For Information: Implications of a reduced FISS in 2021

PREPARED BY: IPHC SECRETARIAT (R. WEBSTER; 1 DECEMBER 2020)

PURPOSE

To provide the Commission with the likely implications of a 2021 FISS design reduced from the '*minimum 2021 FISS design*' proposed by the IPHC Secretariat and endorsed by the Scientific Review Board in 2020.

BACKGROUND

The IPHC Secretariat has proposed a '*minimum 2021 FISS design*', and also for the subsequent two years (2022, 2023), which are projected to achieve data quality targets with respect to variance and bias (IPHC-2020-SS09-03). This paper will outline the likely implications of reducing the 2021 FISS on the following key areas:

1) Increased uncertainty in estimates from unsurveyed IPHC Regulatory Areas;
2) Potential for bias in estimates of overall stock trends;
3) Effects on stock distribution, harvest rates and stock assessment model;
4) Impact on future FISS planning.

DISCUSSION

IPHC Regulatory Areas at the ends of the stock's range (within the IPHC Convention Area) - IPHC Regulatory Areas 2A, 4A and 4B - were unsurveyed in 2020, and as a result, coefficients of variation (CV; a measure of the variability relative to the mean) for estimates of density indices were outside of the target range of ≤15%, with values of 22%, 25% and 25% respectively for the three areas for O32 WPUE. The only new data in IPHC Regulatory Area 4CDE for 2020 came from the small Alaska Department of Fish and Game trawl survey in Norton Sound, and the CV for this area increased from 10% in 2019 to 12% in 2020. The proposed minimum FISS designs for 2021-23 are projected to lead to CVs within the target range for IPHC Regulatory Areas 2A, 4A, and 4B (**Table 1**), while the proposed full design in IPHC Regulatory Area 4CDE, together with an anticipated NMFS Bering Sea trawl survey in 2021, will also ensure a CV well below 15% for that area, and address concerns that the distribution may be changing more rapidly than historically observed in this IPHC Regulatory Area.

Table 1. Projected coefficients of variation (%) by year for mean O32 WPUE following completion of the 2023 FISS based on proposed 2021-23 FISS designs.

IPHC Regulatory Area	2020	2021	2022	2023
2A	22	13	13	15
4A	16	9	9	10
4B	16	11	10	13

If the proposed 2021 design is not fully implemented, we estimate uncertainty at near-historic levels in areas at the ends of the stock's range within the IPHC Convention Area, with CVs of 26% in IPHC Regulatory Area 2A (greatest since 2006), 30% in 4A (greatest in the entire 1993-2021 time series) and 31% for 4B (greatest since 1994) (Table 2).

Table 2. Estimated coefficients of variation (%) by year for mean O32 WPUE assuming no FISS in IPHC Regulatory Areas 2A, 4A and 4B in 2021.

IPHC Regulatory Area	2019	2020	2021
2A	12	21	26
4A	18	24	30
4B	16	25	31

At the level of Biological Region, the CV for Region 4 in 2020 was 12%, and thus already exceeds the regional target range of ≤10%; without a FISS in IPHC Regulatory Areas 4A and 4CDE in 2021, we can expect the CV to increase further outside the target range. Figures 1, 2 and 3 show estimated time series from 2006-21 for these three areas if there is no FISS sampling in 2021, compared with estimates from 2019 and 2020 modelling, showing increasing uncertainty near the end of the series.

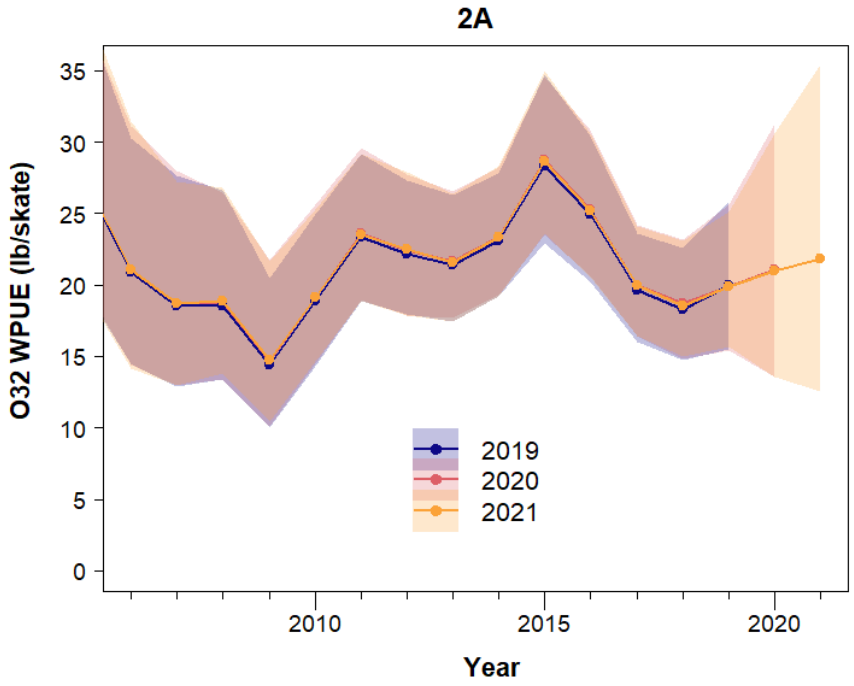

Figure 1. Recent estimated O32 WPUE time series for IPHC Regulatory Area 2A based on modelling in 2019, 2020 and 2021, assuming no FISS sampling in 2021.

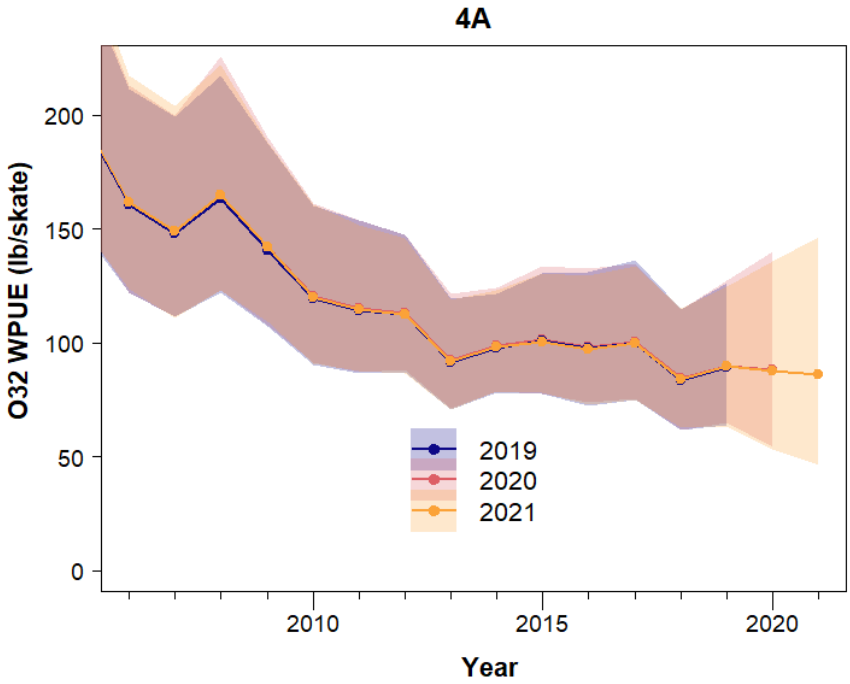

Figure 2. Recent estimated O32 WPUE time series for IPHC Regulatory Area 4A based on modelling in 2019, 2020 and 2021, assuming no FISS sampling in 2021.

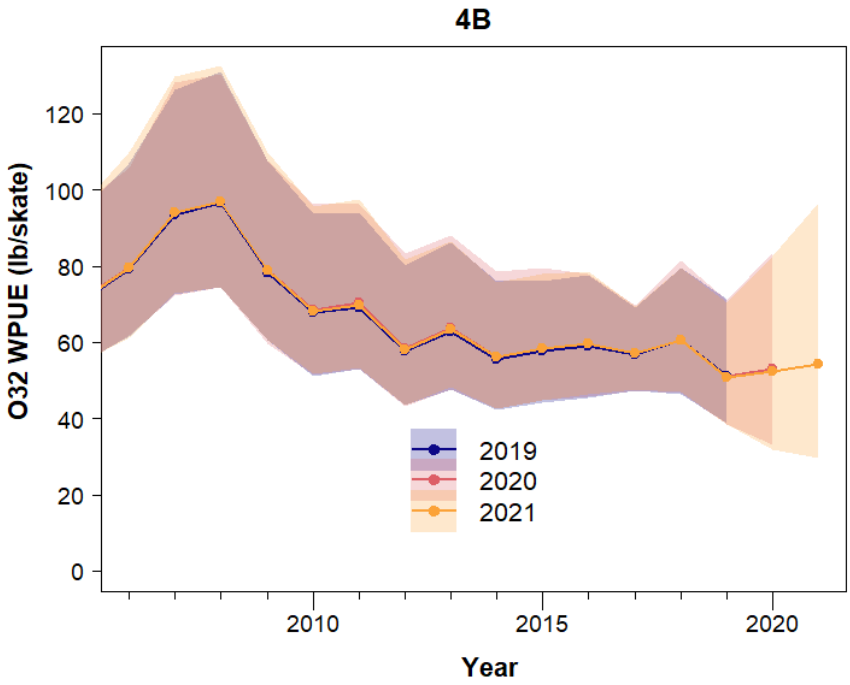

Figure 3. Recent estimated O32 WPUE time series for IPHC Regulatory Area 4B based on modelling in 2019, 2020 and 2021, assuming no FISS sampling in 2021.

Of equal concern is that the lack of data for two consecutive years means we will have no information on stock trends IPHC Regulatory Areas 2A, 4A and 4B since 2019, and limited information in Area 4CDE (with some data expected from trawl surveys): increases or decreases in Pacific halibut density and abundance over that period in unsurveyed habitat will be unobserved, and our estimates of WPUE and NPUE indices may be biased, leading also to biased estimates of overall stock trends and stock distribution among IPHC Regulatory Areas.

While undertaking a 2021 FISS in the core IPHC Regulatory Areas (2B, 2C, 3A and 3B) will maintain a coastwide CV within target, any bias in estimates from the ends of the stock could also lead to bias in estimates of density and trends at the coastwide level. **Figure 4** illustrates the potential effect of not observing the areas at the end of the stock on the coastwide WPUE index. If mean WPUE in unsurveyed areas actually changes by 10 or 20% per year from 2019-21 (something not unusual in the historical time series), this has the potential to affect our understanding of overall stock trends even over this short period.

While the expected NMFS survey in the eastern Bering Sea in 2021 should ensure variance targets are met for IPHC Regulatory Area 4CDE, this survey misses the deeper waters covered by the FISS, which have been historically those with greatest density of Pacific halibut. The Bering Sea is a dynamic region in terms of climate and species distribution, and recent years have seen a pronounced northward shift in the centre of biomass of Pacific halibut (Webster et al. 2020). The absence of any survey in the deeper waters of the Bering Sea shelf edge since 2019, and in the waters of the northern shelf edge since the 2016 expansion, means we will lack an understanding of changes in distribution or overall abundance in these waters during a period when the potential for change is great.

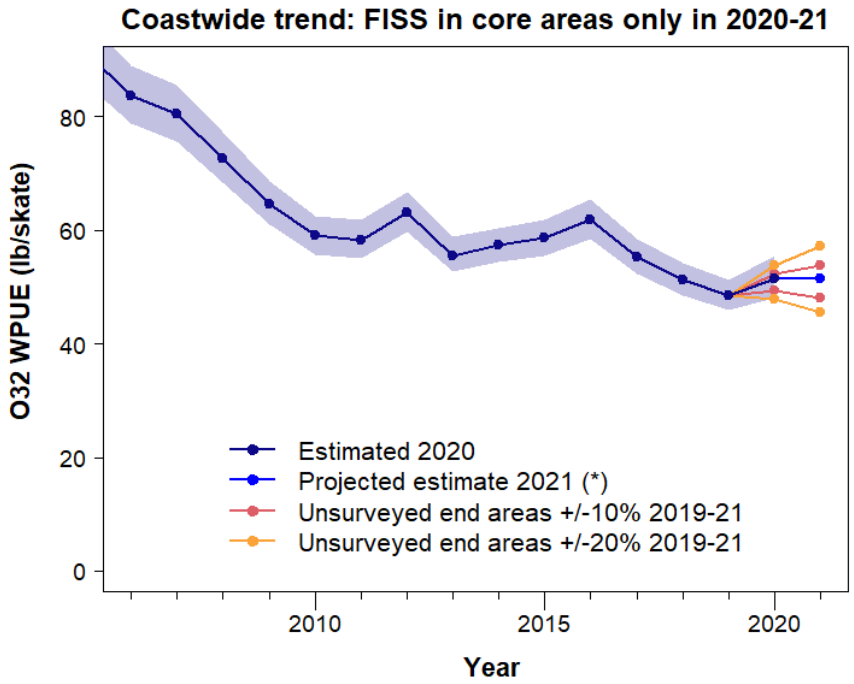

Figure 4. Illustration of the potential bias induced by not observing changes in unsurveyed end areas (IPHC Regulatory Area 2A, 4A, 4B and 4CDE) from 2020-21. *The 2021 projected coastwide estimate assumes no change in mean WPUE in the core IPHC Regulatory Areas (2B, 2C, 3A, 3B) and no observed change in other areas due to no sampling occurring in those areas. Under the different scenarios of +/- 10 or +/-20% per year in the end areas only, the “true” coastwide trend would follow the red and orange lines, and our estimate in blue would be biased.

If no FISS is undertaken in IPHC Regulatory Areas 2A, 4A, 4B and 4CDE in 2021, this will have important implications for the quality of estimates of indices of density and abundance, and for our overall understanding of stock trends and distribution. Together, these four IPHC Regulatory Areas comprise almost 30% of the stock. Importantly, the Pacific halibut stock and fishery are currently in transition between a strong 2005 year-class and more recent 2011 and 2012 year-classes. While the distribution of these year-classes is likely to become more uniform as they age, a two-year sampling gap at the ends of the geographic range (particularly 4A-4CDE) increases the likelihood that stock distribution and therefore realized harvest rates may differ appreciably from those intended by the IPHC's interim management procedure. With reduced precision, the ability of the stock assessment model to update currently predicted trends based on new information is much more limited: increases or decreases in overall stock trend (e.g. **Figure 4**) may not be tracked by the assessment model, which relies heavily on the trend information provided by the annual FISS.

Finally, a second consecutive reduced FISS in 2021 will have implications for the 2022-24 FISS designs as well. Current design planning spreads the most challenging charter regions (logistically and financially) over the three-year time-horizon. In order to 'catch-up' from the much larger variances estimates that would be produced in 2021, an increased level of sampling in 2022 would be required, including the regions omitted in 2021 as well as at least some of those planned for 2022. While our analysis showed that estimation quality can quickly recover from a one-year reduction in the FISS (**Table 1**), the longer such gaps in coverage persist, the more difficult this becomes, and the result may be a period in the time series with permanently high uncertainty around our understanding of stock trends and distribution.

REFERENCES

Webster et al (2020). Monitoring change in a dynamic environment: spatio-temporal modelling of calibrated data from different types of fisheries surveys of Pacific halibut. Can. J. Fish. Aquat. Sci 77(8): 1421-1432.

RECOMMENDATION/S

That the Commission:

1) **NOTE** paper IPHC-2020-SS09-04 that provides the Commission with the likely implications of a 2021 FISS design reduced from the minimum design proposed by the IPHC Secretariat and endorsed by the Scientific Review Board in 2020.