Center for Independent Experts (CIE) 2022 Methodology Review of the ODFW Video-Hydroacoustic Survey Design and Methodology

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Executive Summary

The methods of the ODFW video-acoustic survey as presented during the meeting can provide information contributing to the best scientific information available on stocks of Black and Deacon rockfish (*Sebastes melanops* and *S. diaconus*, respectively, and the closely related *S. mystinus*, or Blue rockfish), and should be endorsed for use to support management. The survey spans the range of these species along the Oregon coast, with additional focus on habitat-mapped areas of higher abundance. At present, the design-based survey design is thought to be preferable to provide an unbiased estimate of abundance of these species; the habitat-based model shows promise to provide a more efficient survey but at present requires further research. Nonetheless, there are issues-potential biases with survey methodologies that need to be addressed, in particular the lack of an *in situ* calibration of the acoustic systems and a target strength scaling model based on the species of interest in the survey environment. Improvements in results and use of data could be made using a narrower-beam split-beam 38 kHz transducer for integration, counting and *in situ* target strength measures.

Main Recommendations (in order of short to longer term)

1. **That reports of backscatter and densities of species include extrapolations to assess the dead-zone, reported separately from the ensonified water column data, then totalled.**

2. **That design-based survey results using presently available target strength and calibration scaling be tested within a formal stock assessment. Tests of apparent survey "q" and size-age deviations should be made as a basis for further research (see 8).**

3. **That a means be found to conduct *in situ* calibration of the acoustic systems with appropriate standard targets. This should be done from the vessels used during the survey with systems configured and setup as during the survey, ideally just prior to the survey.**

4. **That *in situ* research on the target strengths of Black and Deacon-Blue rockfish in the local environment be conducted (at 38 and 201 kHz). If possible, this could be supported by modelling studies – but *in situ* research is the top priority. Gaining access to an acoustic system at 38 kHz with a narrower beam (ca. 7^o) would greatly facilitate this.**

5. **That an acoustic system with 38 kHz transducer with a narrow beam (ca. 7^o) be obtained not solely to conduct *in situ* target strength studies but to replace the wider beam 10^o transducer now in use. A narrow beam reduces the bottom dead-zone.**

6. **That further investigations be made of the spatial correspondence between the densities being measured with camera and acoustics – the presented comparisons were problematic.**

7. **That additional research on the habitat-based survey model be undertaken with the objectives of achieving a better understanding of the model, the results and factors influencing the suggested densities (e.g., would hypoxia impact one design more than others?)**

8. **That once *in situ* calibrations and target strength models are available, research should focus on detection-measurement variation in numbers and sizes is relation to full stock assessment, as explanations for variations or bias in survey "q".**

Background

The review was conducted virtually over 4 days. Contributors included persons from National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), the (Oregon Department of Fish and Wildlife (ODFW), University of Washington, Washington Department of Fish and Wildlife (DFW), the press, and myself as the sole external reviewer contracted by the CIE. Although the virtual format of the meeting restricted face to face discussions and perhaps off-time discussions of the various issues addressed during the meeting, overall, the meeting was well conducted with good participation from participants.

I was sent an electronic package of background material from NMFS some weeks prior to the meeting, although some of the material was out of date with current practices (for example the acoustic material was all based on the use of a 201 kHz system, whereas the current survey to be reviewed was based on integration of a 38 kHz system). In addition, there were gaps in the referenced literature appropriate to this survey and these methods which needed to be filled. I was able to do this through international contacts both prior to and after the review (once I was more familiar with the actual methods used during the survey). The key presenter of the survey from the ODFW was highly co-operative and appreciative of these fill-ins, both during and after the meeting. It was evident that this survey and its component research is innovative, has novel components and good potential to provide an unbiased estimate of the abundance of the target species along the Oregon coast for use in management, and is being conducted by a highly motivated and enthusiastic team of scientists.

There was general agreement at the meeting that the design-based transect survey, supported by video drops to identify species and sizes, can provide an unbiased method to estimate the numbers and then biomass of Black and pooled Deacon-Blue rockfish. There may be other biases, however, especially resulting from potentially inappropriate calibration parameters and target strength model. Both of these potential biases require attention, as they can impact both the accuracy and precision of the estimates of numbers and biomass of these species and are dealt with in detail in following sections and in recommendations.

There were also some less vital issues raised about how well the video measures corresponded to the acoustic record and represented species and size distributions. The species and size data obtained were thought to be the best representation available of what was contained in the acoustic record, but the density comparisons were problematic, with mismatches in the volumes measured (details in a section that follows).

Specific questions for this review (TORs) – short answers

a. Is the survey spatially representative as well as representative of habitats?
   Yes – the evidence presented suggests this is well done. It is fortunate that detailed bathymetry maps are available from multi-beam acoustic surveys for much of the survey area.

b. Is the survey comprehensive enough to provide a population estimate or index and representative length data?
   Yes – the evidence presented suggests the survey can provide a population estimate and representative length data, but there are recommendations as to how this could

be improved (see more specific comments)

c. Are the video and hook and line data fully utilized as an input into the acoustic survey?
Yes – the evidence suggests that the video length data are preferable to the hook and line, but lethal sampling is necessary for weights at length and for ageing and perhaps ecological studies of diet or other things.

d. Should acoustic data within 1 m of the bottom be included directly, as a second estimate or something else?
Yes – it should be used as a separate component of the total measure – so that it is transparent how much of the total is from the extrapolated density in the dead-zone.

e. Are both acoustic frequencies fully utilized?
At present yes – but with a more appropriate narrower beam 38 kHz the 201 kHz would not be necessary other than to use from the small vessel. See detailed comments on acoustic equipment.

f. Where can the survey be pared back in future years to increase efficiency?
It is feasible that the survey could use the habitat specific data and much reduced survey to obtain a result that would have a "q" but may represent trends in the biomass quite well. However, the research is not there yet as there was too much confusion about the methods and results presented from the habitat model results. It would also be essential to know if the proportion of the target species in the habitat specific regions is very large and consistent.

g. How can seasonal hypoxia be included/addressed in surveys?
From the evidence presented, it did not appear that hypoxia would have much influence on overall survey results – as the surveys are done in daytime only when distributions are off bottom for the most part and not influenced by more near bottom hypoxia. Evidence was provided suggesting that distributions may change, but as long as the fish remain within the survey area this should not matter, although it might result in reductions in local densities and influence optimal data processing methods (e.g., integration vs. counts). It was not clear if this would impact the habitat model results more than the general design-based survey – this is an important factor that needs to be investigated.

h. How can a single point population estimate be used in a stock assessment?
At present it could be used to compare to other inputs-results from stock assessment – there is no doubt that a time series of these surveys would be much more valuable to determine trends and consistency of survey results.

i. Are the composition data from visual and hook and line facets of the survey unbiased and sufficiently representative of the ensonified schools?
The composition data from the video data are thought to have greater promise to gain unbiased comparisons to the ensonified schools and the broader fish population.

Detailed commentary

1. Overall survey design

The survey design is good, as it encompasses the entire Oregon coastal zone with 15 km spaced transects perpendicular to the coast, supplemented with more tightly spaced transects over habitat considered to be prime for the species of interest. It is fortunate that a high percentage of this region has been mapped with multibeam acoustics and thus habitat types can be determined for most areas. Transects are run offshore to inshore to help with transducer stability and to limit noise. This is inefficient in terms of survey time but may be necessary in this environment to achieve the best data possible from the acoustic systems. The diagonal return transects between the parallel transects are not used in the survey but should be investigated to determine is the data are usable as this would increase coverage considerably (if randomness is a required property of the design the return diagonals could be used as a separate grid – a spatial model approach which could be further investigated would not require randomness in the placement of transects).

The overall design-based transect survey should produce an unbiased estimate of the mean backscatter received by the acoustic systems and a measure of its uncertainty (there may be bias as a result of inappropriate calibration – dealt with in following sections). The analytical methods and software (Echoview Inc.) used are well known in acoustic surveys and well tested and used worldwide, enabling direct comparisons with other research and surveys. Nonetheless, there are several novel aspects to this survey, including the use of a higher frequency with narrower pulse widths and beam to count fish in lower density areas, combined with lower frequency integration in areas of higher density, and the use of video-drop data to identify species and fish size.

The habitat-based model approach to survey design is also novel and shows promise to obtain a more efficient estimate of abundance of the target species. These species are associated closely with rocky habitats with near-negligible acoustic signal evident over sandy bottom. In terms of the dead-zone, any near-bottom fish are less likely to be missed over sandy bottom compared to rocky areas. This occurs because the true dead-zone, where fish cannot be separated from the bottom echo, is likely less with sandy habitats, as a consequence of less rugosity and slope compared to rocky areas. These considerations favor a habitat-based model over a pure design-based survey. It was evident during the meeting, however, that the habitat-based approach needs work and is not ready for prime time, as the results and the model presented were at once confusing, did not appear to be well understood by the researchers, and did not coincide with the more time-tested design approach to survey design (suggesting twice the biomass).

A good survey design depends on a good understanding of factors that may influence distribution both within and between surveys. Stability is the objective. The possible influence of hypoxic conditions on the Oregon coast on the distribution of these rockfish species was examined. It appeared that Deacon-Blue rockfish descend to near bottom at night when oxygen levels are adequate but stay more pelagic when anoxic conditions prevail. As surveys are conducted entirely during daytime, these movements should not bias the survey results, as long as fish do not leave the survey area.

Recommendation: That design-based survey results using presently available target strength and calibration scaling be tested within a formal stock assessment. Tests of apparent survey "q" and size-age deviations should be made as basis for further research (see section on Use in Stock Assessment).

Recommendation: That additional research on the habitat-based survey model be undertaken with the objectives of achieving a better understanding of the results and factors influencing the suggested densities (e.g., would hypoxia impact one design more than others?)

2. The acoustic system

The acoustic system used is a Biosonics DT with 201 (7°) and 38 (10°) kHz transducers. These were deployed in a purpose-built aluminum body which was deployed at the midships at depths of approximately 2 m. The initial surveys (as in the published literature) were done exclusively with the 201 system, but the recent survey presented to the panel used the 38 system for estimates of backscatter and the 201 to count single targets in areas outside the aggregations were too dense to allow counting or recognition of many single fish within the acoustic beam. The 201 was also used from a smaller vessel to survey shallow and rocky areas where the larger survey vessel could not go.

Switching to a 38 kHz transducer for integration of backscatter from this survey is a good move. The reasons for this are several. Both modelling and *ex situ* investigations of the directivity of *Sebastes* species ensonified at 38 kHz is much less extreme than at 201 (or 200 as in some of the literature) kHz. Hence, target strengths of *Sebastes* are much more stable at 38 than at 201 kHz, and any scaling of backscatter with mean target strengths should be expected to be much less uncertain at 38 than at 201 kHz. In addition, using 38 kHz will enable comparisons with more studies that have been done, and will be done, on various *Sebastes* species in the Pacific and Atlantic oceans. There are negatives, of course, as using 38 kHz will necessitate longer pulse durations, lesser ability to isolate single targets, and increased bottom dead-zone, but overall, the benefits exceed the downsides, and it is recommended that this becomes the main frequency used on this survey. These negatives could be ameliorated considerably with the use of a narrower beam 38 kHz transducer, such as the 7° transducers available commercially. Such a transducer would greatly assist *in situ* target strength studies of the species of interest in the environment of the survey, which would represent the optimum way forward for scaling of backscatter to numbers of fish.

Recommendation: That a 38 kHz transducer with a narrow beam (ca. 7°) be obtained at a minimum to conduct *in situ* target strength studies and possibly to replace the wider beam transducer now in use.

3. An appropriate calibration of the acoustic systems

At present and during the development of this survey method all calibrations of the Biosonics Inc. 201 and 38 kHz transducers-systems have been done at the Biosonics laboratory tank in Seattle. Although having a base calibration and quantification of the beam parameters and power received from a standard target in a lab under highly controlled conditions is a necessary first step in calibration and optimal use of the various systems and transducers available, which cannot be done at sea, an *in-situ* calibration to establish calibration power parameters is near mandatory for any acoustic survey. Given the variations that can arise from differing platforms (ships), cabling, electrical power and circuits, and the environment, lab calibrations may not reflect the levels under survey conditions. The lack of deep-water wharfs and sheltered areas on the Oregon coast has made attempts to do an *in-situ* calibration problematic. Nonetheless, there are areas off Washington and California that would allow this, and if possible, this should be undertaken. There is no way to predict whether potential bias will be relatively large or small by using a lab calibration (or its direction). It is important to note that there is nothing incorrect about the current calibrations done by the manufacturer, in fact they are necessary to determine beam characteristics which cannot be done easily *in situ*, but these are far less likely to vary under survey conditions than power levels, which should be determined *in situ* with the components of the acoustic system in place exactly as during the survey.

Recommendation: That a means be found to conduct *in situ* calibration of the acoustic systems with appropriate standard targets. This should be done from the vessels used during the survey with systems configured and setup as during the survey, ideally just prior to the survey.

4. An appropriate target strength model

An important issue with this survey is the lack of a survey site- and species-specific target strength model for the species of interest in the survey environment in which they are measured. There has been research on other species of *Sebastes* both in the NW Pacific, primarily by Korean scientists, and in the North Atlantic off the Grand Bank and in coastal Newfoundland and off Iceland and Norway, with various frequencies, analytical techniques, and under various conditions of depth, distribution, and size structures (all of which may impact target strength and an appropriate model). A summary table of most of available research is given in Table 1.

There was much discussion on the use of 38 and 120 kHz transducers and impacts on integration and Target Strength models to be used to convert integrated power levels to fish density – this has changed from the earlier surveys reported in the literature when only a 201 kHz transducer was used as it was the only system available at the time. For the present survey a 10^{o} 38 kHz transducer was used for integration and the 7^{o} 201 kHz for counting single targets, taking advantage of narrow pulse widths and beam pattern of the 201. A narrower beam 38 kHz transducer would likely assist both integration (lesser dead zone) and potential *in situ* target strength measures and using 38 kHz for integration is a better choice than using the 201 for several reasons.

In the meeting it was suggested that given the lack of a survey specific target strength model, the best approach would be to average the results from Kang and Hwang 2003, Gauthier and Rose 2002 and 2003, and Kang 2015 at 38 kHz (with SD to represent the uncertainty of present knowledge) and that these statistics be used to scale the integrated backscatter from the survey. Doing so would ignore data from other frequencies and some extreme Standard equation b values that have been reported (see Table 1). Given the range of species, sizes, distribution differences and frequencies, the range of model coefficients reported are, with some exceptions, remarkably similar. Nonetheless, even a small error in applied target strength can seriously impact resultant conversion of the acoustic measure to numbers of fish (for example, 1 dB is about 15%, but 3 dB is 50%, which is unacceptable – a reasonable target error is +- 1 dB).

As some of available research on Sebastes target strength was not available to the meeting, I agreed to investigate this and to use contacts in Korea to see if additional work had been done that was not available to the meeting. This I have done, and the results are included in Table 1, which include additional model parameters from the additional Korean research and from the North Atlantic. Unfortunately, there has been no work on *Sebastes* target strength of any species in the NE Pacific that I am aware of. This is a fundamental gap in the knowledge needed to fully utilize the results of the survey method presented.

Use of models from other species, other environments (or no environment in the case of models), is not optimal. A need for research on TS of Black and Deacon Rockfish in the local environment should be a top priority.

As no local research was presently available, a model derived from other species and sites must suffice at present. Noting that strong frequency differences have been reported (see Table 1), only 38 kHz reports should be considered, but studies using various methods and species at present must be pooled. Summary statistics are shown in Table 2 for the B_{20} at 38 kHz from various studies. Using all studies, regardless of species, site, method, or environment, the B_{20} mean is -68.6 (SE 0.37, n=15). Removing the upper and lower 10% of values the B20 is -68.6 (SE 0.24, n=11). Using only the 4 reports discussed in the meeting, with high and low values removed, the B20 was -68.4 (SE 0.3, n=4). There is little to choose among these values as they do not differ significantly ($P<0.01$). The only difference is the implied uncertainty. All of these will scale mean backscatter to biomass with similar results. As the uncertainty in target strength is typically not included in the confidence intervals around survey estimates (but perhaps should be, see Rose et al. 2000), an accounting of the uncertainty in the target strength model used here should be stressed in any report, especially given the lack of a locally determined model directly applicable to this survey.

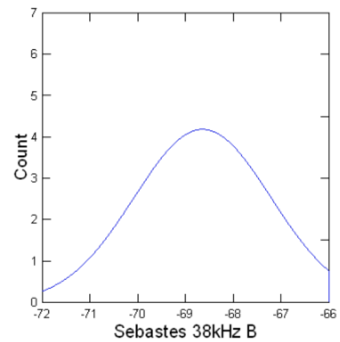
Table 1 Available data on Sebastes target strength based on standard B_{20} equation. Note in several cases using the B_{20} equation did not result in the best fit to the data.

Reference	Frequency (kHz)	System	Common name	Species	Geography	Method	B_{20}	r^2	n	Length (cm)	
Mun et al. 2006	70	split-beam	Black	S. schlegeli	NW Pacific	ex situ	-71.3	0.7	30	17.5-32	
	120	split-beam	Black	S. schlegeli	NW Pacific	ex situ	-66.9	0.37	30	17.5-32	
	70	split-beam	Golden	S. thompsoni	NW Pacific	ex situ	-72	0.32	20	19.5-28	
	120	split-beam	Golden	S. thompsoni	NW Pacific	ex situ	-67.7	0.64	35	18.5-28	
Hwang 2015	38		Dark banded	S. inermis	NW Pacific	model	-69.1			12.9-18	
	70		Dark banded	S. inermis	NW Pacific	model	-69.8			12.9-18	
	120		Dark banded	S. inermis	NW Pacific	model	-70.2			12.9-18	
	200		Dark banded	S. inermis	NW Pacific	model	-70.9			12.9-18	
Yoon et al. 2017	38	split-beam	Black	S. schlegeli	NW Pacific	ex situ	-67.1		14	25.8-29.5	
	70	split-beam	Black	S. schlegeli	NW Pacific	ex situ	-68.6		14	25.8-29.5	
	120	split-beam	Black	S. schlegeli	NW Pacific	ex situ	-69.9		14	25.8-29.5	
	38		Black	S. schlegeli	NW Pacific	model	-66.4				
	70		Black	S. schlegeli	NW Pacific	model	-67				
	120		Black	S. schlegeli	NW Pacific	model	-67				
Son and Hwang 2002	38	split-beam	Black	S. schlegeli	NW Pacific	ex situ	-68.4	0.36	21	9.8-23.9	
	120	split-beam	Black	S. schlegeli	NW Pacific	ex situ	-73.4	0.25	21	9.8-23.9	
	200	dual-beam	Black	S. schlegeli	NW Pacific	ex situ	-70.8	0.49	21	9.8-23.9	
Gauthier and Rose 2001	38	split-beam	Atlantic redfish	S. mentella/fasciatus	NW Atlantic	ex situ	-68.1	0.18	16	24.5-30	
Gauthier and Rose 2002	38	split-beam/dual-beam	Atlantic redfish	S. mentella/fasciatus	NW Atlantic	in situ	-68.5	0.67		14.8-32.3	Corredted for depth dependence
	38	split-beam/dual-beam	Atlantic redfish	S. mentella/fasciatus	NW Atlantic	in-ex situ pooled	-68.3	0.7		14.8-32.3	
	38	split-beam/dual-beam	Atlantic redfish	S. mentella/fasciatus	NW Atlantic	weighted in-ex situ	-68.7	0.48		14.8-32.3	
Kang and Hwang 2003	38	split-beam	Black	S. schlegeli	NW Pacific	ex situ	-67.7	0.64	21	9.8-23.9	
	120	split-beam	Black	S. schlegeli	NW Pacific	ex situ	-74.3	0.3721	21	9.8-23.9	
	200	dual-beam	Black	S. schlegeli	NW Pacific	ex situ	-72.8	0.1681	21	9.8-23.9	
Reynisson and Sigurdsson 1996	38	split-beam	Atlantic redfish	S. mentella	N Atlantic	in situ	-71			26-45	TS stronger at shallower depths
Reynisson 1992	38	split-beam	Atlantic redfish	S. mentella	N Atlantic	in situ	-71.3			30-41	TS stronger at shallower depths
Orlowsky 1987	38	single beam	Atlantic redfish	S. mentella	N Atlantic	in situ	-69.4			36 mean	Reported in Reynisson 1992
Foote et al. 1986	38	split-beam	Atlantic redfish	S. marinus??	NE Atlantic	in situ	-66.5			19.7 mean	
Ermolchev 2010	38	split-beam	Atlantic redfish	S. mentella	N Atlantic	in situ	-69.5				Russian grey literature cited in ICES 2010
ICES 2010	38	mostly split-beam	Atlantic redfish	S. mentella mostly	N Atlantic	meta-analysis	-69.7				Rejected due to poor fit in meta-analyses

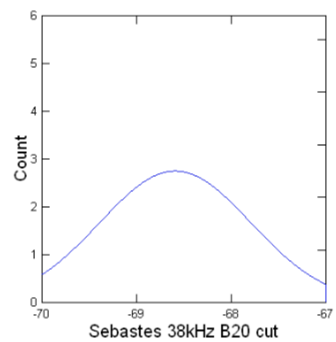
Table 2 Summary statistics of B_{20} from 15 experiments on various Sebastes species using various methods at 38 kHz (top), by removing the lowest and highest 2 values (middle), and using only data from Kang and Hwang 2015, Hwang 2003, and Gauthier and Rose 2001, 2002. The means do not

differ (P<0.01); removing the extreme values and increasing N does reduce uncertainty.

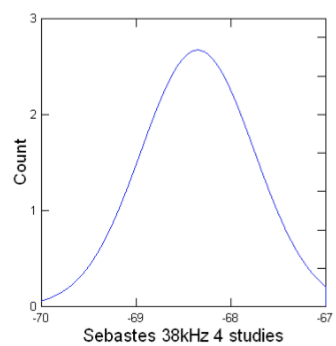
	Sebastes 38kHz B
N of Cases	15
Minimum	-71.300
Maximum	-66.400
Arithmetic Mean	-68.647
Standard Error of Arithmetic Mean	0.369
95.0% LCL of Arithmetic Mean	-69.439
95.0% UCL of Arithmetic Mean	-67.855
Standard Deviation	1.430



	Sebastes 38kHz B20 cut
N of Cases	11
Minimum	-69.700
Maximum	-67.100
Arithmetic Mean	-68.591
Standard Error of Arithmetic Mean	0.241
95.0% LCL of Arithmetic Mean	-69.127
95.0% UCL of Arithmetic Mean	-68.055
Standard Deviation	0.798



	Sebastes 38kHz 4 studies
N of Cases	4
Minimum	-69.100
Maximum	-67.700
Arithmetic Mean	-68.350
Standard Error of Arithmetic Mean	0.299
95.0% LCL of Arithmetic Mean	-69.300
95.0% UCL of Arithmetic Mean	-67.400
Standard Deviation	0.597



Recommendation: That *in situ* research on the target strengths of Black and Deacon rockfish in the local environment is a top priority. If possible, this could be supported by modelling studies – but in situ research is the top priority.

5. Identification of species and size

This survey utilizes some novel methods using stereo video "drops" to identify species, measure fish lengths and potentially to assess video-determined fish densities to compare to those measured acoustically. These non-lethal methods are to be commended. Spatial correspondence of acoustic and video measures was a key concern, but it appears that the target *Sebastes* species (Black and Deacon) are relatively stable in their distributions, and of great importance, do not respond much to the deployment of the camera system (this is highly beneficial as many other species would not be so co-operative. The time lapse between acoustic and video observations was short (7-10 minutes) and in most cases there was a qualitative match between acoustic observations (aggregation, no aggregation, nothing much at all) and what the camera observed during the drop. Of importance, there was no reported change in acoustic backscatter before, during or after the camera drop. In addition, repeated transects over areas where aggregations were present indicated similar distributions – this supports the notion that aggregations of these species are relatively stationary at the scales of measure used in this survey.

It is important that not all drops are over identified aggregations. The information provided indicated that the proportions of drops were about 60/40 for directed and haphazard drops where no aggregations had been identified from the acoustic record. This is thought to be appropriate to reduce any bias introduce in the sampling.

The measures of lengths of the ensonified fish numbered in the thousands from the video and these are thought to be less biased than catch data which often is biased by high-grading or fishing methods favoring larger individuals (for example it was reported that smaller Deacon rockfish did not show up in the fleet catch data). Use of the video size data in the scaling of backscatter and age structure is supported.

Comparisons of video determined fish density were used to compute a target strength model – this resulted in a very low B_{20} value in the standard 20 log TS-length model. Correlations of video reported densities and acoustic densities of the same schools were poor and far from a theoretical 1:1 relationship. However, it is likely that these comparisons were problematic as the volumes sampled could not possibly have been equivalent. For example, the 38 kHz transducer has a half-power "footprint" diameter of about 5.25 m at 30 m which would mean it is sampling about 16 m^3 of water for a vertical meter at that depth, and > 200 m^3 overall. Even the 201 kHz transducer would have a "footprint" of about 3.6 m and sample over 100 m^3. As the camera is sampling a much lower volume and possibly in the densest part of the aggregation, and the comparisons were made with overall acoustic densities, it is predictable that the camera measures would be much higher than the acoustic measures, and the suggested B_{20} value from the camera densities be much lower to compensate, especially at high densities (this is what the presented comparisons showed).

Recommendation: Further investigate the spatial correspondence between the densities being measured with camera and acoustics – the presented comparisons are problematic.

6. Dead-zone issues

During these surveys a relatively large proportion of the acoustic backscatter (to 30%) was estimated to come from the acoustic bottom dead-zone (the zone near bottom in which bottom echo and fish echoes cannot be separated). This estimate is an extrapolation of near bottom backscatter that can be measured on the assumption that this represents the backscatter that would be measured if the dead-zone could be ensonified. In most but not all cases for semi-pelagic fishes, this is a reasonable assumption. For semi-pelagic species whose main distributions are well off bottom but are often down to bottom, not making this extrapolation will almost certainly underestimate the backscatter and hence the fish biomass of a survey. A limitation of this approach is that if there is no backscatter in the volume immediately above the dead-zone, then none will be attributed to the dead-zone, even if fish are there. If this occurs in more than minor areas of the survey, the acoustic method is inappropriate. In this case it does not appear to be the case, as video drops in areas where little backscatter is present do not indicate concentrations of fish in the would-be acoustic dead-zone. It is important, nonetheless, that video-drops be made regularly over such areas to estimate how much backscatter might be missed in such areas.

The dead-zone is a function of the depth, acoustic pulse duration and the beam pattern of the transducer used. After the acoustic wave front strikes bottom, fish will not be detected as the bottom in almost all cases (not all) will have a much stronger echo than any fish present. As all acoustic beams spread with distance from the transmitting transducer, the dead-zone will increase with depth, and larger beam patterns will have larger dead-zones because of the wider footprint of the beam as it impinges on the bottom.

For the systems used during this survey, the estimated bottom dead-zone for the 200 kHz transducer with 7° beam transmitting 0.4 ms sound pulses is 0.36 m at 30 m, and 0.39 m at 50 m. For the 38 kHz transducer with 10° beam transmitting 1 ms pulses, the bottom dead-zone is 0.86 m at 30 m and 0.94 m at 50 m, 1.1 m at 100 m. Using a lesser pulse duration would lessen the dead-zone, for example for the above 38 kHz transducer would have a dead-zone at 30 m of 0.71 m using a 0.8 ms pulse. A 38 kHz transducer with a beam of approximately 7°, such as commonly used with the Kongsberg Simrad EK60 systems, the dead-zone with a 0.8 ms pulse at 30 m would be further reduced to approximately 0.66 m and to 0.69 m at 50 m. The above estimates are what should be expected under optimal bottom conditions (flat) and limited transducer movement – actual survey condition dead-zones are likely to be somewhat greater. The point of the above discussion is to identify possible reductions in the dead-zone, which for this survey is important, using a narrow beam 38 kHz transducer and possible narrower pulse widths (this would have to be examined during calibration).

Recommendation: That reports of backscatter and densities of species include extrapolations to assess the dead-zone, reported separately from the ensonified water column data, then totalled.

7. Use in Stock Assessment

The ultimate use of this survey, its estimates of abundance, biomass and age structure is in assessment of the state of the stocks of these fishes. To assess its potential to benefit stock assessment, it is important to determine if the results can be utilized as an absolute measure of abundance, in which case even a single survey may provide bounds or confirmation of the results of alternative methods and stock synthesis models. There are some at present some unexamined assumptions. If there is no bias in the calibration parameters and the target strength model (lack of precision is OK but best quantified), and the survey is detecting-measuring the full stock, the survey "q" should be unity (1). A non-unity "q" could result from bias in any of these factors or a combination of them. At present, it is not possible to know if these assumptions have been met, and with respect to calibration and target strength, it would be serendipity if they did. A more detailed examination of the present results within a full stock assessment (not done at this meeting) is necessary to test the apparent "q" of this survey, noting that at present it will be difficult to determine what is causing a deviation from a unity "q".

Progress in dealing with *in situ* calibrations and development of a more appropriate target strength model will go a long way in eliminating any biases introduced by use of the present measures. Once this is accomplished, more detailed examination of survey "q" in relation to detection-measurement of the full stocks and size ranges becomes more possible and interesting. This should be a longer-term objective.

A non-unity "q" reduces the usefulness of a single survey although within year sizes or age compositions may still have value, but a time series of the survey over several or many years becomes much more useful and valuable, allowing both testing of the consistency of the survey in reflecting size-age dynamics and abundance, and relationships within a full stock assessment.

Recommendation: once *in situ* calibrations and target strength models are available, research should focus on detection-measurement variation in numbers and sizes is relation to full stock assessment, as explanations for variations or bias in survey "q".

8. Panel Proceedings

The meeting was well-chaired and despite the limitations of being a video conference meeting proceeded well. Most of the presentations were clear, well prepared and presented enthusiastically. Discussions of the various issues resulting from the survey were widespread and productive. All participants were professional and courteous both during the meeting and in subsequent interactions. From my standpoint, however, the organization was less than ideal, as I was brought to Portland under the aegis of the CIE and the communications from NMFS that this was an in-person meeting, only to be informed after I arrived at the purported meeting site that it was a virtual-only meeting. After unnecessarily travelling to Portland, I had no information on access to the virtual meeting – fortunately a kind person at the Fishery Council printed off instructions to join the meeting. I had no choice then but to stay at the hotel in Portland for the week as if I had travelled home, I would have missed the meeting. When I informed by CIE contact, who contracted me and made my travel and hotel arrangements, he expressed incredulity at the situation, and was very apologetic, as he had no idea either that this meeting was now virtual. It was no help that I had only a small MacAir computer with me, making it difficult and unnecessarily tiring (eyestrain) to focus on the small screen during the meeting. All in all, while the meeting went well and was very productive, my own ability to participate was less than ideal.

Recommendation: Information for any further external reviewer participation should be kept up to date – there was obvious lack of communication between the organizers of this review meeting with the CIE and hence with this reviewer. I received no communication from either that this meeting was virtual, or of a changed agenda, only background material, tickets to travel, hotel accommodation and instructions to show up for the meeting at the Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384 at 0830h on September 27th, 2022 (which I did). This needs work as it involved needless expense and inconvenience!

Publications consulted during this review:

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Appendix 2

Performance Work Statement (PWS)
National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Center for Independent Experts (CIE) Program
External Independent Peer Review

2022 Methodology Review of the ODFW
Video-Hydroacoustic Survey Design and Methodology

September 27-30, 2022

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards[1].

Scope:

The National Marine Fisheries Service and the Pacific Fishery Management Council will hold a workshop to review and evaluate new survey methodology developed by the Oregon Department of Fish and Wildlife (ODFW) for a combined video-hydroacoustic technique intended to provide abundance estimates of semi-pelagic rockfish in untrawlable rocky habitats such as that occurring off the Oregon coast.

The goals and objectives of the workshop are to:

1. provide an independent external review of the combined video-hydroacoustic method;
2. identify research needed to improve the methodology;

[1] https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/memoranda/2005/m05-03.pdf

3. advance expert advice as to whether abundance data produced by this method would contribute to the best scientific advice/information available for use in stock assessments;
4. meet the mandates of the Magnuson-Stevens Fisheries Conservation and Management Act (MSA) and other legal requirements;
5. follow a detailed calendar and fulfill explicit responsibilities for all participants to produce required reports and outcomes; and
6. increase understanding and acceptance of video-hydroacoustic methodology and peer reviews

The specified format and contents of the individual peer review reports are found in **Annex 1**. The Terms of Reference (TORs) of the peer review are listed in **Annex 2**. Lastly, the tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements:
NMFS requires 1 reviewer to conduct an impartial and independent peer review in accordance with this Performance Work Statement (PWS), OMB Guidelines, and the ToRs below. The chair, who is in addition to the single reviewer, will be provided by the Scientific and Statistical Committee of the Pacific Fishery Management Council; although the chair will be participating in this review, the chair's participation (i.e. labor and travel) is not covered by this contract. The reviewer shall have working knowledge and recent experience in the following:

- hydroacoustic fishery surveys;
- statistical methods used for the analysis of the data captured by such surveys;
- familiarity with rugose bottom acoustics of semi-pelagic species;
- conversion of scientific echosounder data to fish densities.

Ideally, the reviewer should also be familiar with these additional areas:

- visual surveys using stereo-cameras to inform species and length composition;
- issues relating to catchability/detectability in video surveys;
- stereo video calibration and system design;
- hook and line sampling.

The CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Tasks for the Reviewer:
Deliverables herein.

1. <u>Pre-review Background Documents</u>: Review the following background materials and reports prior to the review:

Rasmuson, L.K., Fields, S.A., Blume, M.T., Lawrence, K.A. and Rankin, P.S., 2022. Combined video–hydroacoustic survey of nearshore semi-pelagic rockfish in untrawlable habitats. *ICES Journal of Marine Science*, *79*(1), pp.100-116., https://doi.org/10.1093/icesjms/fsab245

<u>Rasmuson, L. K, 2021. Susceptibility of five species (Sebastes spp.) of rockfish to different survey gears inferred from high resolution behavioral data. Science Bulletin 2021-05. Oregon Department of</u>

Fish and Wildlife, Salem, https://www.dfw.state.or.us/mrp/publications/docs/Rockfish%20Height%20off%20Bottom.pdf

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Other background information and reports will be provided no less than two weeks prior to the start of the peer review. The NMFS Project Contact will make available to the CIE reviewer all necessary background information and reports for the peer review, though use of electronic mail and/or an FTP site. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. The CIE reviewer shall read all documents in preparation for the peer review.

2. Attend and participate at the review meeting. The meeting will consist of presentations by NOAA, ODFW, and other scientists, and others to facilitate the review, to answer any questions from the reviewers, and to provide any additional information required by the reviewers.

3. After the review meeting, reviewers shall develop an independent peer review report in accordance with the requirements specified in this PWS, OMB guidelines, and TORs, in adherence with the required formatting and content guidelines; reviewers are not required to reach a consensus.

4. Assist the Chair of the meeting with contributions to the summary report. The summary report will not be submitted to, reviewed, or approved by the Contractor.

5. Deliver their reports to the Government according to the specified milestones dates.

Foreign National Security Clearance

When a reviewer participates during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for the reviewer who is a non-US citizen. For this reason, the reviewer shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30-50 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/ http://deemedexports.noaa.gov/

The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance:

The reviewer shall conduct an independent peer review during the panel review meeting scheduled in Portland, Oregon **or virtually dependent on conditions of the COVID 19 pandemic** during the following dates: September 27-30, 2022.

Period of Performance

The period of performance shall be from the time of award through November 2022. The reviewer's duties shall not exceed 14 days to complete all required tasks.

Schedule of Milestones and Deliverables: The contractor shall complete the tasks and deliverables in accordance with the following schedule.

Within two weeks of award	Contractor selects and confirms reviewer
Two weeks prior to the panel review	Contractor provides the pre-review documents to the reviewer
September 27-30, 2022	The reviewer participates and conducts an independent peer review during the panel review meeting
Within three weeks of the panel review meeting	Contractor receives reviewer draft report
Within two weeks of receiving draft report	Contractor submits final report to the Government

Applicable Performance Standards
The acceptance of the contract deliverables shall be based on three performance standards:
(1) The report shall be completed in accordance with the required formatting and content; (2) The report shall address each ToR as specified; and (3) The report shall be delivered as specified in the schedule of milestones and deliverables.

Travel
All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790). International travel is authorized for this contract. Travel is not to exceed $5,500.00.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement

NMFS Project Contact(s)

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Annex 1: Peer Review Report Requirements

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the methods reviewed can provide information leading to the best scientific information available, and whether therefore they should be endorsed for use in analyses to support management.

2. The report must contain a background section, description of the individual reviewers' roles in the review activities, summary of findings for each TOR in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the TORs.

a. Reviewers must describe in their own words the review activities completed during the panel review meeting, including a brief summary of findings, of the science, conclusions, and recommendations.

b. Reviewers should discuss their independent views on each TOR even if these were consistent with those of other panelists, but especially where there were divergent views.

c. Reviewers should elaborate on any points raised in the summary report that they believe might require further clarification.

d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

e. The report shall be a stand-alone document for others to understand the weaknesses and strengths of the science and methods reviewed, regardless of whether or not they read the summary report. The report shall represent the peer review of each TOR, and shall not simply repeat the contents of the summary report.

3. The report shall include the following appendices:

Appendix 1: Bibliography of materials provided for review
Appendix 2: A copy of this Performance Work Statement
Appendix 3: Panel membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review
Terms of Reference for the Peer Review

2022 Methodology Review of the ODFW
Video-Hydroacoustic Survey Design and Methodology

The CIE reviewer is contracted to complete their independent peer review based on the Terms of Reference (ToRs). Therefore, the CIE-NMFS review and approval process is based on whether the CIE independent report addresses each of the following ToRs.

2. Become familiar with the background documents prior to the review panel meeting.
3. Discuss the technical merits and deficiencies of the data and analytical methods during the open review panel meeting.
4. Provide constructive suggestions for current improvements if technical deficiencies are identified.
5. Determine whether the science reviewed is considered to be the best scientific information/methodology available.
6. When possible, provide specific suggestions for future improvements in any relevant aspects of data collection and treatment, modeling approaches and technical issues, differentiating between the short-term and longer-term time frame. Among other topics, consider:
    a. Is the survey spatially representative as well as representative of habitats?
    b. Is the survey comprehensive enough to provide a population estimate or index and representative length data?
    c. Are the video and hook and line data fully utilized as an input into the acoustic survey?
    d. Should acoustic data within 1 m of the bottom be included directly, as a second estimate or something else?
    e. Are both acoustic frequencies fully utilized?
    f. Where can the survey be pared back in future years to increase efficiency?
    g. How can seasonal hypoxia be included/addressed in surveys?
    h. How can a single point population estimate be used in a stock assessment?
    i. Are the composition data from visual and hook and line facets of the survey unbiased and sufficiently representative of the ensonified schools?
7. Provide a brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

Annex 3: Proposed Agenda

2022 Methodology Review of the ODFW
Video-Hydroacoustic Survey Design and Methodology
September 27-30, 2022
Portland, OR

Point of contact: Andi Stephens (Andi.Stephens@noaa.gov)

Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

This is a public meeting, and time for public comment may be provided at the discretion of the meeting Chair. This is a technical review panel meeting, to review the scientific merits and technical applications of the proposed methodology, and will follow the Pacific Fishery Management Council's (Council) terms of reference for methodology reviews. The Methodology Review Panel will review the reports and produce a report to the full SSC, in advance of the November 2022 Council meeting in Garden Grove, California. Data collected using this methodology may be used in future groundfish stock assessments.

<u>TUESDAY, SEPTEMBER 27th</u>

A. 8:30 am Call to Order, Introductions, Approval of Agenda, and Terms of Reference, Assignment of Rapporteur Duties — John Budrick, Chair; Council Staff

B. 9:00 am Topic 1 – How are the acoustic data generated?
   a. Acoustic system/capabilities/configuration
   b. Survey design

9:00 am Presentation of acoustic system/capabilities/configuration
10:15 am BREAK
10:30 am Presentation of acoustic survey design
11:45 am Discussion and Requests

12:30 pm LUNCH

C. 1:30 pm Topic 2-How stereo cameras used to determine species and size composition?
   a. Stereo video camera system/capabilities/configuration
   b. Survey design

1:30 pm Presentation of video camera system/capabilities
2:45 pm BREAK
3:00 pm Presentation of the survey design
4:15 pm Discussion and Requests

5:00 pm Adjourn for the day

WEDNESDAY, SEPTEMBER 28th

D. 8:30 am Topic 3 – How do downward-looking cameras estimate dead zone biomass?
   a. Stereo camera system/capabilities/configuration
   b. Survey design

8:30 am Presentation of stereo camera system/capabilities/configuration
9:30 am Presentation of the survey design

10:15 am BREAK

10:30 am Discussion and Requests

E. 11:00 am Responses to requests from Tuesday

12:30 pm LUNCH

F. 1:30 pm Topic 4 – Combination of acoustic and composition data to estimate abundance.
   a. Relationship between target strength and length.
   b. Application of composition data.

1:30 pm Presentation the relationship between target strength and length.
2:30 pm Application of composition data.
3:00 pm Discussion and Request

3:30 am BREAK

G. 3:45 pm Topic 5 – Collection of age composition data.
   a. Sampling design.
   b. Application of composition data.

3:45 pm Presentation the sampling design for age composition data collection.
4:30 pm Application of composition data.
4:45 pm Discussion and Request

5:00 pm Adjourn for the day

THURSDAY, SEPTEMBER 29th

H. 8:30 am Responses to requests from Wednesday
10:15 am BREAK
I. 10:30 am Topic 6 – Application of results in stock assessments.
   a. Application of biomass estimates
   b. Application of length composition data
   c. Application of age composition data
   d. Independent estimates of OFL = Biomass*Fmsy

J. 10:30 am Application of biomass estimates

K. 11:00 am Application length composition data
L. 11:30 am Application age composition data
M. 12:00 am Independent estimates of OFL = Biomass*Fmsy
N. 12:15 am Discussion and Request

12:30 pm LUNCH

O. 1:30 pm Further discussion and drafting of report
P. 3:00 pm Additional responses to requests from Wednesday

5:00 pm ADJOURN

<u>FRIDAY, SEPTEMBER 30th</u>

Q. 8:30 am Responses to requests from Thursday
R. 9:30 am Where do we go from here?
   a. Use in Assessments and Management Advice

10:15 am BREAK

S. 10:30 am Where do we go from here? (cont.)
   b. Future work

T. 11:30 am Further discussion and drafting of report

12:30 pm ADJOURN

Appendix 3

Known Participants in the review (I may have missed someone in the virtual setting)

John Budrick
Rob Davis
John DeVore
John Field
Owen Hamel
Kristen Hinton
Kristen Marshall
Kate Pierson
Andre Punt
Leif Rasmuson
George Rose (External CIE reviewer)
Jason Schaffler
Theresa Tsou
Jessica Watson
Chantel Wetzel
Ali Whilman