

Research Vessels *Shearwater* and *Shark Cat* Summary of CY2012 Accomplishments

- Support area: 1,470 square miles
- Total days at sea: 77
- R/V *Shearwater* days at sea: 60
- R/V *Shark Cat* days at sea: 17



NOAA's R/V *Shearwater* at Santa Barbara Island during the 2012 Shipwreck Reconnaissance Expedition. Photo credit: Robert Schwemmer, NOAA/CINMS.

The 62' Research Vessel *Shearwater* is the first of her class and has proven over the last nine years of operation to be an effective platform for research, maritime heritage, education, and outreach missions in Channel Islands National Marine Sanctuary (CINMS), and a model for other sanctuary vessels that have followed. The 28' Research Vessel *Shark Cat* was acquired by CINMS from Monterey Bay National Marine Sanctuary in 2010 and has proven to be an effective, lower cost option for several projects.

RESEARCH: Highlights Aboard R/V *Shearwater* & *Shark Cat*

The majority (75%) of operational days at sea aboard R/V *Shearwater* and *Shark Cat* are research missions. These 58 days at sea supported eight research projects. Most of these are annual projects that continued to receive multi-year support in 2012:

- Plumes and Blooms: monthly oceanographic sampling of conductivity, temperature, and depth in the Santa Barbara Channel in collaboration with University of California, Santa Barbara (UCSB)
- *Pseudo-nitzschia* Bloom Dynamics: biannual deployment and retrieval of sediment trap in collaboration with the University of South Carolina
- Maritime Heritage Shipwreck Reconnaissance: CINMS scuba surveys
- West Coast Observatory Moorings: servicing data loggers and acoustic tag receivers in collaboration with Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO)
- Seabird Habitat Restoration: in collaboration with Channel Islands National Park
- Blue Whale Monitoring: in collaboration with Cascadia Research Collective and Scripps Institution of Oceanography
- Underwater Acoustic Monitoring in the Santa Barbara Channel: in collaboration with Scripps Institution of Oceanography



CINMS working diver, Julie Bursek, attaches a temperature logger to a subsurface mooring during biannual servicing of West Coast Obs Moorings. Photo credit: Claire Fackler, NOAA/ONMS.

Summary highlights from several projects are listed below.

R/V *Shark Cat* ideal platform for PISCO larval recruitment free-diving operations

Starting in April of 2012, in collaboration with the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), the R/V *Shark Cat* was used to monitor the spatial and temporal patterns of juvenile fish recruitment within Channel Islands National Marine Sanctuary. With sites ranging from San Miguel to Anacapa Islands, the speed and efficiency of the R/V *Shark Cat* made it an ideal platform for this research. From April to December of



Samples of juvenile Stripetail Rockfish (*Sebastes saxicola*). Photo credit: Peter Carlson, UCSB/PISCO.

2012 the array of eight sites, each containing artificial substrate that attracts larval fishes, was sampled every month. Over the course of the season PISCO tracked over 6,000 incoming larval individuals of numerous species

including Rockfish (*Sebastes Spp.*), Cabazon (*Scorpaenichthys marmoratus*), and Kelp Bass (*Paralabrax clathratus*). Coupling this

recruitments data with previous years of CINMS supported sampling and CINMS oceanographic data, researchers are able to elucidate the long term recruitment patterns within the Santa Barbara Channel.

Subsurface Sediment Trap Mooring Retrieval and Deployment

In June, the R/V *Shearwater* successfully recovered and redeployed a large subsurface sediment trap mooring in the Santa Barbara Basin. A 340 meter subsurface mooring with two Mark VII automated sediment traps were recovered, serviced and redeployed, requiring complex and tightly choreographed deck operations and vessel maneuvering. The mooring is part of a multi-year collaborative project with Dr. Claudia Benitez-Nelson, Dr. Robert Thunell, and Eric Tappa (University of South Carolina's Marine Science Program & Department of Earth & Ocean Sciences), Dr. Clarissa Anderson (University of California Santa Cruz), and Dr. David Siegel (University of California Santa Barbara's Plumes and Blooms Program). The project focuses on a study of the production and export of domoic acid, a toxin produced by harmful algal blooms, from surface waters to depth in the Santa Barbara Basin. The mooring will enable suspended and sinking Pseudo-nitzschia cells as well as domoic acid concentrations to be directly compared with samples collected during monthly CTD profiles and surface sampling collected as part of the Plumes and Blooms Program.



R/V *Shark Cat* in Santa Barbara Harbor. Photo credit: LTJG Lyndsey Keen, NOAA/CINMS.

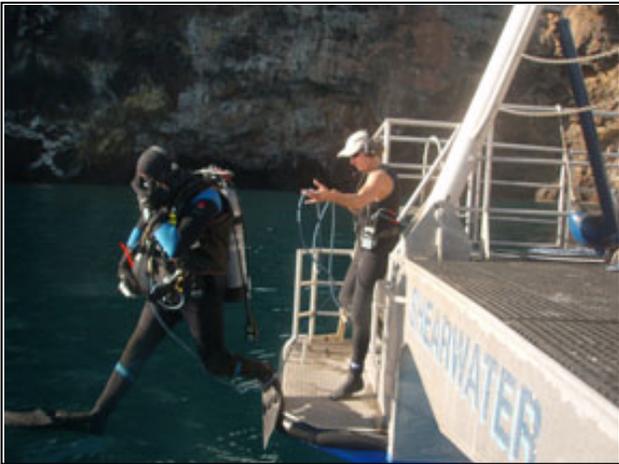


University of South Carolina's Eric Tappa recovers sediment samples collected over the past 7 months in the Santa Barbara Basin, as Vessel Operations Coordinator Lyndsey Keen operates the scientific winch and University of South Carolina's Senior Associate Dean for Natural Sciences, Dr. Robert Thunell, guides the mooring cable onto the winch drum. Photo credit: Shauna Bingham, NOAA/CINMS.

Researchers are currently developing a predictive model to help understand when toxigenic *Pseudo-nitzschia* blooms occur and the underlying mechanisms that have induced these blooms over the past two decades. A paper resulting from this research was published this past year:

Sekula-Wood, E., Benitez-Nelson, C.R., Bennett, M.A., Thunell, R.C. (2012) Magnitude and composition of sinking particulate phosphorus fluxes in Santa Barbara Basin, California. *Global Biogeochemical Cycles*, 26, GB2023, doi:10.1029/2011GB004180.

West Coast Observatory Environmental Monitoring and Acoustic Animal Movement Monitoring Programs



Research Coordinator Steve Katz entering the water from the R/V *Shearwater* to service instruments during Oct. 2012 West Coast Obs cruise, using tethered communications equipment. Education Coordinator Julie Bursek serves as line tender. Photo credit: Claire Fackler. NOAA/ONMS.

During spring and fall 2012, the research department for Channel Islands National Marine Sanctuary conducted a series of dives to service 13 subsurface moorings, recovering old and deploying new instruments to monitor local conditions.

Instrumentation included Acoustic Doppler Current Profilers (ADCP), temperature loggers and VR2 acoustic receiver/data loggers to detect fish tagged with acoustic transmitters. The ADCPs and temperature loggers are part of a 6 year study to evaluate near-shore water circulation and its impact on larval transport across marine protected area (MPA) boundaries. This is a collaborative project between CINMS and PISCO. The VR2 receivers are

part of a collaborative project with the Monterey Bay Aquarium and California State University Long Beach looking at movement of large sharks along the California coast. In the spring 2012 download several sharks were detected including two adult white sharks tagged in Central California (Ano Nuevo Island and the Farallon Islands) and one juvenile white shark tagged in Ventura, California. In addition, two 7-gill sharks tagged in San Francisco Bay by colleagues at UC Davis were detected consistently from January-April 2012 at Santa Rosa Island. In the October 2012 schedule of data downloads we detected an additional, previously undetected white shark tagged as part of a cooperative project with CSU Long Beach and the Monterey Bay Aquarium. In addition, a seven-gill shark that was originally tagged in San Francisco bay by colleagues at UC Davis was seen again in August at Santa Rosa Island; the second year in a row that this animal has been seen here in-between return trips to San Francisco Bay. These studies are important for several reasons: 1) the studies of interactions between larval transport and ocean circulation are the only ongoing studies of larval transport and potential MPA service in supporting increased larval recruitment regionally; and 2) our study of large predator movement has demonstrated significant connectivity between sanctuary sites on the west coast and will be important in defining the scale of relevant management assessments on the west coast.

Additionally, the October operations represented the first effort to conduct this operation with solo divers supported from surface vessels with communications tethers. The use of tethered divers reduces over-all risk to the agency, and thus increases safety by reducing the number of staff exposed at any one time to the inherent risks of diving. The funding to extend CINMS research department capacity was made available by a reprogramming of West Coast Observatory funding from the ONMS West Coast Regional Office.

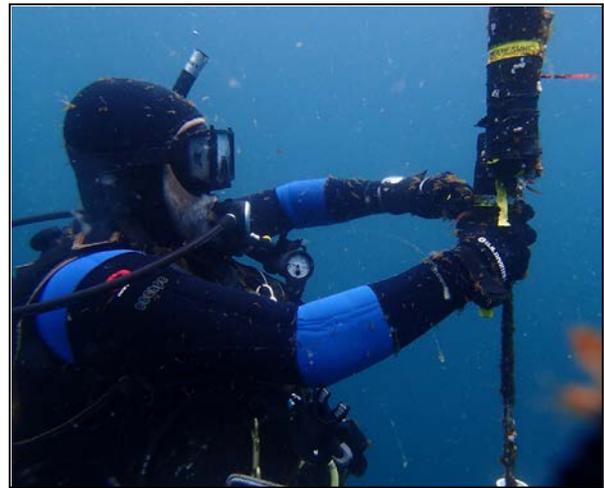
Research Cruise to Evaluate Whale Behavior in Response to Large Ships

From August 22-29, 2012, the R/V *Shearwater* conducted a cruise to support a project to evaluate responses of blue whales to large vessel shipping in CINMS. Whales were tagged with a variety of



Deployment of an Acousonde acoustic/ultrasonic recorder on a blue whale off the Palos Verdes area of LA in 2011, which provided data during a close ship approach. Photo credit: Kelly Stingle, Cascadia Research Collective.

instrumentation and then surveyed. The tags usually fall off the animal and are retrieved within 24hrs. The data from the tag (position, depth, hydro-acoustic, etc.) can then be downloaded and analyzed. The project is a partnership between CINMS, Cascadia Research, and Scripps Institution of Oceanography. This is the final cruise of a project that has been ongoing for three years and funded by a grant from the NOAA Fisheries Service Office of Science and Technology to CINMS and the Office of Naval Research to partners at Cascadia Research. The project involved attaching data-recording tags to blue whales in the paths of oncoming cargo ships using Cascadia's RHIB *Ziphid*, as well as making marine mammal observations from the flying bridge of R/V *Shearwater*. This year, the cruise was adapted to include two days of work with PUMA unmanned aerial vehicles (UAVs) that were used to evaluate the utility of UAVs for spotting whales and measuring their body lengths from the air. The operation was in collaboration with NOAA's Unmanned Aircraft System (UAS) program, with operational support provided by NOAA's Aircraft Operations Center (AOC). The Puma UAS was used to search for whales, and successfully obtained footage of whale activity, feeding, and tagging operations. The cruise also included two days of work with the Oceanic Preservation Society film crew that was



Research Coordinator Steve Katz servicing instruments during Oct. 2012 West Coast Obs cruise, Channel Islands National Marine Sanctuary. Photo credit: Claire Fackler, NOAA/ONMS.

instrumentation and then surveyed. The tags usually fall off the animal and are retrieved within 24hrs. The data from the tag (position, depth, hydro-acoustic, etc.) can then be downloaded and analyzed. The project is a partnership between CINMS, Cascadia Research, and Scripps Institution of Oceanography. This is the final cruise of a project that has been ongoing for three years and funded by a grant from the NOAA Fisheries Service Office of Science and Technology to CINMS and the Office of Naval Research to



Humpback whale breaching near R/V *Shearwater* during the August 2012 project. Photo credit: ENS Kevin Doremus, NOAA/AOC.

attempting to film whales and Cascadia staff applying tags. The cruise included visual surveys covering over 900 nautical miles between Santa Barbara and Dana Point, California, and the tagging of nine whales. To help address the problem of ship strikes on endangered blue whales, tagging studies are needed to help understand whale behavior relative to ship approach. A Sanctuary research permit was issued for this work, and applicable marine mammal permits were issued by the National Marine Fisheries Service.

VESSEL REPAIRS & UPGRADES: Highlights for R/V *Shearwater* & *Shark Cat*

R/V *Shark Cat* Maintenance and Upgrades

R/V *Shark Cat* underwent a two-week maintenance period in August 2012 to complete scheduled maintenance on the Yamaha outboards, as well as address several deficiencies noted in the biennial Small Boat Examination (SBEX). Work included installing a gasoline fume detector and carbon monoxide detector, rewiring the shore power system to comply with American Boat and Yacht Council (ABYC) safety standards and installing a

galvanic isolator, replacing the fuel lines, and replacing the dated depth sounder with a

transducer integrated into the Lowrance Chartplotter. These upgrades greatly increase the margin of safety and continue the effort to gradually convert the former patrol boat to a research and dive platform, suitable for operating in remote areas of the sanctuary.



R/V *Shark Cat* getting re-launched after 2-week repair period at Ventura Harbor Boat Yard. Photo credit: LTJG Lyndsey Keen, NOAA/CINMS.

Shipyard Repairs and Upgrades Completed for R/V *Shearwater*

A \$98K repair and upgrade contract for the R/V *Shearwater* was awarded in July 2011. After two short in water repair periods in September and December 2011 and a month-long dry dock at Ventura Harbor Boat Yard in January 2012, the repair period was completed on February 3, 2012. Work included annual maintenance on the vessel's hull paint, main engines and generators, installation of remote battery switches, and hydraulic valve replacement for the crane and A-frame. Items found during a recent fleet inspection were also addressed, including repair of remaining minor hull plate



R/V *Shearwater* on blocks during January 2012 maintenance period. Photo credit: LTJG Lyndsey Keen, NOAA/CINMS.

corrosion, addressing minor weld cracking in the bow, and the installation of rudder stops. In addition, upgrades to R/V *Shearwater* included installation of clean power/inverter systems to support sensitive scientific electronics, upgrades to the CCTV camera system, installation of a 220VAC 50A outlet in the dry lab, and installation of a hydrophone pole mounting system. The upgrade portions of the package were supported in part by the Fishery Resource Analysis and Monitoring (FRAM) Division of NOAA's Northwest Fisheries Science Center to accommodate Seabed Autonomous Underwater Vehicle Operations.

Additionally, R/V *Shearwater* was hauled out at Ventura Harbor Boat Yard from November 20-21, 2012, to replace its Simrad ES60 transducer. The 50kHz component of the Simrad 50/200 Combi D dual frequency transducer began having problems in July 2012 and completely stopped working shortly thereafter. After investigation by a technician, it was determined the whole transducer needed replacement. The old transducer was sent back to Simrad for further investigation, as it failed after only 2 years of service.

RESOURCE PROTECTION & EMERGING TECHNOLOGIES

Demonstrating the capabilities of the PUMA Unmanned Aircraft System (UAS) for Sanctuary missions



AWFC Joe Murphy, USN UAS Department, deploying a PUMA UAV from R/V *Shearwater*. Photo credit: LTJG Lyndsey Keen, NOAA/CINMS.

get footage of feeding and tagging operations during the whale behavior project. Additionally, the UAS was used as surveillance during a marine protected area (MPA) law enforcement operation. The objective of the Office of National Marine Sanctuaries is to fully integrate the PUMA system as part of standard sanctuary research and enforcement vessel operations, including living marine research (LMR) surveys and marine zone enforcement. These operations within CINMS furthered the understanding of the PUMA system capabilities and limitations for future LMR missions and will help develop accepted standardized operational protocols and methodologies for NOAA and the sanctuaries program.

During the 2012 field season, CINMS operated the PUMA UAS for a variety of research and enforcement operations. The UAS was used to perform seabird nest surveys on Prince Island and compare it with manual counts made by Channel Islands National Park personnel, as well as determine the ability of the UAS to operate discreetly without disturbance to sensitive seabird colonies. The PUMA UAS was also used to track large whales, measure body length and



Photo screen grab of R/V *Shearwater* and data fields recorded by PUMA UAS. Photo credit: ENS Kevin Doremus, NOAA/AOC.

MARITIME HERITAGE: Highlights Aboard R/V *Shearwater*

Science Team Surveys Recent Shipwreck Discovery in Channel Islands National Marine Sanctuary



Five-masted lumber schooner *George E. Billings* shortly after launching flying the Hall Bros. house flag from the mast. The Hall Bros. built the 224-foot wooden vessel at Port Blakely, Washington for their own account in 1903. Photo courtesy of San Francisco Maritime Historic Park: f1.12028

California, the 5-masted schooner had a significant history in the trans-Pacific maritime trade hauling lumber from the Pacific Northwest to Hawaii, Mexico, South America, Australia and Southern California. The vessel was one of only six 5-masted schooners built on the Pacific Coast during the half century of sailing ship construction prior to 1905. The schooner was the largest and last sailing ship built by the Hall Bros. at Port Blakeley, Washington, in their 30-year career building some of the finest sailing ships. During the final two days of the expedition, the science team conducted dives at a Cold War era military anchorage off San Cruz Island as well as surveying the California Gold Rush steamer *Winfield Scott* at Anacapa Island. Additional dives were made at three West Coast Obs stations off Santa Cruz and Anacapa Islands to change out instruments, one of which tracked a recent white shark in the region that was originally tagged in Monterey Bay.

A five-day shipwreck reconnaissance expedition on board the NOAA R/V *Shearwater* was completed in CINMS. The expedition included recording the remains of a newly discovered shipwreck *George E. Billings* that was discovered in February 2011 off Santa Barbara Island. Before the new discovery could be revealed to the public the following week, the archaeological team completed a full survey of the wreck site recording artifacts *in situ*. The archaeological team included scientists from CINMS, Channel Islands National Park and Coastal Maritime Archaeology Resources organization. This is the first shipwreck discovery at the Channel Islands during a NOAA sanctioned expedition. Although *George E. Billings* final days of service was as a commercial fishing barge off Southern

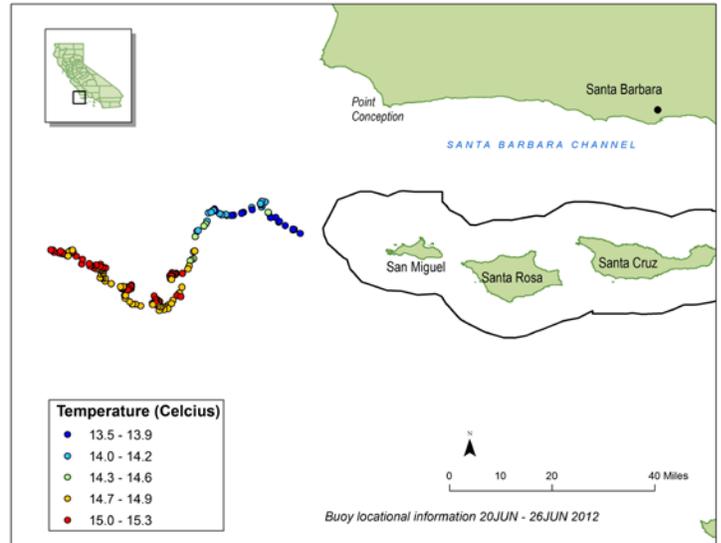


CMAR diver Patrick Smith examines one of two massive mooring bitts discovered at the *George E. Billings* site. Mooring lines were secured from the mooring bitts to similar bitts on wharfs and docks called bollards. Photo credit: Robert Schwemmer, NOAA/CINMS.

EDUCATION AND OUTREACH: Highlights Aboard R/V *Shearwater* & *Shark Cat*

High School Students Release NOAA Drifter Buoy in Channel Islands National Marine Sanctuary

In celebration of Earth Day, CINMS staff teamed up with local partners to help students participate in NOAA's "Adopt a Drifter" Program. Two local schools from Oak Park High School and a fourth grade class from Montalvo Elementary School are partnering with The International Preparatory School in Santiago, Chile to co-adopt and track a NOAA drifter buoy over the next year. On May 1, 2012, the buoy was released within the sanctuary by two eleventh grade students from Oak Park High School. The sanctuary's R/V *Shearwater* supported the buoy release trip, which also included a group of 21 docents from the Ty Warner Sea Center, Santa Barbara Maritime Museum, and University of California Santa Barbara on board to learn more about the research capacities of the sanctuary and the Channel Islands. However, the buoy took an unexpected course and was retrieved on May 15th by sanctuary crew aboard the R/V *Shearwater*, just a mile from coming ashore near Santa Barbara Harbor. On June 18, 2012, during a seabird habitat restoration project with Channel Islands National Park, the buoy was re-deployed by R/V *Shearwater* crew and two Naturalist Corps volunteers three miles south of San Miguel Island. The re-deployment was a success and the buoy is currently drifting westward, traveling further offshore (see image). Student drifter events also occurred in Boston, Miami, Mobile, Seattle, and Maui. Each drifter is part of a global ocean array that students can follow online, along with the particular drifter they adopted. For more information and to track this buoy online, visit NOAA's Adopt a Drifter Program web site at <http://www.adp.noaa.gov/earthday/california.html>.



Path of and temperature data from NOAA drifter buoy released in Channel Islands National Marine Sanctuary on June 18, 2012. Data from NOAA Adopt a Drifter Program. Map by Natalie Senyk, NOAA/CINMS.

CINMS offers tours of R/V *Shearwater* at Santa Barbara Harbor & Seafood Festival

Channel Islands National Marine Sanctuary participated in the Santa Barbara Harbor and Seafood Festival on Saturday, October 13, 2012. Activities included public dockside tours of the sanctuary's research vessel *Shearwater* and a sanctuary information booth next to the Fisherman's Market. The festival raises awareness about the seafood harvested from the Santa Barbara Channel, one of the nation's richest sources of bountiful, sustainable and high-quality seafood. Santa Barbara Harbor's 100+ local fishermen catch between six and ten million pounds of seafood annually, which equates to a \$35-\$40 million industry. 14,000 people were estimated to attend the festival.



Barbara LaCorte, a volunteer member of the Channel Islands Naturalist Corps, helped provide tours aboard the R/V *Shearwater* during the 2012 Santa Barbara Harbor and Seafood Festival. Photo credit: Shauna Bingham, NOAA/CINMS.

SUCCESSFUL SMALL BOAT PROGRAM

Despite fiscal challenges, the R/V *Shearwater* and R/V *Shark Cat* were successfully operated and managed by Channel Islands National Marine Sanctuary for 77 mission and training days in calendar year 2012. The platforms were vital to maintaining important long-term monitoring projects with partners in addition to meeting the needs of new partners and outreach opportunities.



CINMS staff, contractors, volunteers, and associates pose after conducting safety drills and demonstrations aboard R/V *Shearwater* on July 13, 2012. Photo credit: Robert Schwemmer, NOAA/CINMS.