Monterey Bay National Marine Sanctuary Symposium

Sanctuary Currents 2014

Marine Debris

How Do You Pitch In?

Saturday, April 26, 2014

California State University Monterey Bay

University Center, Seaside, CA

U.S. Department of Commerce

Monterey Bay National Marine Sanctuary Symposium
Sanctuary Currents 2014

Marine Debris: How Do You Pitch In?

Saturday, April 26, 2014
California State University Monterey Bay
University Center, Seaside, California

Planning Committee
James Lindholm, Ashley Knight, Ben Walker, and Devon Warawa
California State University Monterey Bay

Andrew DeVogelaere and Erica Burton
NOAA's Monterey Bay National Marine Sanctuary

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Marine Debris: How Do You Pitch In?

By now we are all familiar with our collective role in polluting the planet, the ocean included. It is a rare trip to the beach or tide pools, even here in the beautiful Monterey Bay, that doesn't involve the discovery of marine debris in some form, be it a beer can, a bottle cap, or an increasingly ubiquitous cigarette butt. But we are also critical for the many potential solutions; solutions ranging from the relatively small-scale beach clean-up to much larger scale bans on plastic bags.

The annual Sanctuary Currents Symposium provides an exciting opportunity to bring scientists, managers, students and members of the public together to address the most important issues of the day with respect to the Monterey Bay and beyond, and this year we are taking on marine debris. Please join us for a morning of lively discussions about the many scales of problems and solutions, ranging from the small plastic nurdles to a state-size garbage patch, from the deep sea to the intertidal, from local policies to the international arena. Discussions will occur around plenary sessions featuring internationally-recognized scientists, a research poster session, and exhibitry throughout the day.

Dr. James Lindholm

James W. Rote Distinguished Professor of Marine Science & Policy

Director of the Institute for Applied Marine Ecology

California State University Monterey Bay

PROGRAM OF EVENTS

8:00 – 8:45 AM **REGISTRATION**
This is a FREE event, pre-registration is not necessary

9:00 – 9:15 AM **WELCOME**

Paul Michel
Superintendent
Monterey Bay National Marine Sanctuary

Dr. James Lindholm
James W. Rote Distinguished Professor of Marine Science & Policy
Director of the Institute for Applied Marine Ecology
California State University Monterey Bay
Chair, Sanctuary Research Activity Panel
Research Representative, Sanctuary Advisory Council

Dr. Andrew DeVogelaere
Research Coordinator and SIMoN Program Director
Monterey Bay National Marine Sanctuary

9:15 – 9:40 AM **TRASH IN THE DEEP SEA: BRINGING A HIDDEN PROBLEM TO LIGHT**

Susan von Thun
Senior Research Technician
Monterey Bay Aquarium Research Institute

9:40 – 10:05 AM **THE INVISIBLE CONSEQUENCES OF MISTAKING PLASTIC FOR DINNER**

Dr. Chelsea Rochman
Postdoctoral Scholar
Aquatic Health Program, School of Veterinary Medicine
University of California Davis

10:05 – 10:30 AM **TRACKING THE TRASH: DISTRIBUTION OF MARINE PLASTIC POLLUTION ON SURFACE WATERS (2009 TO PRESENT)**

Carolynn Box
Environmental Coordinator
5 Gyres Institute

10:30 – 11:00 AM **BREAK**

11:00 – 11:25 AM	**THE ENDLESS AND MAGICAL PROMISE OF PLASTIC: FROM BABIES, TO AIRPLANES, TO TOOTHPASTE** Daniella Russo Executive Director and Co-founder Plastic Pollution Coalition
11:25 – 11:50 AM	**PICKING IT UP: COLLECTING DATA AND TRASH TO PROTECT OUR COAST AND OCEAN** Eben Schwartz Marine Debris Program Manager California Coastal Commission
11:50 AM – 12:30 PM	**LUNCH**
12:30 – 2:15 PM	**RESEARCH POSTERS SESSION**
2:15 – 3:00 PM	**ED RICKETTS MEMORIAL AWARD and LECTURE** **THE OCEANOGRAPHY OF THE MBNMS TODAY AND IN THE FUTURE** Dr. Francisco Chavez Senior Scientist Monterey Bay Aquarium Research Institute
3:00 – 3:30 PM	**RESEARCH POSTER AWARDS and CLOSING REMARKS**

INVITED SPEAKER ABSTRACTS

Ballroom 9:00 AM – 11:50 AM

Susan von Thun
Senior Research Technician
Monterey Bay Aquarium Research Institute

TRASH IN THE DEEP SEA: BRINGING A HIDDEN PROBLEM TO LIGHT

Worldwide concern about marine debris has increased over the last decade as scientists and media outlets have brought the issue into the public eye. Using advanced technologies, such as remotely operated vehicles, the Monterey Bay Aquarium Research Institute (MBARI) is helping to uncover the far-reaching presence of man-made debris in deep ocean ecosystems. Over the past 25 years, we have recorded evidence of debris up to 13,000 feet deep and 300 miles offshore from waters off of central and southern California, the Pacific Northwest, Hawaii, and the Gulf of California. In the Monterey Bay National Marine Sanctuary, the majority of debris items were single-use, recyclable items. Plastic shopping bags and aluminum beverage cans were most common. Surprisingly, plastic and metal were found relatively more frequently at deeper depths, suggesting that the extent of debris on the seafloor may be far greater than known to date. This evidence implies that submarine canyons may collect and serve as conduits for transporting debris from coastal to deep-sea habitats. Monterey Canyon is one of the best-studied areas of the world's deep ocean and with vast regions of the deep sea remaining unexplored, we can presume that the amount of marine debris greatly exceeds that reported to date. It is far too expensive and impractical to locate and retrieve debris already on the deep seafloor. The best solution is to reduce our reliance upon single-use, throwaway items. Recycling, reusing, and properly disposing of trash items will help keep litter from entering the ocean.

Dr. Chelsea Rochman
Postdoctoral Scholar
Aquatic Health Program, School of Veterinary Medicine
University of California Davis

THE INVISIBLE CONSEQUENCES OF MISTAKING PLASTIC FOR DINNER

Plastic debris has become recognized as a serious threat in marine habitats globally. This material contaminates habitats from the poles to the equator and species of marine life globally via entanglement and ingestion. Today, it is a fact that hundreds of species have been found with plastic debris in their gut content. One of the 'so what?' questions often raised is, "how is plastic harming wildlife upon ingestion?" Such process may be physical and/or chemical in nature. For example, plastic debris carries toxins such as BPA and flame-retardants (e.g. PBDEs) from the manufacturing process, and also sorbs chemical pollutants such as pesticides (e.g. DDT), industrial chemicals (e.g. PCBs), metals (e.g. lead) and petroleum combustion products (e.g. PAHs) from surrounding waters. We examined the consequences of plastic ingestion in fish, as we know that over 40 species of fish have been shown to ingest this material. Moreover, we chose fish because it is commonly consumed as seafood by our own species. We exposed polyethylene plastic,

clean and with sorbed chemical contaminants from San Diego Bay, CA, to adult Japanese medaka (*Oryzias latipes*) for 1- and 2-month periods and tested for several endpoints including: bioaccumulation of chemicals, mortality, weight loss, histopathology and gene expression. Results from this study in addition to information regarding the hazards of plastic debris will be presented.

Carolyn Box
Environmental Coordinator
5 Gyres Institute

TRACKING THE TRASH: DISTRIBUTION OF MARINE PLASTIC POLLUTION ON SURFACE WATERS (2009 TO PRESENT)

Plastic pollution, plastic trash mainly entering our water bodies from land-based sources, has been documented in the five subtropical gyres and Great Lakes. The 5 Gyres Institute has collected over 600 surface water samples during 12 expeditions confirming through scientific research that plastic pollution is a worldwide environmental issue. By inviting scientists, policy makers, ocean enthusiasts, and socially conscience companies, 5 Gyres has been able to collect important scientific data that supports 5 Gyres' mission to promote solutions to plastic pollution.

Using unique 335 micron mesh neuston nets deployed from sailing vessels, 5 Gyres continues to document the abundance and weight of plastic pollution throughout many unchartered areas of the world's oceans. Visual observations of large floating debris is documented through one-hour observations, revealing important information that can be combined with the neuston net data to understand the complete picture of the plastic pollution burden on our oceans. Highest concentrations have been documented in the Mediterranean Sea at up to 890,000 plastic pieces per square kilometer and over 92% of our samples collected worldwide contained plastic pollution. These sets of data have been incorporated into an ocean model to estimate the global distribution, count and weight density, of marine plastic pollution. Model results show interesting patterns of accumulation, but also high production areas, or "hot spots," where land-based contributions of plastic are heaviest.

In order to be more efficient and effective in monitoring plastic pollution, 5 Gyres has developed a citizen science program, called "iGyre," which allows partnering organizations, volunteer scientists, sailors, and adventurers to collect valid scientific data that will be utilized to update our oceanographic model each year. 5 Gyres anticipates that this effort will more than quadruple the available data globally.

Daniella Russo
Executive Director and Co-founder
Plastic Pollution Coalition

THE ENDLESS AND MAGICAL PROMISE OF PLASTIC: FROM BABIES, TO AIRPLANES, TO TOOTHPASTE

Plastic pollution is a global threat, and one of the great challenges facing the planet today. It is the nexus of eco-system degradation, environmental justice and public health. Marine plastic pollution is directly linked to the explosive rate of consumption of disposable plastic on land. It affects all life and all eco-systems. The need for response is urgent. We must confront this crisis with a bold systems approach, combining viral behavior change, disruptive innovation, and forward thinking policies.

Eben Schwartz
Marine Debris Program Manager
California Coastal Commission

PICKING IT UP: COLLECTING DATA AND TRASH TO PROTECT OUR COAST AND OCEAN

California Coastal Cleanup Day is the biggest and one of the longest-running volunteer events in the state. Since 1985, participants have turned out by the tens of thousands to beaches and inland waterways throughout California, scouring the environment clean of the litter and other debris that accumulates over the course of the year. Equally important, volunteers in most areas collect data on the trash they are picking up. This data record has provided invaluable insight into what the most frequently littered items are, where they can be found, and even where they may have originated. The data were originally used to inform educational efforts and to help the California Coastal Commission expand the cleanup beyond its original focus on the coast – the cleanup now operates in 54 of California's 58 counties. More recently, advocacy groups and local governments have used the data as a basis for passing new regulations such as smoking bans and limits on plastic bags and expanded polystyrene foodware. As we move into the future, this critical form of citizen science will inform policymakers and the public about the effectiveness of specific actions that have been undertaken with the goal of reducing the amount of marine debris created and preventing the flow of that debris to our ocean.

ED RICKETTS MEMORIAL AWARD and LECTURE

Ballroom 2:15 PM – 3:00 PM

Dr. Francisco Chavez
Senior Scientist
Monterey Bay Aquarium Research Institute

THE OCEANOGRAPHY OF THE MBNMS TODAY AND IN THE FUTURE

Debris is defined as the remains of something broken down or destroyed. In keeping with the theme of the conference I use the definition liberally to include carbon dioxide (CO_2) resulting from the burning of fossil fuels. The increase of CO_2 in the atmosphere resulting from the burning of fossil fuels leads to changes in climate as well as an increase in ocean acidity. I use historical records to describe variations in the oceanography and ecosystems of the Pacific and in the waters of the Monterey Bay National Marine Sanctuary (MBNMS). Past variations allow for speculation about what might occur in the future.

ABOUT FRANCISCO CHAVEZ

Francisco Chavez is a biological oceanographer with interests in how climate variability and change regulate ocean ecosystems on local and basin scales. He was born and raised in Peru, has a BS from Humboldt State and a PhD from Duke University. He was one of the founding members of the Monterey Bay Aquarium Research Institute (MBARI) where he has pioneered time series research and the development of new instruments and systems to make this type of research sustainable. Chavez has authored or co-authored over 200 peer-reviewed papers with 10 in *Nature* and *Science*. He is past member of the National Science Foundation Geosciences Advisory Committee, has been heavily involved in the development of the US Integrated Ocean Observing System (IOOS), is a member of the Governing Board of the Central and Northern California Coastal Ocean Observing System (CeNCOOS) and the Science Advisory Team for the California Ocean Protection Council. Chavez is a Fellow of the American Association for the Advancement of the Sciences; honored for distinguished research on the impact of climate variability on oceanic ecosystems and global carbon cycling. He was awarded a Doctor *Honoris Causa* by the Universidad Pedro Ruiz Gallo in Peru in recognition of his distinguished scientific career and for contributing to elevate academic and cultural levels of university communities in particular and society in general.

HISTORY OF ED RICKETTS MEMORIAL AWARD and LECTURE

Ed Ricketts was born in Chicago in 1897 and studied ecology at the University of Chicago. He moved to the Monterey Peninsula in 1923 and opened Pacific Biological Laboratories, providing specimens and slides to research institutions. Ricketts met John Steinbeck in 1930 and became a major influence on the author's writing and philosophy, serving as the inspiration for many notable Steinbeck characters. On their famous trip aboard the *Western Flyer*, Ricketts and Steinbeck explored the Gulf of California and collaborated on the book *The Sea of Cortez*. Ricketts also wrote *Between Pacific Tides*, an ecological handbook of intertidal marine life that is still used as a textbook at many universities. The scientific catalogue of organisms documented by Ricketts, both aboard the *Western Flyer* and during his other studies, has been invaluable to marine scientists. His work and unconventionally holistic approach to science has inspired generations of researchers.

The Ed Ricketts Memorial Lecture was created to honor lifetime achievement in the field of marine science. The first award was presented in March 1986. Recipients are selected by members of the Monterey Bay National Marine Sanctuary Research Activity Panel.

Previous Award Recipients

2013 Mark Carr
2012 Ken Johnson
2011 Michael Foster
2010 Rikk Kvitek
2009 Bruce Robison
2008 James P. Barry
2007 Gary B. Griggs
2006 Dave Epel
2005 Barbara A. Block
2004 John Pearse
2003 James Estes
2002 Jane Lubchenco
2001 Mary Silver
2000 Paul K. Dayton
1999 Joseph Connell
1998 George Somero
1997 Greg Cailliet
1996 Steve Webster
1995 Dick Parrish
1994 Wayne Sousa
1992 Jim Childress
1991 Walter Munk
1990 Gene Haderlie
1989 John Martin
1988 Sandy Lydon
1987 Dick Barber
1986 Joel Hedgepeth

EXHIBITORS

Lobby – All Day

Please take time to visit the exhibitor tables in the Lobby featuring organizations addressing marine debris. Mingle and find out about their activities and volunteer opportunities. There are many ways we can all reduce marine debris. Find out how you can make a difference and get involved with one of these organizations. How do you pitch in?

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5 Gyres Institute - http://5gyres.org
An institute dedicated to conducting research and communicating the global impact of plastic pollution in the world's oceans and employing strategies to eliminate the accumulation of plastic pollution in the 5 subtropical gyres.

70 Degrees West - http://www.70degreeswest.com
A multimedia documentary project that explores a changing climate and the strength of the human spirit from the North Pole to the South Pole along a single line of longitude. This project hopes to expand global awareness of the impact our modern world has on environmental and humanitarian struggles in several unique and fragile eco-regions.

Institute for Applied Marine Ecology, California State University Monterey Bay - http://sep.csumb.edu/ifame
An institute at CSUMB that focuses on user-driven science, connecting original ecological research with end-users in state, federal and international governments, with students as an integral part of the data collection process.

NOAA's Marine Debris Program - http://marinedebris.noaa.gov
A federal program dedicated to investigating and solving the problems that stem from marine debris, in order to protect and conserve our nation's marine environment, natural resources, industries, economy, and people.

NOAA's Monterey Bay National Marine Sanctuary - http://www.montereybay.noaa.gov
A federally protected marine area offshore of California's central coast established for the purpose of resource protection, research, education, and public use. Volunteers help educate visitors about wildlife, collect important research data from sanctuary beaches and watersheds, and provide advice on key sanctuary management and protection issues.

Plastic Pollution Coalition - http://plasticpollutioncoalition.org/
A global alliance of individuals, organizations, and businesses working together to stop plastic pollution and its toxic impacts on humans, animals and the environment through a variety of campaigns, that seek to educate and encourage action on the topic of plastic pollution.

Save the Earth - http://www.savetheearth.org
A non-profit corporation dedicated to the expansion of environmental awareness in our society, and funding environmental research at colleges and universities. Author Chet Forrest will exhibit his new book, Emotions for the Ocean*, with short stories about science and conservation.*

Surfrider Foundation, Monterey Chapter - http://surfridermonterey.weebly.com
An organization dedicated to the protection and enjoyment of the oceans, waves, and beaches through a powerful activist network. Surfrider offers many campaigns and programs that citizens can join, including beach cleanups and youth education programs.

RESEARCH POSTER ABSTRACTS

Conference Room 12:30 PM – 2:15 PM

Researchers and students from around the region present the results of their research in scientific posters, with an emphasis on the communication of complex science to diverse audiences. Come view their latest findings in the central California area and talk to scientists conducting the research.

Adelaars, Jason (1), and Leslie Rosenfeld (2)

1) Moss Landing Marine Laboratories
2) Central and Northern California Ocean Observing System

PREDICTIONS OF MARINE DEBRIS DEPOSITION ALONG THE CENTRAL CALIFORNIA COAST

The Pacific Garbage Patch consists of an aggregation of organic and human-generated material, arranged by the North Pacific Subtropical gyre. Much of this debris comprises of highly buoyant particulates, such as plastic and foam, which are resistant to degradation and may persist in nature for decades. Spatial and temporal variability of the gyre and the garbage patch could cause the reintroduction of debris matter back into the boundary currents, where there is a potential for material deposition onto the California coastline. The eastern boundary of the gyre moves along the populated California coastline, where regions generate economic revenue from coastal tourism and commercial fishing. An increase in marine debris deposition onto California's coast would impact marine ecosystems, aesthetics, and local economies. Understanding nearshore (~6 km from shore) ocean current patterns could assist marine stakeholders in planning for the effects of marine debris. Therefore, the purpose of this project was to measure the percent of time nearshore currents flowed toward shore along the central California coast. This was achieved by examining seasonal variation of HF-radar derived surface currents. The goal was to identify coastal regions that experience more persistent onshore water movement and therefore are more likely to experience marine debris deposition. The result is a map depiction of localized hotspots along the coastline where marine debris may be more likely to be deposited. Stakeholders could benefit from this map by targeting funds and beach clean-up efforts on impacted areas.

Aiken, Emily, Michael Esgro, Ashley Knight, and James Lindholm

Institute for Applied Marine Ecology, California State University Monterey Bay

DIRTY BOTTOMS: ROV OBSERVATIONS OF MARINE DEBRIS

The Institute for Applied Marine Ecology (IfAME) conducts ROV surveys of the deep subtidal as part of several ongoing ecosystem characterization projects. Since 2009, IfAME has collected thousands of photographs of the seafloor from a variety of study regions off the coast of California. Though generally not a formal part of the sampling programs, geo-referenced observations of marine debris depict a distribution that transcends all sites (Point Arena to La Jolla), depths (15 to 450 m), and habitats surveyed. The type and amount of debris observed varied widely, including fishing nets, traps, beverage containers, and hoses. Line and monofilament were the most commonly observed debris items to date, with both of these items occurring throughout all surveyed areas. Recently deposited debris was generally devoid of marine life, while long-submerged debris (such as a jet engine found off Laguna Beach) provided habitat structure for a variety of fishes and invertebrates.

Ammann, Karah, Pete Raimondi, Christy Bell, Maya George, and Nathaniel Fletcher

University of California at Santa Cruz

LONG-TERM MONITORING PROGRAM DETECTS SEA STAR WASTING SYNDROME IN THE MONTEREY BAY NATIONAL MARINE SANCTUARY

Initial observation of the current outbreak of sea star wasting syndrome occurred in Summer 2013 during long-term monitoring by the Multi Agency Rocky Intertidal Network (MARINe). The temporal and spatial scale of monitoring that MARINe conducts allows for detection of abnormal occurrences, such as disease and subsequent changes in population. Symptoms of sea star wasting syndrome include white lesions in the ectoderm, decay of tissue surrounding the lesions and fragmentation of the body and death. The ultimate cause is not clear although such events are often associated with warmer than typical water temperatures. Rocky intertidal monitoring protocols include three permanently marked plots established in areas of high ochre star (*Pisaster ochraceus*) density. For each individual found, researchers record size and disease category. As of February 2014, signs of wasting syndrome in *Pisaster ochraceus* have been observed at 61 of 101 long-term monitoring sites. Several other intertidal sea star species have also been affected by sea star wasting syndrome. These observations span from Alaska to San Diego but vary in intensity. Preliminary results of long-term monitoring data in the Monterey Bay National Marine Sanctuary show a significant decrease in sea stars at some sites, whereas the change at other sites falls into the range of “normal” temporal variation. Data also show a marked increase in recruitment pulses at many sites. The broad-scale presence of the disease and lack of warmer water temperatures is troubling. Scientists anticipate that such a large mortality event of a keystone species could alter intertidal and subtidal seascapes.

Anderson, Laura (1), Michael Frenock (2), Rani Gaddam (1), Melissa Miner (1), Pete Raimondi (1), Melissa Redfield (1), and Rachael Williams (1)

1) University of California at Santa Cruz
2) Oregon State University

TRACKING SEA STAR WASTING SYNDROME: A COLLABORATIVE EFFORT BY RESEARCHERS AND CITIZEN SCIENTISTS

Sea star wasting syndrome describes a set of degenerative symptoms found in sea stars that often results in death. While wasting events have been observed in the past, the current incident along the west coast of North America is unique in its spatial scale and number of species affected. Previous wasting events in the early 1980s and late 1990s primarily impacted fewer species of sea stars in Southern California. The current event is known to extend from Alaska to Southern California and has affected over fifteen sea star species, including nine that occur within the Monterey Bay National Marine Sanctuary. The expanse of coastline in need of monitoring makes collaboration key to maximizing monitoring coverage. By working with citizen science groups, other researchers, and interested members of the public, we have created a sea star wasting syndrome tracking map that is continuously updated with syndrome presence/absence information as we receive new details. Tracking the geographic progression may help determine the source(s) of this outbreak, as the possible causes may vary depending on whether the outbreak started from a single location or multiple points of initiation. In this capacity, the tracking map is helping to inform several epidemiological studies that are investigating potential causative agents. Our tracking map, information on how to become involved in contributing to data collection, and numerous other resources about sea star wasting may be found on our website, seastarwasting.org.

Arias, Anamaria (1,2), Antonio Pantaleón (1,2), Nancy Rebollar (1,2), and Amanda Santellan (1,2)

1) Watsonville High School, Watsonville, CA
2) Watsonville Area Teens Conserving Habitats (WATCH) Program, Monterey Bay Aquarium

FISH DIVERSITY AT WHISTLESTOP LAGOON

We analyzed the fish diversity in different parts of Whistlestop Lagoon, which is located in the Elkhorn Slough National Estuarine Research Reserve (ESNERR). Within W. Lagoon, there are areas where *Ulva spp.*, a species of sea lettuce, is present and other areas where it is absent. We tested the hypothesis that there would be differences in fish diversity between areas with sea lettuce and areas without. Two people would go inside the lagoon with a five feet tall and 30 feet long seine net, and take two to three fish samples. Once we brought back the net we would look through everything and remove all the fish. We recorded the species, the total length, the color, and the location in which it was found. After we finished recording all of the data, we released all the fish that we caught back to their habitat. Our results show that we caught a lot of fish that are poor swimmers, meaning that they probably weren't fast enough to get away from the net, but this wasn't always the case, we found some fast swimmers. We found that the poor swimmers, such as the Bay Pipefish, were usually found by the sea lettuce. Given that large areas of W. Lagoon contain sea lettuce, this lagoon may be a critical habitat inside Elkhorn Slough for fish like the Bay Pipefish.

Arias, Asunción (1,2), Anthony Elias (1,2), Natalia McLaughlin (1,2) and Nancy Vaca (1,2)

1) Watsonville High School, Watsonville CA
2) Watsonville Area Teens Conserving Habitats (WATCH) Program, Monterey Bay Aquarium

MACROINVERTEBRATE DIVERSITY IN *ULVA* AND *BRYOZOA* HABITATS

In Elkhorn Slough National Estuarine Research Reserve (ESNERR) there is a manmade lagoon called Whistle Stop Lagoon where we conducted our research. ESNERR is considering tearing it down because it's falling apart and it takes too much time and money to be constantly repairing it. To determine if this would affect the living things in the water and around the levee, our group researched the difference in macroinvertebrate diversity in *Ulva* and *Bryozoa* habitats. Bryozoans are tiny, colonial organisms, also known as "moss animals." *Ulva* is a genus of algae, commonly known as "sea lettuce." *Ulva* is native, and there has been an excess of it in Whistle Stop Lagoon because of runoff agricultural water from the Salinas River. *Bryozoa* is a non-native genus, but isn't invasive. They are both providing habitats for macroinvertebrates. To conduct our experiment we collected samples from both habitats and for each sample we counted each clade we could see with the naked eye. Our results suggest that there is higher diversity in the *Bryozoa* habitat. In each 10 mL sample from the *Ulva* habitat was a 2.4 clade richness, while in *Bryozoa* a 3.4 clade richness. The difference was even greater with the species density in the habitats. There was a 13.6 individuals/10 mL in the *Ulva* habitat, with a 41.5 individuals/10 mL in the *Bryozoa*. These habitats are important because they are the home to many macroinvertebrates and are a food source for fish in the slough. Clearly, little things do count!

Banuelos, Stephanie, Yvette Becerra, Justin Cordova, Molly Fredle, Amanda Good, Lee Hausner, Fumi Kojima, Matt Lawson, Gavin Leavitt, Carylann Menzies, Peter Morrow, Maria Neidhardt, Stephanie Polito, Elizabeth Ramsay, Nicole Rodriguez, Jessica Simpson, Ryan Solymar, Griffin Srednick, Mitchell Takata, Alex Tyrrell, Oliviya Wyse, Cliff Yi, and Gabriel Zahner

California State University Monterey Bay

MAPPING PREDICTED MOVEMENTS OF CORAL REEF FISHES IN THE FLOWER GARDEN BANKS NATIONAL MARINE SANCTUARY

Successful applications of spatial approaches to management, such as marine protected areas (MPAs), require detailed information on the movement behavior of the species they seek to protect. In the case of NOAA's Flower Garden Banks National Marine Sanctuary (FGBNMS) in the Gulf of Mexico, the three off-shore, coral-capped banks that fall within the boundaries of the Sanctuary are part of a larger complex of banks throughout the area. As the Sanctuary Program considers whether to expand its boundaries to encompass additional banks, important questions remain as to a) the extent to which coral reef fishes show fidelity to the FGBNMS, and b) the extent to which fishes move between the Sanctuary and the other adjacent banks. In preparation for a field study on fish movements using acoustic telemetry to begin in Fall 2014, we reviewed the literature on the fishes found in the FGBNMS in order to make predictions about likely patterns in fish movements. Potential distribution factors gleaned from the literature included average fish size, average water depth, habitat association, site fidelity, and distance traveled for each species of interest. The fishes were binned into three categories-- groupers, jacks, and parrotfish—to account for variation in the amount of information available on individual species. These data were used to predict patterns in fish movement within and near the FGBNMS. The resultant maps form the hypotheses which will be evaluated using acoustic telemetry.

Banuelos, S, E Bradley, R Carlson, M Fredle, L Hausner, J Jung, V Larwood, G Leavitt, D McDermott, P Morrow, M Neidhardt, D Petrie, P Saboro, C Stanford, D Steinke, R Storm-Larsen, M Takata, A Tyrrell, J Watson, W Mcenery, K Olejniczak, A Quackenbush, N Sadrpour, and J Urness

California State University Monterey Bay

IS IT WORKING? TEST FOR SUCCESS OF EXPERIMENTAL TIDAL SCOUR CONTROL SILL IN ELKHORN SLOUGH WITH A 13 YEAR BATHYMETRIC TIME SERIES

Home to over 340 bird species, a designated National Estuarine Research Reserve, and one of the few remaining coastal wetlands in California, the Elkhorn Slough had been under increasing assault from tidal scour since the opening of the Moss Landing Harbor mouth in 1946. Bathymetric surveys beginning in 1988 documented accelerating rates of tidal flow, erosion and habitat loss. In an effort to reverse this trend the Reserve's Tidal Wetlands Restoration Project chose to construct an experimental sill across the mouth of a major slough tributary (Parson's Slough) in 2011. The sill was designed to mute the overall tidal exchange of the system thereby slowing tidal currents and scour. The purpose of this research is to determine whether or not this strategy is successfully altering the rates and patterns of erosion in the Elkhorn Slough. Our approach has been to extend the CSUMB Seafloor Mapping Lab's high-resolution bathymetric time series begun in 2001 to quantify changes in the spatial distribution of sediment erosion and deposition since the 2011 installation of the sill. For 2009, new and novel mapping technologies were adopted to increase survey coverage, efficiency and accuracy, including vessel-mounted topographic LIDAR for mapping the intertidal at low tide and wide-swath hull-mounted interferometric sidescan sonar for mapping the subtidal at high tide. The 2013 and 2014 data will be compared to those from 2001, 2003, 2005, 2007, 2009 and 2010 using surface model DEM raster subtraction in GIS.

Barnes, Cheryl L (1) Richard M Starr (1,2), James T Harvey (1), Scott L Hamilton (1), and Paul N Reilly (3)

1) Moss Landing Marine Laboratories
2) California Sea Grant
3) California Department of Fish and Wildlife

REPRODUCTIVE BIOLOGY OF CALIFORNIA HALIBUT (*PARALICHTHYS CALIFORNICUS*): RESULTS FROM THE CENTRAL COAST

In 2011, the California Department of Fish and Wildlife conducted a stock assessment for California Halibut (*Paralichthys californicus*). However, limited reproductive data were available for incorporation into stock assessment models. In an effort to reduce data deficiencies surrounding California Halibut reproduction, 704 fish (261 male, 443 female) were collected from recreational anglers, spear divers, commercial hook-and-line fishermen, and seafood processors throughout central California. Specimens were measured, weighed, and sexed upon capture. Where possible, maturity stages were assigned macroscopically, gonads were weighed to calculate gonadosomatic indices (GSI), and ovarian tissues were preserved for histology and estimates of batch fecundity. Livers were also weighed to calculate hepatosomatic indices (HSI). GSI and HSI values from mature females and spawning males were used to determine temporal variation in energy allocation, illustrating the height and duration of the spawning seasons in 2012 and 2013. The weekly fraction of spawning females was evaluated throughout this time period and used as a proxy for spawning frequency. Combining spawning frequency and the duration of the spawning season with impending estimates of batch fecundity using oocyte size frequency distributions and the gravimetric method is expected to provide an estimate of realized annual fecundity for this continuous species. Additionally, evaluations of the relationships between growth rates and environmental variables using thin-sectioned otoliths and basic life history theory will further enhance our understanding of California Halibut reproduction while providing essential information for use in future stock assessments.

Bell, Christy, Maya George, Melissa Redfield, and Pete Raimondi

Long Marine Lab, University of California at Santa Cruz

ASSESSMENT OF THE PATTERN OF INTERTIDAL COMMUNITY COMPOSITION AS A FUNCTION OF DISTANCE FROM THE ALDER CREEK LANDSLIDE

In the spring of 2011, a series of landslides occurred along Highway 1, south of Big Sur, California at Alder Creek. Surveys were conducted to characterize the intertidal community near the Alder Creek landslide in December 2012 and again in December 2013. Because of the gradient of tidal exposure, intertidal areas exhibit strong species zonation patterns. Our surveys were designed to sample the shoreline so that the gradient of high, mid and low zones would be evaluated. This design will allow us to determine if the pattern of community composition in each zone varies as a function of distance from the landslide. We will present some of the preliminary results of our surveys to determine if the patterns of intertidal community composition changed over time and if they are consistent with an impact to the community resulting from the landslide. We will sample the site again in December 2014 and hope to present the final results next year.

Bimrose, Kate L (1), Kirsten Lindquist (1), Jan Roletto (2), and Sherry Lippiatt (3)

1) Farallones Marine Sanctuary Association
2) Gulf of the Farallones National Marine Sanctuary
3) NOAA's Marine Debris Program

MARINE DEBRIS IN GULF OF THE FARALLONES AND MONTEREY BAY NATIONAL MARINE SANCTUARIES

In the wake of the 2011 Japanese earthquake and tsunami NOAA's Marine Debris Program provided funding to Gulf of the Farallones National Marine Sanctuary (GFNMS) and Farallones Marine Sanctuary Association (FMSA) to join the Marine Debris Monitoring and Assessment Project. GFNMS and FMSA joined the pilot project with other state, federal, and local partners in British Columbia and the five affected US states, Hawaii, Alaska, Washington, Oregon, and California. Since July 2012, citizen scientists have implemented NOAA designed protocol to survey and record debris at four beach sites within GFNMS and the northern Monterey Bay National Marine Sanctuary. Items are recorded within six debris categories; plastic, lumber, rubber, glass, metal and cloth/fabric as well as other/unclassifiable. Of the almost 2,000 items recorded over 78 surveys, roughly 80% of all debris is plastic, namely small hard fragments, followed by treated lumber. Additionally, in the first 18 months zero items were confirmed nor reported as tsunami debris via the NOAA disasterdebris@noaa.gov reporting system.

Information from our program provides important baseline data about the type, frequency, and persistence of marine debris on our shores. Moreover, data analysis may have site-specific, regional, and national implications, such as: 1) assisting NOAA in targeting local sites and time periods for effective beach cleanup efforts, while minimizing disturbance; 2) site-comparison analyses to better understand the scope of the marine debris problem within our sanctuaries and along the West Coast, and; 3) facilitating the most efficient use of limited federal funding for prevention and mitigation efforts.

Blakely, Jessica

California State University Monterey Bay

PREDICTIVE MODELING OF ROCKFISH HABITAT

Assessing fish distribution is essential for ecosystem-based management and the implementation of marine protected areas. Predictive habitat suitability models can be used by management to determine areas essential to maintaining fish stocks. The purpose of this study was to determine habitat characteristics associated with Yellowtail/Olive (*Sebastes flavidu)* and Gopher (*Sebastes carnatus*) rockfish aggregations. Bathymetry data was collected in spring 2012 using a high-resolution multibeam sonar at the Del Monte Shalebeds in Monterey, CA. Depth, slope, slope of slope, VRM, TPI, and distance to peaks were derived from the 50 cm digital elevation model. Fish points were collected from spring 2002 and fall 2003 using a ROV. A generalized linear model (GLM) was created for each species using derived bathymetric habitat data and the fish points. Twenty percent of the original observations were reserved for model validation. Cohen's Kappa was used to determine model agreement with the observations. The Yellowtail/Olive rockfish model was in substantial agreement with the data while the Gopher rockfish model was in moderate agreement. These results indicate that these rockfish species are aggregating in areas with rocky, high-relief habitat and are associated with relative peaks. Depth was a significant factor for Yellowtail/Olive rockfish. Marine Protected Areas and ecosystem-based management techniques can be improved by using these models to better place protection areas.

Borchers, Amara, and Claire Jellison

Santa Catalina School, Monterey, CA

CORRELATING ALGAL DISTRIBUTIONS AND WAVE STRESS IN THE INTERTIDAL

Algae in the intertidal zone changes in abundance and location throughout the seasons each year in the Monterey Bay Area. We looked specifically at Stunted Turkish Towel (*Mastocarpus* spp.), Flattened Rockweed (*Fucus gardneri*), and Nori (*Porphyra* spp.) (chosen because of their common occurrence) over time at locations with varying impact stresses. We observe higher densities of the algae with stronger published thallus strengths earlier in the year in exposed areas. Later, around March, as wave forces subside, algae with higher thallus strengths become less prevalent and other more fragile algae appear along the transects. We observed, in the transects we conducted and Limpets data, that Turkish Towel emerges earlier in spring than the other two algae at the fairly exposed Asilomar Point (according to CDIP buoy data). Then, later in the year as other algae appear along the transects TurkishTowel declines in numbers and shifts in position possibly due to the competition of emerging algae with weaker stipe. However, at the more sheltered intertidal of Point Piños this trend is not visible. Using data collected by the Limpets program at Asilomar and the more sheltered Point Piños, we are examining the correlations between wave height, stipe strength, and competition to explain the adjustments of algae numbers and locations throughout the year.

Cebrian-Paskell, Barbara, Christopher Cross, Aaron Tinker, and Felicia Van Stolk

Marine Science Institute

DECLINE IN DIVERSITY OF FISHES IN THE SOUTH SAN FRANCISCO ESTUARY

The Marine Science Institute (MSI) in Redwood City, California is a non-profit educational institution that instructs participants in the ecology and conservation of the San Francisco Estuary (SFE) through experiential learning programs. Daily field trips in the southern SFE aboard an oceanographic research vessel form the core of MSI's curriculum. Three or four fish trawls are conducted each voyage, and trained fish interns collect data on the fish caught in each otter trawl net tow. Fish are identified to species, the standard length is recorded, and individuals of the same species are grouped into size classes and counted. We have collected data from nearly 10,000 trawls since MSI's founding in 1970. Our initial discoveries include a slight increase in species richness, declines in total fish catch per trawl and fluctuations in the diversity of more than 130 species recorded. Our records reflect the Pelagic Organism Decline (POD) from 2001-2009, well documented in the northern reaches of the SFE.

Cheng, Tiffany (1), and Siyu Huang (1)

1) Careers in Science Intern Program and the California Academy of Sciences
2) Long-term Monitoring Program and Experiential Training for Students (LiMPETS)

ACANTHOCEPHALAN PARASITE (*PROFILICOLLIS* SPP.) LOADS IN CORRELATION TO PACIFIC MOLE CRAB (*EMERITA ANALOGA*) SIZE

Since 2002, San Francisco Bay Area students, including Careers in Science interns at the California Academy of Sciences, have been participating in marine ecosystem monitoring through a joint project with the Long-term Monitoring Program and Experiential Training for Students (LiMPETS), at the Gulf of the Farallones National Marine Sanctuary. Each year students collect population and demographic data on Pacific mole crabs (*Emerita analoga*), an indicator species that lives in the sandy beach habitat in temperate regions along the Pacific Ocean. Studying Pacific

mole crabs helps evaluate the health of California's intertidal systems and how human activities, geologic changes, and climate changes all make huge impacts to the intertidal ecosystems. Pacific mole crabs, or sand crabs, are filter feeding crustaceans that inhabit the intertidal swash zone and are known to be an intermediate host for parasitic 'spiny-headed' worms (*Profilicollis* spp.) in the phylum Acanthocephalan. Sampling and data collection takes place during their reproductive period, which occurs from spring to fall, and includes measuring total body length of the Pacific mole crabs and dissecting them to determine the presence of acanthocephalan parasites. We conducted several analyses using the data we collected in conjunction with LiMPETS long-term data. Specifically, we compared body length, gender, and parasite abundance from Pacific mole crabs sampled from four beaches located in the city and county of San Francisco. Our results indicated that larger Pacific mole crabs do not necessarily have more parasites, but are more likely to have at least one parasite, while female Pacific mole crabs carrying eggs have more parasites than females without eggs, or males. Further analysis will be conducted to determine if other factors affect Pacific mole crab parasite loads.

Chiu, Jennifer A (1), Richard M Starr (1,2), Dean E Wendt (3), Cheryl L Barnes (1,2), Grant T Waltz (3), Andrea L Launer (1), and Corina I Marks (1)

1) Moss Landing Marine Laboratories
2) California Sea Grant
3) California Polytechnic State University, San Luis Obispo

VOLUNTEER ANGLERS OF THE CA COLLABORATIVE FISHERIES RESEARCH PROGRAM

The California Collaborative Fisheries Research Program (CCFRP) aims to evaluate the effectiveness of four marine protected areas (MPAs) along the central California coast and provide information about economically important marine species for conservation and fisheries management. An important part of our program is to engage the public in MPA monitoring by working with volunteer anglers to conduct catch and release fishing surveys. Volunteer anglers aboard charter boats follow standardized scientific protocols to aid in the collection of information about species compositions, lengths and catch rates. These dedicated volunteer anglers, of all fishing experience levels, are essential to the success of this project. Numerous individuals return year after year and participate on multiple trips per season even though their travel ranges from tens to hundreds of miles to the harbors. It is through positive experiences, word-of-mouth, our website and social media that we are able to continue recruiting new volunteers. Since CCFRP's inception in 2007, we have worked toward bridging the gap between scientists and the community, and thus have been able to work collaboratively to better understand nearshore fish stocks. In this poster, we describe the demographic of the volunteers, catch rates as a function of volunteer experience, the proportion of anglers who return for multiple field seasons and the methods used to recruit our anglers.

Collazo, Rigo (1,2) Antonio Hernandez (1,2), Sofia Renteria (1,2), and Lillian Uribe (1,2)

1) Pajaro Valley High School, Watsonville, CA
2) Watsonville Area Teens Conserving Habitats (WATCH) Program, Monterey Bay Aquarium

CULVERTS VS. OPEN TIDAL FLOW AFFECTS CALIFORNIA COASTAL SHRIMP AT ELKHORN SLOUGH

Elkhorn Slough is an estuary preserved by the Elkhorn Slough National Estuarine Research Reserve (ESNERR) aimed at restoring the health of ecosystems in the slough. Elkhorn Slough, an important fish nursery, is home to aquatic life such as the California coastal shrimp (*Heptacarpus paludicola*) and oriental shrimp (*Palaemon macrodactylus*), an important food source for fish. Our interest in discovering the effects of water flow on shrimp abundance was spurred by the

importance of the shrimp to our slough's ecosystem. Our testable question asks, "Are there more shrimp where there is more tidal flow as opposed to less tidal flow?" Whistlestop Lagoon's culverts, located in Elkhorn Slough, restrict flow, making it an ideal location to test our hypothesis; there is higher shrimp abundance where there is a lower tidal flow. In order to answer the question, we collected samples with a seine net, measured flow with a meter stick, timed with a stopwatch, and used a turbidity test kit, within our two locations in Whistlestop Lagoon. We also checked on tides during our fieldwork to see if that had an effect on our data. Our results showed us that the low tidal flow had higher shrimp abundance opposed to the higher tidal flow as well as a higher abundance of sea lettuce.

Davidson, Gabby (1,2), Abraham Fuentes (1,2), Jeffrey Sanchez (1,2), and Victor Yanez (1,2)

1) Pajaro Valley High School, Watsonville, CA
2) Watsonville Area Teens Conserving Habitats (WATCH) Program, Monterey Bay Aquarium

QUANTIFYING THE SUCCESS OF WETLAND RESTORATION: COMPARISON OF DIVERSITY, RICHNESS, ABUNDANCE, AND EVENNESS OF MACROINVERTEBRATES

One measure of success in restoration is assessing the health of macroinvertebrate diversity. Macroinvertebrates make up one of the most important biological communities in an ecosystem due to the fact that they can be primary consumers, pollinators, or decomposers, and are necessary for the food chain to thrive. It is for this reason that we wanted to investigate how restoration in different habitats affects macroinvertebrate diversity, abundance, richness, and evenness in Watsonville's wetlands. Our group compared three different restored habitats: wet meadow, seasonal riparian and perennial riparian. Our research was conducted in Hanson Slough and West Struve Slough found in Watsonville, California. For our methods, we established a 15.24 meter by 22.86 meter plot at each site to sample the fauna. We used pitfall traps and a beating net trap to capture numerous species of arthropods. Our results showed that the greatest macroinvertebrate abundance, evenness, richness, and diversity were found in the perennial riparian site. Therefore, this perennial riparian habitat restoration produced the healthiest macroinvertebrate community for a wetland, but that may be because this habitat was recently restored. With the results of this study, we hope to educate organizations, such as the City of Watsonville, on the beneficial impacts of wetland restoration. We would also like this study to continue in order to create a long-term time-series dataset. This can help us to observe the progression of these restored habitats as they rebound from the drought California is currently experiencing.

De Beukelaer, Sophie, and Karen Grimmer

NOAA's Monterey Bay National Marine Sanctuary

RETRIEVING LOST FISHING GEAR FROM DEEPWATER HABITAT

The Monterey Bay National Marine Sanctuary (MBNMS) and partners have developed and tested novel deepwater retrieval procedures using specialized tools on a HD2 Remotely Operated Vehicle (ROV). The ROV is designed to remove lost fishing gear such as nets and traps--which cause hazards to marine organisms, fishermen and researchers--from the seafloor in depths up to 300m. In 2009, efforts were focused within Portuguese Ledge State Marine Conservation Area and resulted in the removal of more than 500 pounds of fishing gear, including a crab pot, a boat anchor, two 100-foot rockfish gillnets and a 40-foot rockfish gillnet fragment. During September 2010, the search for fishing gear focused on the edges of Monterey and Soquel Canyons, and within the Portuguese Ledge and Point Lobos State Marine Conservation Areas. The team retrieved 450 feet of rockfish gill net, two crab pots, a spot prawn trap and 600 pounds of lead weights. In 2011, we surveyed Point Sur platform in addition to surveying sites in Monterey Bay

and removed one rockfish gillnet and three traps. Invertebrates associated with the retrieved gear were collected and entered in the California Academy of Sciences Invertebrate Zoology Collection. This project is a model of successful collaboration resulting in: HD outreach video and images; characterization of biological communities and descriptions of specimens not found before in Monterey Bay; a positive relationship between fishermen, scientists and marine managers; and a safer environment for fishermen, deepwater submersible researchers, and the organisms that inhabit those environments.

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de Nesnera, Kristin L

Long Marine Laboratory, University of California at Santa Cruz

IDENTIFYING KEY HABITAT ASSOCIATIONS FOR MUSSEL RECRUITS ALONG CENTRAL CALIFORNIA ROCKY SHORES

Mytilus californianus is a key foundation species along the rocky shores of California. This mussel forms dense beds that provide habitat for a diverse community of algal and invertebrate species. Mussels are broadcast spawners and their larvae settle onto rocky shores following a three week pelagic swimming period. Recruiting mussels are considered poor settlers of bare rock and are thought to instead require associations with habitat-forming species to facilitate post-settlement growth and survival. Understanding these species associations is critical to predicting the persistence and recovery of mussel beds, but they have not been well studied. As a result, very little quantitative data exist to identify the particular species or conditions that favor mussel recruitment.

I conducted field surveys at four rocky intertidal sites in Santa Cruz, CA, to identify positive and negative associations between mussel recruits and available substrate in the upper and lower tidal range of the mussel bed zone. I used a Chi-square analysis to determine if the frequency of mussel recruits settling with a substrate was significantly different from what would be expected based on natural frequency of that substrate. I then used the standardized deviates from this analysis to determine the directionality of each substrate association. At all sites, mussel recruits exhibited significant positive and negative substrate associations ($p<<0.005$). Standardized deviates identified several positive associations with biological substrates. Many of the positive and negative associations identified in these surveys were unexpected and reflect the need for further research at this life history stage.

Denney, Christian (1), Anne Tagini (1), Donna Kline (1), Mary Gleason (2), and Rick Starr (1,3)

1) Fisheries and Conservation Biology Lab, Moss Landing Marine Laboratories
2) The Nature Conservancy
3) California Sea Grant

EXPLORATION OF THE CAPABILITIES OF A NEW STEREO VIDEO TOOL FOR THE MONITORING OF HARD-BOTTOM FISH SPECIES

In 2002, the Pacific Fisheries Management Council (PFMC) closed a swath of area along the western coast of the United States in response to declining populations of several Rockfish (genus *Sebastes*) species, creating the Rockfish Conservation Areas (RCAs). Since that time, monitoring strategies have primarily focused on soft bottom habitat using trawl sampling and have not targeted rocky, complex areas that many species of Rockfish prefer. In an attempt to better monitor those areas, we used a new stereo video lander and commercial fishing gear to develop techniques to survey populations of Rockfishes in the RCAs. In this poster, we report on our initial calibrations of the lander and calculations of its capabilities and limits including volume/area

observed (~25m^3/~10m^2), species accumulation curves when both baited and unbaited, and accuracy of length measurements using the SeaGIS software (SE +/- between 1% and 5% of total body length). Additionally, we report on our field use of the tool over the past year, detailing over 150 deployments and 100 hours of recorded video supporting the study of the RCAs in Central California.

DeRango, Geno, Barbie Halaska, and Romy Sidelsky

The Marine Mammal Center

IDENTIFICATION OF PINNIPEDS ENTANGLED IN MARINE DEBRIS ON THE CENTRAL CALIFORNIA COAST

The Marine Mammal Center (TMMC) has been responding to marine mammals in distress throughout northern and central California since 1975. Approximately 10-15% of our patients strand annually due to human-related injuries or interactions, and many of these interactions are a result of marine debris. Entangled pinnipeds are typically high-interest cases at TMMC due to being highly-visible to the general public. Recently, TMMC has improved its capacity to respond to a variety of species of pinnipeds entangled in marine debris with specialized rescue procedures and an improved entanglement management system that identifies individual animals afflicted by debris. Our management system has allowed us to track commonalities such as haul-out patterns within the Monterey Bay area and the type of fisheries gear seen on pinnipeds. The Marine Mammal Center's Stranding Department has begun to look into trends such as severity of trauma and spatial distribution of strandings related to gear types. Data compiled from identifying fisheries gear commonly used in the Monterey Bay National Marine Sanctuary is instrumental to preventing further interactions between fisheries and marine mammals.

DeVogelaere, Marissa (1), Erica Burton (2), and Chad King (2)

1) St. Francis High School, Watsonville, CA
2) NOAA's Monterey Bay National Marine Sanctuary

MARINE DEBRIS ON DAVIDSON SEAMOUNT: 4,000 TO 11,500 FEET DEEP

Davidson Seamount, part of the Monterey Bay National Marine Sanctuary, is considered a relatively pristine habitat. We documented marine debris over 176 kilometers using video transects and still images from NOAA/MBARI cruises in 2002 and 2006. Forty-four pieces of marine debris were documented with 41% being metal and 25% being plastic. These included bowls, buckets, cans, a broom, plastic bags, and train wheels. This debris mostly rains down from boat discards, as opposed to other deep-sea habitats where debris can originate from the shoreline and is pushed by currents along the continental shelf and into canyons.

Eggleston, Caitlin E. and Alicia M Magliato

San Lorenzo Valley High School, Felton, CA

THE EFFECT OF THE DISAPPEARANCE OF THE *PISASTER OCHRACEUS* ON THE *MYTILUS CALIFORNIANUS* AND SURROUNDING SPECIES AT DAVENPORT LANDING

Pisaster ochraceus (sea stars) at Davenport Landing in California experienced a general decline in population. These observations were first seen in July while we were counting various species along the vertical transect at Davenport Landing Beach using mainly a quadrat and 50 meter measuring tape. After observing the significant decline in sea star population, we became curious to find out what effects might occur on the various species that inhibit the same location as the sea

stars. We specifically wanted to focus on the relationship between the disappearance of the sea stars and the effects on the sea mussel population due to the recent disappearance. We compared our data to past data collected through the LiMPETS website, and found a steady decrease in sea stars and a general increase in mussels. Although the human factor is an uncontrolled variable (people sometimes harvest mussels in our vertical transect area), we hope to prove that the absence of the *Pisaster ochraceus* at the Davenport Landing site will lead to increasing populations and ultimately and overabundance of mussels in the upper sections (near the ocean), leading to unbalanced biodiversity at the tide pools.

Elsmore, Kristen E (1), Tristin A McHugh (1), Pete T Raimondi (1), and Paul Leary (2)

1) University of California at Santa Cruz
2) Stanford University

3-DIMENSIONAL HABITAT MAPPING OF TWO MARINE RESERVES

Temperate rocky reefs and kelp forests are some of the most productive and diverse ecosystems on earth, in part because they exhibit a great deal of spatial heterogeneity in habitat characteristics. To gain a better understanding of how habitat characteristics (e.g. relief, substrate type, and wave exposure) influence the composition of the associated marine community, we conducted detailed spatial surveys in two longstanding marine reserves on California's central coast. The Landels-Hill Big Creek Marine Reserve in Big Sur, CA and Hopkins Marine Reserve in Monterey, CA provide ideal study sites, given their marine protected status, permanent transect cables located 150 yards off-shore, and popularity among academic institutions for research studies and field training. Although the cables at the two sites are used for various educational purposes almost daily, no institution has had the capacity, time or funds to formally construct a 3-Dimensional map of these permanent cables. In Fall 2013, a team of divers from UC Santa Cruz, Hopkins Marine Station, and the Monterey Bay Aquarium, sampled the permanent transects at each site collecting data on: depth, relative wave action, substrate type, mobile and sessile invertebrates, fish, and algae. The spatially explicit map of the habitat surrounding these cables allows students and researchers to run preliminary statistics on habitat associations, species-specific associations, or physical and biological habitat associations. This map and data set provide further support for the marine reserve system and enhance training, education, and research opportunities provided through the University of California, Santa Cruz.

Fennie, Hamilton W (1), Scott L Hamilton (1), Susan M Sogard (2), and James P Barry (3)

1) Moss Landing Marine Laboratories
2) NOAA's Southwest Fisheries Science Center, National Marine Fisheries Service
3) Monterey Bay Aquarium Research Institute

THE EFFECTS OF ELEVATED CO_2 ON THE BEHAVIOR AND PHYSIOLOGY OF JUVENILE ROCKFISHES

The rapid increase of anthropogenic carbon dioxide (CO_2) emissions to the atmosphere is altering seawater chemistry at an alarming rate. Many studies have shown that elevated dissolved seawater CO_2 (i.e. pCO_2) concentrations and associated decreases in seawater pH will have negative impacts on marine organisms that secrete calcium carbonate structures. Recent research has shown that elevated pCO_2 affects the behavior and physiology of several tropical and temperate fishes, but some species appear to be resilient to near future pCO_2 levels. Here, we investigated the effects of near future pCO_2 levels (4 different pH treatments: 7.2, 7.5, 7.8, and 8.0) on two species of juvenile rockfishes (Genus *Sebastes*) after 2-3 months exposure to treatment conditions. We examined behavioral lateralization (a test of brain functional asymmetry), critical swimming speed, and metabolic rate of Copper (*S. caurinus*) and Blue Rockfish (*S. mystinus*),

finding species-specific responses to elevated pCO_2. Copper Rockfish exhibited shifts in their behavioral lateralization, decreased critical swimming speed, and changes in their aerobic performance when exposed to elevated pCO_2, while Blue rockfish appeared more resistant. These findings indicate that climate change may induce species specific effects that reduce the fitness of some species of temperate reef fish, which could alter the species composition of California's kelp forests in the future.

Figueroa, Luis (1,2), Mimi Leveque (1,2), and Juan Torres (1,2)

1) Watsonville High School, Watsonville, CA
2) Watsonville Area Teens Conserving Habitats (WATCH) Program, Monterey Bay Aquarium

CRAB DIVERSITY IN OPEN WATER VS. *ULVA* HABITAT

Runoff from agriculture fields goes into Old Salinas River and then makes its way into Elkhorn Slough National Estuarine Research Reserve (ESNERR). There's an area in ESNERR called Whistle Stop Lagoon where excess *Ulva* grows. *Ulva* is a genus of algae that grows in areas with an excess of phosphates often caused by nearby runoff. Our study compared differences in crab species diversity and richness, as well as nutrient levels at *Ulva* and open water habitats in Elkhorn Slough. In order to answer our question we set up traps in both habitats to gather data about crab diversity and richness. Our data showed that there were a higher number of all crabs in the *Ulva* habitat but they were smaller in size, while the open water habitat crabs were bigger in size but there were fewer. The diversity in Elkhorn Slough is vital to the reserve in order to keep species that are native. The nutrient levels are helpful for plant growth in the slough, but uncontrolled plant growth can reduce habitat space for animals and affect native species population viability. Invasive species, such as the European Green Crab, can adapt faster to changes in habitat than native crab species in ESNERR. Thus, changes in habitat resulting from expansion of *Ulva* habitat may favor invasive species survivability while making native species more vulnerable to population declines. This study is important to the slough because crab behavior can be affected by high levels of nutrients that get to Whistle Stop Lagoon from agricultural runoff. Elkhorn Slough is a reserve that should conserve the native species of the central coast wetlands.

Fournier, Trevor (1), Geoff Wheat (1), Steve Moore (2), and Sean Burns (3)

1) University of Alaska, Fairbanks
2) California State University Monterey Bay
3) Monterey Academy of Ocean Sciences

HIGH SCHOOL STUDENTS VIDEO SAMPLING AND FUTURE RESEARCH OF COMMERCIAL WHARF #2 WALL

Providing students with significant research opportunities in high school is important for promoting STEM-related fields in college. We have developed the foundation for such a program by engaging a senior from the Monterey Academy of Ocean Sciences (MAOS) at Monterey High School. This foundation represents a senior project and is based on recording and cataloging video data of a vertical Quadrat string that was temporarily stationed at Commercial Wharf #2 in Monterey, CA along a cement wall. Monitoring species diversity and abundance of intertidal organisms is an appropriate introduction for high school students into the field of marine science. Supervised dives have been performed and future actions will be to finalize the training materials and have students perform data collection on their own. The goal is for students to use an ROV equipped with a High Definition Video Camera and perform dives every two weeks at a designated location while noting physical and variable conditions. Data collected will be stored and sorted by date and time for later analysis of the seasonal (and ultimately, yearly) change in species abundance and diversity. We anticipate that involvement in this program will enable students to use the video data and metadata

to develop their research projects, address biological or physical oceanographic questions, and to further the development and capability of the ROV.

Garcia, Cristal (1,2), Briana Lopez (1,2), and Abigail Melchor (1,2)

1) Watsonville High School, Watsonville, CA
2) Watsonville Area Teens Conserving Habitats (WATCH) Program, Monterey Bay Aquarium

THE IMPACT OF OCEAN ACIDIFICATION ON A NATIVE AND AN INVASIVE CRAB SPECIES IN ELKHORN SLOUGH, CALIFORNIA

Ocean acidification has been a significant problem since the Industrial Revolution began. Oceans and other bodies of water absorb carbon dioxide emissions, which leads to a decrease of pH. Our project examines the effect of ocean acidification on the reaction time of invasive European green crabs (*Carcinus maenas*) and native yellow shore crabs (*Hemigrapsus oregonensis*) and which species will adapt better to changes in pH. Our research was conducted with crabs collected from Elkhorn Slough National Estuarine Research Reserve (ESNERR) in Central California. We observed the reaction time of these two species of crabs in pH levels that range from 6.8 to 8.0. Overall our results demonstrated that the crabs exposed to lower pH levels have a slower reaction time than the crabs in the higher pH levels. Our results have also shown that the European green crabs are adapting faster than the yellow Shore crabs as indicated by their reaction time. Going into this experiment we wanted to learn more about the issue of ocean acidification. Coming out of this experiment, we have not only learned the issues, but we have also started to teach others about ocean acidification.

Haile, Esther (1), and Moria Robinson (2)

1) California State University Monterey Bay
2) University of California at Davis

THE EFFECTS OF NECTAR RESOURCES ON OVERWINTERING MONARCH BEHAVIOR

Each year, migrating monarch butterflies overwinter in parts of Mexico and California. Monarchs exhibit many behaviors while overwintering that include nectaring, flying, and clustering. While microclimate largely drives monarch overwintering site choice and behavior, the presence of nectar producing plants may also play a role. Since the 19th century, humans have heavily modified the California coast through deforestation, species introduction, and the creation of gardens. We hypothesize that 1) sites with greater human modifications (i.e. gardens) have a greater diversity and quantity of nectar producing plants, 2) there would be a greater proportion of nectaring monarchs in areas of greater human modification, and 3) there would be an increase in the proportion of nectaring monarchs as the season progressed. We surveyed three overwintering sites around Big Sur, CA weekly for seven weeks during the winter and spring of 2013-14. The number of monarchs seen flying, nectaring, and clustering was recorded for each site. Results of plant surveys show marked variation in nectar resources between the sites. We found a significant difference in the proportion of nectaring monarchs between the sites with the greatest and the fewest nectar resources. The proportion of monarch that was active increased at sites over the monitoring period. We conclude that sites with high nectar abundance have a larger proportion of nectaring monarchs. Habitat modification can pose a counterintuitive problem, as monarchs that are more active while overwintering tend to have low lipid reserves and are less likely to survive migrating to their summer breeding sites.

Jefferies, Sarah V

Moss Landing Marine Laboratories

INVESTIGATING THE REPRODUCTIVE SEASONALITY OF TWO RECENTLY SYNONYMIZED MORPHOLOGIES OF MACROCYSTIS PYRIFERA

Two of the recently synonymized species of *Macrocystis* occur locally and vary in their reproductive mode. The *pyrifera* morphology produces sporophylls for sexual reproduction and the *integrifolia* morphology grows vegetatively via a rhizome. These morphologies are stratified by depth: the sexual morphology generally occurs in water deeper than 3m and the vegetative morphology only occurs in shallow water (<3m). From January 2013 to January 2014, quarterly subtidal surveys were conducted in Stillwater Cove, California across a depth gradient from 1m to 4m in order to understand the effect of water depth on sexual reproduction. Reproductive tissue samples were collected along with corresponding depth data, and these samples were brought back to the lab for processing and zoospore culturing. Samples were measured for sporophyll size and weight, soral size and weight, and soral percent cover, metrics related to reproductive investment. Regressions between zoospore output and water depth show a strong positive relationship over all seasons except summer. Soral weight, area and percent cover showed no consistent directional relationship with water depth over the sampling period. Additionally, there was seasonal variation in the strength of these relationships, with summer and fall displaying the strongest relationships, and winter and spring showing the weakest. These results indicate that sexual reproductive output increases with depth, but there is no corresponding change in investment. There have been very few studies which compare the morphologies of *Macrocystis*. Integrative studies like these are needed to understand the relationship between these morphologies and their impacts on the nearshore environment.

Kang, Caleb, Josue Aguilar, Talalelei Vaiaoga, and Frederick Williams

James Logan High, Union City, CA

WHAT IS THE CORRELATION BETWEEN PURPLE SEA URCHIN AND IRRIDESCENT ALGAE POPULATIONS?

The purpose of this project was to study the correlation between sea urchins and iridescent algae. We used information from the LIMPETS monitoring website that includes graphs and quantitative measurements. We used these measurements to relate the abundance of urchins to iridescent algae. Why is this important to us? To begin, sea urchins are one of the main grazers of flat algae found on rocks and prevent algal blooms. In addition, sea urchins are prey to various species such as sea otters, snails, crabs, etc. They prevent algae from overpopulating while providing food for many predators.

Kline, Donna (1), Rick Starr (1), Mary Gleason (2), John Field (3), Huff McGonigal (4), Steven Rienecke (2), Christian Denney (1), Anne Tagini (1), Jahnava Duryea (1), and Corina Marks (1)

1) Fisheries and Conservation Biology Lab, Moss Landing Marine Laboratories
2) The Nature Conservancy
3) NOAA's Southwest Fisheries Science Center, National Marine Fisheries Service
4) Environmental Defense Fund

SUPPORTING A SPATIAL ANALYSIS OF THE DISTRIBUTION AND SIZE OF REBUILDING STOCKS IN THE ROCKFISH CONSERVATION AREA (RCA) THROUGH DIRECTED FISHING AND VISUAL SURVEYS

Depth-based Rockfish Conservation Areas (RCAs) have been an important, though coarse-scale, tool to support rebuilding overfished species (OFS). However, limited research exists on fine scale demographic and distribution patterns for rebuilding species that could allow fishermen to better target healthy populations (Chilipepper, Yellowtail, and Widow Rockfishes) while avoiding OFS (Cowcod, Canary, Yelloweye). Rocky habitats that many of these OFS inhabit are under-sampled in annual coast-wide trawl surveys. Consequently, we do not know enough about their distributions to inform bycatch avoidance plans and promote fishing opportunities for underutilized stocks. We assembled a broad partnership that includes fishermen, NGOs, fisheries agencies, and academics to conduct collaborative research focused on 1) modeling and mapping predicted OFS distribution; 2) ground-truthing predictive maps through scientific sampling of encounter rates with OFS using directed fishing; and 3) characterizing abundance, length, and habitat associations of OFS in those same locations using stereo-visual survey techniques. Field surveys in year one yielded 419 fishing sets and 398 lander drops in central California locations identified by finalized predictive distribution maps. Directed fishing landed 16 species, primarily epibenthic and midwater rockfishes including two rebuilding species – Bocaccio and Canary. The ratio of target to rebuilding species was 8:1. Video observations included species landed as well as Cowcod and Yelloweye in areas fished. This work will provide new data and insights on distribution and abundance of both rebuilding and healthy fish populations that should ultimately enable improved access to healthy fish stocks by fishermen while maintaining effective conservation measures for rebuilding species.

Klosinski, Jarred

Moss Landing Marine Laboratories

TIME SERIES ANALYSIS OF THE ABUNDANCE AND RETENTION OF SEAWEED WRACK

Kelp wrack is an important feature of beach ecosystems along temperate coastlines. In California, kelp forests deliver high quantities of wrack to nearby beaches. Sediment size along the shore can be used to quantify both the abundance and retention of beach wrack. To test the relationship between grain size, deposition, and retention, beach-cast seaweeds were monitored along rocky and sandy shores between Davenport, CA and Carmel, CA from April 2013 to March 2014. Spatial and temporal variation of wrack abundance and retention was significant over this time period. Wrack abundance peaked in winter at the rocky intertidal compared to sandy beaches, which exhibited no change throughout the study. Consistently higher abundances of wrack were found in the rocky intertidal due to its composition of large boulders. Additionally, retention was longer on sandy beaches than the rocky intertidal due to differences in grain size and slope. Ultimately, the coastal geology contributes to the site-specific differences in the abundance and the retention of wrack in central California. The location of algal detritus on a beach determines its retention, which can be ecologically relevant to understanding the life history of the organisms that utilize the wrack.

Launer, Andrea L (1), and Rick M Starr (1,2)

1) Moss Landing Marine Laboratories
2) California Sea Grant Extension Program

SEX-SPECIFIC DIFFERENCES IN MOVEMENT AND RESIDENCY OF LEOPARD SHARKS (*TRIAKIS SEMIFASCIATA*) IN A CALIFORNIA ESTUARY

Estuaries are ecologically important interfaces of marine, freshwater, and terrestrial habitats which contain high habitat heterogeneity, making them important habitats for many resident and migrant species. Many shark species are seasonally abundant in estuaries, utilizing the habitat for reproduction and as nurseries. Habitats in estuaries are susceptible to alteration from anthropogenic and environmental effects such as global climate change, agricultural runoff, and dredging activities. These changes may have different impacts on groups within a shark population because sex-specific segregations are common for many shark species including Leopard Sharks (*Triakis semifasciata*). Movements of Leopard Sharks (n=17) were recorded using acoustic receivers (n=9) moored in Elkhorn Slough, CA, an important coastal estuary for Leopard Sharks, from March to September 2013. Residency was assessed by individual shark and compared by sex (male n=9; female n=8) but were not statistically significant. Proportion of detections was calculated by region and a Bray Curtis similarity plot revealed significant groupings 87% similarity. All groupings had a large contribution towards similarity from detections in the Fork region of the slough but differed in their reliance on other areas. No patterns of sexual segregation were apparent though there may be some distinct patterns of movement by sex. These data will be used to determine differential habitat use of Leopard Sharks within estuarine habitats and will help to predict how the population will be affected by future habitat changes.

Lilly, Laura (1,2,3,4,5), Todd Hallenbeck (2), Emilio Mayorga (3), Jenn Patterson (4), and Darren Wright (5)

1) California Sea Grant State Fellowship Program
2) West Coast Governors Alliance on Ocean Health (WCGA)
3) Networked Association of Northwest Ocean Observing Systems (NANOOS)
4) Central and Northern California Ocean Observing System (CeNCOOS)
5) Southern California Coastal Ocean Observing System (SCCOOS)

LINKING OCEANOGRAPHIC DATA TO WEST COAST MARINE DEBRIS MANAGEMENT

Physical oceanographic data provides important support to marine management and policy decisions, including marine debris, ocean acidification, sea level rise and marine spatial planning. However, West Coast managers and researchers, especially those working with marine debris, currently lack streamlined access to easily understandable and usable oceanographic data products. The West Coast Integrated Ocean Observing System (IOOS) Regional Associations (SCCOOS, CeNCOOS and NANOOS) are working with the West Coast Governors Alliance (WCGA) Marine Debris Action Coordination Team to better link physical oceanography to marine debris data.

Through surveys of non-profit agencies, state and federal debris managers, and beach clean-up organizers, we have highlighted specific oceanographic timescales, spatial scales and data formats that will aid in marine debris management. Useful data variables identified include surface ocean currents, winds, wave direction/magnitude, and river watersheds. The newly-created WCGA West Coast Ocean Data Portal (WCODP) will serve as a gathering site for West Coast marine-related datasets, as well as summary physical oceanographic images, graphs and other products that we will create, to facilitate West Coast-wide marine-related decision-making.

Our goal in providing these data will be to help marine debris managers answer questions such as: 1) How is trash moving along the West Coast based on surface currents and wind movements? 2) Which beaches should cleanup coordinators focus efforts on? 3) Where specifically does land-based debris originate? How can we more effectively reduce debris at those upstream points? 4) Are current trash-related policies and bans having an effect? What effect may future bans have?

Makukhov, April D (1), Laura Rogers-Bennett (2,3), Cynthia A Catton (3), and Jennifer K O'Leary (4)

1) California State University Monterey Bay
2) Bodega Marine Laboratory, University of California at Davis
3) California Department of Fish and Wildlife, Bodega Bay
4) Hopkins Marine Station, Stanford University

INITIAL ASSESSMENT OF RED ABALONE SETTLEMENT RATES IN THE MONTEREY BAY

Abalone are important grazers that help maintain coralline-dominated benthic space. In California, abalone supported recreational and commercial fisheries, but overfishing and disease caused fisheries closures in central and southern California. Currently, two species are on the federal endangered species list. Understanding abalone recruitment is critical to management and recovery; however, little is known about abalone settlement rates over space and time. Abundances of young-of-the-year abalone in recruitment modules deployed by the National Parks Service and the California Department of Fish and Wildlife have been sporadic, exhibiting boom and bust years. In 2012, we conducted the first assessment of larval abalone settlement in central California, where abalone are less dense but highly aggregated due to sea otter predation. We surveyed 33 coralline covered cobbles at Hopkins Marine Station in Lovers Point State Marine Reserve; we found and genetically identified 16 red abalone (*Haliotis rufescens*). Using the same method in northern California, only 3 newly settled abalone were found in surveys of 80 cobbles/site at 6 sites in Mendocino and Sonoma Counties. Thus, during this year of poor fall recruitment in northern California, fall abalone settlement was higher in central California. These data suggest abalone recruitment may be temporally decoupled in central and northern California. Continued monitoring of abalone settlement will help elucidate how red abalone populations have maintained their densities in central California despite high levels of predation. Key remaining questions are whether these less dense but aggregated populations have consistent or sporadic recruitment and whether high recruitment years differ regionally.

Marks, Corina I (1), Richard M Starr (1,2), Dean, E Wendt (3), Cheryl L Barnes (1,2), and Grant T Waltz (3)

1) Moss Landing Marine Laboratories
2) California Sea Grant
3) California Polytechnic State University, San Luis Obispo

ECOLOGICAL INSIGHTS AND FISH POPULATION TRENDS FROM THE CALIFORNIA COLLABORATIVE FISHERIES RESEARCH PROGRAM

Combining the expertise and ideas of academic and agency scientists, resource managers, and recreational fishing communities, the California Collaborative Fisheries Research Program (CCFRP) investigated spatiotemporal changes in species compositions, sizes, and catch rates of nearshore fishes in central California. Data from four marine protected areas (MPAs) and associated reference sites were compared to evaluate MPA performance and provide information for fisheries management. From 2007 to 2013, we worked with 717 recreational anglers, 12 sportfishing vessels, and 20 captains from four different ports to conduct 244 standardized hook and line surveys. Utilizing scientifically rigorous catch and release methods, we fished for a total of

6,813 hours to catch 46,857 fishes from 46 different species. Of those caught, 40,443 were tagged to gain information about movement patterns and survivorship through recapture. From this long-term dataset, we have been able to detect a number of recruitment pulses, fluctuations in catch rates due to environmental variability, and effects of protection and habitat quality on fish sizes and densities. In addition to MPA monitoring, we have begun to incorporate the seven years of existing data into a variety of new, data-limited fishery models.

McCollough, Rhiannon, Ashley Knight, and James Lindholm

Institute for Applied Marine Ecology, California State University Monterey Bay

STEEP AND DEEP: HABITAT ASSOCIATIONS OF PRAWNS IN SOUTHERN CALIFORNIA

Spot prawns (*Pandalus platyceros*) and Ridgeback prawns (*Sicyonia ingentis)* support a valuable commercial fishing industry in Southern California. Despite their economic importance, our understanding of the distribution of prawns has largely come from trawl and trap studies where more fine-scale habitat associations cannot be directly observed. In 2011 and 2012, we used a remotely operated vehicle (ROV) to collect continuous video imagery of demersal communities at four sites in southern California: Point Vicente, Laguna Beach, La Jolla, and San Clemente Island. From this imagery, we collected geo-referenced observations of 473 Spot prawns and 835 Ridgeback prawns. Both species of prawns were frequently observed in soft-sediment areas with steep slopes (e.g., canyon walls) and ranged in depth from 70 to 380 m. On average Ridgeback prawns were observed in shallower depths (160 m) than Spot prawns (228 m). Ridgeback prawns were seen on the steep continental slope at the Laguna and Point Vicente sites and in the submarine canyons off La Jolla. Spot prawns were also seen on the slopes of Laguna and the canyons off La Jolla but were seen on the steep slope off the eastern shore of San Clemente Island. These results suggest that depth, slope, and substrate play an important role in prawn distribution and can serve as the foundation of future management measures.

Melcher, Madeleine, and Danielle Chabot

San Lorenzo Valley High School, Felton, CA

ENVIRONMENTAL IMPACTS ON BIODIVERSITY AND INTERSPECIES RELATIONS IN THE TIDE POOLS

Our goal is to successfully collect data following LiMPETs (Long-term Monitoring Program and Experiential Training for Students) protocols and examine the possible impacts of environmental change. We hypothesize that there will be a change in common algae and animals in the rocky intertidal zone due to the evolution of our environment. We believe that organisms will be influenced by the differentiation in their environments over years and seasons. One factor that may be impacting the fluctuation of species is upwelling. Upwelling increases nutrient concentrations in nearshore areas, and these increases provide additional sustenance for select filter feeders. We have observed symbiotic relationships between several species, and hypothesize that the increased populations of some species may be relatable to increases and decreases in others. We collect data approximately twice a month during low tides at Davenport Landing State Beach. We follow the LiMPETs protocols for collecting data in the already established 15m X 15m anemone plot. Using a random number table, we determine the populations of various organisms utilizing a one-meter square quadrat. We record this data, repeat the process, and create graphs to monitor population changes over time. From our data, we determine which species populations have changed , and then hypothesize, test, and research why. We are examining the correspondence between the increase and decrease in certain species counts and observing the impact that increased nutrient levels, caused by upwelling, may have on species such as the California sea mussel. Thanks go to our fabulous mentor, Dr. John Pearse.

Mercado, Laura (1), John Haskins (2), Rikke Preisler (2), and Kerstin Wasson (2)

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ELKHORN SLOUGH ESTUARY WATER QUALITY REPORT CARD

Water pollution is an environmental problem that threatens the health of aquatic systems and consequently their ability to continue providing goods and services. An attempt to improve water quality and prevent or stop negative ecological impacts is to educate non-scientific audiences about water pollution issues. The purpose of this project was to develop a product capable of communicating a scientific message to non-scientific communities. We analyzed a long-term water quality database maintained at Elkhorn Slough estuary, a National Estuarine Research Reserve located in California central coast, to create a report card that describes the current status of the estuary's waters. We selected nine parameters measured monthly at 24 sites, and searched the literature for appropriate thresholds. Our analysis allowed us to examine the scope, frequency and magnitude with which thresholds were exceeded and to produce composite index scores (ranging from 0 to 100) for each site. The resultant report card is a clear and concise form of communication that can be used by community members and decision-makers to identify areas of least and most concern. Overall, our report card is a tool intended to help advance knowledge about Elkhorn Slough water pollution issues and encourage voluntary and regulatory actions to improve water quality.

Miller, Gwen J (1), Fred Watson (1), Marc Los Huertos (1), and Ross Clark (2)

1) California State University Monterey Bay
2) Central Coast Wetlands Group

DO TEMPERATURE AND DISSOLVED ORGANIC CARBON PLAY A ROLE IN NITRATE REMOVAL WITHIN A TREATMENT WETLAND?

Treatment wetlands can be used to reduce nitrate loading into surface water and the coastal ocean. In this study I evaluated the relationship between temperature and denitrification within a Central Coast wetland, the Molera treatment wetland. I collected water samples at the inlet and outlet of the wetland and analyzed the samples for dissolved organic carbon, nitrate plus nitrite, and ammonium. Temperature, salinity, pH and dissolved oxygen measurements were also obtained at the inlet and outlet. Samples were collected every 3.5 from June 2012 until February 2014.

A series of generalized linear models with a Tobit distribution was created to assess the postulate that temperature and carbon positively influences denitrification. The models were compared using Akaike's Information Criterion. Log_{10} evidence ratios (LERs) were used to compare model parameters and terms coined by Kass and Raftery (1995) were used to interpret LERs.

The results show the wetland successfully removed nitrate from the water. The best fit model included both temperature and carbon following a combined zero/first order decay. There was decisive evidence higher temperatures lead to increased denitrification (β_T = -0.94, $LER\text{-}_T$ = 3.08). Unexpectedly, there was substantial evidence that nitrate removal was higher with lower carbon concentrations (β_C = 0.002, $LER\text{-}_C$ = 0.82). Further analysis should be conducted on the relationship between carbon and nitrate removal, but it is likely that carbon additions will increase nitrate removal within the wetland. Furthermore, designing a wetland that retains heat will help maximize nitrate removal.

Moritsch, Monica, and Pete Raimondi

Ecology and Evolutionary Biology, University of California at Santa Cruz

IDENTIFYING ENVIRONMENTAL AND ANTHROPOGENIC FACTORS ASSOCIATED WITH SEA STAR WASTING DISEASE THROUGH LARGE-SCALE GEOSPATIAL ANALYSIS

Since summer 2013, an epidemic of sea star wasting disease (SSWD) has been documented in intertidal and subtidal habitats over most of the North American west coast, from Alaska to San Diego. Past outbreaks have reduced intertidal and subtidal sea star populations to the point where they were nearly absent; populations have severely declined during the 2013 event as well. For infectious diseases to spread, they require a susceptible host and appropriate conditions. Whereas prior SSWD events were limited to regional outbreaks associated with warmer-than-average temperatures, it is not yet known what pathogenic agent is responsible or what factors are driving an epidemic of such large-scale spatial extent. To identify potential factors associated with disease occurrence, we combined data from PISCO's sea star surveys and citizen scientist reports of disease along the Pacific coast from summer 2013 to early 2014. Using GIS to perform geospatial analysis, we searched for correlations between disease occurrence and several environmental and anthropogenic factors including: anomalous temperatures, anomalous salinities, distance from densely populated areas, and distance from coastal wastewater outfalls. While these factors do not necessarily cause SSWD, they may influence host susceptibility through physiological stress or provide conditions which the pathogen needs to thrive and spread. Understanding the driving factors behind SSWD will allow us to predict where this epidemic and its ecological consequences are most likely to occur.

Morrow, Peter (1), Raphael Kudela (2), Kendra Negrey (2), Jonathan Zher (2), Kendra Turbo Turk (2), Kelly Davidson Chou (3), Lilia Corona (3), Jon Detka (1), Marc Los Huertos (1), and Cécile E. Mioni (1,2)

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2) Institute of Marine Sciences and Ocean Sciences Department, University of California at Santa Cruz
3) Mt View Sanitary District, Martinez, CA

DETERMINING ENVIRONMENTAL CONTROLS CYANOHABS IN PEYTON SLOUGH MARSHES, CALIFORNIA

Harmful cyanobacteria (CyanoHABs) and the toxins they produce are a growing concern as a source of impairment in California water bodies that affect both water quality and wildlife. From May 2013 to December 2013, we conducted a multidisciplinary, collaborative monitoring program in Peyton Slough marshes to gain a better understanding of the environmental drivers controlling cyanoHAB distribution and abundance. This monitoring effort was supported by the Mt View Sanitary District (Martinez, CA).

The Peyton Slough marsh complex, located in Martinez, CA comprises the Moorhen marsh and the McNabney marsh. It supports a rich and diverse wildlife and is a nesting ground for at least 15 species of birds. Moorhen marsh is a constructed wetland managed by MVSD and is the first wetland on the West Coast to use treated effluent as its primary water source. McNabney marsh is a restored seasonally tidal wetland at the vicinity of Peyton Slough. During Summer 2012, McNabney marsh has been experiencing an unprecedented scum-forming bloom, which greatly impaired water quality and may threaten the wildlife. Since 2009, McNabney marsh's ecology underwent significant changes that may have altered the cyanobacteria assemblage composition. The marsh was open to water exchange with Suisun Bay via a tide gate.

Over the course of this study, potentially toxic cyanobacteria included *Phormidium*, *Oscillatoria margaritifera* and *Planktothrix*. Our results indicate that cyanobacteria abundance in these marshes are controlled by several interacting environmental factors. Variations in cyanobacterial abundance can be best explained by examining individual strains of cyanobacteria rather than by treating all cyanobacteria as a single ecological unit.

Moye, Jessica, and James B Lindholm

California State University Monterey Bay

GENDER-MEDIATED HABITAT ASSOCIATIONS OF KELP GREENLINGS (*HEXAGRAMMOS DECAGRAMMUS*) ALONG THE CENTRAL COAST OF CALIFORNIA

The distribution of marine fish assemblages is broadly correlated with water temperature and depth. Within this classification, various demersal fishes are known to associate with specific substrate types such as rocky reef or unconsolidated sediments. However, information on fine-scale habitat associations, the scale at which individual fish interact with the seafloor, continues to be limited. This study aims to quantify the distribution and habitat associations of Kelp Greenlings (*Hexagrammos decagrammus*) within five geographies of the Marine Life Protection Act's North Central Coast Study Region (NCC) in California. Observational data of Kelp Greenlings were extracted from videographic and still photographic imagery collected by a remotely operated vehicle in summers of 2010 and 2011as part of the baseline characterization of the newly designated network of marine protected areas (MPAs). Analyses of the observations provided information regarding the population's distribution during the NCC MPA's designation, differences in the male and female distribution and abundance, and specific habitats with which each gender is associating. Fine-scale habitat associations were assessed and provided basis for use of predictive models through geospatial analyses in ArcGIS. Maps of statistically significant areas of suitable Kelp Greenling habitat were created, which effectively quantified the amount of suitable habitat within each of the NCC MPAs. Ultimately, this research aims to advance our understanding of Kelp Greenlings in support of current and future monitoring efforts for more effective habitat and species management.

Nguyen, Ashten, and Grace Russell

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COMMUNITY RELATIONSHIPS AMONG MUSSELS AND LIMPETS

We are interested in analyzing the locations of different species and the rocky intertidal is an excellent place to start this procedure. Community structures in the rocky intertidal can be determined by examining the succession and population control of different species such as mussels and limpets. Using the LIMPETS protocol data set, the purpose of this experiment was: 1) to find why mussels and limpets were found in specific locations 2) to determine how succession and dominance influences their location. We also found that another influence is limited resources, which in this case is bare rock. The *Mytilus californianus* could potentially be the dominating species in the community because they claim the most desired location in between the extreme wet and dry areas in the intertidal zone. They therefore force the limpets to be the subordinate species and relocate to the extreme wet and dry areas in the intertidal zone. This information could potentially be used to predict the location of mussel beds in the future and how they would affect the existence of starfish.

Pardieck, Elizabeth (1), Sophie De Beukelaer (2), and Karen Grimmer (2)

1) California State University Monterey Bay
2) NOAA's Monterey Bay National Marine Sanctuary

MONOFILAMENT FISHING LINE DEBRIS PERSISTS AT PORTUGUESE LEDGE SMCA

Marine debris is a growing worldwide problem. We assessed marine debris in Monterey Bay, California using analysis of video imagery collected during the Monterey Bay National Marine Sanctuary Lost Fishing Gear Removal project in September 2010 by the remotely operated vehicle (ROV), Phantom HD2. The Portuguese Ledge State Marine Conservation Area (SMCA), created in 2007, is 27.5 km^2 and we surveyed 18,500 m length of transects within the SMCA. We found 228 individual debris items during this survey and 92% of the items were recreational monofilament fishing line. The survey location was over the actual ledge of Portuguese Ledge which is mostly hard substrate, so over 70% of the debris found was over rocky habitat. Since fishing activities have been restricted at Portuguese Ledge since 2007 when the SMCA was established, input of additional fishing related debris is likely slower than in previous years. However, the monofilament fishing line found during this survey is made of durable plastic that typically takes 600 years to degrade, and so it will persist in this environment for hundreds of years.

Pelon, Katie, Robin C Dunkin, and David Casper

Long Marine Lab, Marine Mammal Stranding Program, University of California at Santa Cruz

THE EFFECTS OF EL NIÑO ON MARINE MAMMAL STRANDINGS IN CENTRAL CALIFORNIA

Marine mammal species thrive in Monterey Bay due to the success of the lower trophic levels and the abundance of available nutrients provided by coastal upwelling. During El Niño events, the thermocline is deepened, the upwelling process is disrupted and primary productivity is reduced. We tested the hypothesis that the implications of decreased primary productivity during El Niño events reach the trophic level of marine mammals, evidenced by increased strandings, through the analysis of records of marine mammal strandings along the Central California coast collected by the Long Marine Lab Marine Mammal Stranding Network and The Marine Mammal Center. In stranding records collected from 1975-2013 across 11 El Niño events, the number of pinniped strandings were significantly higher during El Niño events than in normal conditions or La Niña events ($p=0.0009$). In contrast, the number of cetacean strandings could not be correlated with El Niño events using stranding network data ($p=0.1104$), suggesting that pinnipeds are more likely to strand than cetaceans during El Niño events, possibly due to their nearshore distributions. As marine mammals are sentinel species, these trends provide insight into changes in habitat utilization of marine predators off the Central California coast when prey availability and distribution are modified. This work also highlights the importance of long-term, consistent data collection by local chapters of the National Marine Mammal Stranding Network because such datasets are required to begin to understand complex mechanisms linking oceanographic conditions and population trends in marine predators.

Rhodes, Julianne

California State University Monterey Bay

EVALUATION OF JUVENILE STEELHEAD HABITAT IN THE CARMEL RIVER LAGOON

The Carmel River Lagoon (CRL) provides key rearing habitat for juvenile steelhead (*Oncorhynchus mykiss*) prior to its migration into marine waters. Juvenile steelhead living in coastal lagoons have been found to have faster growth rates and larger size at ocean entry when compared to juveniles

reared further upstream within the freshwater reaches. The success of lagoon-reared salmon has been attributed to abundant food and the longer duration spent in the transition zone where fish can adjust to increasing salinity prior to migrating out to sea. The goal in this study was to examine the availability of good water quality habitat (GWQH) for juvenile steelhead within the CRL. Temperature, salinity, and dissolved oxygen water quality parameters were measured monthly from a kayak using a YSI Model 85 at 0.25 meter intervals from the surface to substrate at five sites. Using criteria established to represent GWQH for juvenile steelhead trout, data from January 2007 to April 2013 were evaluated. Sites N2 and R2, near the mouth of the lagoon, had GWQH 22.1% and 20.3%, respectively, during those years. Site S2 in the south arm of the lagoon had GWQH 13.5% of the time. Sites O1 and O4, located in a part of the lagoon that was excavated and restored in 2004, had GWQH 14.8% and 12.5%, respectively. Under current management practices, the CRL offered GWQH to juvenile steelhead an average of 16.4 % of the time.

Ridgway, Katie, and Lucy Stowe

Santa Catalina School, Monterey, CA

SPACE COMPETITION IN THE ROCKY INERTIDAL

Competition for space can affect organisms that live in the rocky intertidal. We studied the community composition of the rocky intertidal area of Asilomar state beach using the LiMPETS protocol. Here we present a heat map visualization of species by tide height using the R statistical programming environment. This facilitates recognition of spatial distribution patterns in a complex area. Along a vertical transect, common, acorn, and pink barnacles were found to be in relatively high densities with their predator, whelks. We find a negative correlation between mussels and barnacles. This is classically associated with competition and may explain the pattern we are seeing.

Rose, Hannelore
California State University Monterey Bay

GENETIC DIVERSTIY OF SOUTHERN CALIFORNIA RHODOLITHS

Foundation species influence ecosystem processes and increase biodiversity. Rhodoliths, a coralline algae, form large aggregations that support large numbers of associated fauna and flora. Species assemblages and diversity of associated communities vary with both rhodolith species and intra-specific morphologic variation. This characterization of the inter and intra-specific genetics of sample rhodolith species of southern California and Baja California Mexico will be analyzed by variation size at the cox2-cox3 spacer regions and the CO1 region. Genetic analysis revealed Catalina Island rhodoliths to be singular species, distinct from nearby population in the Gulf of California. CO1 reviled less genetic diversity than the COX2_3 regions. COX2_3 results were as expected and there was no large difference between the genetics of organisms of the same species from different sites. These genetic relationships will help provide insight into the effects of rhodolith species on associated fauna.

Sadrpour, Nick

California State University Monterey Bay

THE CALIFORNIA COASTAL COMMISSION, LIVING IN MY VAN DOWN BY THE OCEAN, AND WHAT I LEARNED

During the summer of 2013 I acted as the graduate student intern in the Technical Services Biology Division of the California Coastal Commission. My time with this state regulatory agency

opened my eyes to the depth of projects and vast jurisdiction covered within the coastal zone of California. One high profile project in Malibu, CA involved a proposal to allow an emergency revetment to exist permanently alongside a beach nourishment project. Another project focused around constructing artificial lights on a recreational playing field. These two widely different projects both fall under the jurisdiction of the California Coastal Commission and illustrate the broad landscape that comprises coastal resource issues in California.

Sampson, Sarah, Cori Hume, Tristin McHugh, Colin Gaylord, Hannah Perlkin, and Emily Tucker, Pete Raimondi, and Mark Carr

University of California at Santa Cruz

A RAPID ASSESEMENT OF SEA STAR POPULATIONS AFTER THE ONSET OF WASTING SYNDROME IN CALIFORNIA

Disturbances to an ecosystem generated by disease can cause a swift shift in community structure, particularly when the species affected is a keystone species. To understand the long-term ecosystem impacts of the disease, we must estimate both the magnitude and spatial patterns of the disturbance. By surveying in the field real-time with disease spread, we are able to capture details in time and space that would be missed by snapshots of before and after. Within months of the first report of sea star wasting on the Pacific Northwest coast, researchers from UC Santa Cruz and other institutions organized a rapid response to assess the intertidal and subtidal sea star populations. Field technicians performed observational surveys, recording the densities, distributions, and level of wasting for 10 different species of intertidal and subtidal sea stars. By sampling at previously established permanent PISCO sites, we will be able to estimate changes in density of each sea star species, which is an indication of disease at a particular site. These surveys will provide basic information regarding disease presence and severity in time and space. Using this information we can construct a map from which we can begin to search for patterns in disease spread and estimates for potential long-term effects.

Smith, JG (1), GT Waltz (2), CL Barnes (3), LA Needles (2), RM Starr (3), and DE Wendt (2)

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2) Center for Coastal Marine Sciences, California Polytechnic State University, San Luis Obispo
3) Moss Landing Marine Laboratories

THE RELATIONSHIP OF ENVIRONMENTAL CONDITIONS ON THE CATCH RATES OF NEARSHORE FISH SPECIES ALONG THE CENTRAL CALIFORNIA COAST

The California Collaborative Fisheries Research Program (CCFRP) has been monitoring Marine Protected Areas (MPAs) and adjacent non-protected areas using standardized hook-and-line fishing methods since 2007. One metric calculated from CCFRP data and used to assess fish stocks is the catch per unit effort (CPUE). CPUE is a standardized measure of a fisheries stock, and often used to estimate the fish density or abundance. Perception in the fishing community is that certain environmental conditions also affect CPUE. However, the science demonstrating these relationships has been relatively unexplored. Using a multiple linear regression analysis, we examined the effect of several environmental factors on the CPUE of recreational fish along the California Central Coast. Swell height and wind speed were found to have a significant negative relationship with CPUE. Sampling month and fishing location were also significantly related to CPUE. To complement this analysis, we created an angler survey to assess the perception of the fishing community between environmental conditions. The multiple regression and complementary angler survey serve the dual purpose of elucidating contributing factors to the variability of CPUE calculations and examining the validity of angler perceptions regarding the effect of two environmental conditions on catch rates.

Sogard, Sue (2), John Field (2), Ryan Fields (1)*, Sabrina Beyer (2), Corina Marks (1), Dan Howard (3), Dale Roberts (3), Deb Wilson-Vandenberg (4), and Richard Starr (4)

1) Moss Landing Marine Laboratories
2) NOAA's National Marine Fisheries Service
3) NOAA's Cordell Bank Marine Sanctuary
4) California Department of Fish and Wildlife
*Presenting

PRELIMINARY ASSESSMENT OF THE RESPONSES OF ROCKFISH POPULATIONS TO ROCKFISH CONSERVATION AREAS IN CENTRAL CALIFORNIA

Between 1987 and 1998, the California Department of Fish and Game (CDFG) sampled 2267 sport fishing trips and recorded data on species compositions, size and catch rates for nearly 300,000 fishes. In 2001, seven rockfish species (Bocaccio, Canary Rockfish, Cowcod, Darkblotched Rockfish, Pacific Ocean Perch, Widow Rockfish and Yelloweye Rockfish) were declared overfished, leading to the creation of fishery closures in the form of Rockfish Conservation Areas (RCAs) in 2002. In an effort to assess how the RCAs have affected rockfish populations along Central California in the 11 years since they were implemented, particularly in the relatively shallower regions of the RCAs previously frequented by recreational fisheries, a collaborative fishing project was started by the National Marine Fisheries Service (NMFS) and the Fisheries and Conservation Biology Lab at Moss Landing Marine Laboratories. Our objective is to compare estimates of species composition, density, and mean lengths of fishes before and after the RCAs were established. With the help of local captains and volunteer anglers, 23 standardized hook and line fishing surveys have been conducted since October 2012. Over 5000 fishes have been caught from our three sample areas: Half Moon Bay, the Farallon Islands, and Cordell Banks. Here, we present preliminary findings on species composition, catch rates, and size frequency from sample sites inside and outside the closed areas. Future analysis will compare current fishing data with the historical data set collected by CDFG.

Srednick, Griffin S, and Corey D Garza

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A LATITUDINAL EXAMINATION OF *METACARCINUS MAGISTER* (DUNGENESS CRAB) MEGALOPAE RECRUITMENT THROUGH ABIOTIC FACTOR ANALYSIS ON THE CENTRAL CALIFORNIA COAST

The impact variation in larval recruitment has on marine populations can enhance our basic understanding of how populations are regulated and in turn can be used to inform the management of ecologically important marine species. In this study an analysis of megalopae landings was conducted at Moss Landing, California beginning in early March 2013, to assess if variation in larval *Metacarcinus magister* could relate to variation in environmental variables. Light traps were used to collect crab megalopae daily within Moss Landing harbor to examine expected fluctuations in recruitment numbers. Mean Low or Low Water height and time and average daily temperature were collected and used to test for possible associations with megalopae abundance. Fluctuations in megalopae-settler ratio were observed from early March through June as consistent with M. magister larval cycle. Similar studies were conducted at two other California sites: Bodega Bay, and Eureka. Mean megalopae abundance varied between sites, increasing by latitude. A chi-square analysis of mean lower low water (MLLW) with temperature on megalopae abundance was generated and used to model possible abiotic influence on megalopae abundance. This model suggests that MLLW-Temperature interactions are an effective predictor for *M. magister* megalopae abundance and provides researchers a baseline assessment of abiotic influence on nearshore migration of *M. magister* megalopae. Results will be used by the California Department

of Fish and Wildlife to assess latitudinal variations in recruitment and to inform *M. magister* fishery management for the 2013/14 season.

Takata, M (1), S Jorgensen (2), P Kanive (3), T Chapple (4), B Block (4), S Anderson (5), and L Groth (6)

1) California State University Monterey Bay
2) Monterey Bay Aquarium
3) Montana State University
4) Stanford University
5) Point Reyes National Seashore
6) White Shark Adventures

ARE WE CONNECTED? THE LINK BETWEEN WHITE SHARK GROUPS IN THE NORTHEASTERN PACIFIC

White sharks (*Carcharodon carcharias)* comprise a single genetically distinct population in the Northeastern Pacific (NEP). Within the NEP there is limited knowledge about the connectivity between Central California and the Guadalupe Island (Mexico) groups of adult white sharks. Previous studies have documented only a single adult moving between Central California and Guadalupe Island. However, this study relied on acoustic or satellite tags which have a limited effective life span of 2 to 4 years and may underestimate the degree of connectivity. Past studies have validated dorsal fin morphology as an effective identification method for upwards of 26 years. Using an 11 year historic video data set ranging from 2000 to 2011 we are visually identifying individuals to determine connectivity over extended time periods. Our preliminary results point to a more connected population within the NEP than previously thought. A higher level of exchange between these groups would need to be accounted for in population estimates at each site, and would mean that white shark management would need to involve a joint international effort between the United States and Mexico.

Tobosa, Lauren (1), Giacomo Bernardi (2), Will Fennie (3), Scott Hamilton (3), and Cheryl Logan (1)

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2) University of California at Santa Cruz
3) Moss Landing Marine Laboratories

OCEAN ACIDIFICATION EFFECTS ON METABOLIC GENE EXPRESSION IN JUVENILE ROCKFISH

Adverse effects of ocean acidification (OA) add to the growing list of anthropogenic disturbances already affecting exploited fish stocks. Comparing gene expression in vulnerable versus tolerant species exposed to high pCO_2 conditions can elucidate physiological traits responsible for future ecological success in the ocean. We compare transcriptomes of OA-tolerant juvenile blue rockfishes (*Sebastes mystinus*) with less OA-tolerant juvenile copper rockfish (*S. caurinus*) after chronic exposure to four pH conditions (7.2, 7.5, 7.8, 8.0), representing a range of predicted future ocean pH values. Previous work showed that juvenile copper rockfishes exposed to low pH had significantly lower critical swimming speeds and narrower aerobic scopes as compared with controls, whereas blue rockfishes were not affected by low pH. Based on these findings, we hypothesized that copper rockfish will show differential expression of genes underlying a shift from aerobic to anaerobic metabolism under low pH, perhaps due to reduced oxygen affinity of respiratory pigments. Total RNA was extracted from muscle tissue and cDNA libraries were prepared and sequenced using Illumina RNA-Seq. We present a preliminary *de novo* transcriptome for rockfish, which will be used for differential gene expression analysis of metabolic

genes among the four pH treatments. Our study is the first to use high-throughput sequencing to examine gene expression profiles of OA-tolerant vs. intolerant rockfishes, providing important information about sub-lethal changes associated with OA resistance in temperate fishes.

Villalobos, Cristina (1), and Jamie Pierson (2)

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2) Center for Environmental Science, University of Maryland

HYPOXIC IMPACTS ON EGG RESPIRATION RATES OF THE COPEPOD *ACARTIA TONSA*

Eutrophication in the Chesapeake Bay has led to extensive areas of hypoxia (< 2mg O_2 L^{-1}) in the past half-century. The copepod, *Acartia tonsa,* serves as a valuable prey item to higher trophic levels in the Chesapeake Bay, but hypoxia reduces *A. tonsa's* reproductive success. This study investigates one potential physiological mechanism for this negative effect by examining if hypoxia lowers *A. tonsa* egg respiration rates. Egg respiration rates were measured in hypoxic (< 2mg O_2 L^{-1}) and fully oxygenated (>5.99mg O_2 L^{-1}) water. Egg respiration was measured in two-hour intervals for a total of eight hours using a Pro2030 Professional Series YSI probe. We expected lowered egg respiration rate in hypoxic conditions. Results showed that egg respiration is higher in fully oxygenated rather than hypoxic conditions. The results suggest that lowered respiration in hypoxic water can contribute to decreases in *A. tonsa* egg production, sinking rates, and ultimately egg hatching success.

Whitney, Samantha K, Lauren R Boye, Joshua D Ambrose, James C McClure, and Steven W Moore

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TRASH TRANSPORT IN THE CARMEL SUBMARINE CANYON

Previous studies of the Monterey Submarine Canyon suggest that ocean canyons can transport trash away from shore into deeper waters. We investigated whether this process also occurs in the smaller Carmel Submarine Canyon. We deployed a custom made ROV (Remotely Operated Vehicle) from a small boat off of Monastery Beach and surveyed the canyon bottom (thalweg) and surrounding areas from near the beach to a depth of 150 meters (500 feet). We recorded high-definition (1080p) video with a GoPro Hero camera mounted on the ROV and analyzed the video to characterize trash found. For each piece of trash, we recorded the debris type, size, location, material, probable source, and any associated marine life. Examples of trash we found included a dive mask and a golf ball. The dive mask was likely lost in the surf zone, which is notorious for stripping gear off divers at this particular beach. We found it on the bottom of the canyon, roughly 0.5 km from shore at a depth of 110 m (360 feet). This is far deeper than recreational scuba depths, suggesting the mask was transported down the canyon from closer to shore. Some trash we found provided solid structure in an otherwise soft-sediment bottom. Such structure can provide attachment points for sessile marine life (e.g., anemones) and/or hiding places for predators or prey (e.g., there was an octopus inhabiting the dive mask). Thus, transport of trash down canyons may be modifying deep sea habitats in ecologically significant ways.

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THE VALUE OF HABITAT DIVERSITY IN MARINE RESERVES: SPINY LOBSTERS USE OF THE INTERTIDAL ZONE AT THE SANTA CATALINA ISLAND MPA

Marine Protected Areas are a relatively new approach to managing exploited marine species. However, in order for MPAs to be effective, a diversity of habitats that incorporate all necessary ecosystem services for targeted species must be included in their design. The Southern California spiny lobster (*Panulirus interruptus*) is an exploited species for which MPAs have been designed. Previous work suggests this species forages within the intertidal zone during high tide; however the relative importance of this habitat in the early design of MPAs was not considered. As part of a study to test the efficacy of a longstanding MPA on Catalina Island, California, surveys recording abundance, size, and gender were conducted along transects within and without an MPA at high tide. Intertidal habitat composition was also assessed. We hypothesized that lobster demographics were higher in the MPA as well as higher in the intertidal zone relative to the subtidal. Preliminary results suggest current demographic parameters are higher outside of the reserve due to more suitable intertidal habitat.

Young, Mary A

University of California at Santa Cruz

USING SPECIES DISTRIBUTION MODELS TO EVALUATE THE PLACEMENT OF CALIFORNIA MARINE PROTECTED AREAS

With the implementation of spatially explicit policies to protect marine ecosystems, there is a need to acquire reliable spatial information on species distributions. California has rapidly established a state-wide network of marine protected areas and the development of species distribution models (SDMs) can be utilized to help evaluate the placement and efficacy of these MPAs. In this study, I focus on the Central Coast region of California and combine maps of the seafloor with spatially-explicit ecological observation data to create species-habitat relationships to inform SDMs and advance the understanding of ecosystems further than what is achievable through the use of *in situ* data alone. Using generalized additive models, I developed species-habitat relationships for the densities of seven species of ecologically and economically important fish using SCUBA-based biological observation data collected by one of the MPA monitoring organizations (PISCO). I related these observations to a variety of seafloor variables derived from the multibeam bathymetry (rugosity, slope, TPI, and depth) and kelp biomass values derived from LANDSAT imagery. All variables had varying importance in predicting the species distributions, however, complexity and kelp biomass were consistently the most important predictors. Once the best models were chosen using AIC, these species-habitat associations were extrapolated over the study area to evaluate the distributions of species inside and outside the MPAs. This study helps to further our understanding of how the variation in habitat affects the distribution of species and evaluate the effectiveness of the MPAs that were put in place to protect these species.

HOW DO YOU PITCH IN?

Your Community – 365 days a year

Small steps lead to big results. Solving the marine debris problem begins at home.

- Reduce, reuse, and recycle the trash you produce at home, work, and school.
- Opt for products using the least amount of packaging.
- Opt for reusable items instead of single-use products, such as reusable shopping bags, water bottles, and coffee mugs.
- Up-cycle products destined for trash, such as yogurt containers for snacks.
- Opt-out of extra napkins, straws, lids, and other add-ons with carry-out foods.
- Purchase products made from recycled or compostable materials.
- Keep cigarette butts off streets and beaches.
- Join local efforts to pick up trash.
- Keep streets, sidewalks, parking lots, and storm drains free of trash—they empty into our oceans and waterways.
- Share this program with your colleagues, friends, and family.
- Volunteer with an organization addressing marine debris.

List adapted from "Ten Things You Should Know About Marine Debris"
http://oceanservice.noaa.gov/hazards/marinedebris

For more information on NOAA's Marine Debris Program, see:
http://marinedebris.noaa.gov

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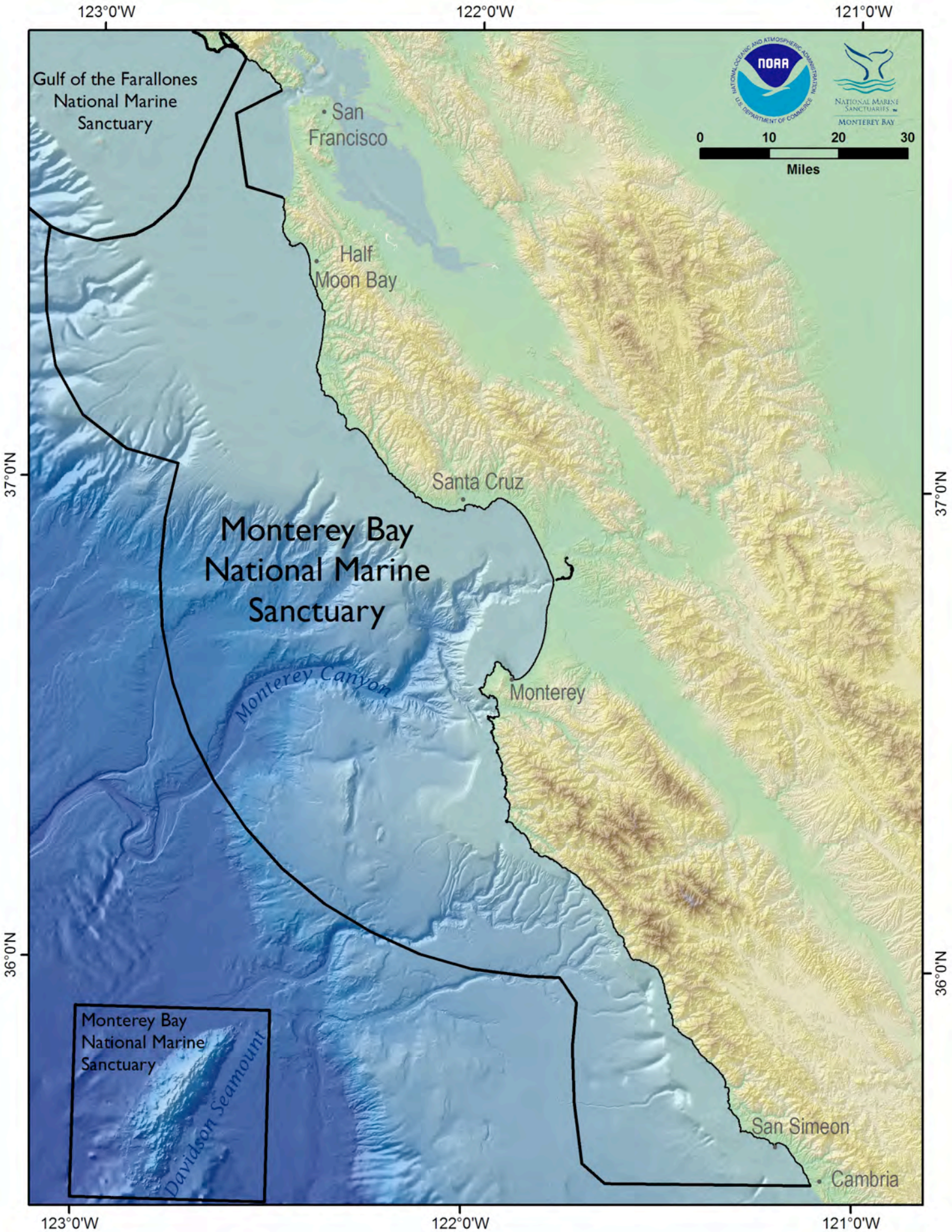
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