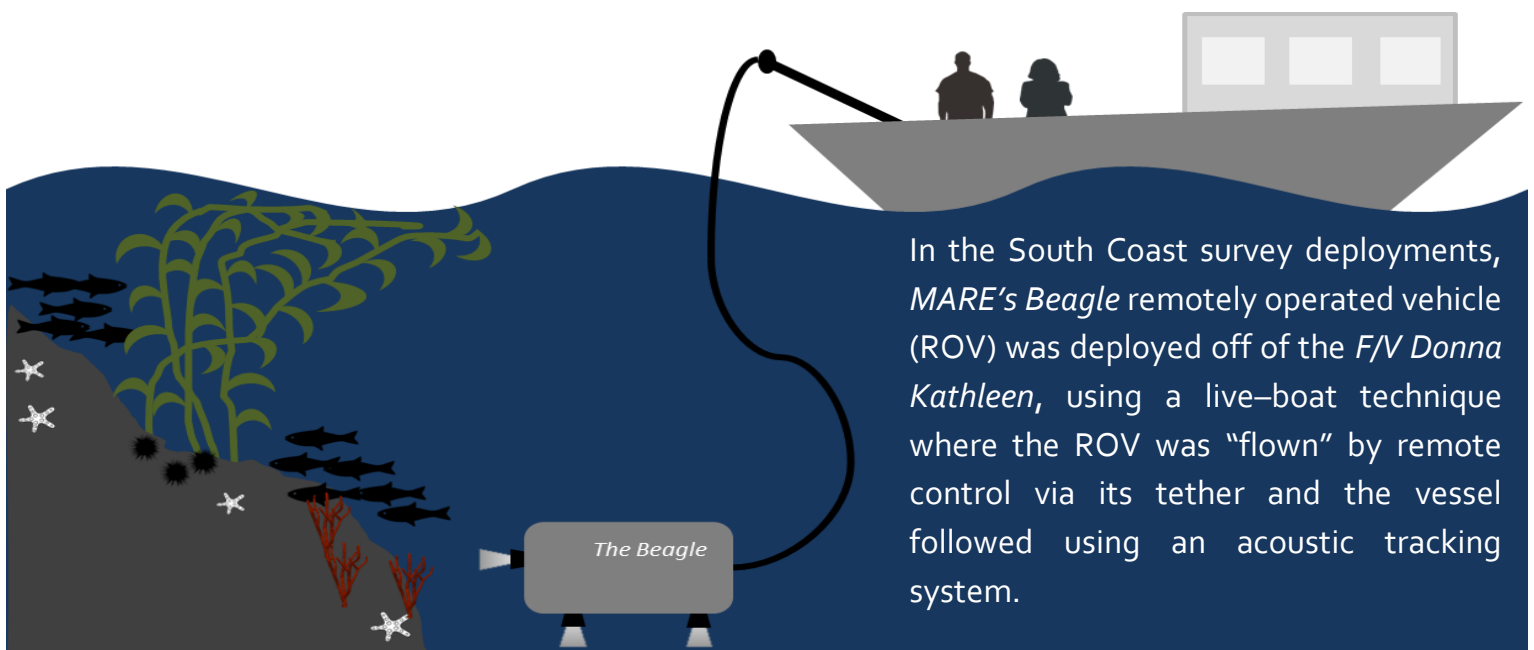




South Coast Marine Protected Areas Remotely Operated Vehicle Surveys

Much of the rocky habitat offshore of California's waters is at depths that make exploration and research very difficult. Most scuba diving for research occurs shallower than 100 feet which limits direct human observation to a narrow band of habitats near shore. In 2014, the California Department of Fish and Wildlife (CDFW) and Marine Applied Research and Exploration (MARE) began a three year statewide survey of California's marine protected area (MPA) network using underwater robotic technology to visually explore these habitats found in deep waters offshore of California. This report presents an overview of key findings from the 2014 South Coast deployments.



In the South Coast survey deployments, MARE's *Beagle* remotely operated vehicle (ROV) was deployed off of the *F/V Donna Kathleen*, using a live-boat technique where the ROV was "flown" by remote control via its tether and the vessel followed using an acoustic tracking system.

ROV Survey Planning

The methods employed for these surveys use the same sampling design that was developed by CDFW during baseline MPA monitoring at the Channel Islands from [2004-2009](#), Central Coast MPAs from 2007-2009, and North Central Coast MPAs in 2011.

The three year statewide survey was divided into **five separate deployments** using MARE's ROV, *The Beagle*. Led by CDFW scientists, MARE's team completed the first two deployments throughout the South Coast, which encompasses California's jurisdictional waters (0-3 nautical miles from shore) from Point Conception in Santa Barbara County to the US-MEX border and includes waters around offshore islands, in 2014.

Subsequent deployments were completed in:

- Fall of 2014 ([North Coast](#))
- Fall of 2015 ([North Central Coast](#))
- Fall of 2016 ([Central Coast](#))

This unprecedented survey was completed at the end of 2016.

The 2014 South Coast ROV surveys were **designed to complement initial baseline surveys** by visiting the original four MPAs explored by the Institute for Applied Marine Ecology (IfAME) in 2011, plus **an additional 7 MPA sites and 21 non-MPA sites** (reference sites) for comparison. Exploration of these additional MPAs and reference sites provides a more thorough characterization of rocky reef habitats throughout the South Coast.



ROV Flights

MARE's ROV is "flown" by remote control via its tether and the vessel followed using an acoustic tracking system. Virtual video swath **transects were preplanned using bathymetry maps** and then "flown" by the ROV pilot who navigates using a live mapping computer screen of the acoustic tracking system and shipboard GPS.



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Site Selection

Sites were chosen within rocky habitat areas identified from seafloor mapping data. These **sites typically ranged between 60 and 100 meters in depth and were 500 meters wide by 1000-2000 meters long** depending on the slope and depth range of the particular area.

Along with collecting baseline characterization information, sites were also selected for their suitability as long-term monitoring index sites which can be revisited over time to measure ecological changes.

Survey Results

The 2014 ROV surveys, by CDFW and MARE, resulted in **the completion of 143 kilometers of planned survey lines across 52 sites**. Video imagery from the hundreds of 500 meter long transects was brought back to the lab where taxonomic experts identified all of the fish and invertebrates encountered. **Tens of thousands of species observations** were combined with detailed habitat descriptions and joined in a database with GPS positions of the path of the ROV. Figure 1 shows an example of four species of fish observed along an ROV transect line at one site inside Farnsworth Offshore State Marine Conservation Area at Catalina Island.

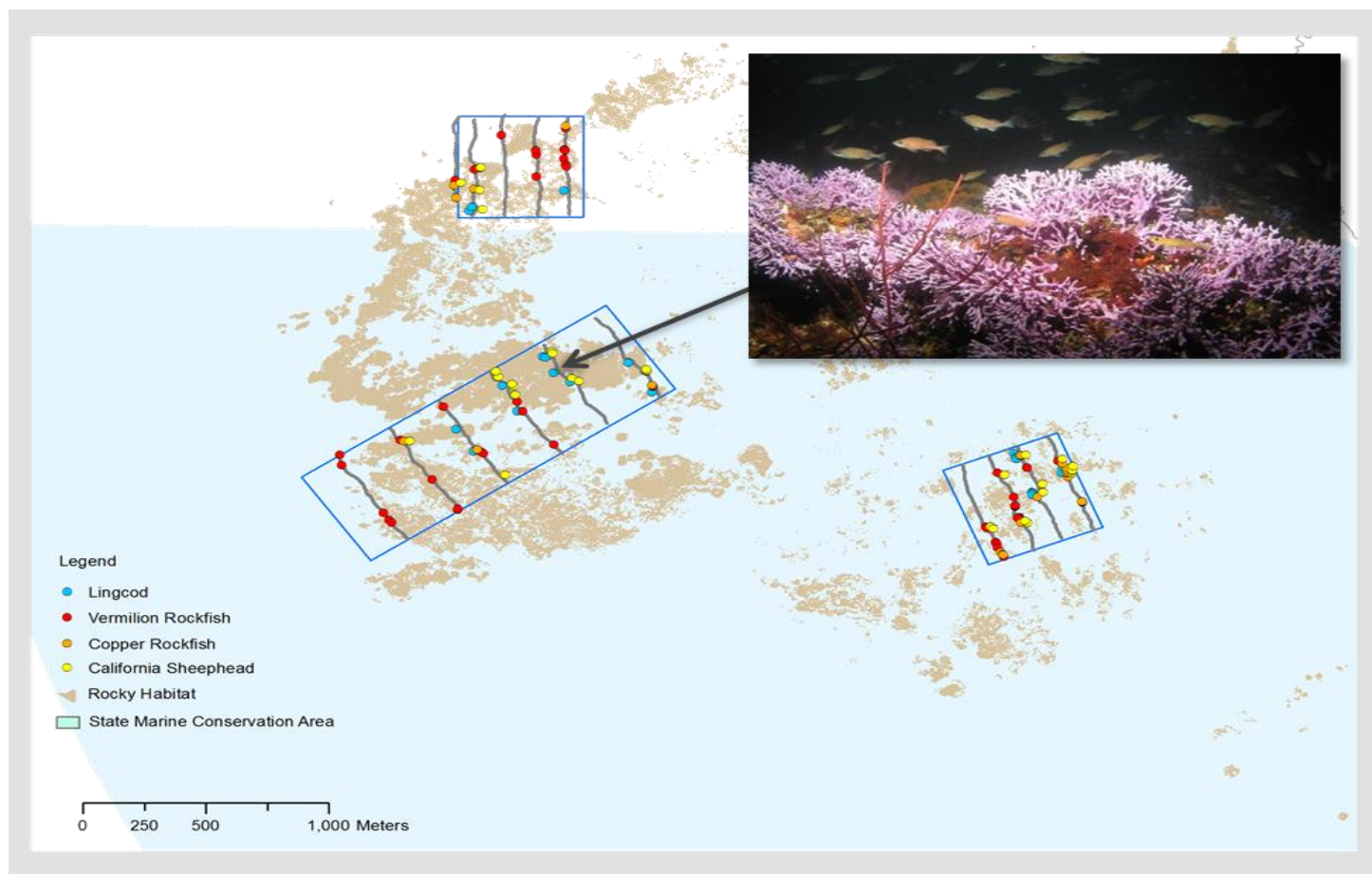


Figure 1. Observations of four fish species plotted over ROV transect lines for three sites at Farnsworth Offshore State Marine Conservation Area, near Santa Catalina Island. Inset photo shows California Hydrocoral, a Red Gorgonian, Squarespot Rockfish, and a Blackeyed Goby.

Figure 2 shows densities (number of fish observed per 100 square meters of area of swath ROV transect) for four fish species were summarized and averaged for each site visited. **Overall, for those fish summarized, densities were much higher at the Northern Channel Islands sites than mainland sites.** Densities were not only smaller, but more variable, at the mainland sites, Santa Catalina Island sites, and Santa Barbara Island sites. Each individual site has unique habitat characteristics and human use patterns that may account for the differences in densities. **Therefore, data from these index sites are most valuable when they are compared to themselves to track changes over time.**

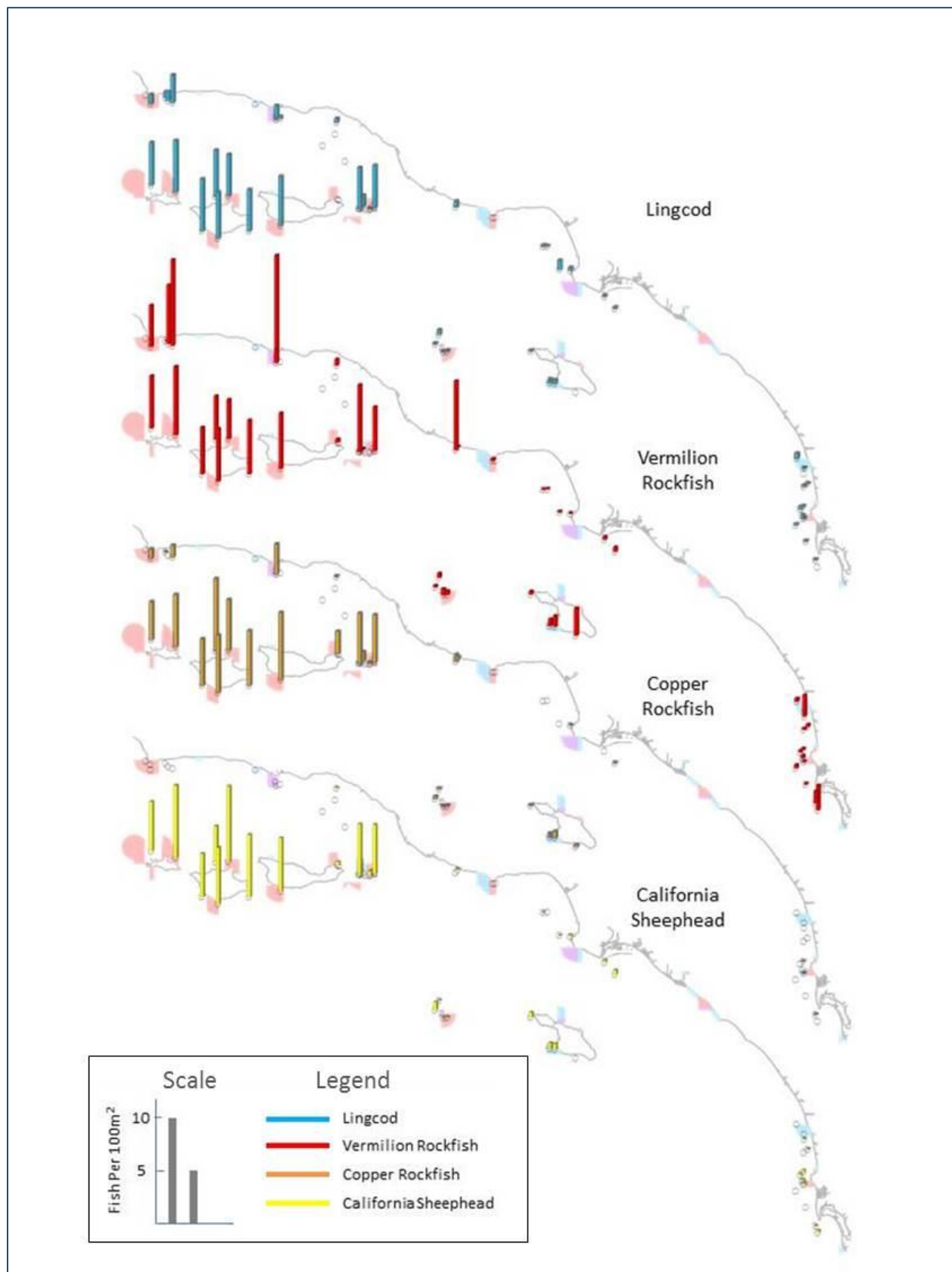
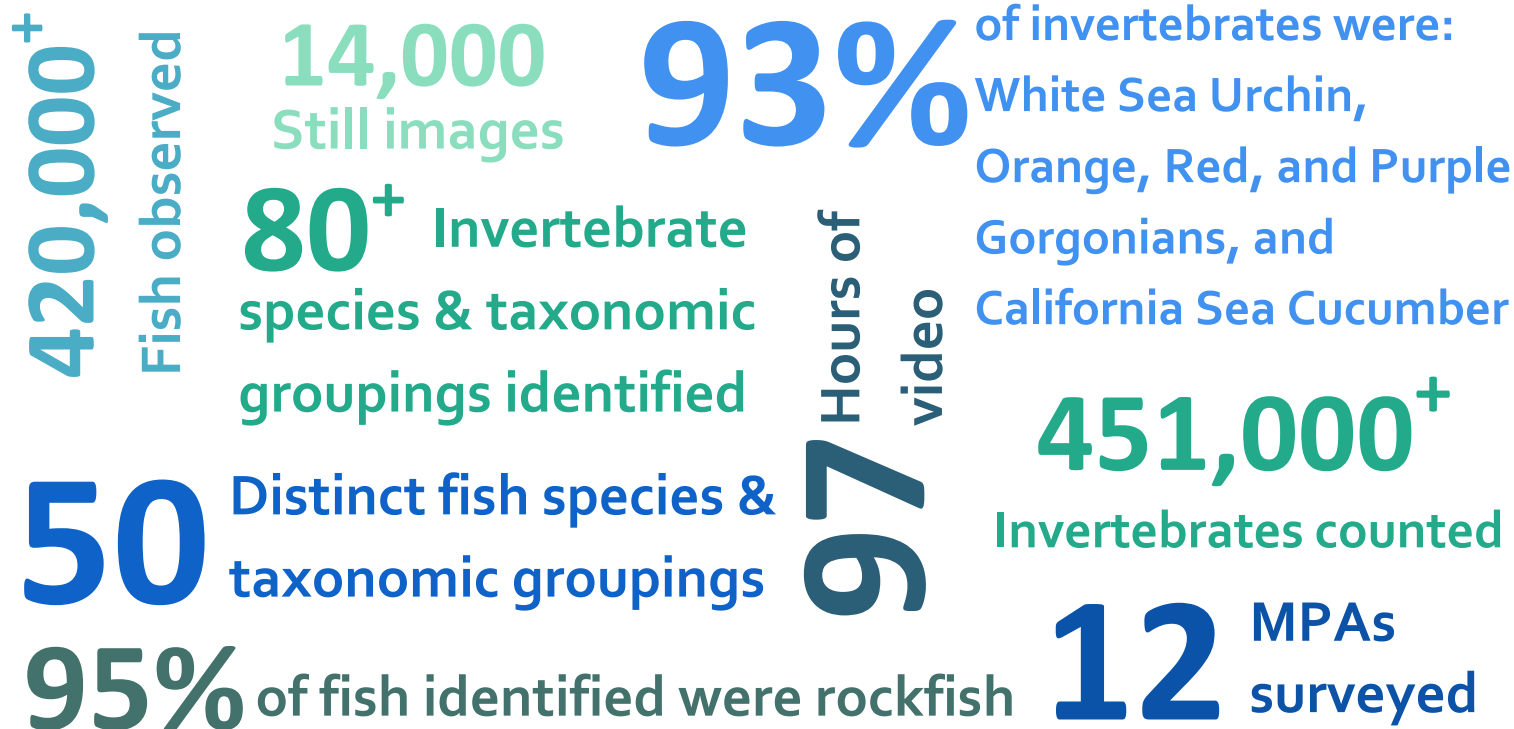


Figure 2. Average density of Lingcod, Vermilion Rockfish, Copper Rockfish, and California Sheephead (number of observations per 100 square meters) observed at each site visited in 2014.

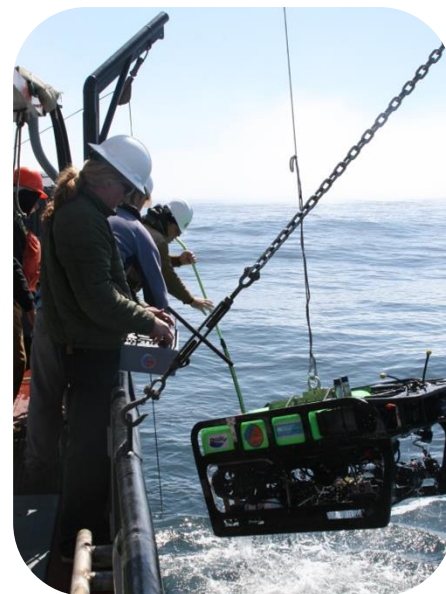
By the Numbers-South Coast



Building Datasets with Partners

During the same 2014-2016 time period as the South Coast CDFW surveys, MARE secured independent funding and repeated surveys at 10 sites in the northern Channel Islands MPAs. MARE's 2014 survey revisited the same sites established by CDFW/MARE in baseline studies performed at the Channel Islands from 2004-2009.

Deep water surveys performed for the South Coast baseline monitoring program by IfAME also used MARE's *Beagle* ROV, but used a broad based sampling design intended to more fully characterize rocky, sandy, and mixed habitats found within the four MPAs of that study. Although not directly comparable for detailed analysis of abundance, the data collected in IfAME's baseline surveys are compatible for more general comparison of species presence and habitat associations. Altogether, surveys by CDFW, MARE, and IfAME have resulted in an unprecedented characterization of deep water habitats in the South Coast, and set the stage for collaboratively monitoring MPAs in the future.



Next Steps

More Analysis

Further analysis is underway to examine factors that may describe species association with habitat and the relationship between protection afforded by MPAs and consumptive use of fisheries resources. Additionally, these 2014 South Coast ROV surveys will complement analyses of habitats and species found in all sites surveyed in the statewide surveys.

Long-term Monitoring

Beginning in early 2017, CDFW will be partnering with the Ocean Protection Council and the University of California, Davis to hire a post-doctoral researcher tasked with conducting an in-depth analysis of the entire statewide dataset. The culmination of all ROV statewide survey data will inform the development of long-term monitoring protocols and site selection, as well as provide a baseline for comparison into the future.

Full reports summarizing the results from each of the five ROV surveys completed as part of CDFW's statewide survey will be available for download at the CDFW MPA management project [webpage](#) in late 2017.

Acknowledgements

Author

Mike Prall, CDFW, Marine Region

Michael.Prall@wildlife.ca.gov

Photo Credits

Copper Rockfish Header

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Lingcod and Gorgonian Header

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Scripps Canyon Marine Life

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ROV Launch

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Skate

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Figure 1 Inset Image

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ROV Boarding

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Female Sheephead and Anemones

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Amanda Van Diggelen, CDFW, Marine Region