Proposal for a Methodology Review of a Combined Visual-Hydroacoustic Survey of Oregon's Nearshore Semi-Pelagic Black (*Sebastes melanops*), Blue (*Sebastes mystinus*) and Deacon (*Sebastes diaconus*) Rockfish

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Proposal Summary

The Oregon Department of Fish and Wildlife (ODFW) requests a methodology review of a new fishery-independent survey for semi-pelagic rockfishes. The 2015 Stock Assessment Review (STAR) Panel report on the most recent assessment of Black Rockfish recommended development of a coastwide fishery-independent survey for nearshore stocks. ODFW has developed this combined visual-hydroacoustic survey to inform the next assessment of the Black Rockfish stock in Oregon, which is tentatively scheduled for 2021. If this methodology is approved, it could be applied to other semi-pelagic stocks across the West coast.

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Significance to Stock Assessment & Management

The lack of fishery independent survey data on nearshore rockfishes (*Sebastes spp.*) continues to be a problem for their sustainable management. Although many species are economically and ecologically important, fisheries for semi-pelagic Black (*Sebastes melanops*), Blue (*Sebastes mystinus*) and Deacon (*Sebastes diaconus*) Rockfish are the cornerstones of Oregon's nearshore recreational and commercial fisheries. This project will provide the first fishery-independent population estimates for Black, Blue and Deacon Rockfish in the state of Oregon. We anticipate that this survey will help reduce uncertainty in estimates of scale in upcoming stock assessments.

Methods

ODFW hosted a joint workshop with federal stock assessors and agency personnel from each of the West coast states to review survey techniques for nearshore rocky reef fishes. Participants concluded that a combination of visual and hydroacoustic tools could produce robust population estimates of semi-pelagic rockfish found in untrawlable habitats. ODFW elected to move forward with a survey based on surveys conducted by the Alaska Department of Fish and Game, that successfully produced abundance estimates of Black Rockfish and were used to inform fishery management (Tschersich, 2015). These sampling protocols are analogous to those used in acoustic trawl surveys, except our species and length composition data are collected with a suspended stereo video camera system. The camera system can be deployed at various heights off bottom, and remains upright and oriented into the current. In addition to two forward-looking stereo cameras, the platform has a downward-looking camera to provide fish densities in the acoustic dead zone. The platform is outfitted with sensors to record depth, temperature, tilt, and optical back scattering. Videos are reviewed using a mean Max-N approach to provide species composition data and length frequency distributions that are combined with the acoustic data to provide an abundance estimate (Bacheler and Shertzer, 2014).

Schools of fish are acoustically sampled using a split-beam scientific echosounder. Previous work was conducted with a 200 kHz, 6.5° digital transducer but future work will be conducted using both a 38 and 200 kHz, digital transducers operating in a multiplexing configuration. Data are analyzed in Echoview combining both single targets and echo integration methods (MacLennan and Simmonds, 2013). Data are then processed by combining species composition and length data from the video with the relationship between target strength and length from Kang and Hwang (2003). Opportunistic fishing during the survey provides corresponding age composition data. Fish are obtained with either computerized jigging machines and/or conventional rod and reel tackle.

Past Work

A grant from the Saltonstall-Kennedy program allowed us to explore four core questions relating to the use and efficacy of this novel methodology: 1) assess and quantify the behavioral impacts of the camera on schooling fish; 2) understand the utilization and abundance of semi-pelagic nearshore rockfish in the acoustic dead zone; 3) validate the ability of these tools to be used to provide a population estimate; and 4) identify a survey design that balances the need for precise and accurate population estimates with the practicalities of a large at-sea survey.

To address question 1, we deployed and retrieved the camera system into schools of fish we were actively ensonifying (Fig. 1). We found that the deployment of the camera system on the schools

does not result in the attraction or repulsion of fish to the school. We also compared the distribution of fish lengths from our camera to fisheries independent and dependent hook & line data; length distributions were similar, except the camera also viewed smaller fish (Fig. 2).

To address question 2, we paired our visual-hydroacoustic method with ODFW's remotely operated vehicle (ROV) to determine the abundance of semi-pelagic rockfish within four geomorphically diverse study areas. Our work quantifying the size of the rockfish population in the acoustic dead zone is ongoing, but preliminary analysis suggests the fraction of the population in the dead zone is relatively small (Fig. 3). This work demonstrated that although semi-pelagic rockfish utilize the acoustic dead zone, the data provided by the downward camera are sufficient to inform dead zone estimation algorithms (Kloser, 1996).

Finally, to address questions 3 and 4, we surveyed Seal Rock reef located near Newport, Oregon. A 2002-2013 mark-recapture study at Seal Rock reef provided a population estimate of the Black Rockfish population that we were used to ground truth the population estimates we generated with our combined visual-hydroacoustic survey (Krutzikowsky et al., 2019). This work demonstrated that these tools are effective at providing comparably accurate estimates of rockfish population sizes. This work also allowed us to optimize survey design to balance cost and data quality. Lastly, our camera system provides adequate data on the size of the dead zone populations at a given time and location to correct the indices derived from a combined visual-hydroacoustic survey.

Proposed Survey

During the spring of 2020 we will operationalize our combined visual-hydroacoustic survey throughout Oregon's nearshore waters. The visual-hydroacoustic survey will be conducted using evenly spaced transects over rocky habitat identified from the best-available GIS layers of nearshore habitat. Transects will occur inshore of the 80 m contour since evidence suggests >99 % of the population of Black Rockfish lives inshore of this depth (Love et al., 2002). Shallow depths will be sampled with small vessels that allow operation in < 2 m of water. 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 using the methods outlined above. We have one year of funding secured from ODFW's Restoration and Enhancement board to do this survey. Ongoing funding is being pursued and requests would be strengthened by a completed methodology review.

Summary

Data provided by this project will provide the first fisheries-independent population estimates for nearshore semi-pelagic rockfish. We will collect these data using a combination of hydroacoustic and underwater stereo-video equipment. The methodologies used here are efficient and cost effective, which could facilitate the expansion of the survey across the entire West coast to include valuable nearshore fish populations in California and Washington. Improvement in the resolution of population scale in nearshore stock assessments is expected to reduce uncertainty in the overfishing limits and harvest specifications derived from the assessment results. This will benefit commercial and recreational fishermen, and the coastal communities that rely on those industries, by promoting the long-term, sustainable management of commercially important nearshore species.

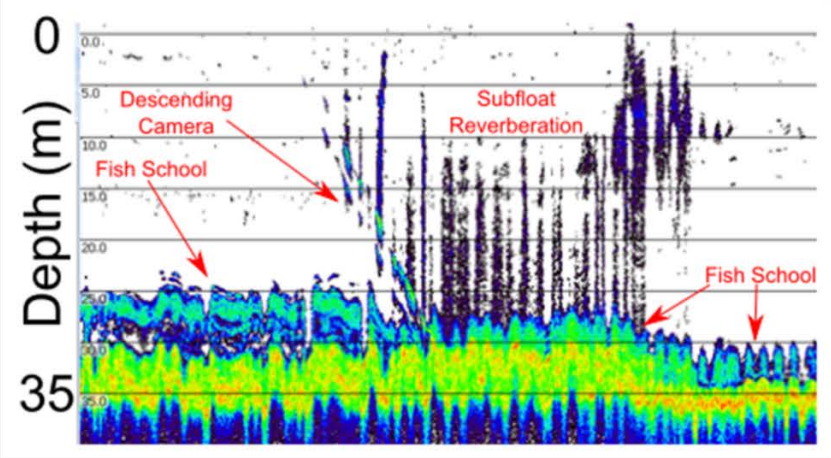

Fig. 1. Echogram depicting the deployment and retrieval of the suspended camera system into a suspended school of semi-pelagic rockfish.

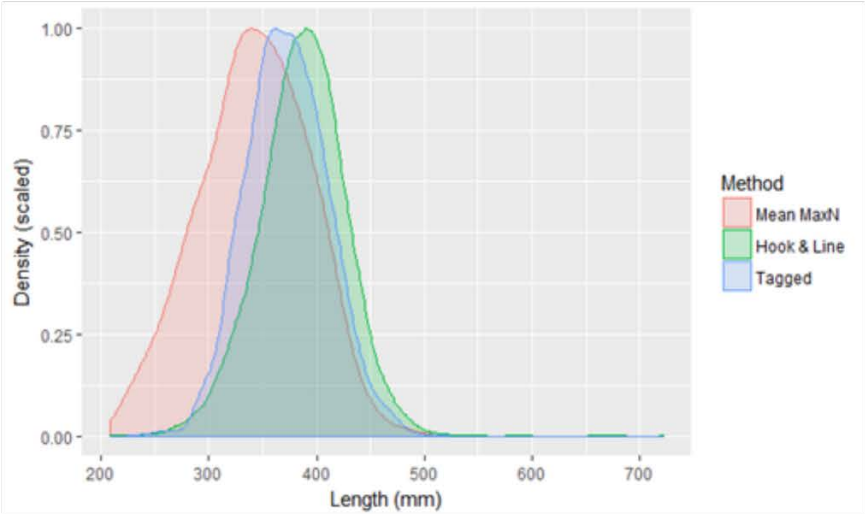

Fig. 2. Distribution of Black Rockfish lengths observed with the stereo video system (Mean MaxN), in the recreational fleet (Hook & Line) and those tagged as part of the Black Rockfish pit tagging project.

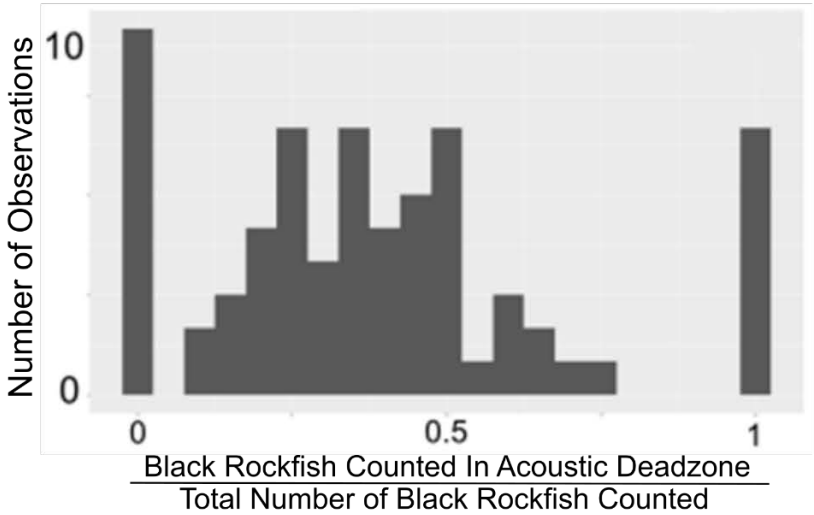

Fig. 3. Ratio of Black Rockfish counted in the acoustic deadzone to the total number of counted for each of 122 camera drops conducted during a test survey at Seal Rock reef.

References

Bacheler, N.M., Shertzer, K.W., 2014. Estimating relative abundance and species richness from video surveys of reef fishes. Fishery Bulletin 113, 15–26. https://doi.org/10.7755/FB.113.1.2

Kang, D., Hwang, D., 2003. Ex situ target strength of rockfish (Sebastes schlegeli) and red sea bream (Pagrus major) in the Northwest Pacific. ICES Journal of Marine Science 60, 538–543. https://doi.org/10.1016/S1054-3139(03)00040-7

Kloser, R., 1996. Improved precision of acoustic surveys of benthopelagic fish by means of a deep-towed transducer. ICES Journal of Marine Science 53, 407–413. https://doi.org/10.1006/jmsc.1996.0057

Krutzikowsky, G., Wagman, D.W., Davis, R., 2019. Annual progress report: Population status of Black Rockfish in Oregon coastal waters. (Oregon Department of Fish and Wildlife Marine Resources Program).

Love, M.S., Yoklavich, M.M., Thorsteinson, L., 2002. The rockfishes of the Northeast Pacific. University of California Press.

MacLennan, D.N., Simmonds, E.J., 2013. Fisheries Acoustics. Chapman & Hall, London.

Tschersich, P., 2015. Hydroacoustic survey of Black Rockfish abundance and distribution operational plan for the Afognak and Northeast districts of the Kodiak management area, 2015. Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services.