



DEEPER UNDERSTANDING

ECOLOGICAL RESEARCH IN PROGRESS

2016

In Oregon, marine reserves are areas in coastal waters dedicated to conservation and scientific research. Our scientific research includes studying both the ecology and the human dimensions of the reserves. Our ecological research, conducted during these early stages of marine reserve implementation, is to learn about Oregon's nearshore ocean environment and the effects that protections — no fishing and no ocean development — have over time on marine communities. Our current research efforts and partnerships are focused in three main areas:

- **Long-term monitoring of marine communities.** We monitor fish, invertebrate, and macroalgal communities from the shores of the intertidal zone to deep rocky reefs (<40m).
- **Methodology development.** We build upon advances in sampling technology and gear to design robust and contemporary survey tools that will function well in Oregon's challenging nearshore environment.
- **Nearshore research.** We support research that expands our understanding of Oregon's nearshore environment and can influence how we manage our marine resources within state waters.

This three pronged approach to ecological research ensures we establish valuable long-term datasets in the reserves, using the best available methodologies, while also pushing the boundaries of our understanding of the nearshore environment. Over time, with these three approaches we will gain a better understanding of each of Oregon's five marine reserve sites and have data and information that helps inform nearshore management at large.

A COLLABORATIVE APPROACH TO RESEARCH

We are working in collaboration with a variety of research partners to study the community ecology of Oregon's marine reserves. Our research partners provide advice, lend different expertise, and help us expand our monitoring program. Partners include marine scientists at universities, agencies, and in the private sector.

Marine reserves are a relatively new management tool in Oregon. Based on what we are learning, our scientific research will evolve and be adapted over time to produce the best possible data. We will continue to ask questions about the ability of our research tools to generate robust, valid, and unbiased data about the ecology of marine reserves implementation and new research studies will be added over time. Our goal is to constantly seek to improve our scientific research based on the best-available science.

RESEARCH CATEGORIES AND CURRENT STUDIES

Our Ecological Research is focused in three general categories (A-C). We conduct a variety of different studies in each of these categories to help us paint different aspects of the picture for each marine reserve site.

The sections that follow provide a brief description of the three general research categories (A-C) and the 17 ecological studies that are currently in process or planned, as of 2016.

A

LONG-TERM MONITORING

Long-term monitoring efforts focus on the nearshore fish, mobile invertebrate, and macroalgal communities inhabit rocky reef habitats in Oregon. These monitoring approaches and the datasets they generate set the “back story” for our marine nearshore communities and provide context to help us understand the reserve effects we might observe over time within Oregon’s system of marine reserves. The long-term datasets being generated by the tools listed below are led by a variety of experts, from within ODFW and from research universities along the west coast.

1

FISHERY-INDEPENDENT HOOK-AND-LINE

This study collects fish data through the help of volunteer anglers aboard chartered fishing boats. We divide the study area into 500m x 500m grid cells. Local fishing knowledge helps ensure grid cells are placed in locations where fish are commonly caught in rocky habitats. On a survey day, five cells are randomly selected and volunteer anglers fish using standardized gear for a fixed amount of time. All fish caught by the volunteers are measured and released. Hook-and-line surveys enable us to have fish in hand to take accurate length measurements. We will look at differences in average fish length before and after the reserve is closed to fishing, both inside the reserve and outside in the comparison areas (monitoring sites open to fishing). By sampling over time, we can determine whether fish sizes as well as catch rates (catch per unit effort) are changing due to cessation of fishing.

Status: Ongoing
Researchers: ODFW



2

REMOTELY OPERATED VEHICLE (ROV)

The remotely operated vehicle (ROV) is our most complex video tool. It is driven by an operator from a boat, controlled via an umbilical cable. The ROV can swim up, down, and around obstacles and follow along a transect line, like a SCUBA diver. The ROV is ideal for surveying rocky habitats all the way out to the deepest parts of the reserves, beyond safe SCUBA diving depths. The high-definition video is later analyzed for fish, invertebrates, and habitat type. We measure the abundance of select invertebrates and fish species. Stereo video capacity has recently been added to the ROV to allow estimations of fish size. Biogenic habitat such as macroalgae, sponges, deep water corals, and gorgonians are quantified as living habitat that may play a role in structuring the observed fish community.



Status: Ongoing
Researchers: ODFW

3 SUDTIDAL ROCKY REEF SCUBA

We use diver based methods to identify and count macroalgal, invertebrate, and fish communities. SCUBA divers conduct surveys in rocky reef habitats at depths between 10- 20m, working in pairs for safety. SCUBA divers survey a 60m² belt transect counting observed organisms and noting the type of habitat and topographic relief of the substrate encountered. Invertebrate and macroalgal surveys occur along the bottom only. Fish transects occur both along the bottom and mid-way up in the water column. In addition to fish counts by species, each individual's size is estimated to the nearest cm. These methods are based on those developed by the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) and are currently being used to survey subtidal communities in California's marine reserves.

Status: Ongoing
Researchers: ODFW, PISCO, Oregon State University (OSU), Oregon Coast Aquarium



4 VIDEO LANDER

The video lander is a stationary, underwater camera system used in rocky habitats. The video lander is deployed for approximately eight minutes of video collection at a time. We then review the high-definition video to estimate relative abundance for target invertebrates and fishes species. The habitat characteristics, which include the depth, geologic substrate, topographic relief, and biogenic habitat, are recorded. The lander can be deployed across a wide range of depths. The affordable lander design and ability to use several landers simultaneously to survey an area, make this tool a cost-effective way to generate large amounts of video data over time as part of a long-term monitoring program. Currently, we are developing stereo-video capacity to the lander fleet to enable estimation of individual fish sizes during video review.

Status: Ongoing
Researchers: ODFW



5 ROCKY INTERTIDAL LONG-TERM BIODIVERSITY

ODFW has partnered with the two largest rocky intertidal monitoring programs on the west coast - PISCO and Multi-Agency Rocky Intertidal Network (MARINe). These programs have long-term data sets that in some cases span more than 20 years. These groups monitor community structure of target assemblages, as well as quantify abundances and sizes of key species. They also record biodiversity hotspots, species - habitat associations, invertebrate larval recruitment, and the effect of oceanographic factors on intertidal communities. With this baseline data, these scientists may be able to detect changes in intertidal areas associated with marine reserves or other stressors impacting Oregon's intertidal communities.

Status: Ongoing
Researchers: Bruce Menge, PISCO, Oregon State University
Pete Raimondi, MARINe, University of California, Santa Cruz



6

SEA STAR WASTING

This is a regional effort to survey the sea star populations in Oregon’s intertidal habitats. Efforts led by OSU and The Nature Conservancy observe prevalence of disease on ochre sea stars and track recruitment of juvenile stars into the intertidal. These continuous monitoring efforts help researchers up and down the west coast document the impacts and potential recovery from sea star wasting disease.

Status: Ongoing

Researchers: ODFW

Bruce Menge, PISCO, Oregon State University

Dick vander Shaff, The Nature Conservancy



The Nature Conservancy
Protecting nature. Promoting life.



7

STANDARD MONITORING UNIT FOR THE RECRUITMENT OF FISHES (SMURFS)

To maximize marine reserve conservation benefits, it is important to protect both juvenile and adult habitats from extractive activity. In 2013, ODFW began a partnership with Dr. Kirsten Grorud-Colvert at Oregon State University (OSU) in an ongoing study to quantify abundance and diversity of pelagic juvenile fishes settling into the nearshore habitats. SMURF (Standard Monitoring Units for the Recruitment of Fishes) devices attached to moorings are currently in use in two marine reserves to sample these juvenile fishes. While monitoring fish settlement is still in its infancy along the Oregon coast, eventually this information can be used to inform managers how to best design, place, and manage these reserves into the future.

Status: Ongoing

Researchers: ODFW, OSU, Oregon Coast Aquarium



B

METHODOLOGY DEVELOPMENT

The marine reserve effort in Oregon is built upon a foundation of adaptive management. Applying this framework to our ecological monitoring efforts allows us to improve, refine, and adapt our existing monitoring methods to produce the best possible data. Our goal is to constantly seek to improve our monitoring methods based on the best-available science. This section highlights current efforts underway to improve our monitoring tools.

8

MINI-LANDER DEVELOPMENT

Rocky reefs in the temperate Northeast Pacific constitute a small portion of the nearshore seabed, yet are highly valued as productive habitat for local fisheries. In this method development study, a cost-effective, compact video lander (“mini-lander”) was evaluated for its ability to survey the diversity and abundance of nearshore (<40 m), rocky reef-associated fish populations. This study sought to: (1) determine the frequency of observation of known nearshore fish species, (2) evaluate the influence of baiting the lander on the observed fish assemblage, (3) identify the optimal deployment time to maximize observed species richness and abundance, and (4) evaluate species-specific behavioral responses to the lander characterized a priori as attractive, avoidance, or neutral. The method observed 15 species belonging to 5 families. Contrary to lander studies in other regions, bait was not found to improve species-specific identification, increase observed species richness or

abundance (at the species or feeding guild level), or shorten deployment duration. A deployment time of 8 min on the benthos was determined as optimal for observing maximum species richness and abundance in the nearshore, doubling the previously described lander drop durations evaluated in deeper Oregon waters. Species-specific attractive or avoidance behavioral responses to this compact lander were not observed. Results confirm that this simple, cost-effective video lander configuration is suitable for sampling the suite of fish species found in the nearshore.

Status: Completed
Researchers: ODFW

9 LANDER STEREO DEVELOPMENT

The Marine Reserve Program has been using underwater video landers (i.e. stationary drop cameras) to collect ecological data on the nearshore fish communities within the reserves. This project will develop and test the addition of stereo-video camera capabilities to the video lander. We propose two specific objectives: (1) develop and calibrate the stereo-video camera system to be deployed on a stationary lander platform; and (2) contribute estimates of fish density and fish size to baseline datasets currently being generated for Oregon's marine reserves. Stereo-cameras have the potential to enhance the performance of video landers by adding capacity to not only size observed fish but also potentially define the area surveyed to determine fish densities.

Status: Ongoing; anticipated completion: June 2017
Researchers: ODFW

10 SCUBA STEREO DEVELOPMENT

The Marine Reserve Program has been using diver-based underwater visual census (UVC) methods to collect ecological data on the nearshore fish communities within the reserves. This project will develop and test the addition of stereo-video camera capabilities to UVC surveys to enable fish sizes to be estimated. We propose three specific objectives: (1) develop and calibrate the stereo-video camera system to be deployed on a SCUBA diver UVC platform; (2) compare accuracy of fish lengths estimated from a stereo-video SCUBA platform to estimates produced by trained scientific SCUBA divers recording size in situ; and (3) develop best-practice methods for incorporating stereo-video techniques into UVC methods used in Oregon's marine reserves. Stereo-cameras have the potential to increase the accuracy of fish length estimates produced by SCUBA divers (compared to currently used diver-based in situ estimates) thereby improving the quality of data generated by this long-term monitoring tool.

Status: Ongoing; anticipated completion: June 2017
Researchers: ODFW

11 FISHERY-INDEPENDENT LONGLINE SURVEYS

While in the early stages of establishing robust, long-term monitoring protocols for evaluating fish communities in Oregon's system of marine reserves, ODFW's Marine Reserve Program is experimenting with alternative fishery-independent methods tailored to each specific reserve site. Here, a longline pilot study was conducted concurrently with the ongoing hook-and-line survey in an attempt to increase the catch of the species of interest

(e.g. rockfishes such as quillback, copper, china, and vermillion), that are valued in the local fishery surrounding Redfish Rocks Marine Reserve. Our objectives were threefold. First, we sought to document gear selectivity to catch target species. Second, we wanted to compare the observed species richness, catch rate (i.e. CPUE), and size distributions for fish species among the sampling approaches. Finally, we sought to compare the cost-benefit of each approach including survey costs, workforce needed, and prevalence of body injury and mortality on fishes induced by the different sampling approaches.

Status: Completed; recommend this combined approach continues at Redfish Rocks
Researchers: ODFW

12 TRIFECTA

Methods of underwater visual censuses (UVC), stationary lander (MaxN) and catch-per-unit-effort (CPUE) are commonly used to estimate abundance of fish communities. While each method is subject to certain biases, in theory they should produce related measures of fish abundance for a specific site at a given point in time. The Trifecta study aims to compare and contrast the metrics characterizing the fish community using 3 different sampling methods: unbaited video lander, SCUBA UVC, and fishery-independent Hook-and-Line. The Marine Reserve Program has been using these tools to monitor and assess Oregon's marine reserves therefore there is a practical need for this information and identify how to maximize the efficiency of each tool to answer the management questions.

Status: Ongoing; anticipated completion: Winter 2016
Researchers: ODFW

13 OPINION PIECE: REALITIES ON MARINE RESERVE IMPLEMENTATION & ASSESSMENT

This effort is a collaborative exploration into the realities of marine reserve implementation, management, and assessment that may often go overlooked in academia or reserve planning. Our goal is to submit a short perspectives/opinion type article for peer-review on the topic of the real-world challenges of evaluating MPA performance using the recommended framework of a Before-After-Control-Impact study design.

Status: Ongoing; anticipated completion: Winter 2017
Researchers: ODFW, PISCO, OSU



C

NEARSHORE RESEARCH

To assist in management of the marine reserves, we seek to understand more about the wider nearshore environment beyond the reserve boundaries.

14 LINGCOD BIOMARKER STUDY

The project goal for this research is to conduct limited fatty acid and isotopic biomarker analysis of targeted fish species for trophic inferences. This method can be used instead of, or in conjunction with, stomach content analysis in fish. These biomarkers can also be used for indicating relative trophic position and physiological 'condition' of fish, particularly because certain essential fatty acids are strong predictors of larval fish



fitness. One of the most powerful applications of isotope and fatty acid biomarkers are in comparative analysis of signatures of conspecifics living in differing habitats or experiencing different management regimes, including marine reserves, to ask whether diets specifically or trophic relationships more generally differ among study areas. This approach will allow us to test the hypothesis that the observed size differences in lingcod (Hexagrammidae) collected in the reserve and in the reference area are a result of trophic/feeding differences. For example, it is possible that lingcod in the reserve are larger because they are eating different and “better” diets (as a result of the reserve). Kelp greenling, also from Hexagrammidae family, will be sampled as a control. This study is a collaboration between ODFW and Dr. Aaron Galloway at the Oregon Institute of Marine Biology, University of Oregon.

Status: Ongoing
Researchers: ODFW, University of Oregon

15 HARBOR SEAL FORAGING STUDY

Sheanna Steingass is a PhD Student at Oregon State University studying the ecology of Pacific harbor seals on the Oregon coast. She is utilizing tracking data to understand habitat utilization, and also conducting studies of dietary composition for harbor seals using stable isotopes. Her research aims to understand the ecological roles of seals inside of and outside of marine reserves in Oregon.

This study is a collaboration between ODFW and Shae Steingass at OSU.

Status: Ongoing
Researchers: OSU



16 TELEMETRY STUDY OF NEARSHORE ROCKFISH IN REDFISH ROCKS MARINE RESERVE

The boundaries of the Redfish Rocks Marine Reserve and Marine Protected Area were established through a participatory community led process, but no study of the movement patterns or home range of the populations of commercially important species was conducted for the site prior to boundary designation. Given the relatively small size of the protected area, it is important to accurately determine the movement behavior of local fish populations in relation to the established reserve boundaries in order to effectively manage the site for these species. This acoustic telemetry study was designed to inform the adaptive management of the marine reserve by revealing details of movement behaviors of adult fish targeted for protection (such as China, Quillback, and Copper Rockfish) and to elucidate our understanding of near shore marine ecology by revealing details of rockfish habitat associations. Between 2011 and 2013, an array of stationary hydrophones was deployed at Redfish Rocks to track the movements of thirty fish tagged with acoustic transmitters.

Acoustic telemetry data are now being analyzed to reveal the movement patterns of the tagged fish in collaboration with ODFW Marine Reserve Program staff.

This study is a collaboration between ODFW and researchers Dr. Scott Heppell and Tom Calvanese at OSU.

Status: Ongoing
Researchers: ODFW, OSU



NEROCYSTIS GENETICS

Kelp forests along the Pacific coast of North America are dominated by one or a combination of three canopy-forming kelp species: *Macrocystis pyrifera*, *Eualaria fistulosa*, and *Nereocystis luetkeana*. Of these three the bull kelp, *Nereocystis luetkeana*, has the largest geographic range in North America. Despite its vast geographic range and important role in coastal ecosystems, *Nereocystis luetkeana* has not been as widely studied as its globally distributed sister kelp, *Macrocystis pyrifera*, because of its poor potential as a sustainably harvestable kelp. For example, the frequency and scale of dispersal in *Nereocystis* is unknown, but it is known that it can occur during one of three points in its life history: as spores, as intact sporophytes, or as detached sori. There are also absolutely no published studies of the population genetic structure in *Nereocystis*. Oregon Marine Reserves Program is collaborating with graduate student Robert San-Miguel to understand the population genetic structure across *Nereocystis*' entire geographic range by contributing samples from three sites along the Oregon coast.

Status: Ongoing;

Researchers: ODFW, University of Wisconsin-Milwaukee

