Data sources and modelling update for the 2018 stock assessment

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PURPOSE

To provide the Scientific Review Board (SRB) a summary of updates to data sources and modelling for the 2018 stock assessment and harvest policy analyses.

INTRODUCTION

Updates and improvements to the data sources supporting the annual stock assessment and harvest strategy policy analyses are made each year as new information and new processing of older information becomes available. Ongoing avenues of data development, specific changes anticipated for inclusion into 2018 models, and changes planned for 2019 were discussed during SRB012 (IPHC 2018), in June 2018. This document provides updates specifically relevant to the 2018 stock assessment, and will be supplemented with additional presentation material as/if 2018 data become available.

ONGOING DEVELOPMENT

There have been no new developments with regard to the use of measured individual fish weights, historical bycatch estimates and biological data, or effective skate (hook-spacing) calculations since SRB012. Similarly, there is no new progress to report with regard to model weighting, Bayesian integration. The IPHC Secretariat's manuscript on ensemble stability is in revision at this time. Status of each of these projects was documented in more detail in the documents and presentations by the Secretariat during that meeting (IPHC Secretariat 2018a, b).

DEVELOPMENT FOR 2018

Space-Time modelling improvements

Based on the results of SRB012, there are no anticipated changes to the basic approach for space-time modelling to be used in 2018.

Enhanced reporting of commercial fishery Catch-Per-Unit-Effort (CPUE) indices

In addition to the delineation of fixed hook and snap gear in the commercial CPUE time-series' presented during SRB012, the SRB "URGED the IPHC Secretariat to further provide a correlation plot between relative CPUEs for each gear type by region". This is provided in **Appendix A**. The comparison generally shows a linear (but not 1:1) relationship between the gear types, but does highlight the relative lack of correlation in Regulatory Area 4B, an Area with relatively low sample sizes.

Data status and trend summary tools

The IPHC Secretariat is moving forward with the development of presentation tools for use during meetings, as well as through the new website. As the complexity of supporting analyses and the number of diverse data sets considered during the annual management process has increased, it has become more challenging to provide the information in easily accessible and efficient formats. Inspired by approaches first encountered through the North Pacific Fishery Management Council's (NPFMC; https://www.npfmc.org/) Ecosystem report and other National Marine Fisheries Service presentations, one potential tool to condense both trend and status information is to 'map' data sources into simple quadrants. A preliminary qualitative approach was discussed during SRB012, and "the SRB REQUESTED the IPHC Secretariat to further code the symbols to indicate relative stock sizes". This approach has been refined to make it easier to combine time-series with the same interpretation of the axes, and to reflect the relative importance of each point. An example using the IPHC's FISS O32 WPUE is provided in **Appendix B**.

Software updates

As discussed during SRB012, the current version of stock synthesis (3.30.11) has at least two features used in the four Pacific halibut models that are incompletely implemented. These features have been included in subsequent development, but that version (3.30.12) remains a beta version in testing (as of August 2018). When a full release is made, the testing and conversion of the four Pacific halibut models will continue. No change in the software version used by the IPHC will be made for 2018 unless all features and results can be mapped identically.

Phase plots and status indicators

During SRB012, a 'phase' plot reflecting stock status and fishing intensity relative to the IPHC's reference points was discussed. Because the IPHC's reference points for stock status and fishing intensity are not logically (or analytically) related, "the SRB REQUESTED that the plot not be coloured with discrete "stoplight" colours", and that the description of the figure make this clear. The revised figure is presented in **Appendix C**.

Routine data updates

Although there may be some preliminary data available for SRB013, it is unlikely that these data will be complete enough for testing in stock assessment models. FISS results will be summarized during the meeting and evaluated for consistency with stock projections, depending on availability.

DEVELOPMENT PROPOSED FOR 2019

A full assessment analysis and review is planned for 2019 (see discussion in IPHC-2018-SRB12-07), which will allow more in-depth investigation and model-based evaluation of the new and/or revised data. Progress continues on the reevaluation of whale depredation accounting in the Fishery Independent Setline Survey time-series, as well as the sex-ratio of

the commercial catch in 2017; both products are anticipated in February 2019. That analysis will also allow for an in-depth exploration of data weighting, parameterization of time-varying processes and other modelling approaches implemented in the four Pacific halibut models comprising the stock assessment ensemble.

SUMMARY

As has been the standard practice since 2015, any changes to existing data sources, and all updated information subsequent to SRB013 will be reported directly in the 2018 stock assessment. Any questions and/or clarifications will be provided for the SRB during the annual conference call held in December (after the IPHC's Interim Meeting IM094, and before the IPHC's Annual Meeting AM095).

RECOMMENDATION/S

The IPHC secretariat requests that the SRB:

a) **NOTE** paper IPHC-2018-SRB013-05 which summarizes ongoing, pending and future data source and modelling development efforts by the IPHC Secretariat.

b) **NOTE** any preliminary data and/or results from 2018 that may be available in presentations made by the IPHC Secretariat (but were unavailable at the time this document was created).

c) **NOTE** any discussion occurring during SRB013, and **RECOMMEND** any improvements to and/or new tools for summarizing and presenting data sources or formulating the 2018 stock assessment.

REFERENCES

IPHC. 2018. Report of the 12th Session of the IPHC Scientific Review Board (SRB012). Seattle, Washington, U.S.A., 19-21 June 2018. IPHC-2018-SRB012-R. 17 p.

IPHC Secretariat. 2018a. Data source development. IPHC-2018-SRB012-06. 10 p.

IPHC Secretariat. 2018b. Modelling updates. IPHC-2018-SRB012-07. 11 p.

APPENDICES

Appendix A: Expanded reporting of commercial fishery catch-rates.

Appendix B: Example of data 'mapping'.

Appendix C: Updated 'phase' plot.

APPENDIX A

Expanded reporting of commercial fishery catch-rates.

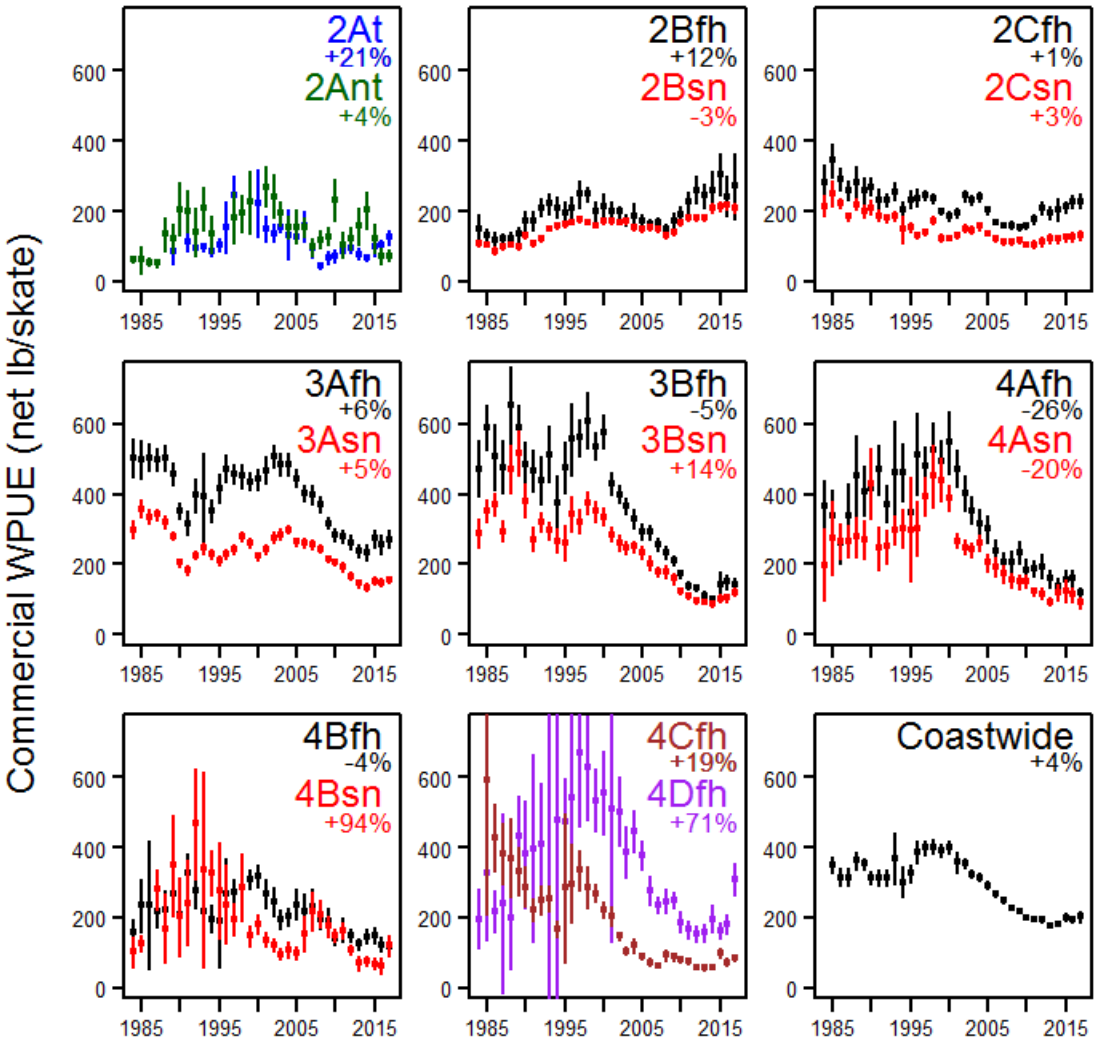

Figure A1 (duplicated from IPHC-2018-SRB012-06). Commercial WPUE: Area 2A delineated by fishery (t = tribal, nt = non-tribal), Areas 2B-4B delineated by gear type (fh = fixed-hook, sn = snap gear) and Area 4CDE delineated by Area (4C, 4D; too few snap gear data to summarize). Percentages indicate the change from 2016-2017; vertical bars an approximate 95% confidence interval based only on between-set variability.

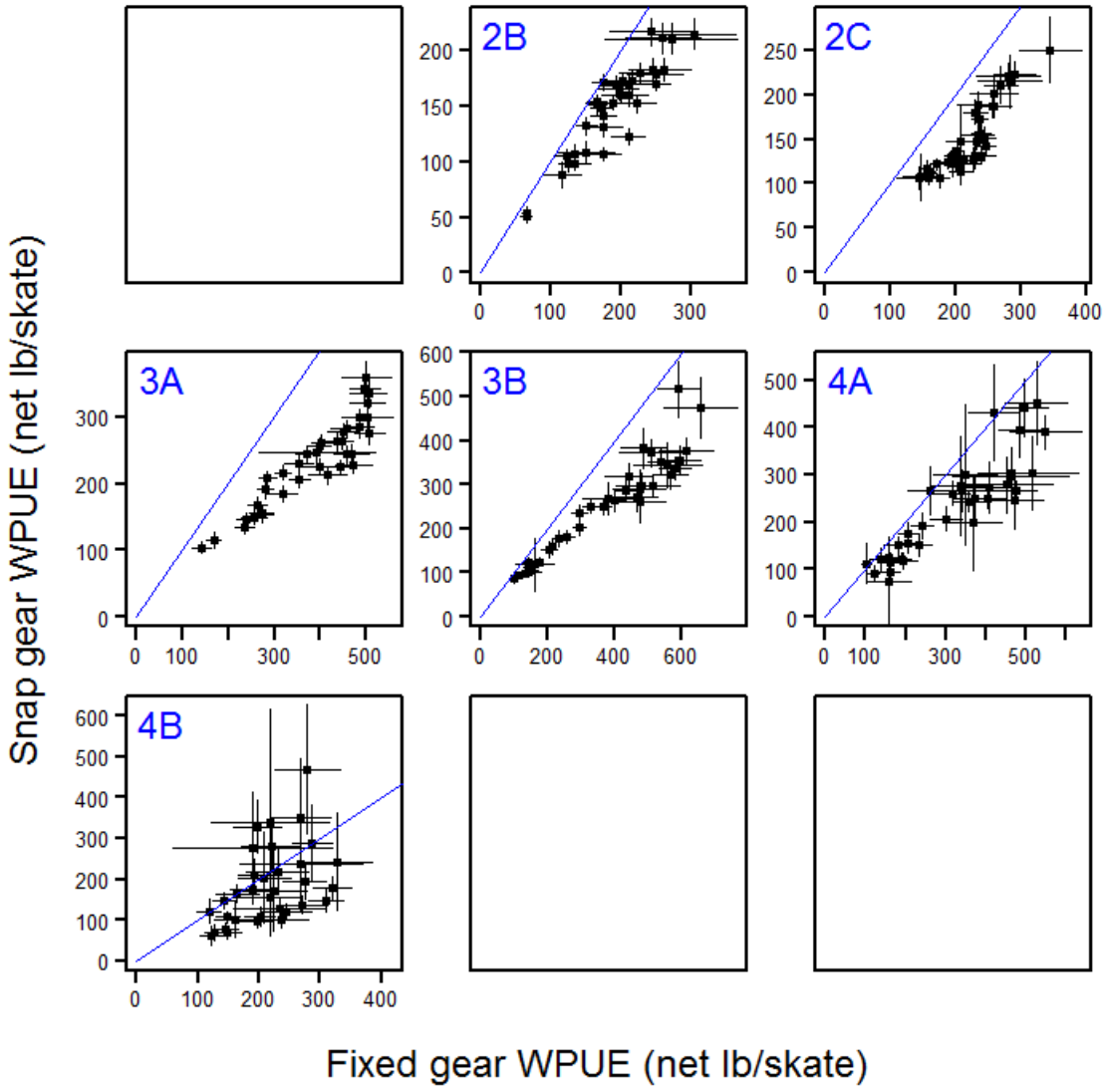

Figure A2. Relationship between commercial annual WPUE by gear type and Regulatory Area. Points indicate individual years; vertical and bars an approximate 95% confidence interval based only on between-set variability. The diagonal line represents a 1:1 relationship for comparison. Format follows Figure A1, with comparisons shown only for those Regulatory Areas where snap and fixed-hook gear have been delineated.

APPENDIX B

Example of qualitative data mapping where “status” is determined relative to the time-series mean, and recent trend is relative to the most recent five years. It may be desirable to provide a small set of panels, or perhaps colored series (by data type) on a single panel reporting trends across a variety of data sources for simultaneous evaluation. Provided below is a single example, where the FISS catch rate estimates from the S-T model (Figure B1) are ‘mapped’ and labelled (Figure B2).

In order to provide a basis for Figure B2 that can be applied to any time-series with a consistent interpretation, the a simple analytical approach was used. The status (*s*) in the terminal year (*y*) is defined on a scale from -1.0 to 1.0, with 0.0 in the center of the plot. If the current value (x_y) is above the mean of the time series ($\bar{x}$), it’s status is calculated relative to the highest value in the time series, given by:

$$s = \frac{x_y - \bar{x}}{\max(\mathrm{x}_{1,\ldots,y}) - \bar{x}}$$

If the current value is below the mean, it’s status is calculated relative to the lowest value in the time series:

$$s = \frac{\bar{x} - x_y}{\min(\mathrm{x}_{1,\ldots,y})}$$

Similarly, the trend of the terminal three years is also reported on a scale of -1.0 to 1.0, and centered on 0.0. The trend (*t*) is defined as the slope (b_y) of a linear regression (without a fixed intercept), and calculated relative to the maximum and minimum slope over any three year period in the observed time series

$$t = \begin{cases} \dfrac{b_y}{\max(\mathrm{b}_{3,\ldots,y})} \; where \; b_y \geq 0.0 \\ \dfrac{-b_y}{\min(\mathrm{b}_{3,\ldots,y})} \; where \; b_y < 0.0 \end{cases}$$

This formulation leads to a simple interpretation on each axis: 1) is the value currently above or below the mean, and its value is relative to the previously observed range, and 2) is the recent trend positive or negative, and how rapidly is it changing relative to the observed time series. Thus, series with different absolute values or units (survey NPUE vs. fishery WPUE) can be overlain on the same figure with the same interpretation. Alternative approaches utilizing axes on absolute scales (rather than relative to each time-series), would require a subjective choice of which ranges to consider high vs. low.

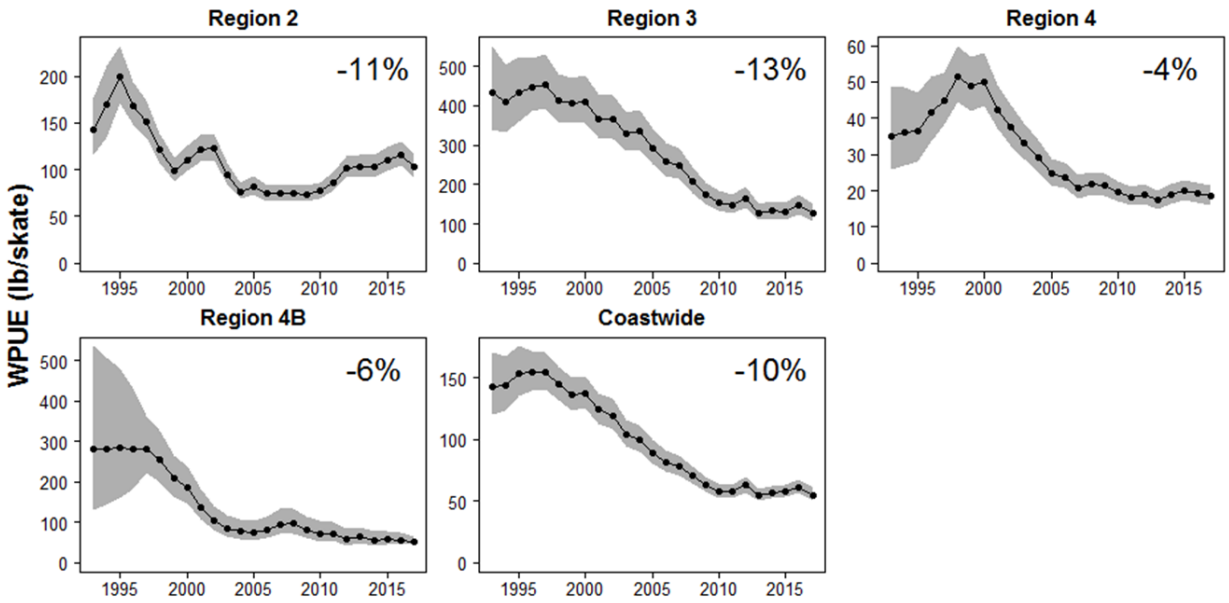

Figure B1. Survey O32 WPUE by Region. Percentages indicate the change from 2016-2017; shaded area indicates an approximate 95% credible interval.

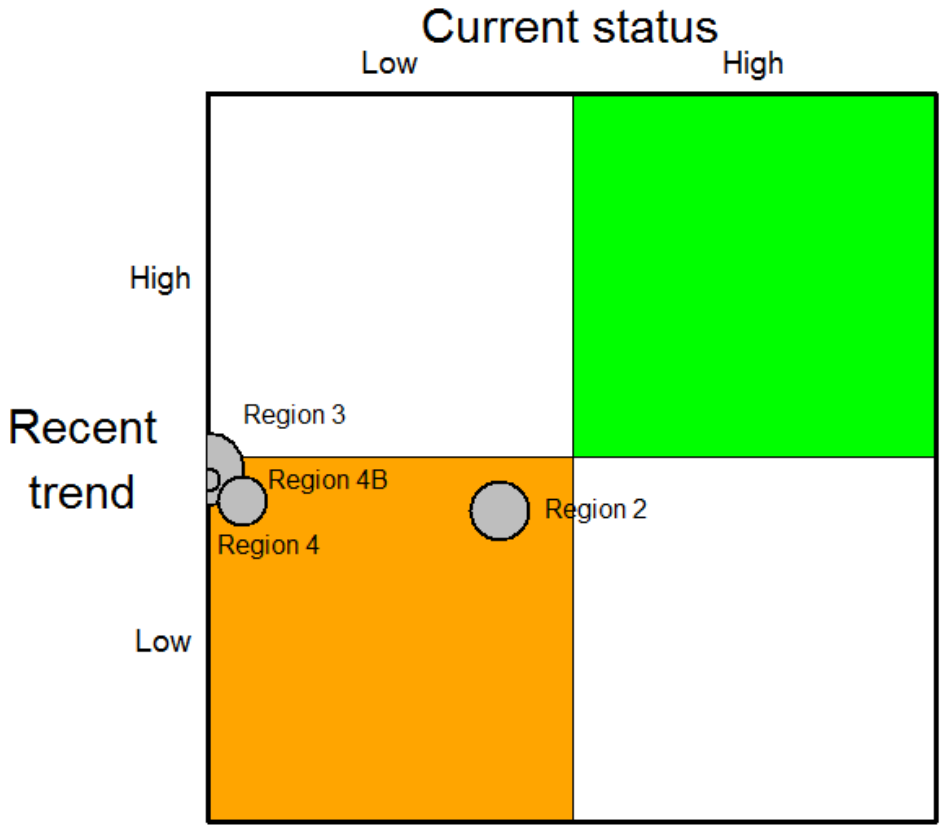

Figure B2. Survey WPUE by Region (identical data from Figure B1) 'mapped' to show current (2017) status (relative to the time-series mean) and three-year trend (relative to the trends observed over the time series). Circles indicate individual Regions, with the area of the circles proportional to the contribution to the aggregate coastwide WPUE (i.e., the 2017 WPUE distribution). See text for quantitative description of the axes.

APPENDIX C

Updated 'phase plot' reflecting the stock and fishing intensity relative to IPHC reference points ($SB_{20\%}$, $SB_{30\%}$) and the fishing intensity 'handrail' (SPR=46%).

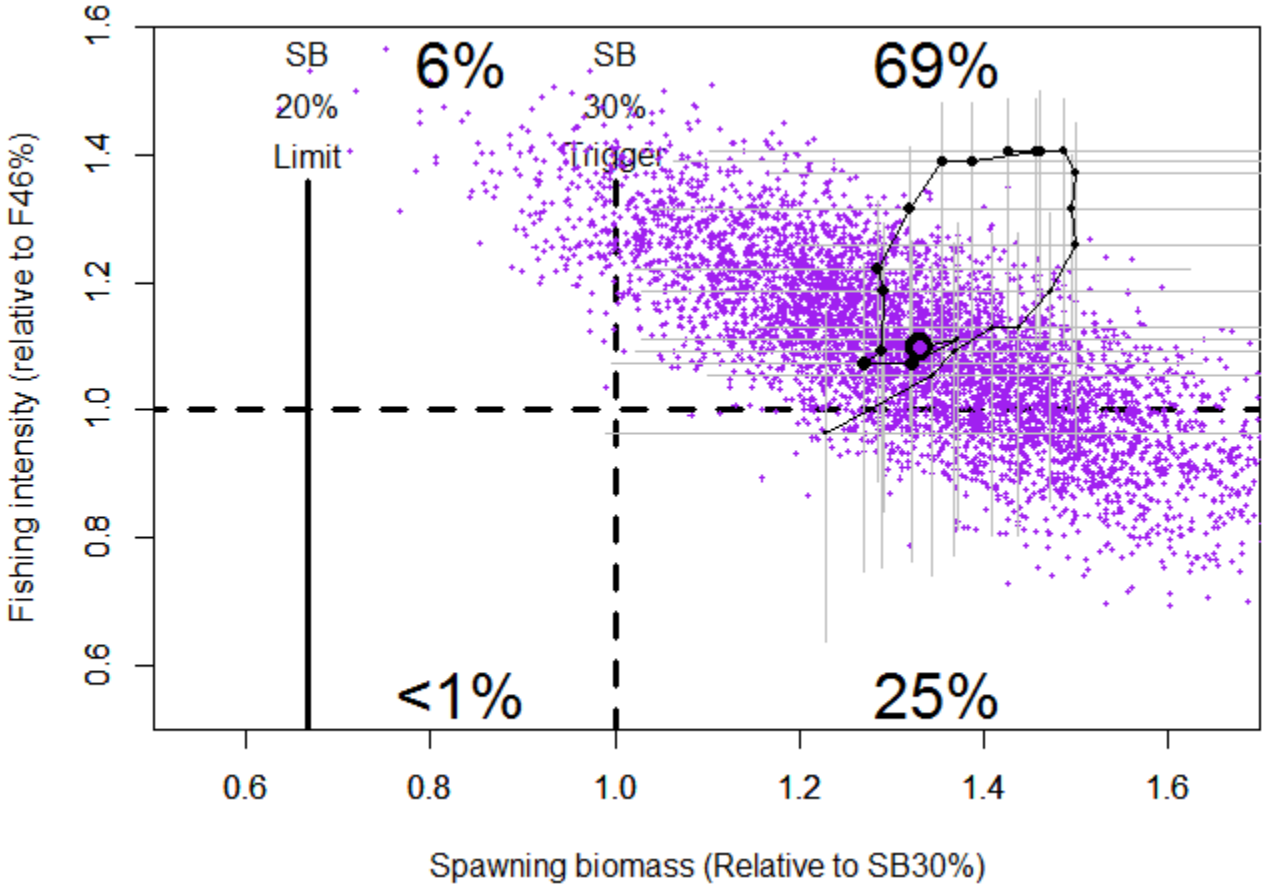

Figure C1. Recent stock (female spawning biomass) status relative to the IPHC's $SB_{30\%}$ and $SB_{20\%}$ reference points (x axis), and fishing intensity status relative to the 'handrail' reference level of SPR=46% (y axis). Connected points indicate years since 1996, with point size increasing to 2017 (purple filled point). Vertical and horizontal lines indicate approximate 95% credibility intervals for each year; small points (purple) represent an approximation of the bivariate uncertainty in the terminal year, with percentages printed on the figure describing the relative probability of the terminal estimate being in each of the quadrants. Note that the two axes are not logically related in that fishing at the reference level does not correspond to the $SB_{30\%}$ biomass level at equilibrium.