April 2021

OREGON'S GROUNDFISH INVESTIGATIONS IN 2020

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 2020, but with some modifications due to COVID-19 precautions and restrictions. 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 2020; however, fish lengths and weights were not collected due to agency-prescribed COVID safety protocols. 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 2020 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, again due to COVID safety protocols. Beginning in 2003, the recreational harvest of several groundfish species is monitored inseason for catch limit tracking purposes.

Other ODFW management activities in 2020 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 2021.

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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 2020, 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 2020 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 2020 was conducted following ODFW-prescribed COVID-19 safety protocols. While the commercial groundfish sampling rate decreased in 2020 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 2020. More information is available on the Oregon Marine Reserves website at http://oregonmarinereserves.com/

Management

Site Management Plan

ODFW released the Cape Perpetua Marine Reserve Site Management Plan in 2020. The Plan outlines the state's marine reserve mandates and describes management, outreach, and community engagement strategies developed for the Cape Perpetua Marine Reserve. The Plan also highlights the local communities' interests in additional activities and research, above and beyond what is being carried out by ODFW.

Human Dimensions Research Reports

Several marine reserve human dimensions research reports were released in 2020. These projects were conducted as collaborations between ODFW and academic researchers.

- 2017-19 Qualitative Evaluation of Impacts of Marine Reserves on Commercial and Charter Fishers: Understanding the Big Picture (OSU Cascades 2020)
- Understanding Oregonians' Coastal Values and Priorities through Participatory GIS Mapping (PSU 2020)
- Cape Perpetua Visitor Surveys (Epperly et al. 2020)

Infographics
ODFW produced several infographics, highlighting some of the initial findings from ongoing marine reserves human dimensions research.

- Coastal Residents' Perspectives of Marine Reserves
- Fishermen's Perspectives of Marine Reserves
- Building and Maintaining Relationships in Marine Resource Management
- Information, Perceptions, and Communication

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 2020 at the following reserves:

- Cape Falcon Marine Reserve: temperature, oxygen and salinity data gathered in the reserve and its comparison area at Cape Meares. Data reveal similar oceanographic conditions between the two sites and no hypoxia (low oxygen conditions) while moorings were deployed July – Sept.
- Cascade Head Marine Reserve: Intertidal monitoring for sea stars and community musselbed surveys were successfully conducted following modified COVID-19 fieldwork protocols. Temperature, oxygen and salinity data were gathered from this reserve and reveal several points of hypoxia (low oxygen conditions) while moorings were deployed July – Sept.
- Otter Rock Marine Reserve: Intertidal monitoring for sea stars and community musselbed surveys were successfully conducted following modified COVID-19 fieldwork protocols.
- Cape Perpetua Marine Reserve: Collaborators with the Partnership for Interdisciplinary Study of Coastal Oceans (PISCO) successfully collected, temperature, salinity, oxygen, and pH data from the marine reserve.

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Research

Nothing new to report in 2020.

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 2020 were down to 1.2 million pounds, or 75.6% of state harvest guideline of 1.6 million pounds after 99.2% attainment the year prior. No major hagfish management actions were taken by ODFW in 2020.

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Dogfish and Other Sharks

Nothing to report in 2020.

Skates

Nothing to report in 2020.

Pacific Cod

Nothing to report in 2020.

Walleye Pollock

Nothing to report in 2020.

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 and 2014 cohorts begin to leave the population. In April 2020, 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 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 potential for COVID-19 outbreaks to disrupt processing operations). Increasing the whiting mothership utilization of their allocation has been a recent focus at the PFMC, with the adoption of a Purpose & Need statement in September 2020.

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Grenadiers

Nothing to report in 2020.

Rockfish

Research

Depth-associated variability of Deacon Rockfish (*Sebastes diaconus*) age, growth and maturity parameters in Oregon waters and their effect on stock status. In press.

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 during late 2016 and throughout 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 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 we combined the nearshore and offshore samples.

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 >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 ontogenetic migration from the nearshore to the offshore. Our finding may indicated 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 minimal) 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.

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Habitat use and activity patterns of Deacon Rockfish (*Sebastes diaconus*) at seasonal scales and in response to episodic hypoxia. In press.
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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Sex identification PCR-RFLP assay tested in eight species of *Sebastes* rockfish. Published.

The phenotypic identification of sex in *Sebastes* rockfish is difficult and often impractical from a management perspective, and the genetic basis of sex determination in the genus is currently uncertain. We tested a previously developed sex identification polymerase chain reaction restriction fragment length polymorphism (PCR-RFLP) assay on 8 species of *Sebastes* rockfish. Results indicated that restriction is species dependent rather than sex dependent in most species.

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

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.

A statewide survey was planned for September 2019 however problems with contracting resulted in this work not being operationalized. Therefore we were going to operationalize the survey in fall 2020. However, covid-19 delayed this implementation. The new hope is to conduct the survey in fall of 2021. The vessel is contracted and sea trials have begun. The hydroacoustic survey will be conducted using evenly spaced transects conducted over the rocky habitat as identified from available GIS layers of nearshore habitat. For each acoustic transect the suspended stereo camera system will be deployed to provide length and species composition estimates. Once collected these data will be used to generate population estimates for Black, Blue and Deacon Rockfish for the state of Oregon using standard acoustic and video analysis methodologies. This project will provide the first fisheries-independent regional population estimates for Black, Blue and Deacon Rockfish in the state of Oregon.

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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. We are working with the state of Oregon and Argos to allow us to retrieve the data from their website. The vessel to tag the fish is contracted and we have the LOA from NOAA.

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

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 a 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 Stock Assessment Teams (STAT) for copper, quillback and vermilion rockfish federal stock assessments during 2020. Staff provided data and consulted with lead assessors on modeling decisions for all three assessments. Additionally, for vermilion rockfish, ODFW staff assisted federal assessors with base model development and sensitivities. ODFW will be continuing to assist with assessment documentation and participation in the Stock Assessment Review (STAR) panels for these species in 2021.

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Management

Federal Nearshore Management Activities

Additional access to nearshore areas was provided as part of the 2021-22 biennial harvest specifications and management measures. During the June 2020 meeting, the PFMC adopted multiple NT-RCA boundary changes in California and allowed for the use of hook and line gear between 30 and 40 fathoms in the area between 40° 10′ N. lat. and 46° 16′ N. lat. Pots/traps, bottom longline, and dinglebar gear were excluded north of 40° 10′ N. lat., due to potential habitat impacts in areas primarily accessed using hook and line gear (see Agenda Item F.1.a, Supplemental GMT Report 4, June 2020 for further details).

For the past two years, the midwater trawl gear type has increased to about 110,000 metric tons.

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Fixed-Gear Nearshore Commercial Fishery

Nearshore rockfish compose the majority of take 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). Landings from 2019 commercial nearshore fishing, logbook compliance, economic data, and biological data were published in the 2019 Commercial Nearshore Fishery Data Update (Rodomsky *et al*. 2020). Weekly updates on landings and model projections allow MRP staff to effectively manage the fishery in-season. In 2020 during COVID-19, overall effort started slow and landings across all species groups except for Other Nearshore Rockfish ran low. In period 3, initial in-season increases of 600 pounds were made to each Black Rockfish bimonthly trip limit for periods 4 through 6. After Black Rockfish catch remained low in period 4, an additional 600 pounds was added to Black Rockfish period 5 and 6 trip limits (1,200 pounds in total to those last two periods) to maximize fisher opportunity and HG attainment. Blue and Deacon Rockfish trip limits were not adjusted up as they do not limit landings. Other Nearshore Rockfish landings ran high late into period 5 so the period 6 trip limit was lowered to 45 pounds and a daily trip limit of 15 pounds was implemented 9/23 to slow landings. In retrospect, this last decrease was too restrictive. End of the year attainment of the Black Rockfish state HG was 82.2%, was 90.5% for Other Nearshore Rockfish and was 29.8% 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

During 2020, trip limits were increased in both the limited entry fixed gear and open access fisheries north of 40º 10′ N lat. Limited entry fixed gear (LEFG) limits of minor slope rockfish & darkblotched rockfish were raised from 6,000 lbs. to 8,000 lbs. per two months. LEFG limits of minor shelf rockfish, shortbelly and widow rockfish increased to 800 lbs. per month from 200 lbs. per month. Yellowtail rockfish limits in the LEFG program increased to 3,000 lbs. per month from 1,000 lbs. The Canary rockfish LEFG limit increased from 300 lbs. to 3,000 lbs. every 2 months.

Open access (OA) trip limits were also increased for many species. Minor slope rockfish and darkblotched rockfish increased from 500 lbs. to 1,000 lbs. OA trip limits increased from 200 lbs to 800 lbs. for minor shelf rockfish, shortbelly and widow Rockfish. Yellowtail and canary

rockfish also increased, from 500 to 1,500 lbs. per month for yellowtail and an increase to 1,000 lbs from 300 lbs. 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 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; however the black rockfish harvest limit continued to decrease by 2-5% through 2020 due to the most recent stock assessment (2015) and applying the time varying sigma to the output of that assessment. 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. In order 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 bag limits (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 July, at which time ODFW required anglers to release those species. 2020 was another high effort year, even with COVID-19 closures and restrictions it had the third highest effort, with just over 103,000 bottomfish angler trips.

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Outreach

ODFW staff did have to reduce in person outreach activities in 2020 due to COVID restrictions and safety protocols. However, we continued to work with anglers via webinars, 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 continue 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 (NMFS) Saltwater Recreational Policy. ODFW staff are planning to continue the outreach and education efforts.

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 2020.

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 2020, the PFMC recommended and NMFS implemented an emergency rule to temporarily allow an extension in the primary sablefish tier fishery from October 31, 2020 to December 31, 2020. The issue of "gear-switching", or using non-trawl gear to harvest sablefish in the trawl individual fishing quota (IFQ) fishery continues to be prioritized by the PFMC, which will consider an analysis of a range of maximum gear switching levels at its April 2021 meeting. 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. There has also been an initiation of a periodic review of the Limited Entry Fixed Gear Permit Stacking Program that will continue into the future (https://www.pcouncil.org/documents/2020/08/d-2-attachment-2-program-review-planning-limited-entry-fixed-gear-permit-stacking.pdf/). The introductory workshop in a Management Strategy Evaluation (MSE) process for sablefish is scheduled for April 27-28, 2021 (https://www.pcouncil.org/events/sablefish-management-strategy-evaluation-workshop-to-be-held-online-april-27-28-2021/).

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Lingcod

Assessment

ODFW staff participated in the STAT for the federal lingcod stock assessment. Staff provided data and advice on modeling decisions. Major model development is planned for spring 2021. Additionally, ODFW staff provided substantial coordination and logistical support to aging efforts for lingcod in 2020 and continuing into 2021. Commercial lingcod samples were sent to be aged at WDFW in 2020, and recreational lingcod samples were mounted and sent to NWFSC for aging in late 2020 and will continue into 2021.

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Management

Commercial Fishery

Trip limits increased for lingcod in both the limited entry fixed gear and open access fisheries North of 40º 10′ N lat. In the limited entry fleet trip limits were increased from 2,600 to 4,000 lbs. every 2 months. In the open access fleet trip limits were increased from 1,200 lbs. to 2,000 lbs. per month. In 2020, the commercial fleets in Oregon landed 294.4 metric tons of lingcod, which was down from 397.1 mt in 2019, likely due to market limits and other factors related to the COVID-19 pandemic.

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Recreational Fishery

Lingcod (*Ophiodon elongates*) 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 2020, anglers landed just over 53,000 lingcod, totaling 162 mt.

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Atka Mackerel

Nothing to report in 2020.

Pacific Halibut

Management

Oregon's recreational fishery for Pacific halibut continues to be a popular, high profile fishery requiring International Pacific Halibut Commission (IPHC), federal, and state technical and management considerations. In 2020, the recommended an annual catch limit for Area 2A (Oregon, Washington, and California) was 1.5 million pounds which the IPHC Commissioners indicated would be in place for four years, until 2022. The recreational fishery for Pacific halibut is managed under three subareas with a combination of all-depth and nearshore quotas. In 2020, the Columbia River subarea quota was 18,494 pounds, the Central coast subarea quota was 271,592 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 2020 recreational landings in the Central coast subarea was 157,887 pounds, 58 percent of the quota. Landings in the Southern subarea were 7,381 pounds (92% of the quota) and in the Columbia River subarea, landings were 5,619 pounds (50 %). Fishing in the Central Coast Subarea was restricted by weather for part of May, June, and much of August and September. Due to COVID restrictions, the Columbia River Fishery did not open until August, rather than the usual early May. Anglers reported a lot of small fish, in the 24-28 inch size range, many of which were released at sea. The average size of landed fish in 2020 was down by approximately 4 pounds net weight from 2019. This low average size was the main contributor to the low quota attainment, as there were more fish landed in 2020 than in previous years, just less poundage.

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Other Groundfish

Kelp Greenling

Management – Commercial Fishery

The commercial Greenling harvest guideline (HG) for 2020 was 118.3 metric tons. Greenling are targeted by very few commercial fishers regardless of the relatively high HG and price per pound paid for live fish. The bimonthly trip limit in 2020 was 1,000 pounds per period set after considering public input, markets and local depletion concerns. Greenling landings ended the year at 10.1% 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 harvest guideline (HG) for Cabezon in 2020 was again 30.2 metric tons. Cabezon catch in the fishery ran low in 2020 for first time a few years. To increase opportunity and attainment, ODFW doubled the initial 2020 bimonthly trip limit to 2,000 pounds for periods 5 and 6. Final commercial fishery attainment was 67.3% 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 goes very quickly. In each of the last several years, the quota has been met in six weeks, at which time ODFW prohibits retention. 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.

The need to develop fisheries independent estimates of demersal fishes in Oregon remains an important need for ODFW. Remote underwater vehicles (i.e. 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 NWFSC and AFSC

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 research was conducted from late October –early November in 2019 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. Sampling was conducted in fall of 2019 and video review is undergoing.

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Aging Activity

Production Aging

In 2020, emphasis was placed on species up for assessment in 2021. Initially, it was believed that there might be a full assessment on Oregon Copper Rockfish, so ODFW produced break-and-burn age estimates for 363 Copper Rockfish from the commercial fishery (73 tested; captured from 2002-2019) and 2298 from the recreational fishery (459 tested, captured from 2005-2019). These ages ended up being used to inform an externally estimated growth curve for a data-moderate assessment.

Due to some uncertainty over the next species to focus on for 2021 assessments, ODFW moved to aging Black Rockfish in preparation for a 2023 assessment. Break-and-burn age estimates were generated for 648 Black Rockfish (0 tested) captured in the 2017 commercial fishery.

In September 2020, ODFW began generating ages for a full 2021 Vermilion Rockfish assessment. To that end, staff produced break-and-burn estimates for 896 Vermilion Rockfish from the commercial fishery (180 tested; captured from 2004-2020) and 621 from the recreational fishery (0 tested; captured from 2009-2019). Aging of samples from the recreational fishery would continue into 2021.

Aging activities affected by COVID-19 in 2020 included the preparation of Lingcod fin ray sections. Typically, agers from PSMFC cut and mount fin ray sections from our recreational catch. Standard practice requires the use of a fume hood for mounting the sections to slides with Cytoseal. Due to COVID-19, PSMFC agers were not able to access their lab, so sections were cut by ODFW personnel and affixed to slides using Crystalbond (a non-toxic thermoplastic resin), and nail polish was used to elucidate annual marks. This method produced clear sections that were able to be read and served as a good alternative to the standard mounting method described in the CARE aging manual.

Age Validation

The 2015 stock assessment for California, Oregon, and Washington stocks of Black Rockfish identified the need for validation and verification of annuli as a recommended avenue for research in order to improve upon future assessments. In May 2020 we began a collaborative study with the Canadian Centre for Isotopic Analysis at the University of Alberta to validate annuli on otoliths of Black Rockfish (a semi-pelagic rockfish), Cabezon (a difficult-to-age sculpin), and Copper Rockfish (a demersal rockfish) using secondary ion mass spectroscopy to measure oxygen isotope ratios in otoliths over the lifespan of the fish. Because an otolith is acellular, metabolically inert, and grows throughout the life of the fish, any elements or compounds accreted onto its surface are permanently retained. Otoliths therefore contain a complete record of the temperature and chemical composition of the ambient water a fish experienced over its lifespan. A known inverse relationship exists between water temperature and $\delta^{18}O$, so our goal is to relate peaks in the $\delta^{18}O$ signal (corresponding to cold water temperatures) to annual marks on the otolith.

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Remotely operated vehicle (ROV) video survey methodology review for nearshore groundfish abundance estimation

Since 2000, ODFW's Marine Resources Program has conducted remotely operated vehicle (ROV) video transect surveys of untrawlable nearshore rocky reefs to assess the distribution and density of demersal fishes and invertebrates as well as their associated benthic habitat

structures. Meanwhile, the Research and Data Needs sections of many recent stock assessments for nearshore and other stocks have included recommendations for a fishery-independent survey in untrawlable habitats. Reports by Stock Assessment Review Panels and the Center for Independent Experts have echoed these recommendations, noting the need to adequately survey populations (or portions thereof) that are not available to the current survey sampling gear in order to understand scale and trends in abundance, and to avoid reliance on fishery-dependent Catch Per Unit Effort (CPUE) indices. To date, data informing the scale of nearshore population sizes is lacking.

In 2020, ODFW and California's DFW jointly participated in a formal methodology review of ROV-based fishery-independent visual surveys for nearshore groundfish species conducted by the Pacific Fishery Management Council's Scientific and Statistical Committee (SSC). The in-person review was conducted over three days in February 2020 in Santa Cruz, CA. The purpose of the review was to determine whether results produced using the data acquisition, compilation, and analysis methods used independently by each of the two states' agencies can be used in future stock assessment models. The data and methods evaluated focus on providing fishery-independent estimates of total abundance for select coastal benthic fish species, with the primary purpose of informing scale in stock assessments. For species with insufficient data to generate robust estimates of absolute abundance, these methods may still produce useful indices of relative abundance. Following positive recommendations from the SSC and review by the full PFMC, in September 2020 the ROV data and methods for both states were endorsed for use by stock assessors for a select list of species, subject to the considerations identified by the SSC for appropriate data usage.

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Publications

Vaux, F., Rasmuson, L., Kautzi, L., Rankin, P., Blume, M., Lawrence, K., Bohn, S., O'Malley, K. 2019. Sex matters: Otolith shape and genomic variation in Deacon Rockfish (*Sebastes diaconus*). Evolutionary Applications 9: 13153-13173