

## Research Vessels *Fulmar* and *R4107* 2019 Accomplishments Summary in Cordell Bank, Greater Farallones, and Monterey Bay National Marine Sanctuaries (March 2020)



NOAA R/V *Fulmar* berthed at Spud Point Marina in Bodega Bay in August 2019. Photo Credit: R.Schwemmer, WCRO

NOAA's Office of National Marine Sanctuaries (ONMS) operates a fleet of small boats to support mission-critical programs in sanctuaries. The research vessels *Fulmar* and *R4107* are based in Monterey, California and are operated by the West Coast Region Office (WCRO) in support of Cordell Bank (CBNMS), Greater Farallones (GFNMS) and Monterey Bay (MBNMS) National Marine Sanctuaries. These two vessels serve as platforms for research, resource protection, and education and outreach missions in the area encompassed by the three central and northern California national marine sanctuaries (NMS) which covers more than 10,000 square miles. During 2019, the vessels spent 106 days at sea and successfully completed 35 missions.

### ***Fulmar* and *R4107* Summary –**

Support area: 10,675 square miles

Projects supported: 24

Missions completed: 35

Days at sea: 103

Total participants: 880

Number of SCUBA dives day: 9



NOAA R/V *R4107* at anchor during a dive mission in Monterey Bay.  
Photo Credit: B. Begun, S. Lonhart NBNMS

The three national marine sanctuaries of northern and central California are some of our nation's most spectacular marine protected areas and offer some of the best marine wildlife viewing in the world. Because of this, they have been dubbed the “Serengeti of the Sea”. Focused along the California coastline from Pt. Arena to Cambria, the sanctuaries includes pristine shorelines, lush kelp forests, steep canyons, offshore islands, banks and seamounts, all teeming with life —from microscopic plankton to the giant blue whale.

The history of California's coast is predominantly a maritime one and hundreds of shipwrecks lie on the seafloor. It is part of the mandate of the National Marine Sanctuary System to inventory and research these archaeological sites, and provide public education about them.

The *Fulmar* and *R4107* are specially designed and equipped to complete projects that fulfill the Office of National Marine Sanctuaries’ mission. The vessels support a wide variety of missions and provide access to offshore sites and extensive stretches of the coastline that cannot be reached by land. Resource protection and management are at the core of the projects supported by the vessels.

GREATER FARALLONES, CORDELL BANK, & MONTEREY BAY NATIONAL MARINE SANCTUARIES



The three National Marine Sanctuaries of central and northern California are a biological hot spot and have a rich maritime heritage.

The majority (91%) of sea days aboard the *Fulmar* and *R4107* in 2019 were primarily dedicated to research missions. Most of the research projects were designed to provide data needed for resource managers to make informed management decisions. The California national marine sanctuaries maintain site specific research projects that contribute to long-term monitoring data sets to meet management plan needs. Details about the research designs, methods, and results of monitoring projects can be found on the Sanctuary Integrated Monitoring Network (SIMoN) website [www.sanctuariesimon.org](http://www.sanctuariesimon.org). While only 2% of the sea days were allocated to education and outreach missions, students, teachers and volunteers had opportunities to participate in most of the research

projects at sea, and were also involved in data analysis. A proportion of the 2019 sea days (6%) were devoted for crew and mission participants training.

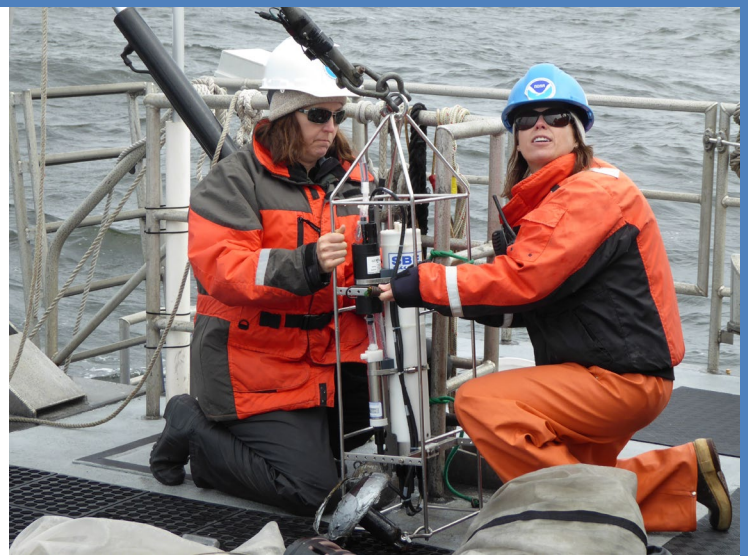


projects at sea, and were also involved in data analysis. A proportion of the 2019 sea days (6%) were devoted for crew and mission participants training.

## RESEARCH HIGHLIGHTS

### Monitoring The California Current Ecosystem

The Applied California Current Ecosystem Studies (ACCESS) project. ACCESS is a collaborative effort of Cordell Bank and Greater Farallones NMS, and Point Blue Conservation Science for ongoing data collection to understand status and trends of sanctuary resources, ecosystem health, and response to climate change. Scientists collect seabird and marine mammal data, oceanographic measurements, marine debris, and sampled for prey availability along predetermined transect lines.



Getting ready to launch the CTD.

Photo Credit: A. Frankle, Pt. Blue/ONMS/ACCESS

Spring upwelling conditions made for rough seas and multiple delays but good ocean productivity indicated by abundant zooplankton and whales. Most notable were abundant krill in both Tucker trawls and some hoop net tows. There was a normal number of humpback whales foraging along the shelf break and over the continental shelf. Scientists also collected data on the locations of Dungeness crab pot buoys, a commercial fishery that closed early this year due to increased risk of whale entanglements. ACCESS data are provided to the Dungeness Crab Fishing Gear Working Group to inform the Risk Assessment and Mitigation Program to look at risk to humpback whales and locations of out of season commercial gear.



In July cruise, during peak upwelling, high levels of phytoplankton, zooplankton and krill were recorded. Humpback whales were observed throughout the region and across the shipping lanes. No blue whales were observed during this cruise, which is somewhat uncommon. The seabird observer recorded lower than average numbers of common murre with chicks.



During the Fall Cruise typical oceanographic conditions and productivity were recorded, with scattered bait balls of krill and fish, copepods and gelatinous invertebrates. Humpback and blue whales were distributed mostly along the 200-meter isobaths, and some humpbacks were obviously feeding on small schooling fish across the shelf. There were surprisingly high numbers of Arctic terns, Sabine's gulls, south polar skua and various jaegers throughout the sanctuaries.



Krill (top), Common Murre (middle), Blue Whale (bottom).

Photo Credit: J. Jahncke(top), D. Devlin (middle), D. Presotto (bottom)

Pt. Blue/ONMS/ACCESS

## California Marine Protected Area Long-Term Monitoring

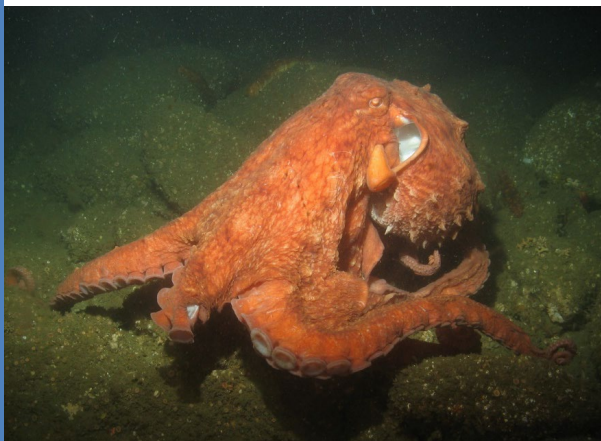
Marine Applied Research & Exploration (MARE) led an expedition aboard the *Fulmar* from Bodega Bay to Point Bouchon and around the South East Farallon Islands from August 3<sup>rd</sup> to August 21<sup>st</sup>, 2019. This survey was a collaborative effort with three California State University campuses (Moss Landing Marine Laboratories, Monterey Bay and Humboldt) and University of California Santa Barbara, as a part of the state's long-term marine protected areas (MPA) monitoring program to determine if MPA protection benefit deep-water ecosystems and to monitor how these systems change over time. Researchers completed 23 dives with MARE's Remotely Operated Vehicle (ROV) *Beagle*. The team conducted 140 video transects, 500 meters each) and recorded 16,000 photos to characterize habitat and benthic communities at 22 different sites.



ROV Beagle on board the *Fulmar* in Monterey. Photo Credit: MARE

## Rapid Assessment of Fish Population In Deepwater High Relief Habitats

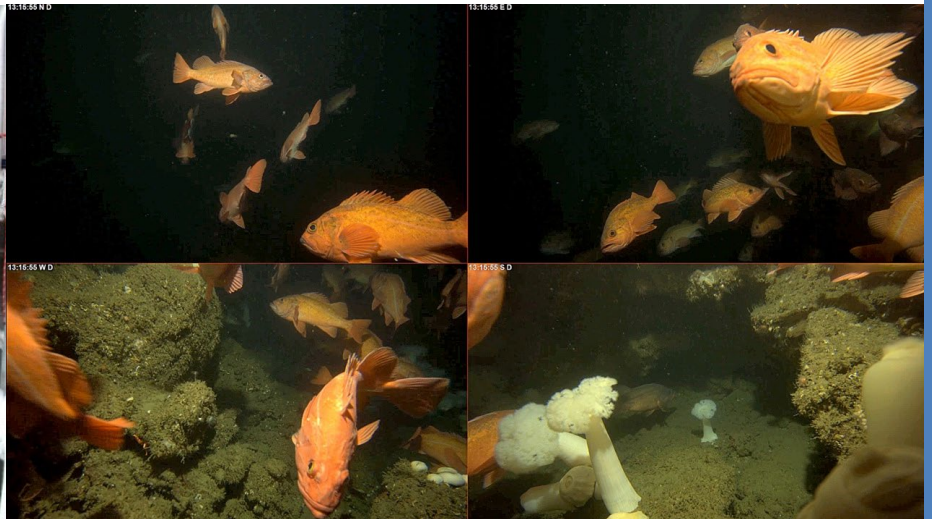
In the past three years, a collaborative of scientists and engineers from multiple institutions, including Moss Landing Marine Laboratories (MLML), Monterey Bay Aquarium Research Institute, Marine Applied Research and Exploration, The Nature Conservancy and California State University Monterey Bay designed and built a video lander system, the Benthic Observation and Survey System (BOSS), that is used to survey continental shelf and slope rockfishes living in high-relief habitats. In 2019, with the help of the Monterey



Giant Pacific Octopus in Bodega Bay. Photo Credit: MARE

Bay National Marine Sanctuary and Channel Islands National Marine Sanctuary, The researchers continued to field-test the BOSS to demonstrate how the system can rapidly assess fish and invertebrate populations across large spatial distributions. This type of rapid assessment will help the NMS program evaluate changes in benthic resources due to climate change. The Sanctuaries Research Vessels *Fulmar* and *Shearwater* are excellent vessels for this type of work because they are highly maneuverable around a stationary point and they can move quickly from one sampling site to another. Also, they are comfortable vessels for multi-days operations away from the home ports.

## WCRO Vessels Support Dive Operations



BOSS on the back deck of the *Fulmar*, schools of canary, vermilion 4 yelloweye and bocaccio rockfishes, white-plumed anemone.

The *R4107* can deploy small dive teams during day trips out of Monterey and served as a dive platform for three missions. The *Fulmar* has even greater dive support capabilities, with an on-board Nitrox air compressor, a deployable skiff, significant range, and berthing accommodations for up to ten divers working in remote sections of the coast for up to five days at a time. The 13 feet inflatable skiff can deploy divers to and from shallow water sites that cannot be reached with the *Fulmar*. Three dive missions were successfully completed for the *Fulmar* in 2019. The inflatable is also used to access dive site close to the harbor and along Cannery Row in Monterey when the *Fulmar* is at her berth in Monterey. In 2019, the *Fulmar* skiff conducted five days of dive operations to support three projects.



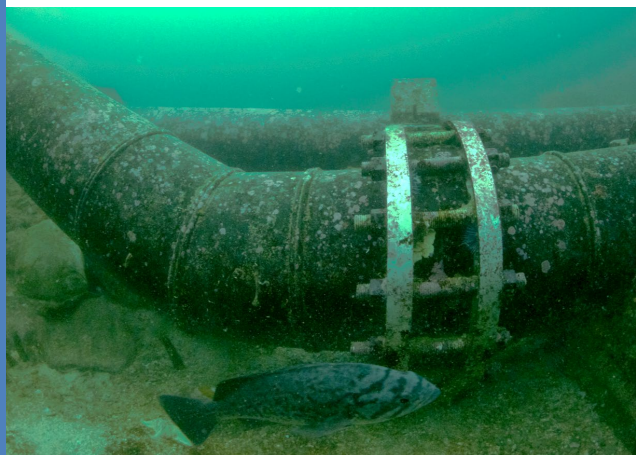
NOAA diver enter the water from the R4107.  
Photo Credit: S. Lonhart, MBNMS

### **Ecosystem monitoring off The Sonoma Lost Coast In Greater Farallones NMS**

For the second consecutive year, scientists from Greater Farallones and Monterey Bay NMS, and WCRO collaborated with science divers and staff from California Department of Fish and Wildlife (CDFW) to survey long-term study sites along the Sonoma County coastline. With the *Fulmar* serving as the base of operations, divers used multiple smaller vessels to access dive sites, collecting data on fishes, invertebrates and algae. Since 2015, purple urchins have increased dramatically in Sonoma and Mendocino counties, leading to kelp overgrazing and deforestation, which in turn cause the closure of the recreational red abalone fishery, and the red urchin fishery to be declared a disaster. Monitoring data collected during this cruise augment ongoing efforts by CDFW researchers and their more than 20 years monitoring program.

### **Monterey Bay Aquarium Pipelines Surveys**

The Monterey Bay Aquarium is in the process of planning to replace subtidal structures associated with its seawater intake infrastructure. The *R4107* was used as a platform for NOAA science divers to survey the intake pipes, capturing video and still images of the organisms living on the pipes and the adjacent seafloor. This is part of an ongoing effort to minimize the disturbance due to construction. NOAA science divers and Hollings fellows also used the *Fulmar* skiff as part of a project to capture 360 images of subtidal habitat in Monterey Bay, and in particular, the habitat surrounding the intake pipes of the Monterey Bay Aquarium.



A blue rockfish whelk swim by the Monterey Bay Aquarium intake pipes. Photo Credit: S. Lonhart, MBNMS

### Granite Canyon Biodiversity Survey

Over 60 years ago, then Stanford Ph.D. student Jim McLean conducted solo dives along the Big Sur coastline and published a paper describing the flora and fauna associated with coastal kelp forests. Monterey Bay NMS scientist, Dr. Steve Lonhart seeks to re-survey these same areas and compare what McLean found in the 1960s and how it may differ in the 2020s. The NOAA Monterey Bay dive team dove from the R4107 to get familiar with the site, and to determine how intact the current community is in light of the recent purple urchin population explosion in various parts of California. The area was hard hit by urchin overgrazing, but the topography was quite interesting and will be an interesting site to monitoring in the future.

### Invasive species surveys

Sanctuary research divers conducted subtidal surveys with Smithsonian Environmental Research Center (SERC) scientists, revisiting sites studied in 2014, which resulted in a publication co-authored by MBNMS Dr. Steve Lonhart and Chad King. Divers accessed the Copper Roof House (Carmel Bay) and McAbee (Monterey Bay) from aboard the 4107. There was little evidence of new invasive species in Carmel Bay, however the invasive bryozoan *Watersipora* was near the breakwater area and McAbee, which had been expected.

### Kellet's Whelk Genetic Study

NOAA research divers collected Kellet's whelks for a collaborative genetics project with California Polytechnic State University San Luis Obispo. Divers searched the kelp forest for large whelks, which were transported by a graduate student to San Luis Obispo for breeding experiments. This species is an emerging fishery and little is known about its life history, particularly larval transportation and population connectivity.



The Kellet's whelk is a large gastropod that expanded its range northward into central California in the 1970s. Photo Credit: S. Lonhart, MBNMS

### Monterey Tide Gauge Servicing

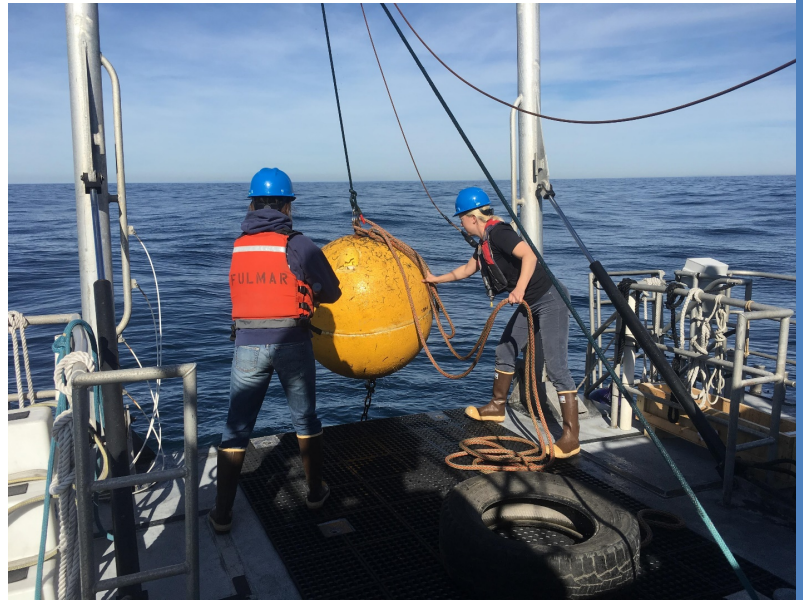
The *Fulmar* skiff also was used by divers from NOAA Center for Operational Oceanographic Products and Services (CO-OPS) to for tide gauge maintenance in Monterey. CO-OPS divers conduct annual servicing of in-water instrument packages that capture tidal data. Monterey Bay NMS and WCRO staff supported the divers during their in-water operations, which took place next to Fisherman's Wharf in Monterey Bay. All efforts were successful and expedited due to the assistance of sanctuary staff.



The *Fulmar* skiff is used to support dive operation close to Monterey Harbor. Photo Credit: S. Lonhart, MBNMS

### Cordell Bank Ocean Noise Reference Station

Knowledge of the soundscape of the sanctuary is an important component to understanding the habitat quality in the sanctuary. Cordell Bank NMS and NOAA's Pacific Marine Environmental Lab recovered a NOAA noise reference station (NRS) hydroacoustic buoy and deployed a new mooring from the *Fulmar*. This is the third two-year deployment of an NRS in Cordell Bank NMS following on the 2015 and 2017 deployments. The recovered buoy recorded sound in Cordell Bank and Greater Farallones NMS for two years and the data will provide a characterization of the local soundscape, analysis of how ambient sound varies over time, and how it compares to other reference sites. Additional questions about sound from whales and ships will be explored. This buoy is the 11<sup>th</sup> of 12 NRS buoys and the fourth in a national marine sanctuary. It will be recovered again in 2021.



Cordell Bank NMS and PMEL researchers deploy a hydroacoustic buoy using the *Fulmar* A-frame and capstan.  
Photo Credit J.de Marnigac, WCRO



### Sanctuary Soundscape in Monterey Bay National Marine Sanctuaries

In another underwater sound study within the National Marine Sanctuary System, NOAA and the U.S. Naval Postgraduate School (NPS) are working with numerous scientific partners to study sound within seven national marine sanctuaries and one marine national monument. Standardized measurements are being collected to assess sounds produced by marine animals, physical processes (e.g., wind and waves), and human activities. Collectively, this information will help NOAA and the Navy measure sound levels and baseline acoustic conditions in sanctuaries.

In 2019, NPS lead the effort in Monterey Bay National Marine Sanctuary. Acoustic and environmental data are collected using acoustic recorders and temperature sensors deployed on moorings at three locations in the Sanctuary. Two sites in Monterey Bay collect acoustic data on sound trap ST500 acoustic recorders and the third site at Sur Ridge uses a HARP recorder for data collection. NPS used the *Fulmar* and *R4107* to deploy and recover the moorings during three separate cruises.

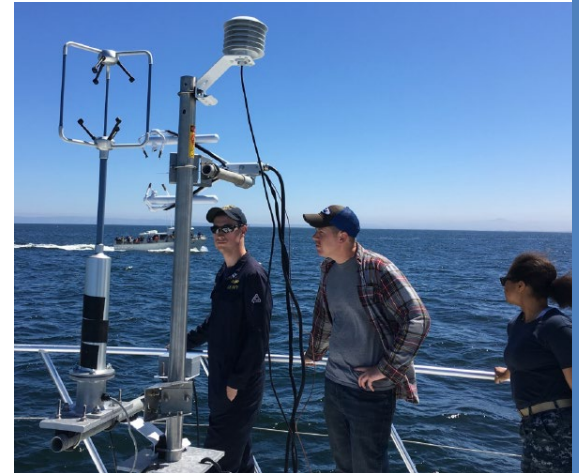
NPS students deploy a Soundtrap ST500 off the *Fulmar* back deck.

Photo Credit: J. Chagoya, U.S. Navy.

### **Partnering with the Naval Postgraduate School to study Monterey Bay NMS.**

NPS has been using the WCRO vessels for other projects to conduct science and education missions that studied oceanographic and physical properties of the Monterey Bay NMS. In addition to providing an opportunity to conduct real-world laboratory science, the collected data supports graduate students class projects and theses. Research projects included the development of network to collect in-situ environmental and acoustic data from autonomous platforms, the testing of sensitive meteorological instruments under different speeds and sea conditions, and the testing of radio frequencies for high-speed data communication from ship to land stations within Monterey Bay. In 2019, NPS conducted 15 sea days during eight missions on the *Fulmar* and *R4107*.

NPS scientists conducted several experiments on the *R4107* in July and *Fulmar* in September. These experiments involved measuring optical atmospheric turbulence by several different methods. They deployed two different sonic anemometers (one from Campbell Scientific, the other from Gill Instruments) to compare, as well as several thermocouples that allow post-deployment analysis of the optical turbulence. They observed issues with the performance of some of these instruments when they were deployed on a US Navy ship, especially when the ship was traveling at high speeds. The deployment on these two NOAA vessels allowed us to characterize these instruments at sea before future deployments on Navy ships.

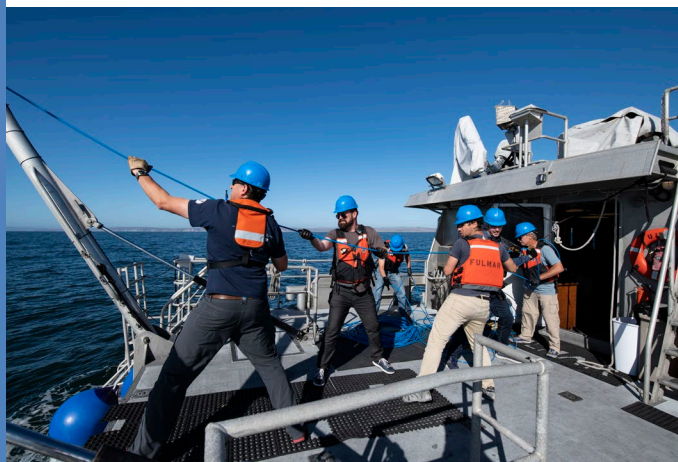


NPS students monitor their instrument on the *R4107* fore deck. Photo Credit NPS

### **Exploring dark water in Monterey Bay National Marine Sanctuary**

The Monterey Bay Aquarium (MBA) was able to complete two full day cruises aboard the *Fulmar* during the 2019 field season. MBA scientists performed plankton tows using a 0.5 m bongo net at depths ranging from 300 to 800 meters to collect and keep several species of midwater crustaceans as part of research and development of a deep sea exhibit opening at MBA in 2021. They also evaluated the *Fulmar* for use of ROV for a potential deepwater expedition in the fall or 2020.

### **Using Remote Survey to search for Maritime Heritage Resources in Greater Farallones National Marine Sanctuary**

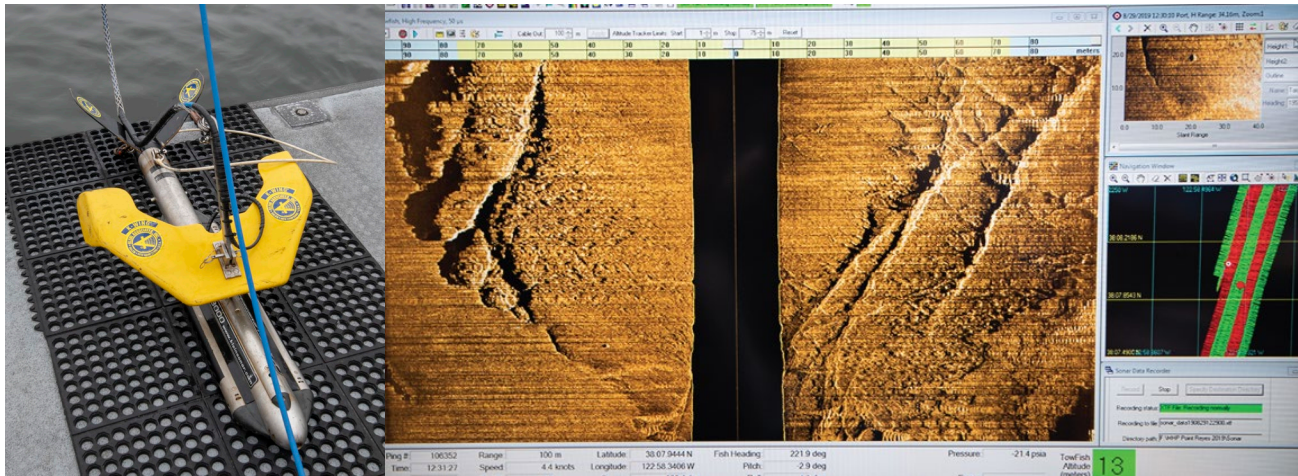


NPS students deploy a Soundtrap ST500 off the *Fulmar* back deck. Photo Credit: R Schwemmer, WCRO

Marine Archeologists from ONMS Maritime Heritage Program led a six days survey from the *Fulmar* in Greater Farallone NMS using a sidescan sonar and a small ROV. The primary objective was to locate and catalog acoustic anomalies on the seabed that may represent man-made objects. Such anomalies would then be evaluated and prioritized for their potential candidacy as historic properties as defined by the National Register of Historic Places. The mission was a partnership with citizen scientists who provided the ROV to collect video and expertise in analyzing potential targets from the sidescan data. The team surveyed approximately 80 line miles in an area beginning .5 nautical miles from shore and extending



2.7 nautical miles (nm) out to sea. Each leg was approximately 2.5 nm long. The total coverage area surveyed 8.13 nm<sup>2</sup> of seabed close to shore north of Pt Reyes. Two ROV dives were conducted to groundtruth potential anomalies. The sidescan sonar data and video imagery will provide Greater Farallones NMS management documentation to make informed decisions on resource protection and enforcement, as well as education and outreach opportunities.



Sonar imagery of the seafloor North of Pt Reyes recorded using the Klein sidescan towfish (left). Photo Credit: R Schwemmer, WCRO

## RESOURCE PROTECTION HIGHLIGHTS

### Dungeness Crab Fishing Gear Demonstration

Monterey Bay NMS, the California Department of Fish and Wildlife (CDFW) and the National Marine Sanctuary Foundation teamed up for gear Innovation demonstration day to inform the efforts of the California Dungeness Crab Fishing Gear Working Group to reduce whale entanglements. The day was funded and supported by the National Marine Sanctuary Foundation as part of their whale conservation program. The purpose of the event was to provide a venue for gear innovators, fishermen, and fishery and resource managers to collaboratively address whale and sea turtle entanglements through technology and gear innovations by demonstrating and/or learning about different gear types that may help reduce the risk of marine life entanglements in Dungeness crab fishing gear. The *Fulmar* served as an observation deck while gear developers on the CDFW Patrol Vessel *Steelhead* demonstrated six different types of gear in Monterey Bay. Some known as “ropeless” gear, remove the need for constant lines in the water thereby reducing the risk of entanglement. Other types of gear include long soaker systems, and using lines with a weak link and are designed to release when an animal puts pressure on the line. A diversity of technologies were reviewed in the field by agencies, fishermen and nonprofits, and valuable information was collected and will be used to evaluate and rate the performance for each gear type. The information will be brought back to the Working Group for discussion and will likely be followed up by additional selective testing in 2020. Whale entanglements are identified by the West Coast Regional Resource Protection Coordinators as a priority over the next 5 years as the issue represents one of the major threats to large whales. Gear innovation is one of the areas to explore that could ultimately allow “whale safe” fishing in high risk areas.

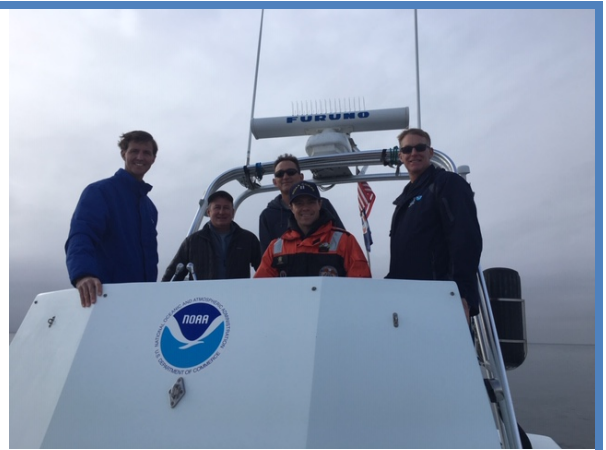


Fishermen, resource managers and innovators depart Monterey on the *Fulmar* for a gear demonstration. Photo Credit: J. de Marignac, WCRO

## EDUCATION AND OUTREACH HIGHLIGHT

### Deputy NOAA Administrator experience Monterey Bay National Marine Sanctuary

In December, Rear Admiral Tim Gallaudet, Ph.D., USN Ret. cruised across Monterey Bay aboard the *R4107* from Santa Cruz to Monterey to experience first-hand the abundance and diversity of marine mammal and seabird in Monterey Bay. Sanctuary staff briefed him on how NOAA and partners respond to reports of entangled whales as the *R4107* conducted a search pattern in an effort to relocate an entangled humpback. The entangled whale was not relocated during this mission but over 30 humpback whales were observed. The number of confirmed entangled whales off the U.S. West Coast in 2019 decreased compared to the recent years peak but 16 of the 26 entangled whale recorded in 2019 were off California. Although, WCRO vessels supported only two sea days in 2019 for whale disentanglement related missions, members of the WCRO vessel team continued to train for and participate to whale disentanglement as part of the California Whale Rescue Network. Monterey Bay NMS staff also participated in a working group that focus on finding ways to reduce the risk of entanglements.



RDML Gallaudet on *R4107* fly bridge with WCRO staff and Monterey Bay NMS Superintendent Paul Michel. Photo Credit: A. DeVogelaere, MBNMS



Dr. Steve Lonhart (MBNMS) briefs to national press fellows prior to a dive off the *Fulmar*. Photo Credit: L. Uttal, MBNMS

### National Press Fellows learn about research in Monterey Bay National Marine Sanctuary

Monterey Bay and WCRO hosted 24 National Press Fellows on board the *Fulmar* for a half day cruise. The fellows were taken out to view wildlife (humpback and gray whales, white sided dolphins, various seabirds) and hear about Monterey Bay NMS natural history. NOAA divers deployed off the *Fulmar* and swam through the kelp forest offshore of the Hopkins Marine Station, capturing underwater video to compare to a site that is dominated by urchins. The video was shown to the media to great effect, and generated numerous questions. A plankton tow was taken and sample was projected on a screen for sharing with press fellows.

### *Fulmar* open house

In May, the WCRO vessel team gave tour of the *Fulmar* to the public during the U.S. Coast Guard Station Monterey open house. Over 150 members of the public learned about the vessel and Monterey Bay NMS. The tour consisted of multiple stations including a meet and greet the captain in the wheel house, a whale disentanglement tools exhibit, and a ROV station where member of the public had the opportunity to pilot a small ROV in Monterey harbor.

### PERSONNEL PROFICIENCY AND TRAINING

WCRO dedicated 6 sea days for crew proficiency and training with partners. Personnel qualifications and readiness are essential to the safety and success of WCRO vessel operations. In addition to training on the vessels, WCRO personnel also participated of other trainings including basic life support, dive emergency drills and whale disentanglement operations.



*Fulmar* captain Rayon Carruthers demonstrates donning a survival suit. Photo Credit: L. Uttal, MBNMS

## NOAA Monterey Bay Dive Unit Winter Safety

Annual safety training is completed by NOAA divers, both from shore, and from aboard NOAA vessels. Divers practiced how to extricate a person from the water using a Stokes Litter. The crew of the *Fulmar* were intimately involved, and their expertise facilitated hands-on practice, skills development, and a safe environment to conduct the training. Practicing emergency situations is key to a proper response and maintaining safety skills.

## VALUABLE REGIONAL ASSETS

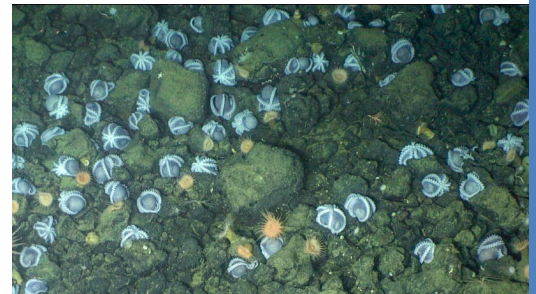
WCRO vessels presence and crew availability provided opportunities to collect ancillary data and assist local researchers. In February, the *Fulmar* and its crew recovered an oceanographic buoy from the Coastal Data Information Program (CDIP) that was adrift off the coast of Big Sur. CDIP measures, analyzes, archives and disseminates coastal environment data for use by coastal engineers, planners and managers, as well as scientists and mariners. In December the *R4107* recovered a wave glider from Liquid Robotics that had gone array and was going to wreck itself on the rocky shore off the Monterey Peninsula. Wave gliders are autonomous unmanned surface vessels powered by wave and solar energy. The vessels readiness and the crew experience with these scientific equipment were essential in the success of these rescue missions. In addition the vessel crew can record whale sightings using the Whale Alert application and derelict gear locations for during at sea operation and transits.

The *Fulmar* also facilitated personnel and gear transfer to and from the R/V *Atlantis* In March, May and October. The *Nautilus* was conducting research and exploration missions National Marine Sanctuaries. A Jacob's ladder was used to descend to the *Fulmar* and ascend to the *Atlantis*. A crane transferred gear in a cargo net down to the *Fulmar*. The March transfer included a Monterey NMS researcher that conducted deep submersible dives down to 1,400 meters near the summit of Davidson Seamount and to 3,243 meters to re-visit the "Octopus Garden" that he and the rest of the crew of the exploration vessel *Nautilus* discovered the previous year. This discovery of over 1,000 brooding females is only the second of its kind in the world.

The *Fulmar* and *R4107* are vital to maintaining important long-term monitoring projects with partners in addition to forging alliances to meet the needs of new partners and new outreach opportunities for the three northern and central California sanctuaries. The *Fulmar* crew has been essential to the success of ONMS mission. Investments in vessel operators and crew by the West Coast Regional Office Vessel Operations Team, enable the vessels to be ready to respond with minimal notice for a wide variety of missions. The emphasis on training, safety, customer service and preventive maintenance contribute to make the *Fulmar* and *R4107* operation team, a model among the NOAA Small Boat Program. The *Fulmar* continue to be an icon for sanctuary research.



NOAA divers and crew recover a diving using the *Fulmar*'s crane and Stokes litter during a training exercise. Photo Credit: WCRO



Brooding octopuses discovered near Davidson Seamount at a depth of 3,240 meters.

