a new beta App that can be used to crowd-source CINC marine mammal sightings data with other West Coast Sanctuaries. This App may be another citizen-science based tool that can be used to provide near-real time data on whale locations to boaters and large vessels transiting the West Coast. This program was recognized as the Take Pride in America Federal Volunteer Program in 2011. Each year CINC volunteers interact with over 300,000 members of the public. Their marine mammal photos have resulted in at least 1,145 positive identifications of individual animals made by CINC volunteers. CINC volunteers also provide citizen science support as needed for other partner researchers and organizations such as the COSEE Harmful Algal Bloom Network and The Nature Conservancy at Santa Cruz Island.

Project: Monterey Bay National Marine Sanctuary Snapshot Day

Objectives/Goals: On the first weekend in May, volunteers from San Mateo County to San Luis Obispo County participate in the annual Snapshot Day Event. Over 200 trained volunteers participate in this Sanctuary-wide volunteer water quality monitoring event designed to increase information and public awareness about water quality issues affecting watersheds that drain to Monterey Bay National Marine Sanctuary.

Start date of project: 2000

Project scale/size: In 2012, 214 volunteers tested 186 sites and contributed over 1100 hours.

Progress/Impact: This community event provides a one-day "snapshot" of the health of the rivers and streams that flow into the Monterey Bay National Marine Sanctuary. Temperature, dissolved oxygen, pH, and conductivity are measured in the field, while water samples are collected for laboratory analysis of nutrients and bacteria levels. Volunteers test for *E. coli*, enterococcus, nitrate, and orthophosphate. The volunteers collecting this valuable information play a key role in our community as stewards of our watersheds. The information they provide is used by resource agencies, local governments and community groups to protect and improve the health of our local streams.

Project: Monterey Bay National Marine Sanctuary First Flush

Objectives/Goals: First Flush is an annual storm water monitoring event occurring during the first significant rain event of the season. The first major storm event of the season has some of the most concentrated pollutants that have accumulated on streets, roofs, and parking lots during dry weather months. This is considered the First Flush. The goal of this effort is to characterize the First Flush storm water runoff that is flowing into the Monterey Bay National Marine Sanctuary and to identify urban watersheds with storm flows that contain high concentrations of metals, bacteria and nutrients.

Start date of project: 2000

Project scale/size: 50 volunteers test 40 sites and contribute 250 hours yearly.

Progress/Impact: First Flush has been able to provide data for sites in San Mateo, Santa Cruz, and Monterey Counties, which provides the sanctuary and local government information on water quality issues in the area that may be harmful to both humans and marine life. Volunteers collect samples that are tested for *E. coli*, enterococcus, nitrate, orthophosphate, urea, total copper, total zinc, total lead and TSS.

Project: Monterey Bay National Marine Sanctuary Urban Watch

Objectives/Goals: Urban runoff is one of the leading sources of pollution into coastal waters. The Urban Watch monitoring program volunteers are local residents and community members that become involved in learning more about water quality and urban pollution issues. Urban Watch volunteers monitor storm drain outfalls for the dry weather months (June-October). Volunteers are trained in water quality monitoring: collecting water samples and conducting basic field analysis using an EPA approved LaMotte Storm Drain Pollution Detection Kit that contains tests for detergents, ammonia, chlorine, copper, pH, and turbidity.

Start date of project: 1998

Project scale/size: The Urban Watch Water Quality Monitoring Program is conducted in the Cities of Monterey, Pacific Grove, and Capitola through the efforts of the Monterey Bay National Marine Sanctuary, the SEA group and the Coastal Watershed Council. Yearly 30 volunteers contribute 500-1000 hours.

Progress/Impact: This continuing program has helped the cities of Monterey, Pacific Grove, and Capitola and the Monterey Bay National Marine Sanctuary identify and implement targeted educational programs aimed at addressing common urban pollutants entering the Monterey Bay National Marine Sanctuary.

Project: Beach COMBERS (Monterey Bay National Marine Sanctuary)

Objectives/Goals: A beach monitoring study, utilizing volunteers to sample beaches for dead marine birds and mammals and tar balls throughout the Monterey Bay and San Simeon areas. The primary goal of the program, designated Beach COMBERS (Coastal Ocean Mammal / Bird Education and Research Surveys), is to obtain information on rates of stranding for all species of marine birds and mammals in Monterey Bay. Pairs of trained volunteers survey their beach segment during the first week of each month at low tide. The program is a collaborative project between Moss Landing Marine Laboratories (MLML) the Monterey Bay National Marine Sanctuary (MBNMS), and other state and research institutions including the California Department of Fish and Game and Marine Wildlife Veterinary Care and Research Center (MWVCRC), with the specific goal of using deposition of beach cast carcasses as an index of the health of the sanctuary.

Start date of project: 1997

Project scale/size: Volunteers contribute over 500 hours yearly.

Progress/Impact: The long-term objectives of the program are to provide a baseline of information on the average presence of beachcast marine organisms and to assist the Sanctuary in the early detection of mortality events triggered by natural and anthropogenic environmental perturbations such as harmful algal blooms and oil spills.

Project: Beach Watch (Gulf of the Farallones National Marine Sanctuary)

Objectives/Goals:

- Provide a baseline data set on the presence of live and beach cast marine organisms;
- Assist Sanctuary management in the early detection of natural and human-caused environmental events;
- Develop a network of volunteer expert surveyors who can respond during an oil spill; and
- Educate the public about the sanctuary system, the coastal environment, and how they can make a difference in protecting their beaches.

Start Date: 1993

Project Scale/Size: Spanning over 240 km of coast from Bodega Head to Point Año Nuevo, 110 km of outer coast and estuarine shoreline are surveyed every two weeks. One hundred and twenty volunteers annually contribute over 5000 hours of survey time.

Progress/Impact: Beach Watch was one of the first citizen science monitoring projects within NOAA and the first citizen science project within the Office of National Marine Sanctuaries. The Beach Watch project collects a wide variety of data, which are later incorporated into sanctuary management decision-making: identify species that are most vulnerable to anthropogenic stressors such as disturbance, entanglement and marine debris, identify the health and trends of key species and stressors such as Snowy Plovers and sea otters, aid in the prioritization of management decisions across stressors and vulnerable habitats and key species during oil spill response and clean-up efforts, relate baseline conditions to post-anthropogenic impacts and scale restoration efforts as needed after an oil spill, spatio-temporal patterns of live and dead birds to alert management to unusual mortality events and identification of causative factors such as waste management practices near the San Mateo County coast, natural resources damage assessment and how the Beach Watch program has served as a model for other cost-effective, citizen-science programs. Data from Beach Watch have supported natural resources damage assessment and provided scaling for restoration projects resulting in over $50,000,000 in settlement funds used for greater protection of seabirds, marsh lands, and lost recreational-uses from five oil spills.

Project: LiMPETS (Long-term Monitoring Program and Experiential Training for Students)

Objectives/Goals: LiMPETS (Long-term Monitoring Program and Experiential Training for Students) is an environmental monitoring and education program for students, educators, and volunteer groups. Two distinct monitoring programs make up the core of the LiMPETS network: the Rocky Intertidal Monitoring Program and the Sandy Beach Monitoring Program. Both programs connect students to the ocean, involve them directly in a real scientific endeavor, and increase their awareness of, and interest in, the coastal ecosystems of California's National Marine Sanctuaries. These citizen scientist 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 vision of LiMPETS is to be recognized and respected as one of the nation's premier student-based citizen science programs.

Start date of project: 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.

Project scale/size: Approximately 4,000 teachers and students along the coast of California are involved with the collection of rocky intertidal and sandy beach data as part of the LiMPETS network. 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.

Progress/Impact: LiMPETS was awarded 3 yrs of funding to help establish baseline for NCC MPAs. The results will help lay foundation for future assessments of effectiveness of MPAs and will inform CA whether data is useful and can complement research conducted by scientists. In the process, students and teachers learn about Sanctuaries AND state MPAs. 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. Expanded to serve middle and high school students, undergraduates, and community groups, the program operates in California from Bodega Bay in Northern California to San Diego, with three regional centers: San Francisco, Monterey Bay, and Santa Barbara. LiMPETS has grown to reach approximately 4,000 participants in California per year, 60% of whom are high school aged students. To date, LiMPETS is the only regional student-based citizen science program that has a strong science foundation, an advisory panel, a breadth and depth of educational resources, including a 5-unit curriculum, and an innovative website with data entry, query and graphing capabilities. LiMPETS has the power to reach broadly and go deep, optimizing the impact on the students it serves, on communities, and on marine resources within the state of California.

Project: Rocky Shore Partnership and California Biodiversity Monitoring: (Gulf of the Farallones National Marine Sanctuary)

Objectives/Goals: This program is run as a partnership between the GFNMS and the California Academy of Sciences ('Academy'). The original goals of this project were to engage visitors to Duxbury reef and to monitor the effect of high visitorship on the reef. Our goals were to increase stewardship of the reef by education especially around proper tidepool etiquette. We are in the process of shifting the goals of this project.

Program began: January 2009 at Duxbury Reef in Marin County and is now being revamped and expanded to San Mateo County.

Project scale/size: Over 50 people have been trained to monitor at Duxbury reef. These volunteers have contributed over 500 hours over the past 3 years to Citizen Science and Stewardship at Duxbury Reef. Last year, 2012, 70 people participated in six field days at Pillar Point Reef in San Mateo County. They contributed over 350 hours of biodiversity monitoring at the reef.

Progress/Impact, basically, how are they doing: Originally funded by Cape Mohican Trustee funds and only designed to monitor for trampling on one beach (Duxbury Reef in Marin County, CA). We are continuing the training and monitoring at Duxbury for one final year of the trustee funding. We have modified protocols; goals and training to more closely align with GFNMS management education and stewardship goals and Academy research and education goals. This shift will ensure future funding for this kind of work. The Academy has just finished a year of planning for Citizen Science funded by the S.D. Bechtel Foundation and is in the process of applying for future funding. The Academy will continue to work in partnership with GFNMS on this project.

Project: COASST Seabird Survey (Olympic Coast National Marine Sanctuary)

Objectives/Goals: The Coastal Observation and Seabird Survey Team (COASST) is a citizen-science program established to identify the carcasses of marine birds found on beaches along the coast of the Pacific Northwest. COASST is a project of the University of Washington in partnership with state, tribal and federal agencies, environmental organizations, and community groups along the coasts of Oregon, Washington and Alaska. Pairs of specially trained COASST volunteers conduct monthly surveys of a particular stretch of coastline. Each bird carcass is measured, identified, photographed, marked, and left in place for potential re-find on subsequent surveys. Visitor use and oil presence or absence is also recorded. Partners include: University of Washington, Olympic Coast National Marine Sanctuary,

Makah, Quileute, and Hoh Tribes, Quinault Indian Nation, and regional organizations. In Alaska: Alaska Maritime National Wildlife Refuge.

Start date of project: 1998

Project scale/size: COASST volunteers have contributed up to 10,000 hours per year.

Progress/Impact: COASST data have created a baseline, or the 'normal' pattern, for beached bird mortality. Armed with this information, we can detect unusual events such as increased mortality due to low food availability, weather or oil spills.

Perhaps most importantly, COASST data can be used to identify long-term changes in the status of our resident marine bird populations.

Project: Shoreline Debris Monitoring (Olympic Coast National Marine Sanctuary)

Objectives/Goals: Olympic Coast National Marine Sanctuary (OCNMS), funded by a grant from NOAA's Marine Debris Program, initiated shoreline debris monitoring in 2012 following NOAA's Marine Debris Shoreline Survey Field Guide methods published in 2012. OCNMS volunteers originally initiated shoreline debris monitoring in 2001 using data categories standardized by the U.S. Environmental Protection Agency and Ocean Conservancy. Heightened interest in shoreline debris data associated with concerns about materials originating from the March 2011 Japan tsunami coincided with release of the new NOAA methods, which prompted significant modification of OCNMS' shoreline debris monitoring program. Shoreline debris data will be used to document temporal, spatial, and composition patterns in debris deposition on Washington's coastline, and to the extent possible to identify changes in debris types and volumes associated with the March 2011 tsunami debris.

Start date of project: 2012

Project scale/size: In 2012, new shoreline debris monitoring methods were initiated at 6 sites on the outer coast of Washington state. The goal for 2013 is to expand this monitoring network to cover a broader geographic area and include a greater number of monitoring sites and volunteers.

Project: Sanctuary Ocean Count (Hawaiian Island Humpback Whale National Marine Sanctuary)

Objectives/Goals: Each year over 2300 volunteers take to the shores of Hawaii on the last Saturday of January, February, and March to documents whale behavior. The Sanctuary Ocean Count project aims to increase public awareness of the sanctuary and current ocean issues, including threats to humpback whales while also promoting responsible viewing of all marine wildlife. The project was initiated as a means to provide Hawaii residents and visitors with the opportunity to observe humpback whales in their breeding grounds by conducting a yearly shore-based census during the peak-breeding season. Although the census does not claim to provide scientifically accurate results, it serves as a tool to supplement scientific information gathered from other research activities. The count also provides snapshot data as well as information on how whales use inshore waters on an average peak season day. Sanctuary Ocean Count project participants learn about threats to whales, including the threat of entanglement in marine debris and fishing gear which leads to the death of over 300,000 cetaceans worldwide each year. After learning about threats and how to properly report animals in distress,

volunteers become the sanctuary's "eyes on the water". They are able to properly report incidents and related details in a timely manner allowing the response network to have a better chance of rescuing whales. This same process benefits other natural resources such as critically endangered Hawaiian monk seals, sea turtles, and dolphins. Over 150 Sanctuary Ocean Count site leaders receive mandatory training from the sanctuary each year.

Start date of project: 1996

Project scale/size: Over 2,300 volunteers participate in 60 locations around Oahu, Kauai, and Hawaii. In the past 17 years over 20,000 volunteers have donated over 100,000 hours.

Progress/Impact: The Sanctuary Ocean Count has created an increased awareness of the Hawaiian Island Humpback Whale National Marine Sanctuary and its resources including a Governor proclamation three times celebrating the event and Humpback Whale Awareness month.

Project: Team Ocean (Florida Keys NMS and Monterey Bay NMS)

Objectives/Goals: On the water naturalist who also assist in stewardship and citizen science activities in Florida Keys National Marine Sanctuary and Monterey Bay National Marine Sanctuary

Start date of project: 2000

Project scale/size: Each year volunteers donate about 1000 hours at Florida Keys and an additional 1000 hours at Monterey Bay.

Progress/Impact: Volunteers in Florida Keys picked up over 10,000 pounds of marine debris per year. Team Ocean volunteers in Monterey Bay interact with almost 5,000 people per year including preventing marine mammal disturbance or giving safety warning.

Other programs we are aware of, but did not receive information from:

- **NOS Mussel Watch (http://ccma.nos.noaa.gov/about/coast/nsandt/musselwatch.aspx)**
- **NMFS Beach Watch (http://farallones.org/volunteer/beach_watch.php)**
- **NMFS Ocean Count (http://hawaiihumpbackwhale.noaa.gov/involved/ocwelcome.html)**
- **NMSF Team Ocean (http://floridakeys.noaa.gov/volunteer_opportunities/teamocean.html and http://montereybay.noaa.gov/educate/to/welcome.html)**
- **NMFS Partner Program LiMPETS (http://limpetsmonitoring.org)**
- **NMFS Partner Program REEF (http://www.reef.org/programs/volunteersurvey)**
- **NMFS Partner Program: Coral Reef Monitoring Data Portal (http://monitoring.coral.org/home)**