OREGON'S GROUNDFISH FISHERIES AND INVESTIGATIONS IN 2018

OREGON DEPARTMENT OF FISH AND WILDLIFE
2019 AGENCY REPORT

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Edited by:

Alison Whitman

Contributing Authors:

L. Aylesworth, T. Buell, C. Don, C. Heath, L. Kautzi, G. Krutzikowsky, S. Marion, L. Mattes, L. Rasmuson, C. Sharpe, B. Rodomsky, J. Watson and A. Whitman

Oregon Department of Fish and Wildlife
Marine Resources Program
2040 SE Marine Science Drive
Newport, OR 97365

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1) AGENCY OVERVIEW

MRP Program Manager:	Dr. Caren Braby
Resource Management and Assessment:	Dave Fox
Fishery Management:	Maggie Sommer
Technical and Data Services:	Justin Ainsworth

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.

2) SURVEYS
   a) RECREATIONAL FISHERIES MONITORING AND SAMPLING

Sampling of the ocean boat sport fishery by MRP's Ocean Recreational Boat Survey (ORBS) continued in 2018. Starting in November 2005, major ports were sampled year-round and minor ports for peak summer-fall season. Catch during un-sampled time periods in minor ports continues to be estimated 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, length and weight of landed groundfish species at Oregon coastal ports during 2018. 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. 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. Beginning in 2003, the recreational harvest of several groundfish species is monitored inseason for catch limit tracking purposes.

Other ODFW recreational management activities in 2018 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 2019

Contact: Lynn Mattes (lynn.mattes@state.or.us), Christian Heath (Christian.t.heath@state.or.us)

b) 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 in-season monitoring and as a primary commercial data source for federal stock assessment. In 2018, preparations continued to add fixed gear fishery logbooks to the PacFIN database. Species composition sampling of rockfish and biological sampling of commercially landed groundfish continued in 2018 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.

Contact: Cameron Sharpe (Cameron.S.Sharpe@state.or.us), Scott Malvitch (Scott.Malvitch@state.or.us)

3) 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 2018. More information is available on the Oregon Marine Reserves website at OregonMarineReserves.com

a) MANAGEMENT

Data contribution to upcoming Cabezon Assessment (2019)

Juvenile fish surveys are conducted with Oregon State University as part of marine reserves monitoring are providing important data for the upcoming cabezon stock assessment in 2019. Cabezon are popular in both the nearshore sport and commercial fisheries in Oregon. Data from Marine Reserve sampling are being used to help stock assessors understand how quickly young cabezon grow and to inform assessments of recruitment patterns. These types of data are often difficult for stock assessors to come by because collecting and aging these very small (< 2 in) juvenile fish is challenging. ODFW is the only nearshore monitoring program currently collecting these data in Oregon. Fisheries managers are also exploring how data from marine reserves monitoring hook-and-line surveys might be used by stock assessors, to understand how relative abundance of cabezon can change from year to year.

Data in Response to Low Oxygen (Hypoxia)

In mid-August 2018, reports of dead fish and crab washing up on beaches prompted researchers and ODFW to believe there were low oxygen conditions along the coast, but little to no data were available to confirm these conditions. The ODFW Marine Reserves team responded by working with Dr. Francis Chan at OSU to deploy oxygen sensors on crab pots from mid-August through mid-September during Hook and Line Surveys. These sensors provided immediate information about oxygen levels in the nearshore while increasing the spatial understanding of when and where these conditions occur along the coast.

Contact: Cristen Don (cristen.don@state.or.us), Lindsay Aylesworth (lindsay.x.aylesworth@state.or.us), Jessica Watson (jessica.watson@state.or.us)

b) MONITORING

Ecological monitoring was conducted at four marine reserve sites this past year. Monitoring included 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. Sampling with core survey tools conducted this year as part of our ongoing monitoring included:

- Hook and Line surveys
- SCUBA surveys
- Video lander surveys
- ROV surveys

Sampling through collaborative activities included:

- Oceanographic surveys (PISCO – Oregon State University and ODFW)
- Juvenile fish recruitment surveys (led by Oregon State University)
- Ocean acidification monitoring in rocky intertidal areas (led by PISCO-Oregon State University)

- Sea star wasting disease recovery monitoring in rocky intertidal areas (ODFW, The Nature Conservancy, and Oregon State University)

Contact: Lindsay Aylesworth (lindsay.x.aylesworth@state.or.us), Jessica Watson (jessica.watson@state.or.us)

c) RESEARCH

The Marine Reserve program collaborated on four new ecological research projects this year. The first explored the presence of microplastics in nearshore rockfish species with researchers at Oregon State University. The second explored variations in canary rockfish growth and reproduction with a graduate student at Moss Landing Marine Laboratories in California. The third collaborative project was through a class project at the Oregon Institute for Marine Biology (OIMB) analyzing invertebrate biodiversity data from ROV surveys. The final new collaborative project explored crab movement related to habitat and oceanography with Oregon State University and the National Oceanographic and Atmospheric Administration (NOAA).

In addition, two new human dimensions research studies occurred in 2018 to understand 1) effort shift among Oregon nearshore fisheries and 2) Oregon coastal residents overall life satisfaction and stated preferences in relation to forest and marine protected areas. The effort shift study helps to understand the impact of marine reserve implementation, family successional planning, and the drivers of fishing behavior. The coastal resident's study pioneered new methods in the human dimensions field while also exploring non-market values of marine reserves, a first for Oregon.

Contact: Lindsay Aylesworth (lindsay.x.aylesworth@state.or.us), Jessica Watson (jessica.watson@state.or.us)

4) REVIEW OF AGENCY GROUNDFISH RESEARCH, ASSESSMENT AND MANAGEMENT
   a) HAGFISH
      i) RESEARCH
      ii) ASSESSMENT

In 2018, two separate data-limited methods were applied to Oregon's hagfish fishery data to explore their utility for assessing the stock. The first method was an attempt to develop a delta-glmm CPUE index from fishery logbook data as a measure of relative abundance of hagfish through time. The second method used fishery length and maturity (visual) measurements in combination with an estimate of the ratio of hagfish natural mortality over growth (Thorson 2017) to conduct a length-based spawning potential ratio assessment. During analysis it was learned that for each method, data sample sizes were too variable from year-to-year to precisely characterize error through time rendering the assessment results too uncertain to be recommended for management use. ODFW is increasing fishery sampling effort and working to improve logbook information to reduce uncertainty and increase the utility of these assessment methods.

Contact: Brett Rodomsky, (Brett.T.Rodomsky@state.or.us), Troy Buell (Troy.V.Buell@state.or.us)

iii) 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 2018 were 1,453,391 pounds, or 90.8% of state harvest guideline of 1.6 million pounds. No major management actions were taken in 2018 by ODFW.

Contact: Brett Rodomsky, (Brett.T.Rodomsky@state.or.us), Troy Buell (Troy.V.Buell@state.or.us)

b) DOGFISH AND OTHER SHARKS
c) SKATES
   i) RESEARCH
   ii) ASSESSMENT

ODFW contributed data to two upcoming skate federal stock assessments in 2018. The primary effort included a commercial catch reconstruction of species-specific skate landings from 1978 – 2018, where gear-specific species compositions were applied to complex-level landings. Historically, skate landings were recorded at the complex level and it is only in recent years that species-specific landings have been required for commercial landings. This reconstruction is to be used in the Big Skate and Longnose Skate stock assessments in 2019. Additional commercial data was also provided to the assessments.

Contact: Alison Whitman (alison.d.whitman@state.or.us)

iii) MANAGEMENT
d) PACIFIC COD
e) WALLEYE POLLOCK
f) PACIFIC WHITING

Pacific whiting (hake) are the highest volume West Coast fishery by far. For example, 2018 landings of 695 million pounds constitute 71% of the 976 million pound total for all species combined. Preliminary stock assessment results (i.e., 1.6 billion lbs for US/Canada) could result in record high quotas for 2019, which are the result of exceptionally strong recent recruitment events. Recent management focus has been to develop new tools to reduce salmon bycatch, and to reduce constraints of bycaught rockfish stocks that have recovered from being overfished.

Contact: Patrick Mirick (Patrick.p.mirick@state.or.us)

g) GRENADIERS
h) ROCKFISH
    i) RESEARCH - Depth-associated variability of Deacon Rockfish (*Sebastes diaconus*) age, growth and maturity parameters in Oregon waters and their effect on stock status

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 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 the 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 >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 area 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 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 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.

Contact: Leif Rasmuson (leif.k.rasmuson @state.or.us)

ii) RESEARCH - Otolith shape and population genetic variation in Deacon Rockfish (*Sebastes diaconus*)

Little is known about intraspecific variation within the Deacon Rockfish (*Sebastes diaconus*), a recently described species found off the West Coast of North America. We used an

interdisciplinary approach to test for population structure among fish sampled at two nearshore reefs (Siletz Reef and Seal Rock) and one offshore area (Stonewall Bank) off the Oregon coast. We found that fish sampled from the three sample sites are differentiable based on otolith shape and genetic variation whether analyzed independently or classified into nearshore and offshore groups. We also identified 92 outlier loci that distinguish males and females, potentially representing sex-linked, putatively adaptive variation. Although sex-linked genetic variation did not appear to affect geographic comparisons, males and females were readily distinguished. Morphometric results indicated that there was significant secondary sexual dimorphism in otolith shape, but further sampling is required to disentangle potential confounding influence of age-structure. We found small but statistically significant otolith shape and genetic differences among Deacon Rockfish sampled off the Oregon coast, regardless of whether the three sample sites were analyzed independently or organized into nearshore (Siletz Reef, Seal Rock) and offshore groups (Stonewall Bank). Although differentiation was low, the fact that we detected statistically significant otolith shape and genotypic differences over such a small geographic scale (<50 km^2) is remarkable in itself. Furthermore, both morphometric and genetic results were comparable to findings from other marine fishes sampled over larger geographic distances.

Sex mattered in our otolith shape and genetic analyses. We found evidence for secondary sexual dimorphism in otolith shape. This result may reflect differences in the growth and lifespan of males and females, and further research is required to disentangle these potential effects among the sample sites. We identified 92 outlier loci that are likely sex-linked sites in Deacon Rockfish, and males and females exhibited statistically significant neutral and putatively adaptive genetic differences. Our otolith shape and genetic results do not provide strong evidence for two potential fish stocks of Deacon Rockfish in the nearshore and offshore. Although morphological and genetic differences were statistically significant, values were low and there was considerable overlap among specimens, and comparisons analyzing the three sample sites independently demonstrated similar results. Stock assessments using similar methods have relied upon stronger patterns in results in order to delineate a stock boundary.

This study provides a first step towards the investigation of intraspecific variation in the recently described Deacon Rockfish species. This study demonstrates the potential of RAD sequencing studies to provide substantial population genetic information for species that have not been previously investigated. Much work is still required to study how the species differs from Blue Rockfish (and other relatives) in biology and management requirements. If future genetic analyses of *Sebastes* want to include the Deacon Rockfish, the sequence data presented here should be compatible with reads from the previous RADseq studies of other rockfish species that also used the *SbfI* restriction enzyme. The shaper otolith digitization method easily allows datasets to be combined as well, and therefore both geometric morphometric and genetic data from this study should permit genus-wide studies of rockfish diversity.

Contact: Leif Rasmuson (leif.k.rasmuson @state.or.us)

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

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*), becomes 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 months), 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.

Contact: Leif Rasmuson (leif.k.rasmuson @state.or.us)

iv) ONGOING RESEARCH

1. Black rockfish ageing error

The past Black Rockfish federal stock assessment has noted that ODFWs Black Rockfish ages have a positive correlation between the age of the fish and the age reading CV. We will be working this year to determine the cause of this trend in CVs and attempt to reduce it.

Contact: Leif Rasmuson leif.k.rasmuson@state.or.us, Lisa Kautzi Lisa.A.Kautzi@state.or.us

2. Yelloweye rockfish habitat modeling

Using the >1,000 video lander drops conducted by ODFW Marine Fisheries Research Project since 2009, we are developing habitat models and comparing the findings generated by VAST and R-INLA.

Contact: Leif Rasmuson (leif.k.rasmuson@state.or.us)

3. Sex linked genetics of rockfish

Sex had an observable effect in the genetic data for Deacon Rockfish, and 92 outlier loci (sites with strong differentiation) were identified between males and females. Future research is required to determine the genomic identity of these outlier loci (as rockfish currently lack an annotated reference genome), but the outliers did not map to the same region identified as a Y sex chromosome in Black-and-Yellow and Gopher rockfish by a previous study.

Contact: Leif Rasmuson (leif.k.rasmuson@state.or.us)

4. Discard mortality of Yelloweye Rockfish associated with nearshore live fish longline fishery

In partnership with ODFWs marine reserves program we will examine the delayed mortality of Yelloweye rockfish caught in the nearshore live fish longline fishery that are released by venting.

Contact: Lindsay Aylesworth Lindsay.x.aylesworth@state.or.us, Leif Rasmuson leif.k.rasmuson@state.or.us

v) ASSESSMENT
vi) MANAGEMENT – Fixed Gear 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 fishery 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 product for fresh fish markets. Landings are regulated through bimonthly trip limits, minimum size limits, and annual Harvest Guidelines (HGs). Weekly updates on landings allow MRP staff to effectively manage the fishery in-season. Landings from 2017 commercial nearshore fishing, logbook compliance, economic data, and biological data were published in the 2017 Commercial Nearshore Fishery Summary (Rodomsky et al. 2018).

In 2018, in-season adjustments were made to trip limits for all rockfish species management groups. For Black Rockfish, early season projections indicated risk of exceeding the harvest guideline under adopted trip limits. Therefore, the period 3 trip limit was reduced from 1,800 pounds to 1,500 pounds. As the season progressed and the rate of effort in the fishery declined, projected HG attainment fell behind and ODFW raised the trip limit for Black Rockfish from 1,500 pounds to 1,800 pounds in periods 5 and 6. For Blue, Deacon and Other Nearshore Rockfish mid-year projections indicated landings were relatively high and bimonthly trip limits needed to be reduced to maximize chances of keeping these fisheries open through the year. Effective 7/5/2018, the Blue and Deacon Rockfish trip limit was dropped from 300 pounds to 100 pounds and the Other Nearshore Rockfish trip limit was dropped from 450 pounds to 200 pounds for periods 4 – 6. These reductions resulted in 96.5% attainment of the combined Blue, Deacon and Other Nearshore Rockfish commercial HG.

Contact: Brett Rodomsky, (Brett.T.Rodomsky@state.or.us), Troy Buell (Troy.V.Buell@state.or.us)

vii) MANAGEMENT – Mid-water Rockfish Trawl fishery

The reemergence of the mid-water trawl rockfish fishery has been one of the greatest success stories for US West Coast Fisheries. The fishery had been dormant since the 1990's due to widow and canary rockfishes being overfished. These stocks have now recovered, as has the fishery in 2017 and 2018. The ex-vessel value of the fisheries in both those years combined was $14 million.

Contact: Patrick Mirick (Patrick.p.mirick@state.or.us)

viii) MANAGEMENT – Recreational Fishery

Black rockfish (*Sebastes melanops*) remains the dominant species caught in the recreational ocean boat fishery; however the black rockfish harvest limit continues to decrease by 2-5% annually and will continue to decrease for the next several years. As in recent years, the retention of yelloweye rockfish (*S. ruberrimus*) was prohibited year round. In order to remain within the yelloweye rockfish impact cap (via discard mortality), the recreational groundfish fishery was restricted pre-season to inside of 30 fathoms from April 1 to September 30. Black rockfish has become as much of a limiting factor as yelloweye rockfish. The fishery season structure and regulations, such as 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 pre-season adjustments, the recreational bottomfish fishery daily bag limit had to be reduced beginning on July 1 from five to four fish per angler per day. Effort and catches were much lower in June than projected. Additionally, the catches in July and early August were lower than anticipated with the reduced bag limit, this allowed the bag limit to return to five fish per day in mid-September. Even with the decreased bag limit for the peak summer months, 2018 had the highest bottomfish effort on record, with over 109,000 angler trips.

Contact: Lynn Mattes (lynn.mattes@state.or.us), Christian Heath (Christian.t.heath@state.or.us)

ix) MANAGEMENT – Recreational Fishery Outreach Activities

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 16,000 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 appears to be successful. Prior to the beginning of the campaign, fewer than 40 percent of anglers used descending devices. After the campaign, the percentage of users 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 usage rates to approximately 94 percent for 2017 and 95 percent in 2018. Additional outreach efforts include: videos online that show fish successfully swimming away after release with a device, rockfish barotrauma flyers have been produced, and videos on how to use the various descending devices have been produced. 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. Based on a slowdown in requests for descending devices it is believed that the majority of anglers

have them. Additionally, the funding that has provided devices has been fully used. Therefore, ODFW will no longer be distributing devices, but will continue with the outreach and education efforts.

Additionally, ODFW has been educating anglers on a 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 float 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.

Contact: Lynn Mattes (lynn.mattes@state.or.us), Christian Heath (Christian.t.heath@state.or.us)

i) THORNYHEADS
j) SABLEFISH

Sablefish is considered the most important stock for West Coast groundfish fisheries excluding whiting. It supports large-scale pot and longline fisheries in Oregon, and is of high value for bottom trawlers in the DTS multi-species strategy (dover sole/thornyheads/sablefish). A new full stock assessment will be conducted in 2019, of which many are optimistic due to large bycatch events of juvenile sablefish in the past few years. ODFW contributed substantial support to the upcoming sablefish assessment in 2018. There has also been recent focus on reconsideration of sablefish allocations, which has been highly contentious. This includes proposals to limit or freeze the amount of IFQ allocation that can be taken by longlines and pots so that more can be available for trawlers. It also includes proposals to allow the transfer or sale of unused southern area sablefish IFQ to move to the northern area that has high attainments.

Contact: Patrick Mirick (Patrick.p.mirick@state.or.us)

k) LINGCOD

Lingcod is one of the most valuable, but underutilized species on the West Coast. For longline fisheries, the primary shelf habitats of lingcod are closed to a Rockfish Conservation Area that is used to minimize impacts to overfished yelloweye rockfish. For bottom trawl, the shelf habitat is open, but they have been constrained by low IFQs of yelloweye rockfish. There is however optimism that lingcod attainments could increase by large degrees for both longline and trawl fisheries due to faster than expected rebuilding progress of yelloweye rockfish, which has resulted in higher bycatch limits and reduce fishery constraints. ODFW contributed data and support to the most recent lingcod stock assessment and continues to collect data for future assessments.

Contact: Patrick Mirick (Patrick.p.mirick@state.or.us)

l) ATKA MACKEREL
m) PACIFIC HALIBUT/ IPHC ACTIVITIES

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 2018, the recommended an annual catch limit for Area 2A (Oregon, Washington, and California) was 1.19 million pounds. The recreational fishery for Pacific halibut is managed under three subareas with a combination of all-depth and nearshore quotas. In 2018, the Columbia River subarea quota was 11,682 pounds, the Central coast subarea quota was 215,463 pounds, and the Southern coast subarea quota, was 8,982 pounds. Landings in the sport Pacific halibut fisheries are monitored weekly to track landings in relation to 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 2018 recreational landings in the Central coast subarea was 204,408 pounds, 95 percent of the adjusted sub-area quota. Landings in the Southern subarea were 6,043 pounds (67% of the sub-area quota) and in the Columbia River subarea, landings were 15,834 pounds (135 %). The Columbia River Subarea all-depth fishery opened a week prior to any other halibut fishery in either Washington or Oregon. That opening weekend also had the nicest weather of the summer, leading to a large shift in effort and an unanticipated increase in landings. This was the primary cause of the overage in that sub-area.

Contact: Lynn Mattes (lynn.mattes@state.or.us), Christian Heath (Christian.t.heath@state.or.us)

n) OTHER
   i) KELP GREENLING

The 2015 Kelp Greenling stock assessment found that the Oregon stock biomass is far larger than is being exploited in fisheries. This resulted in a Greenling commercial Harvest Guideline (HG) far larger than can reasonably be attained under current effort levels (2018: 144.3 metric tons). After two-thirds of the 2018 season, over 90% of the harvest allocation was still available. On 9/1/2018, ODFW staff raised the bimonthly trip limit from 800 pounds to 1,000 pounds for periods 5 and 6 to increase Kelp Greenling opportunity for fishers while considering markets and local depletion concerns. With in-season adjustments final commercial fishery attainment was 12.4% of the annual HG.

Contact: Brett Rodomsky, (Brett.T.Rodomsky@state.or.us), Troy Buell (Troy.V.Buell@state.or.us)

   ii) CABEZON
      (1) RESEARCH - Age reading of Cabezon (*Scorpaenichthys marmoratus*): 1) comparison of thin-section and break-and-burn methods and 2) comparison of growth curve fits

Previous ageing work on Cabezon by the Oregon Department of Fish and Wildlife was completed using the thin-section method because of the small otolith size and a perceived increase in pattern clarity. Recently however, the ODFW marine age reading team elected to try to decrease the amount of time spent on sample preparation while maintaining pattern clarity. A few common methods of otolith preparation were tested, but ultimately the best clarity came from soaking the otoliths in a 50% ethanol solution for at least a week and applying the break-and-burn method. Thus, one of the goals of this study was to 1) determine how much bias there was between the break-and-burn and thin sectioning and 2) assess bias and precision between current and previous ODFW age readers. In addition to examining how methodological differences in age and growth affect bias and precision of age estimates, we also wanted to examine how these differences ultimately impact parameter estimates obtained when fitting growth functions. Further, previous growth function parameter estimates in Oregon were generated solely from the recreational fishery and with a temporally restricted dataset. Therefore, we reanalyzed the data, examining the effect of port and fishery on the larger dataset while accounting for differences between readers. Finally, in the most recent Cabezon stock assessment, the assessors note a significant difference between Oregon and California male growth function parameters. Therefore, we reassessed parameter estimates for male Cabezon in Oregon to determine whether increasing the size of our dataset affected the growth function parameter estimates. In recent assessments (e.g. kelp greenling), the lack of young and small fish has been shown to have a profound impact on the ability of the model to establish the scale of the stock. Therefore, we also tested the effect of adding size data for young and small fish by: 1) assessing different techniques for anchoring the growth function at or near the origin and 2) testing how these different anchors affect the estimated growth function parameters.

Cabezon sagittal otoliths are small, opaque structures measuring approximately 5 mm in length. The first year is not always easy to distinguish from surrounding growth checks, but it frequently occurs between approximately 1.2 and 1.5 mm. The second year is more prominent and is typically seen at about 1.9 mm. Splitting of the annuli during years 1-3 also occurs, making it easy to over age young fish. The best method of otolith preparation for production ageing of Cabezon appears to be a combination of soaking the structure in 50% ethanol then burning one half or more for ageing. The average coefficient of variation and percent error were both very high between readers and methods while the average percent agreement between methods was very low. Comparison of the age bias plots show that there is clear evidence of age bias between all of the different reader and method combinations. All three tests of symmetry (McNemar, Evans-Hoenig, and Bowker) indicate that the different method/reader combinations are not symmetrical around the 1:1 axis; in other words there is strong evidence of age reading bias.

Our best-fit hierarchical model for the recreational data included sex as a fixed effect and reader as a random effect. Our best-fit hierarchical model for the fishery model only included sex as a fixed effect. A potential concern with these fishery analyses is that the commercial fishery data were only obtained from the non-live fish fishery. Inherent in the differences between the dead fish and live fish fishery is a selectivity for smaller “dinner plate-sized” individuals. Thus, the live-fish fishery is likely selecting not only smaller fish but also fish that grow more slowly. Therefore,

during the stock assessment process when back calculating ages using the length at age key for the live fish fishery, we suggest a sensitivity analysis using the lower confidence bound of our best-fit model as the length at age-key for this fishery. Unlike the commercial fisheries, in the recreational fishery it is likely the sizes and ages are representative of Oregon's Cabezon population. During bottomfish charters with fisheries observers, 91% of all Cabezon caught were retained. Of the 9% that were released, 86% of those were released because they were below the legal limit. In other words only 1.25% of the Cabezon caught were released due to potential high grading. The parameter estimates generated by anchoring the growth curve by forcing t_0=0 or including fish from the SMURFs as age 0 or 0.5 drastically altered the parameter estimates and overall shape of the best-fit line. Overall we see that the residuals from not including the SMURF fish and not forcing t_0=0 had the best overall fit. This is not surprisingly considering an inherent quality of the von Bertalanffy growth function is that it generally fits better when not anchored at zero. Although including the SMURF fish makes biological sense, the goodness of fit is reduced when forcing t_0=0.

In this study we find that ethanol-soaked otoliths read using the break-and-burn method provide a dramatic increase in the number of structures that can be aged each day. However, our work also demonstrates that there is a large amount of age reading bias and overall lack of precision between otolith preparation methods and readers. The large difference between the ages generated using either thin-sectioning or break-and-burn is a concern because ages from 2005-2008 were read using thin-sectioning and all other years were read using break-and-burn. This work highlights the difficulties of ageing Cabezon and strongly argues for the need to conduct age validation studies for future stock assessments.

Contact: Leif Rasmuson (leif.k.rasmuson @state.or.us)

(2) ONGOING RESEARCH

1. Examination of other structures for ageing Cabezon.

We will examine Cabezon vertebrae and spines to see if they will be a viable structures for ageing Cabezon in the future given the issues aging from otoliths.

Contact: Leif Rasmuson leif.k.rasmuson@state.or.us, Lisa Kautzi Lisa.A.Kautzi@state.or.us

(3) ASSESSMENT

ODFW contributed substantial support and data to the federal stock assessment for Cabezon in 2018, in addition to participating in the stock assessment team. Major data products include a historical recreational catch reconstruction, multiple fishery dependent datasets for indices of abundance, all age composition data and a detailed associated analysis on aging bias and confidence, and finally, two new fishery-independent datasets.

Contact: Alison Whitman (alison.d.whitman@state.or.us)

(4) MANAGEMENT

Cabezon catch rates in the 2018 commercial nearshore fixed gear fishery were very high. As early as March and based on projections, ODFW staff recognized the remaining bimonthly limits were likely too high to keep the fishery open all year. After consulting industry advisors, Cabezon trip limits were dropped from 2,500 pounds to 1,500 pounds for period 3; from 2,500 pounds to 500 pounds for periods 4-5; and from 2,000 to 500 pounds for period 6. As the season progressed into period 5 it became clear that additional restrictions were needed to maximize the chances the fishery remained open all year. On 10/5/2018, a daily limit of 15 pounds per day was implemented and the period 6 trip limit was dropped from 500 pounds to 45 pounds. Final commercial fishery attainment was 97.1% with in-season adjustments.

Contact: Brett Rodomsky, (Brett.T.Rodomsky@state.or.us), Troy Buell (Troy.V.Buell@state.or.us)

5) ECOSYSTEM STUDIES

a) OPERATIONALIZING A SURVEY OF OREGON'S NEARSHORE SEMI-PELAGIC ROCKFISH

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 proximity to the ODFW main office 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 three times on locations with either large schools of rockfish or rocky reef habitat. For each video drop we collected a minimum of two 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 maximum number (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 in the summer of 2018 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.

Our next step is to use these methods to implement a statewide survey. ODFW's Marine Fisheries Research Project will be conducting this survey over the course of 1-1.5 months from late August to early October 2019 over all of Oregon's nearshore rocky reefs. 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.

Contact: Leif Rasmuson (leif.k.rasmuson @state.or.us)

b) 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. 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 five 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.

Contact: Leif Rasmuson (leif.k.rasmuson @state.or.us)

c) SURVEYS OF SUBTIDAL ROCKY AREAS WITH THE VIDEO LANDER

In 2018, extensive work was done drafting a final report on video lander survey work conducted on an approximately 30.2 km2 area of subtidal nearshore rocky reefs in the marine waters from Cape Foulweather to Alsea Bay, Oregon. Much of the preliminary results of this work has already been reported to the TSC over the past several years. The final report is anticipated to be published as an ODFW Informational Report in 2019.

Contact: Greg Krutzikowsky (greg.k.krutzikowsky@state.or.us)

d) AGING ACTIVITIES

During 2018, 4,920 age estimates were produced from recreational and commercial sampling for research and assessment purposes. With the primary goal of preparing for the 2019 Cabezon federal stock assessment, 1,315 recreation structures were aged, and 269 tested to provide estimates of aging error. An additional 233 Cabezon were aged as part of an agency report (See Publications section) comparing the use of thin sectioning versus break and burn ageing methods and the comparison of growth curve fits. Outside of assessment and project work, Black Rockfish ageing continued as a priority with 1,498 commercial (295 tested) and 1,089 recreation (221 tested) aged.

Contact: Lisa Kautzi (Lisa.A.Kautzi@state.or.us)

6) PUBLICATIONS

1) Rasmuson, L.K., Kautzi, L.A., Aylesworth, L., Wilson, M.N., Grorud-Colvert, K., 2019. Age reading of Cabezon (Scorpaenichthys marmoratus): 1) comparison of thin-section and break-

and-burn methods and 2) comparison of growth curve fits (No. 2019– 04), ODFW Informational Report. Oregon Department of Fish and Wildlife.

2) Depth-associated variability of Deacon Rockfish (*Sebastes diaconus*) age, growth and maturity parameters in Oregon waters and their effect on stock status. In review. Contact: Leif Rasmuson (leif.k.rasmuson @state.or.us)

3) Otolith shape and population genetic variation in Deacon Rockfish (*Sebastes diaconus*). In review. Contact: Leif Rasmuson (leif.k.rasmuson @state.or.us)

4) Habitat use and activity patterns of Deacon Rockfish (*Sebastes diaconus*) at seasonal scales and in response to episodic hypoxia. In review. Contact: Leif Rasmuson (leif.k.rasmuson @state.or.us)