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OREGON'S GROUNDFISH INVESTIGATIONS IN 2021

Marine Resources Program
Oregon Department of Fish and Wildlife

2040 SE Marine Science Drive
Newport, OR 97365
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OREGON DEPARTMENT OF FISH AND WILDLIFE
2021 TSC AGENCY REPORT

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Agency Overview

MRP Program Manager:	*Dr. Caren Braby*
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The Oregon Department of Fish and Wildlife's Marine Resources Program (MRP) is responsible for assessing, monitoring, and managing Oregon's marine habitat, biological resources, and fisheries. The MRP's main office is located at the Hatfield Marine Science Center in Newport, OR and includes two additional offices in Newport. There are also field stations in Astoria, Charleston, Brookings, and Corvallis. The MRP has primary jurisdiction over fisheries in state waters (from shore to three miles seaward) and participates in regional and international fishery management bodies including the Pacific Fishery Management Council, the International Pacific Halibut Commission, and the North Pacific Fishery Management Council. Management strategies developed at all levels affect Oregon fish and shellfish stocks, fisheries, resource users, and coastal communities. Staffing consists of approximately 60 permanent and more than 60 seasonal or temporary positions. The current annual program budget is approximately $9 million, with about 76% coming from state funds including sport license fees, commercial fish license and landing fees, and a small amount of state general fund. Grants from federal agencies and non-profit organizations account for approximately 24% of the annual program budget. Funding levels have been relatively stable over recent years.

ODFW staff place rockfish with barotrauma in a recompression cage during an at-sea survey.

Contents

Surveys

Recreational Fisheries Monitoring and Sampling

Sampling of the ocean boat sport fishery by MRP's Ocean Recreational Boat Survey (ORBS) continued in 2021, with limited issues relating to the ongoing global COVID-19 pandemic. A combination of ongoing hiring and employment issues related to the pandemic and the lack of affordable housing on the coast lead to several ports being staffed for shorter time periods than in previous years. Starting in November 2005, major ports were sampled year-round and minor ports for peak summer-fall season. We continue to estimate catch during un-sampled time periods in minor ports based on the relationship of effort and catch relative to major ports observed during summer-fall periods when all ports are sampled. Lingcod (*Ophiodon elongatus*), multiple rockfish species (*Sebastes* spp.), Cabezon (*Scorpaenichthys marmoratus*) and Kelp Greenling (*Hexagrammos decagrammus*) are the most commonly landed species.

The ORBS program continued collecting information on species composition of landed groundfish species at Oregon coastal ports during 2021. Fish lengths and weights were collected again in 2021; however, sampling was slightly limited as there were times for safety reasons (COVID-19) that samplers had the ability to opt out of collecting samples. Since 2003, as part of a related marine fish ageing research project, lingcod fin rays and otoliths from several species of nearshore groundfish, including rockfish species, Kelp Greenling and Cabezon, were gathered, with some modifications in 2021 due to COVID safety protocols. Starting in 2001, a portion of sport charter vessels were sampled using ride-along observers for species composition, discard rates and sizes, location, depth and catch per angler; however, that sampling was suspended in 2020 and 2021 due to COVID safety protocols. This sampling program is anticipated to restart in spring 2022. Beginning in 2003, the recreational harvest of multiple groundfish species is monitored inseason for catch limit tracking purposes.

Other ODFW management activities in 2021 include participation in the U.S. West Coast Recreational Fish International Network (RecFIN) process, data analysis, public outreach and education, and public input processes to discuss changes to the management of groundfish and Pacific Halibut fisheries for 2022.

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Commercial Fisheries Monitoring and Sampling

Commercial fisheries monitoring data from commercial groundfish landings are collected throughout the year and analyzed by ODFW to provide current information on groundfish fisheries and the status of the stocks off Oregon's coast. This information contributes to fisheries management decisions, stock assessments, in-season adjustments to nearshore fisheries, and economic analyses.

Commercial fishery data, including logbooks, fish tickets, and biological data, are uploaded to the Pacific Fisheries Information Network (PacFIN) on a regular basis and are used for inseason monitoring and as a primary commercial data source for federal stock assessment. In 2021, preparations continued to add fixed gear fishery logbooks to the PacFIN clearinghouse. Species composition sampling of rockfish and biological sampling of commercially landed groundfish continued in 2021 for commercial trawl, fixed gear, and hook and line landings. The majority of the landings were monitored at the ports of Astoria, Newport, Charleston, Port Orford and Brookings, with additional sampling occurring routinely at Garibaldi, Pacific City, Depoe Bay, Bandon, and Gold Beach. Biological data including length, weight, age (from collected age structures: otoliths, vertebrae, and fin rays), sex, and maturational status continued to be collected from landings of major commercial groundfish species. All sampling in 2021 was conducted following ODFW-prescribed COVID-19 safety protocols. While the commercial groundfish sampling rate decreased in 2021 because of the need to avoid fish plants with active COVID-19 outbreaks, adequate sampling of all sectors was accomplished.

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Marine Reserves

The ODFW Marine Reserves Program is responsible for overseeing the management and scientific monitoring of Oregon's five marine reserve sites. These sites, from north to south, include: Cape Falcon, Cascade Head, Otter Rock, Cape Perpetua and Redfish Rocks. Reserves are a combination of marine reserves (no fishing) and marine protected areas (some types of fishing activities allowed), as determined by public process. Each reserve has distinct habitat and biological characteristics, and as such, requires site-specific monitoring and research planning. This section presents an update on management and ecological monitoring and research activities from 2021. More information is available on the Oregon Marine Reserves website at http://oregonmarinereserves.com/

Management

Marine Reserves Program Synthesis Report: 2009 - 2021

The ODFW Marine Reserves Program recently completed the *Marine Reserves Program Synthesis Report: 2009-2021* providing a comprehensive overview of the first 10 years of marine reserves implementation in Oregon.

Never Before in Oregon

Implementation of Oregon's marine reserve system is the first long-term nearshore ocean conservation and monitoring program executed by the state. It is the only ecosystem-focused, fisheries-independent monitoring program designed to track and understand ocean changes occurring in Oregon's state waters. It also is the first comprehensive human dimensions research program focused on examining economic, social, and cultural dynamics of the

Oregon coast and coastal communities in relation to marine resources. Beyond Oregon, it is one of the most comprehensive human dimensions research programs ever focused on Marine Protected Areas (MPAs).

An Important Check-in

This report serves as an important check-in on the development and execution of this relatively new nearshore conservation and monitoring program. It gives Oregonians a chance to reflect on the accomplishments, challenges, lessons learned, and contributions since the program's inception. This information can be used to inform adaptive management of the program and serves as a valuable case study for use by other MPA and long-term monitoring programs.

In the report you'll find:

- How our program has implemented the marine reserve legislative mandates including: ecological monitoring, human dimensions research, outreach, community engagement, management plans, and enforcement.
- Results and takeaways from ecological and human dimensions monitoring and research conducted by ODFW and our collaborators.
- The costs of marine reserve implementation, including what state staff and funding resources have been available and how ODFW has spent state resources.
- Challenges, lessons learned, and contributions made by the program.

Monitoring

Ecological monitoring includes sampling with core tools (ODFW-led) and through collaborative activities. Sampling was conducted both in the reserves and in comparison areas outside of the reserves still open to fishing. Despite the challenges of COVID-19, the marine reserve ecological monitoring team successfully conducted oceanographic and intertidal monitoring in 2021 at the following reserves:

- Cape Falcon Marine Reserve: Subtidal temperature, oxygen and salinity data were gathered in the reserve and its comparison area at Cape Meares.
- Cascade Head Marine Reserve: Intertidal monitoring for sea stars and community musselbed surveys were successfully conducted following modified COVID-19 fieldwork protocols. Subtidal temperature, oxygen and salinity data were gathered from this reserve.
- Otter Rock Marine Reserve: Intertidal monitoring for sea stars and community musselbed surveys were successfully conducted following modified COVID-19 fieldwork protocols. Our collaborators at Oregon State University resumed sampling for juvenile fish recruitment surveys; subtidal temperature, oxygen and salinity data were gathered from this reserve.
- Cape Perpetua Marine Reserve: Collaborators with the Partnership for Interdisciplinary Study of Coastal Oceans (PISCO) successfully collected data on intertidal sea stars and musselbeds, and subtidal data on temperature, salinity, oxygen, and pH from the

marine reserve.

- Redfish Rocks Marine Reserve**:** Subtidal temperature, oxygen and salinity data were gathered from this reserve.

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Research

Nothing new to report in 2021.

REVIEW OF AGENCY GROUNDFISH RESEARCH, ASSESSMENT AND MANAGEMENT

Hagfish

Management

The commercial hagfish fishery operates year-round. Two types of trap gear are typically used by the hagfish fleet, a 55-gallon drum and five-gallon bucket. Each of these contains escape holes to increase the size selectivity of the commercial fishery. Commercial hagfish landings in 2021 were down to 785,977 pounds, or 49% of state harvest guideline of 1.6 million pounds, continuing the decline in landings observed in 2020. Lower landings are largely attributable to reduced effort, as the number of trips declined to 53% of the 2019 level while pounds landed per trip has remained stable. No major hagfish management actions were taken by ODFW in 2021.

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Dogfish and Other Sharks

Assessment

ODFW staff participated in the federal spiny dogfish assessment in 2021 by providing data to the assessment and advice on modeling decisions to the stock assessment team (STAT).

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Skates

Nothing to report in 2021.

Pacific Cod

Nothing to report in 2021.

Walleye Pollock

Nothing to report in 2021.

Pacific Whiting

Management

The US (and Canadian) whiting total allowable catch (TAC) and catch continues to be near record high levels. The new assessment does continue the trend of decreased abundance as the very strong 2010, 2014 and 2016 cohorts begin to leave the population. In March 2021, the Pacific Fishery Management Council (PFMC) recommended and National Marine Fisheries Service implemented an emergency rule to allow an at-sea Pacific whiting processing platform to operate as both a mothership and a catcher-processor within the same calendar year. This action was taken to allow for continued mitigation of risk associated with the COVID-19 pandemic and impacts associated with current processing limitations in these two sectors (i.e., to better ensure a processor would be available to take fish from catcher vessels in the mothership sector, given the continued instances of COVID-19 outbreaks that disrupt processing operations). Increasing the whiting utilization package was finalized in March 2022. Council adopted the whiting utilization final preferred alternatives which will be in effect in 2023.

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Grenadiers

Nothing to report in 2021.

Rockfish

Research

Cross-Shelf Variability of Deacon Rockfish (*Sebastes diaconus)* Age, Growth, and Maturity in Oregon Waters and Their Effect on Stock Status. Published.

The goals of this study were to understand how age, growth and maturity parameters vary with sex and depth in the Deacon Rockfish. As efforts were made to sample a variety of size classes, from both the nearshore and offshore, we also assessed how age composition differed between the two areas and determined what the implications of these differences would be on the reproductive output of the population. Finally, we incorporated the results of this study into the most recent Deacon Rockfish stock assessment and evaluated how altering life history parameters influenced the stock status.

Deacon rockfish were collected nearly monthly at offshore and nearshore sites during favorable weather periods out of Newport, Oregon. Samples were collected periodically from December 2016 to November 2017. The offshore study area was Stonewall Bank and the surrounding area out to 146 m of water depth. The nearshore study areas included Seal Rock and Siletz reefs. Recreational hook and line gear was used for all collections. Terminal gear included a variety of plastic baits, small to medium sized flies and Sabiki rigs (herring jigs).

Prior efforts to collect small Deacon and Blue Rockfish in nearshore waters off Oregon have shown that Sabiki rigs are capable of capturing Deacon Rockfish from adult sizes down to as small as ~8 cm, helping to offset gear-related bias in size-selectivity of typical hook and line fishing gear. Approximately 50 Deacon Rockfish were collected per reef area per sampling day. Fish were measured (cm, fork length) and sexed and otoliths collected for age determination. Ovaries and testes were be examined and assigned a maturity stage. For females, a small section of ovary from fish in stages 1, 2, 3, 6 and 7 were collected and placed in cassettes for histological preparation and microscopic evaluation of maturity. Ovary samples were preserved in 10% buffered formalin and later transferred to 70% ethanol for storage. Ages were determined using the break and burn technique applied to sagittal otoliths) or a variation of the technique in which sagittal otoliths are broken and "baked" for several minutes prior to age determination. For all fish 21 cm or shorter, a caudal fin snip was taken and stored in 100% ethanol (molecular grade) for DNA analysis to confirm species identification.

Our primary goal was to better understand how age, growth and maturity parameters differed between Deacon Rockfish that resided in nearshore and offshore waters off central Oregon. Our study suggests that age and growth parameters do differ by both area and sex but, not surprisingly, sex was a more influential factor than area. We were unable to compare nearshore and offshore age and length at 50% maturity due to the small number of immature females collected offshore. We did find that age and length at 50% maturity values were similar between the nearshore and when nearshore and offshore samples were combined. However, based on larger lengths of offshore females, our work suggests that a significant component of the total reproductive output in Oregon may come from offshore. It is worth noting that this is based on the assumption that the number of females in the nearshore and offshore are equal.

Although our best fit von Bertalanffy model included both sex and area, the effect of area on the parameter estimates was relatively minimal. Primarily, growth rate (k) differed with males in the nearshore growing faster than males in the offshore whereas females in the offshore grew faster than females in the nearshore. Regardless of area, male growth rate was faster than for females. The larger offshore individuals (both male and female) had a more diverse distribution of ages than individuals of the same size class in the nearshore. The offshore individuals we sampled stopped experiencing fishing pressure in 2007 due to the establishment of the Stonewall Yelloweye Rockfish Conservation Area. In the 10 years since its closure, the offshore fish have experienced essentially no fishing pressure allowing larger individuals to obtain older ages than normally occurs for populations experiencing fishing pressure. However, the greater than 10 year age difference suggests that while the complexity of offshore age structure has increased due to the lack of fishing pressure, there were, prior to closure, likely more older fish offshore. It is worth noting when the offshore re-opens to fishing, these larger older individuals are likely to be removed from the population. Although most of the offshore individuals were large mature females, we did capture young-of-the-year individuals. This finding is important because regional knowledge suggests Deacon Rockfish only settle in the nearshore and exhibit an onotogenetic migration from the nearshore to the offshore. Our findings may indicate that there is less movement of individuals

between the nearshore and offshore than previously hypothesized.

Re-running the most recent stock assessment and forcing it to use some of the different growth and maturity parameters influences the spawning stock biomass trajectory and estimates of stock status, but all of the estimates were within the range of uncertainty estimated with the base Oregon Blue/Deacon stock assessment model. Although all of these runs were within the range of uncertainty, the stock trends were effectively the same regardless of where the parameter estimates were obtained from, except for the estimates from California, which caused dramatic differences in the stock trend. Incorporating spatiotemporal variability of growth data into stock assessments is increasingly being shown to have profound impacts of stock trajectory and status. As such, for nearshore stocks that are relatively data poor and rely on each individual state to collect their own data, it is important that growth function parameters be estimated (at a minimum) for each state (using locally obtained data) and the relative effect of spatial dynamics are considered. Further, although spatial variation on growth function parameter estimates are often shown to vary with latitude, few studies consider the effects of cross-shelf variability in growth functions. We argue that cross-shelf variability is important to consider as circulation changes dramatically as you move across the shelf and ultimately these differences may affect both growth rates of adults and the dispersal of their larvae.

Contact: Leif Rasmuson (leif.k.rasmuson@odfw.oregon.gov)

Habitat use and activity patterns of Deacon Rockfish (*Sebastes diaconus*) at seasonal scales and in response to episodic hypoxia. Published.

Knowledge of fish movements and residency are key to design and interpretation of results from bioacoustic sonar and visual survey methods, which are being developed as tools for use in nearshore rocky reef surveys to estimate biomass and species composition. Fishers in Oregon report that an important component of the nearshore catch, Deacon Rockfish (*Sebastes diaconus*), become unavailable to harvest seasonally, and suggest periodic migration away from nearshore reef areas. Seasonal and spatial variation in landings data potentially support this theory. We used a high-resolution acoustic telemetry array and a combination of presence/absence receiver arrays, to study the daily and seasonal movements and the activity patterns of 11 acoustically tagged Deacon Rockfish on a nearshore rocky reef off Seal Rock, Oregon. Over the 11-month study period, most fish (n=6) exhibited high site fidelity. For the duration of the high-resolution array (5 mo), these fish had small home ranges (mean 95% kernel density estimation=4,907 m^2) and consistent activity patterns, except during seasonal hypoxia (defined as dissolved oxygen concentration [DO] < 2 mg l^{-1}). During the summer months, resident fish were strongly diurnal with high levels of daytime activity above the bottom in relatively rugose habitat, followed by nighttime rest periods in deeper water in habitat of relatively less rugosity. During hypoxia, fish exhibited moderate activity levels with no rest periods and moved well away from their core activity areas on long, erratic forays. Wintertime activity levels were moderate with less defined daily patterns, but fish continued to remain within the array area.

Overall, resident Deacon Rockfish displayed high site fidelity and coherence in both seasonal and daily movement patterns, but those consistent patterns were completely altered during extended hypoxia. High long-term survival and consistently high detection of resident fish over 11 months indicates that at least some Deacon Rockfish do not exhibit a seasonal migration away from nearshore reefs. Food items ingested by sampled Deacon Rockfish during this study included gelatinous zooplankton and small planktonic crustaceans: the colonial tunicate *Pyrosoma atlanticum*, hydrozoan *Velella vellela*, ctenophore *Pleurobrachia bachei*, brachyuran zoeae/megalopae, and pelagic amphipods. We suggest Deacon Rockfish may be resistant to standard fishing techniques due to these strong prey preferences, hook size, and potentially eye and visual abilities which allow both Blue and Deacon Rockfish to see and feed upon very small and/or transparent prey items such as gelatinous zooplankton.

Although our sample size was necessarily small, detection and position data for tagged fish was excellent, a trade-off due to using a high density of receivers and co-located sync tags. Mid-water schooling behavior of this species benefits detection rates, which can be problematic for more benthic rockfish in high relief habitat. The high-resolution inner VPS array, combined with the perimeter fence, and accelerometer/depth sensors in the tags, provided additional certainty about the fate of fish that remained inside or left the array. A larger study in southern Oregon, using similar methods but tagging both Deacon and Blue Rockfish inhabiting the same area, could shed light on differences in the two species' movements in various habitats including offshore reefs, which may act as refuges for older, more fecund fish in Oregon, in unfished rockfish conservation areas.

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Operationalizing a survey of Oregon's nearshore semi-pelagic rockfish. Published

A primary challenge for an acoustic-based rocky reef survey is identifying the species composition and size distribution of schools, as species identification of acoustic targets is currently not possible for mixed schools of morphologically-similar rockfish species. Identifying an efficient strategy for quantifying these variables using a suspended pelagic stereo drop-camera was the goal of this proposed work. Acquiring drop-camera footage from as many different schools as possible, containing a diversity of species compositions and size distributions, informed us about the range of school structures and allowed us to evaluate the level of sampling effort needed for future broad-scale surveys.

In the fall of 2017 we established 50 transects off of Newport at Seal Rock reef. These transects were evenly spaced in areas 2 and 3 of the ODFW black rockfish pit tagging project. These transects were established as a test location for conducting a "mock" hydroacoustic survey for nearshore semi-pelagic rockfish. This location presented an ideal test location due to 1) its nearness to the ODFW offices and 2) the presence of robust population estimates for the reef's black rockfish (*Sebastes melanops*) population. Over the course of four days, using a contracted local charter passenger fishing vessel, we collected hydroacoustic data

using a biosonics 200kHz split beam transducer. For each transect we deployed our suspended stereo camera system 3 times on locations with either large schools of rockfish or rocky reef habitat. For each video drop we collected a minimum of 2 minutes of on-bottom time (based on preliminary examination of existing data). A total of 70 miles of acoustics data were collected and 140 video drops were conducted.

We determined that the best way to process our video data was to use a mean MaxN approach rather than the common MaxN approach. We also demonstrated that there was no effect on the size of the fish observed with each method. Finally, regardless of the method used, the distribution of fish size classes from the fishing fleet was similar to that observed with the camera. The only notable difference is the camera saw larger and smaller fish than those observed in the hook and line data. Our system also has downward facing camera that allows us to compare the fish counts in the acoustic deadzone to the counts from the forward camera system. Our work suggests that there was no statistical difference in the number of fish in the down camera for black rockfish and that there were significantly more Blue/Deacon rockfish in the forward camera than the down camera. These data provide an initial suggestion that that the acoustic deadzone will be a manageable concern in relation to our data.

To establish how the deployment and retrieval of the BASS camera affects the behavior of semi-demersal rockfish, we spent multiple days this summer deploying the camera system directly below the transducer that was ensonifying a school of fish. We then remained over the camera system while we ensonified the school and as we retrieved the camera system. Our analyses suggest that the deployment of the camera system on the schools of fish does not result in the attraction or repulsion of fish to the school. Finally, using the data we collected in September of 2017, we were able to generate population estimates for Black and Blue/Deacon rockfish at Seal Rock reef. Our work found similar orders of magnitude population sizes of Blacks as those estimated by the pit tagging project.

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Influence of near bottom habitat use on the efficacy of a combined hydroacoustic video survey for nearshore semi-pelagic rockfish. In Review.

In the present study, our goal was to estimate the influence of the dead zone on the joint acoustic-visual survey designed to provide a population estimate for three semi-pelagic species – Black, Blue (*Sebastes mystinus*), and Deacon Rockfish *(Sebastes diaconus*). We investigated whether demersal rockfish affected the acoustic data and, if so, whether population estimates for semi-pelagic species needed to account for the presence of demersals when apportioning backscattering data. To answer these questions, we compared acoustic swath data and point estimates from our suspended camera with collocated benthic-oriented video data from remotely operated vehicle (ROV) belt transects that were conducted immediately following the acoustic sampling. The resulting data was used to address five questions: 1) Did the different tools (ROV versus suspended camera) provide similar size distribution estimates; 2) Was our sequential sampling approach successful in detecting spatially consistent

concentrations of fish across the reef, 3) Within the acoustic dead zone directly below schools, did the ROV and suspended camera estimate similar species composition and abundance; 4) In areas away from schools, what was the background density of near bottom fish; and 5) How do population estimates for each species differ when estimated from the ROV versus the combined video-hydroacoustic tool?

In this study we set out to determine if the dead zone made an acoustic survey for Oregon's nearshore semi-pelagic rockfish infeasible. To address the question, we paired hydroacoustic and underwater video sampling with ROV video sampling to determine the relative contribution of the dead zone. We first had to assess whether the observations from each tool were similar to one another. In general, we found that there was good spatial coherence in the observations between our two tools, and the densities of observed fish, viewed at the sub-transect scale, were well correlated for the schooling semi-pelagic fish species that were the primary study targets. Further, the length distributions of our target species/species groups differ minimally between the tools and there was little evidence of size selectivity between tools (Kotwicki *et al.*, 2017). Based on these findings, we conclude that by combining these two survey methods we were able to accurately assess the relative importance of fish in the dead zone to an acoustic-based abundance estimate for nearshore semi-pelagic rockfish and support the utility of a combined video-hydroacoustic survey.

While these methods are specifically designed for nearshore species, they can easily be adapted to work with semi-pelagic, shelf rockfish stocks. Our work demonstrates that the dead zone does not negatively affect the ability of the tool to sample our target species/species groups. Our 1 m near bottom exclusion zone enhances the utility of the tool by reducing the number of species we observe. Ultimately this ensures the acoustic density estimate is primarily for target semi-pelagic rockfish and not contaminated by demersal rockfish. Furthermore, targeting fish schools with an easily deployable stereo video system provides an accurate estimate of species composition and length data. In an area where the visibility is characteristically bad, the ability to first identify large schools with hydroacoustic equipment, then deploy cameras directly into these schools, greatly increases the chance of collecting data. In short, we find that the combination of acoustics and suspended cameras are an effective survey tool for semi-pelagic rockfish.

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Statewide Semi-Pelagic Rockfish Survey. Ongoing.

The survey began on August 1, 2021 at the mouth of the Columbia river and progressed southwards. Transects were sampled systematically towards the California border until Cape Blanco at which point transects were sampled in a somewhat random order. This was to allow the vessel to continue to operate in inclement conditions. The survey was completed on October 9, 2021. Small boat operations were conducted in the nearshore on September 11 and October 7-9.

During the survey, from the Columbia River to approximately Heceta Head, low oxygen conditions were observed and appeared to affect fish behavior. In response, additional funds were added to the contract and the section of the survey from Three Arch Rocks to Waldport was resampled from October 17 through November 29, 2021. Hereafter we call this Pass 2 and the data collected from August 1-October 9, Pass 1. During Pass 2, winter conditions were present so survey days were more infrequent than during Pass 1. Further, the Dungeness crab season began on December 1, 2021.

For every full transect, CTD casts were conducted at water depth of 80, 60, 40, and 20 m. A final station was conducted at the shallowest end of the transect. Additional CTD casts were conducted haphazardly throughout the survey to inform speed of sound calculations.

Thirty-seven full transects and 287 rock transects were conducted on pass 1 using the Pacific Surveyor accounting for a total of 3570 km of data collected. 27 transect were conducted on pass 1 using the Arima accounting. Five hundred seven video drops were conducted on Pass 1 and 71 were conducted on Pass 2. Due to the paucity of fish schools on Pass 1, only 48 fishing stations were conducted on pass 1 and 7 on Pass 2. Eight hundred and seven fish were caught during these fishing stations.

These data are in the process of being analyzed and will be presented for a methodology review to the PFMC Scientific and Statistical Committee in the fall of 2022.

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Where are old female Black Rockfish? Ongoing.

During the last stock assessment, scientists showed that the proportion of female black rockfish observed in fisheries catch data starts declining as fish reach ~10 years in age (17 in.). By age 20, the catch is almost entirely males. This begs the following questions. Do large older females die before they reach older ages, and therefore we don't catch them? Alternatively, if older female black rockfish exist, are we not catching them because we use the wrong gear or are we looking in the wrong spot? Knowing if the number of old female black rockfish is truly just a low number or if the catch data is not representing the population is very important. We use these data to determine reproductive output of the population.

We sent out a written survey to the recreational and commercial fleets to determine if they have any hypotheses where these individuals may be. Questions included:

1) Do you think the older female black rockfish are dead or we just don't catch them (Circle one)?
2) If they aren't dead, do you think common current gear can catch old female black rockfish (Circle one)?
3) What is the best gear that could be used?
4) Do the recreational power boat and commercial nearshore fisheries not commonly

operate where old female black rockfish live (Circle one)?

5) If your goal is to fish for old female black rockfish, where would you fish?
6) Do you have any other idea why we don't see them in our catch data?

These data are in the process of being analyzed and next steps will be determined based on the results.

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Inter-Reef Movement of Yelloweye Rockfish. Ongoing.

Yelloweye Rockfish (*Sebastes ruberrimus)*, continue to constrain catch of multiple healthy shelf stocks. One tool that has been used to manage the take of Yelloweye Rockfish is spatial area management through the establishment of places like Yelloweye Rockfish Conservation Areas. A key aspect of effective spatial fisheries management is an understanding of population connectivity. Highly migratory species ultimately may not receive as much protection from spatial closures if they migrate out of closed areas into fished areas. While many rockfish species characteristically have small home ranges making them effective candidates for spatial fisheries management, more data are needed for Yelloweye Rockfish. To answer this question, the ODFW Marine Fisheries Research Project used standard acoustic telemetry techniques, tagged Yelloweye Rockfish in 2005, 2012 and 2013 to understand home range size (Rankin 2019). In all of these studies, the researchers found that some Yelloweye remained in the acoustic array at Stonewall Bank and had a small home range while others left only to return 6+ months later. They also found that some individuals moved up into the water column for a few hours each day before descending back to the bottom. The goal of the proposed project is to understand 1) where do these other Yelloweye Rockfish travel 2) to ascertain if only certain sexes or sizes of fish make these perceived large-scale movements and 3) understand the daily movement dynamics of the species.

While standard acoustic telemetry methods often work well for species with small home ranges, they are not effective for species that make large movements. Further, standard passive tags aren't effective when a species is not actively targeted in fisheries. Pop-up satellite tags are an effective tool for this kind of study and have been proven to be effective at monitoring the movement of rockfish (Rodgveller et al. 2017). We propose to use a chartered fishing boat (paid for with dedicated research funds) to collect Yelloweye Rockfish at Stonewall Bank using hook and line gear. A small fin clip will be collected from the fish to provide both population genetics and sex data. These fish will then be recompressed in barrels for 24 hours on the seafloor. Doing so minimizes the effects of barotrauma on the fish during subsequent tagging. After 24 hours the fish will be recovered, tagged with Desert Star SeaTag-GEO tags and released. Tags will be set to release after 6 months, at which point they broadcast their data to a satellite and back to the office. When tags indicate they have popped off the fish, we will also go out on a boat and attempt to recover the tag using a directional listening device in order to hopefully obtain the much higher resolution data only located on the tag. Regardless which data we use, these data will provide, at minimum, location data

where the tag popped off (ideally more) and extensive data on the daily movement dynamics of the fish. These data will provide insight into the inter-reef movement of this important constraining species as well as insight into the daily behavior of the species.

The tags for this project have been purchased. There were delays in tag delivery so work in 2022 will be to deploy these tags. We will also be attaching standard acoustic telemetry tags (VEMCO) to each fish. A few haphazard moorings will be deployed near the release site. We will use these data along with local magnetic field maps to reduce the assumed geomagnetic error of our satellite tags.

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Susceptibility of five species of rockfish to hydroacoustic and bottom trawl survey gears inferred from high resolution behavioral data. Published.

Fisheries independent surveys are an important data input for stock assessments. However, these surveys are expensive to conduct and require precise, well thought out planning to be effective. Although the amount of money allocated to a survey is often dictated by factors beyond the control of the survey development team, surveys must incorporate their understanding of the biology of the focal species or species group into the survey design. Acoustic telemetry data can provide a high-resolution dataset to answer some of these questions. In this study, we reanalyze past acoustic telemetry studies on Black Rockfish (*Sebastes melanops)*, Copper Rockfish (*Sebastes caurinus*), Deacon Rockfish (*Sebastes diaconus*), Quillback Rockfish (*Sebastes maliger*) and Yelloweye Rockfish (*Sebastes ruberrimus*) in order to apply these data to future survey development. We combined the telemetry data with multibeam bathymetry data to 1) understand how the height off bottom of each species changed throughout the day and 2) simply define the habitat utilized by each species. We found, on average, Black, Deacon and Yelloweye Rockfish were all more than 1 m off bottom, whereas Copper and Quillback remained on, or near the bottom throughout the day. Deacon Rockfish were associated with the most rugose bottom, followed by Yelloweye. Black, Copper and Quillback all utilized low relief habitats. In general, we hypothesize that Black and Deacon Rockfish are good candidates for survey by hydroacoustics, whereas, Copper and Quillback appear to be good candidates for survey by bottom trawl. Surprisingly, due to the habitat they reside in, Yelloweye Rockfish were available to hydroacoustics, and likely not available to bottom trawl. However, Yelloweye Rockfish have variable behaviors, as reported by the original work, and as such, we are wary to suggest that hydroacoustics are an appropriate survey tool. We do, however, propose that Yelloweye potentially contribute to backscattering values of acoustic surveys conducted for midwater rockfish, and that bottom trawls are likely not an effective survey tool for Yelloweye Rockfish.

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Assessment

ODFW staff participated on three STATs for Copper, Quillback and Vermilion rockfish federal stock assessments during 2021. Staff provided data, consulted with lead assessors on

modeling decisions, and developed and ran models for all three assessments. ODFW assisted with assessment documentation and participation in the Stock Assessment Review (STAR) panels for these species in 2021 as full co-authors on each of these assessments (Wetzel et al. 2021; Langseth et al. 2021; Cope and Whitman 2021).

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Management

Federal Nearshore Management Activities

During the April 2021 meeting, the PFMC began scoping changes to the non-trawl rockfish conservation area (RCA) and other spatial management measures in the non-trawl groundfish sectors on the West Coast. Established in 2003 to mitigate impacts to overfished groundfish species, the non-trawl RCA is a coastwide, contiguous area bounded by coordinates that approximate depth contours. All of the overfished groundfish species except Yelloweye Rockfish have been rebuilt and Yelloweye Rockfish is projected to rebuild by 2029. In November 2021, the PFMC adopted a revised statement of purpose and need for action modifying area management measures and prioritized consideration of allowing non-bottom-contact hook and line gear in the existing non-trawl RCA off Oregon and California to provide access to abundant midwater rockfish stocks. The PFMC is also considering narrowing the non-trawl RCA by adjusting the seaward boundaries, eliminating the RCA, and/or modifying the Cowcod Conservation Area off California. More information on non-trawl area management is available on the PFMC website here.

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Fixed-Gear Nearshore Commercial Fishery

Nearshore rockfish compose the majority of landings in the commercial nearshore fishery. In Oregon, this fishery became a limited-entry permit-based program in 2004, following the rapid development of the open access nearshore fishery in the late 1990's. The commercial nearshore fishery exclusively targets groundfish with separate management groups for Black Rockfish, Blue and Deacon Rockfish, Cabezon, Kelp Greenling, and Oregon's "Other Nearshore Rockfish" complex. The fishery is primarily composed of small vessels (25 ft. average) fishing in waters less than 30 fathoms. Fishing occurs mainly with hook and line jig and bottom longline gear types. The majority of active permit holders are located on the southern Oregon coast, resulting in most of the catch landed in Port Orford, Gold Beach and Brookings. Black Rockfish continue to comprise the majority of landings. The fishery supplies mainly live fish markets, but also provides fresh fish products.

Landings are regulated through bimonthly trip limits, minimum size limits, and annual harvest guidelines (HG). In 2021, landings from commercial nearshore fishing, logbook compliance, economic data, and biological data were published in the 2020 Commercial Nearshore Fishery Data Update (Rodomsky and Matteson 2021). Weekly updates on landings and model projections allow MRP staff to effectively manage the fishery in-season. In 2021, overall effort (number of fishing trips) was close to the historical average until July, after which the fishery slowed, and effort

dropped to a new historical minimum by mid-August where it remained through the rest of the year. Black Rockfish landings generally followed the trend in effort, although it remained above the historical minimum. In response, period 5 and period 6 trip limits for Black Rockfish were increased from 1,800 and 1,500 pounds per period respectively to 2,700 pounds per period in both periods to maximize opportunity and HG attainment. Blue and Deacon rockfish landings were above the historical average but did not approach the HG. Blue and Deacon Rockfish trip limits were not adjusted up as they do not limit landings. Other Nearshore Rockfish landings remained near the historical average throughout most of 2021, and trip limits were not adjusted. End of the year attainment of the state HGs was 82% for Black Rockfish, 80% for Other Nearshore Rockfish, and 37% for Blue and Deacon Rockfish. For Cabezon and Greenling management specifics see the Other Groundfish section.

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Federal Non-nearshore Commercial Fishery

Before 2021, during the harvest specifications cycle, trip limits were increased in both the limited entry fixed gear and open access fisheries north of 40° 10′ N lat. Limited entry fixed gear (LEFG) limits of minor slope rockfish and Darkblotched Rockfish were raised from 4,000 pounds to 8,000 pounds per two months, of which no more than 6,000 pounds may be Blackgill Rockfish. LEFG limits of minor shelf rockfish, Shortbelly and Widow Rockfish were separated and Widow rockfish limits increased to 4,000 pounds per two months, shelf rockfish to 800 pounds per month and 200 pounds of Shortbelly Rockfish per month, from 200 pounds per month combined. The Yellowtail Rockfish limit in the LEFG program was increased from 1,000 to 3,000 pounds per month. The Canary Rockfish LEFG limit was increased from 300 pounds to 3,000 pounds every 2 months.

Open access (OA) trip limits were also increased for many species. Minor slope rockfish and Darkblotched Rockfish increased from 500 pounds to 2,000 lbs per month. OA trip limits increased minor shelf rockfish and separated the Shortbelly, shelf and Widow Rockfish. Window Rockfish increased from 200 pounds to 2,000 pounds per two months, shelf rockfish increased to 800 pounds per month and Shortbelly Rockfish has a limit of 200 pounds per month. Yellowtail and Canary Rockfish also increased, from 500 to 1,500 pounds per month for Yellowtail and an increase to 1,000 lbs from 300 pounds every two months for Canary. These trip limit adjustments do not change the projected impacts compared to impacts evaluated in the PFMC's 2019-2020 groundfish harvest specifications analysis, because that analysis assumed the entire annual catch limit (ACL) would be harvested whereas the projected impacts are still below the ACL, even with the increased trip limits.

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Recreational Fishery

Black rockfish (*Sebastes melanops*) remains the dominant species caught in the recreational ocean boat fishery. The Black Rockfish federal harvest limit remained the same in 2021 as in 2020. With Blue and Deacon Rockfish taken out of the nearshore rockfish complex beginning

in 2019, the harvest guideline for that complex was greatly reduced. The retention of Yelloweye Rockfish (*S. ruberrimus*) was prohibited year-round, as it has been since the early 2000s. To remain within the Yelloweye Rockfish impact cap (via discard mortality), the recreational groundfish fishery was restricted pre-season to inside of 40 fathoms from June 1 to August 31. Black rockfish and nearshore rockfish species have become as much of a limiting factor as yelloweye rockfish. The fishery season structure and regulations, such as daily bag limits (with species specific sub-bag limits) and depth restrictions, attempted to balance impacts, as what reduces impacts on one species may increase impacts to the other. Even with those efforts the nearshore rockfish complex harvest guideline was reached in late May, after which time ODFW required anglers to release those species. 2021 was another high effort year, continuing the trend of approximately 100,000 angler trips per year that began in 2015.

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Outreach

ODFW staff did have to reduce in person outreach activities again in 2021 due to COVID restrictions and safety protocols. However, we continued to work with anglers via webinars, conference calls, and online materials.

To reduce bycatch mortality of overfished rockfish species in the sport fisheries, ODFW began an outreach campaign in 2013 with the goal of increasing descending device usage among sport anglers. The effort, branded "No Floaters: Release At-Depth", has distributed over 17,000 descending devices to date, to all charter vessel owners and to the majority of sport boat owners who had previously targeted groundfish or halibut. ODFW staff have also participated in a number of angler education workshops, meetings, and shows to educate anglers and distribute devices. In addition, several thousand stickers and a few hundred hats bearing an emblem of the brand have been distributed with the goal of making rockfish conservation an innate aspect of fishing culture.

This outreach and education campaign continues to be successful. Prior to the campaign, fewer than 40 percent of anglers reported using descending devices. Since the campaign began, the percentage of anglers reporting use increased to greater than 80 percent. To further increase usage, anglers requested that ODFW make descending devices mandatory for any vessel fishing the ocean for bottomfish or halibut. This regulation went into place beginning January 1, 2017, and increased the angler reported usage rates to approximately 95 percent in most ports and months. Additional outreach efforts include: videos online that show fish successfully swimming away after release with a device, rockfish barotrauma flyers, and videos on how to use the various descending devices. This outreach campaign has been the result of collaboration between ODFW, two angler groups (Oregon Coalition for Educating Anglers and Oregon Angler Research Society), Utah's Hogle Zoo, ODFW's Restoration and Enhancement (R & E) program, and the National Marine Fisheries Service Saltwater Recreational Policy. ODFW staff are planning to continue the outreach and education efforts in the future.

Additionally, ODFW has been educating anglers on a relatively new opportunity to use what is termed "longleader gear" to target underutilized midwater rockfish species such as Yellowtail (*S. flavidus*) and Widow (*S. entomales*), while avoiding more benthic species such as Yelloweye rockfish. The longleader gear requires a minimum of 30 feet between the weight and the lowest hook, along with a non-compressible bloat above the hooks, to keep the line vertical in the water column. ODFW has produced informational handouts with the gear specifics, species allowed, and other associated regulations.

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Thornyheads

Nothing to report in 2021.

Sablefish

Management

Sablefish is the most economically valuable species in the West Coast bottom trawl and fixed gear fisheries. Sablefish prices were depressed due to market saturation before COVID-19, and market perturbations caused by the pandemic are leading to even more disruption. In 2021, the PFMC recommended, and NMFS implemented an emergency rule to temporarily allow an extension in the primary sablefish tier fishery from October 31 to December 31, 2021. However, this action did not apply to pot gear until December 10th. The 2021 emergency rule suspended the permit stacking limit and allowed for multiple permit transfers (§86 FR 59873), meaning that pot-endorsed permits could be used by longline vessels to attain up to the limits associated with stacked permits up until December 10th.

The PFMC is continuing to consider changes to the "gear-switching" provision of the trawl individual fishing quota (IFQ) program which allows the use of non-trawl gear to harvest trawl IFQ. In September 2021, the PFMC adopted a range of alternatives that would limit gear switching by several different approaches, and is expected to refine these alternatives and provide guidance for further analysis in June 2022. The gear-switching issue arose during the first 5-year review of the trawl IFQ program and is centered on concerns by trawl fishermen that fixed gear participation has led to higher sablefish quota lease rates and reduced their ability to catch co-occurring stocks. Gear-switching participants are concerned that limits adopted now could undermine significant investments already made to fish in the IFQ fishery with non-trawl gear, under a legal provision of the program. More information on gear-switching is available on the PFMC website here.

The PFMC is also conducting a periodic review of the Limited Entry Fixed Gear Permit Stacking Program. In March 2022, the PFMC recommended including research and data needs recommended by its advisory bodies in the draft review document and seeking public review on the final draft. In addition, the PFMC initiated development of a cost recovery program for this fishery as required by the Magnuson-Stevens Fishery Conservation and Management Act.

An introductory workshop on a Management Strategy Evaluation (MSE) process for sablefish was held April 27-28, 2021 (https://www.pcouncil.org/events/sablefish-management-strategy-evaluation-workshop-to-be-held-online-april-27-28-2021/). The purpose was to engage stakeholders and tribal nations from Alaska, Canada and the West coast to start a dialogue among regions about sablefish science and management.

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Lingcod

Assessment

ODFW staff participated in the STAT for the federal Lingcod (*Ophiodon elongates*) stock assessment and a full co-author on the assessment for the northern lingcod stock (Taylor et al. 2021). Staff provided data, advice on modeling decisions and contributed analyses to the final assessment. Additionally, ODFW staff provided substantial coordination and logistical support to aging efforts for lingcod in both 2020 and 2021. Commercial lingcod samples were aged at WDFW in 2020, and recreational lingcod samples were mounted and sent to NWFSC for aging in late 2020 and 2021. ODFW staff also participated in the STAR panel review for the two lingcod assessments in the summer of 2021.

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Management

Commercial Fishery

Trip limits were increased for Lingcod in both the limited entry fixed gear and open access fisheries North of 40º 10′ N latitude. In the limited entry fleet, trip limits were increased from 2,000 to 4,000 pounds every two months. In the open access fleet, trip limits were increased from 900 pounds to 2,000 pounds per month. In 2021, the commercial fleets in Oregon landed 321.8 metric tons of Lingcod, down from 397.1 mt in 2019, likely due to continuing market limits and other factors related to the COVID-19 pandemic.

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Recreational Fishery

Lingcod is a popular target in the Oregon recreational bottomfish fishery. Many anglers especially like to target Lingcod during the months when the fishery is open to all-depths, as larger Lingcod are thought to occur in deeper offshore waters. Lingcod have their own daily bag limit (2 per angler per day), separate from the other bottomfish. There is also a minimum size limit of 22 inches. In 2021, anglers landed just over 48,000 lingcod, totaling 145 mt.

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Atka Mackerel

Nothing to report in 2021.

Pacific Halibut

Management

Oregon's recreational fishery for Pacific Halibut (*Hippoglotus stenolepis*) continues to be a popular, high-profile fishery requiring International Pacific Halibut Commission (IPHC), federal, and state technical and management considerations. In 2021, the IPHC recommended an annual catch limit for Area 2A (Oregon, Washington, and California) of 1.5 million pounds which the IPHC Commissioners indicated would be in place for four years, 2019-2022. The recreational fishery for Pacific Halibut is managed under three subareas with a combination of all-depth and nearshore quotas. In 2021, the Columbia River subarea quota was 18,662 pounds, the Central coast subarea quota was 274,403 pounds, and the Southern coast subarea quota, was 8,000 pounds. Landings in the sport Pacific Halibut fisheries are monitored weekly for tracking landings versus catch limits. The majority of Halibut continue to be landed in the central coast subarea, with the greatest landings in Newport followed by Garibaldi or Pacific City. Total 2021 recreational landings in the Central coast subarea were 123,005 pounds, 45 percent of the quota. Landings in the Southern subarea were 5,699 pounds (71% of the quota) and in the Columbia River subarea, landings were 21,480 pounds (115 %). Fishing in the Central Coast Subarea was restricted by weather for part of May, June, and many anglers switched to coho salmon fishing in July-September, as it was one of the best coho salmon season in many years. The Columbia River Subarea was able to open as scheduled in early May with good catches. The subarea was allowed to exceed its allocation due to there being additional quota available from other Washington subareas. Anglers reported a lot of small fish, in the 26-30 inch size range, many of which were released at sea. The average size of landed fish in 2021 was up by approximately 1/2 pounds net weight from 2020. This low average size was a contributor to the low quota attainment, as there were more fish landed in 2021 than in previous years, just less poundage.

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Other Groundfish

Kelp Greenling

Management – Commercial Fishery

The commercial Kelp Greenling HG for 2021 was 108.0 metric tons. Greenling are targeted by very few commercial fishers despite the relatively high HG and price per pound paid for live fish. The bimonthly trip limit in 2021 was 1,000 pounds per period set after considering public input, markets, and local depletion concerns. Greenling landings ended the year at 9% of the HG attained. Barring changes in targeted effort catch rates and markets, Greenling attainment is likely to continue to remain low.

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Cabezon
Management – Commercial Fishery
The commercial HG for Cabezon increased from 30.2 metric tons in 2020 to 35.0 metric tons in 2021 based on a new stock assessment. Cabezon landings ran close to the historical average through most of the year but were projected to come in well below the HG. To increase opportunity and attainment, ODFW increased the bimonthly trip limit from 1,500 pounds per period to 2,000 pounds for periods 5 and 6, after which landings did increase above average. Final commercial fishery attainment was 79% after in-season adjustments.

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Management – Recreational Fishery
Cabezon (*Scorpaenichthys marmoratus*) is another popular target for some recreational bottomfish anglers. Cabezon have a one-fish sub-bag limit as part of the general marine bag limit, and a 16 inch minimum size, additionally the season does not open until July 1. The Cabezon harvest guideline has remained relatively constant over the last ten years. Even with the average angler catching less than one per day, the quota normally goes very quickly. In each of the previous several years, the quota has been met in six weeks, at which time ODFW prohibited retention. However, in 2021, the season remained open through the end of the year. This was due to a combination of less summer effort on bottomfish due to the good Coho Salmon season and a large year class of Cabezon moving out of the fishery. Fishing is prohibited January through June as that is the time that Cabezon generally spawn and nest guard. Prohibiting fishing during those months, is intended to protect Cabezon during that time.

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Ecosystem Studies

Effectiveness of quantitative stereo landers during day and night. Ongoing.

The need to develop fisheries independent estimates of demersal fishes in Oregon remains an important need for ODFW. Stationary remote underwater vehicles (i.e. video landers) are being used for this purpose in multiple countries throughout the world as well as providing stock assessment data to at least four of the regional fisheries management councils. A key benefit of their use is their simplicity in deployment and retrieval which ultimately makes them an economically strategic tool for monetarily limited agencies. However, there remain ways for us to increase their efficiency. Chartering vessels is inherently costly and time investment to either 1) have a boat not work at night or 2) make runs back and forth to port is not cost effective. Therefore, being able to operate a vessel both during the day and night

allows a vessel to be run more efficiently. However, if the species and number of fish detected differ significantly between day and night the results can have dramatic impacts on the development of an index.

Lander drops are being conducted at three regions: nearshore reef sites (Seal Rock or Siletz Reef), mid-shelf reef site (Stonewall Bank), and near-shelf break (Daisy Bank). At each region three grids of 100 drops were established over areas presumed to have a rocky substrate based on available multibeam data. Sample locations were selected that are >400 m apart. Beginning 5 hours before sunset the odd numbered drop locations were sampled until sunset. Following sunset sampling reversed back on the grid only sampling the even numbers. Two stereo lander systems are hop-scotched throughout the study area to increase efficiency. CTD casts equipped with a light meter are made haphazardly throughout the day to characterize the water column. Landers are left on the bottom for 15 minutes to record video. Videos are then scored for both MaxN and mean MaxN. Field work for this project is ongoing.

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Untrawlable habitat survey in partnership with Peter Frey (NWFSC), John Harms (NWFSC) and Kresimir Williams (AFSC). Ongoing.

Survey biologists with NOAA Fisheries in Seattle and Newport are interested in partnering with the commercial and sportfishing industries in the Pacific Northwest to improve stock assessments for Lingcod and shelf rockfish. We are planning to charter one commercial and one sportfishing vessel to conduct a study comparing the effectiveness of four different methods for collecting abundance and biological data for groundfish species found in rocky, high-relief habitats. The four methods are:

- Hook and line gear deployed by rod and reel
- Stereo video imagery from a small, stationary lander
- Stereo still camera imagery from a semi-moored housing
- Environmental DNA (eDNA) collected from water samples near the seafloor

The fieldwork was conducted in 2019 from late October –early November off the Oregon coast between Cascade Head and Heceta Bank in a depth range of 20 –125 fathoms and will target a variety of banks, reefs, and other rocky habitats. Results from this study will help determine the most effective and efficient gear to use in designing a larger, more comprehensive monitoring program for groundfish in the untrawlable habitats of the Pacific Northwest. Video review is ongoing.

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