DEVELOPMENT OF A NEW TROPICAL TUNA MEASURE WORKSHOP 2 (TTMW2)
Electronic Meeting
6-10 September 2021

ADDITIONAL ANALYSES TO INFORM WCPFC DISCUSSIONS ON CMM 2018-01 REQUESTED BY SC16

WCPFC-TTMW2-2021-IP11[1]
27 April 2021

Paper prepared by the SPC-OFP

[1] This paper and the accompanying spreadsheet were previously posted to the TTMW1 meeting as **WCPFC-TTMW1-2021-02_rev1**

DEVELOPMENT OF A NEW WCPFC TROPICAL TUNA MEASURE
WORKSHOP 1 (TTMW1)
Electronic Meeting
26-30 April 2021

ADDITIONAL ANALYSES TO INFORM WCPFC DISCUSSIONS ON CMM 2018-01 REQUESTED BY SC16

WCPFC-TTMW1-2021-02_rev1[1,2]
27 April 2021

SPC-OFP
Pacific Community (SPC), Noumea, New Caledonia

[1] This is meeting paper **WCPFC17-2020-16** issued 6 November 2020. The accompanying spreadsheet to this paper (**TTMW1-2021-02a**) is an updated version from that issued at WCPFC17 (**WCPFC17-2020-16a**).
[2] This REV1 replaces the version posted 26th March 2021. A correction has been made to the legends of Figures 1 and 3 to ensure ranges match the correct colours in the plot.

COMMISSION
SEVENTEENTH REGULAR SESSION
Electronic Meeting
8-15 December 2020

ADDITIONAL ANALYSES TO INFORM WCPFC17 DISCUSSIONS ON CMM 2018-01 REQUESTED BY SC16

WCPFC17-2020-16
6 November 2020

SPC-OFP
Pacific Community (SPC), Noumea, New Caledonia

Executive Summary

SC16 requested that the Scientific Service Provider provide information to inform the Commission of options for the tropical tuna CMM (SC16 outcomes document paragraph 79; see Appendix 1). Following agreement of the latest stock assessments for WCPO bigeye and yellowfin tuna at SC16, the SC request called for updates to specific plots in SC15-MI-WP01 (Figures 2 and 3 for yellowfin and bigeye tuna, respectively), with further summaries of the implications of different fishing levels on these stocks.

To this end, stochastic projections from the latest bigeye and yellowfin stock assessments have been performed, where future fishery conditions are defined under the specified grid elements of fishing effort (purse seine) and catch (longline) multipliers. The resulting levels of bigeye and yellowfin equilibrium stock depletion ($SB/SB_{F=0}$) have been estimated. The following procedure was used:

- Stochastic projections were run for 30 years into the future from each 2020 stock assessment model within the agreed structural uncertainty grid for the bigeye or yellowfin stock.
- Sufficient projections were performed from each grid model to approximate 1000 simulations for each purse seine effort/longline catch fishing combination for a stock.
- Each future purse seine/longline fishing level combination was defined as a multiplier (scalar) relative to a baseline average period of 2016-2018.
- Future recruitments to the stock were defined by the estimated stock recruitment relationship, with variability around it defined by recruitment estimates from the stock assessment over the most recent 10 years ('recent' recruitment; bigeye only) or the long-term (1962 – 2016; both stocks).
- Catchability was assumed to remain constant into the future (i.e. no effort creep).
- The 'equilibrium' depletion level under the specified purse seine/longline fishing combination was calculated as the median $SB_{2048}/SB_{F=0,\ 2038\text{-}2047}$; after 30 years, the median level had reached equilibrium with the future fishing conditions assumed.
- Risk of the stock falling below the limit reference point (LRP) under the specified purse seine/longline fishing combination was calculated as the proportion of depletion outcomes across the projections under the specified purse seine/longline fishing combination that in 2048 were below $20\%SB_{F=0}$.

Results are presented in terms of the equilibrium depletion level and level of risk of falling below the LRP resulting from the each gear combination for bigeye tuna (Figure 1, Figure 2 and Figure 3, Figure 4 for recent and long-term recruitment assumptions, respectively) and yellowfin tuna (Figure 5 and Figure 6). For levels of future fishing anticipated under CMM 2018-01 scenarios, relative to the 2016-18 'baseline' period, a summary is provided in Table 1.

The relative contribution of purse seine and longline gears to the change in stock depletion, and the approximation of the absolute quantities that correspond to the scalars (for each purse seine scalar, numbers of both associated sets and unassociated sets, and for each longline scalar, longline species catch in mt; SC16 paragraph 79, 1a) are provided in the accompanying spreadsheet, with a different worksheet for each stock/future recruitment assumption.

A table of fishery impact on WCPO bigeye tuna SSB, by fishery sector (for just the diagnostic case model, and including: longline, purse seine associated, purse seine unassociated, pole-and-line, and other) is also provided in the accompanying spreadsheet.

As noted within other SPC-OFP papers to WCPFC17, the new information incorporated within the 2020 yellowfin tuna stock assessment implies a more robust stock than estimated previously, as seen by the minimal risks of falling below the LRP identified at the levels identified here. It should be noted that key areas for further work on the yellowfin assessment were identified for the coming year, and an external review of the assessment is planned for 2022. While the assessment is viewed as the best scientific information currently available, the further work underway may lead to changes in the perception of stock status and robustness.

Table 1. Summary of scalars under CMM 2018-01 relative to 2016-18 average baseline fishing levels

	Purse seine	**Longline**
2016-18 average	1	1
Optimistic	1.11	1
Pessimistic	1.13	1.51

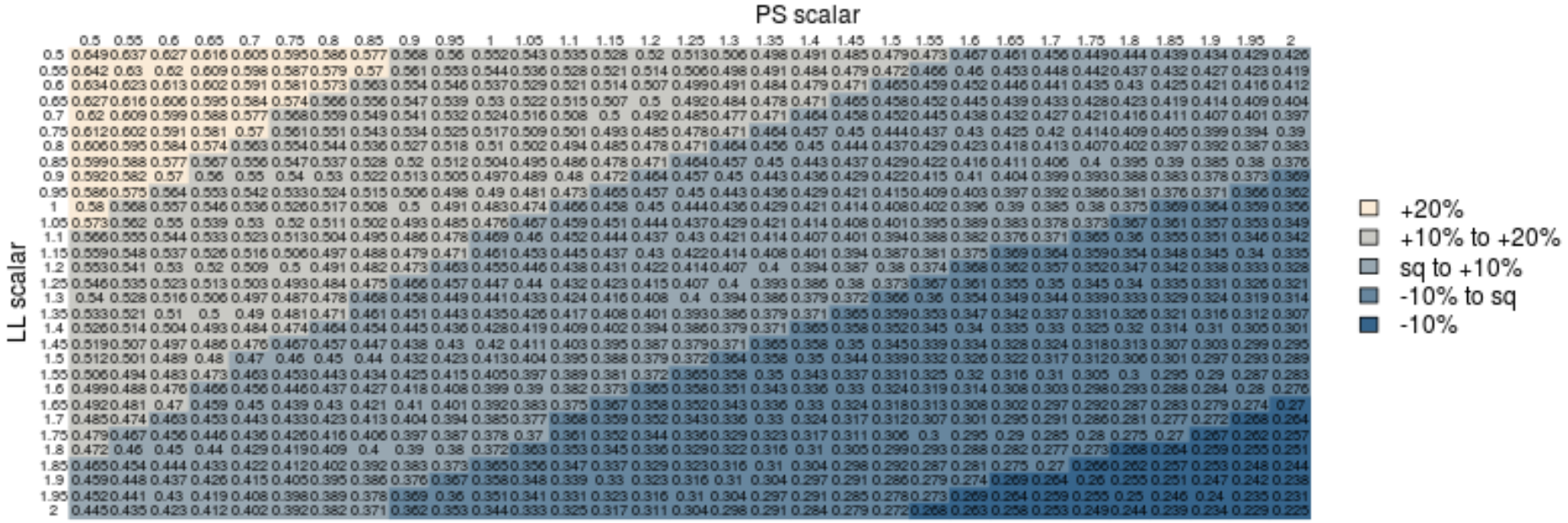

Figure 1. Bigeye equilibrium stock depletion levels ($SB/SB_{F=0}$) resulting under the different purse seine (across) and longline (down) scalars (relative to 2016-18 levels), under the assumption that 'recent' recruitment levels continue. Values indicate equilibrium depletion levels resulting under fishery conditions. Shading indicates depletions relative to average stock depletion levels over the period 2012-15 ('sq'; 37%$SB_{F=0}$), consistent with CMM 2018-01.

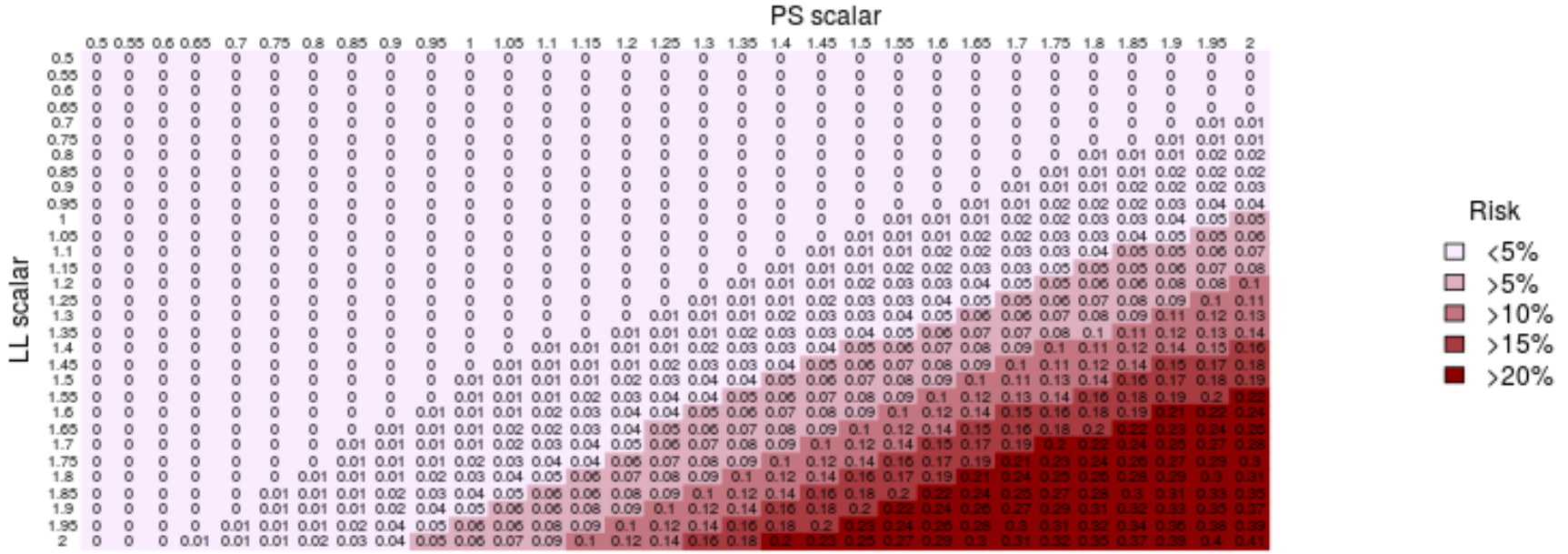

Figure 2. Risk that the bigeye stock depletion levels ($SB/SB_{F=0}$) resulting under the different purse seine (across) and longline (down) scalars (relative to 2016-18 levels), under the assumption that 'recent' recruitment levels continue into the future, will fall below the limit reference point. Values indicate the risk level under those fishery conditions, shading indicates those risk levels relative to 5%, 10%, 15% and 20%.

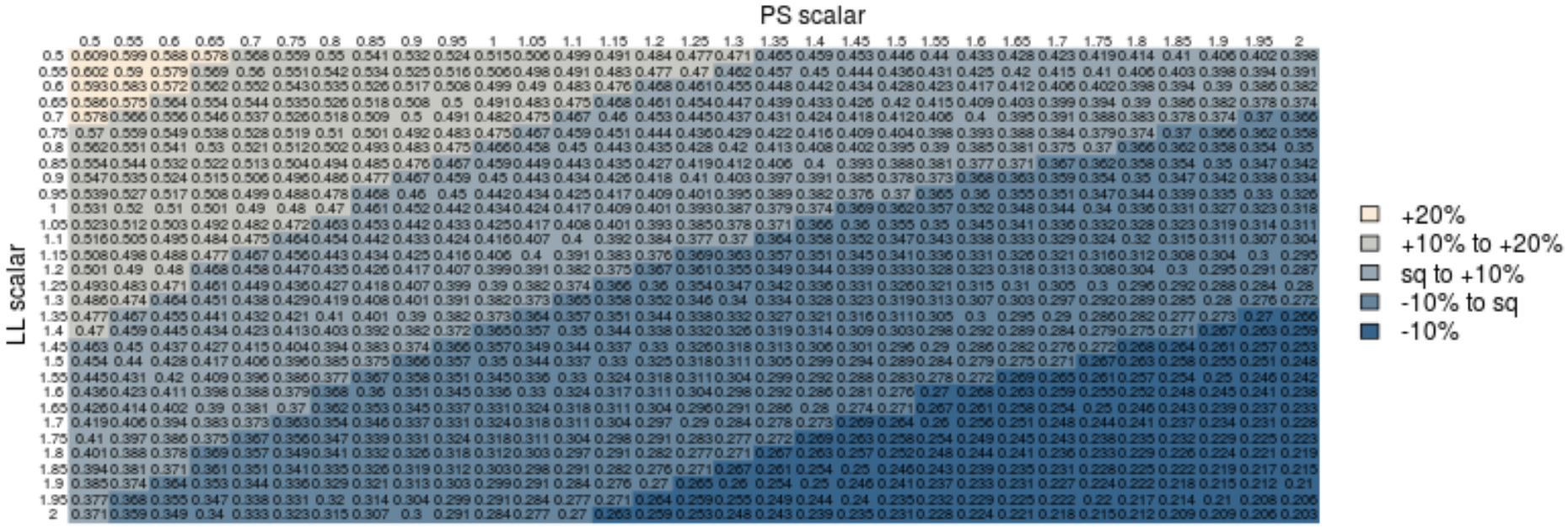

Figure 3. Bigeye equilibrium stock depletion levels ($SB/SB_{F=0}$) resulting under the different purse seine (across) and longline (down) scalars (relative to 2016-18 levels), under the assumption that 'long-term' recruitment levels continue into the future. Values indicate equilibrium depletion levels resulting under fishery conditions. Shading indicates depletions relative to average stock depletion levels over the period 2012-15 ('sq'; 37%$SB_{F=0}$), consistent with CMM 2018-01.

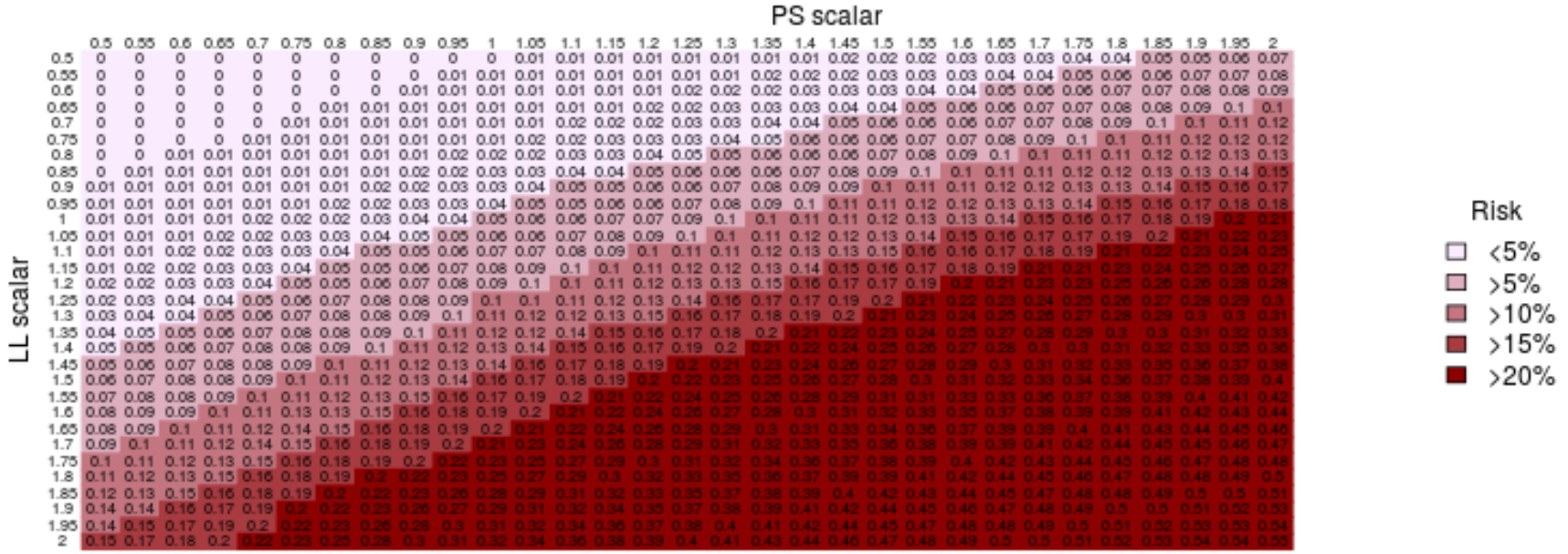

Figure 4. Risk that the bigeye stock depletion levels ($SB/SB_{F=0}$) resulting under the different purse seine (across) and longline (down) scalars (relative to 2016-18 levels), under the assumption that 'long-term' recruitment levels continue into the future, will fall below the limit reference point. Values indicate the risk level under those fishery conditions, shading indicates those risk levels relative to 5%, 10%, 15% and 20%.

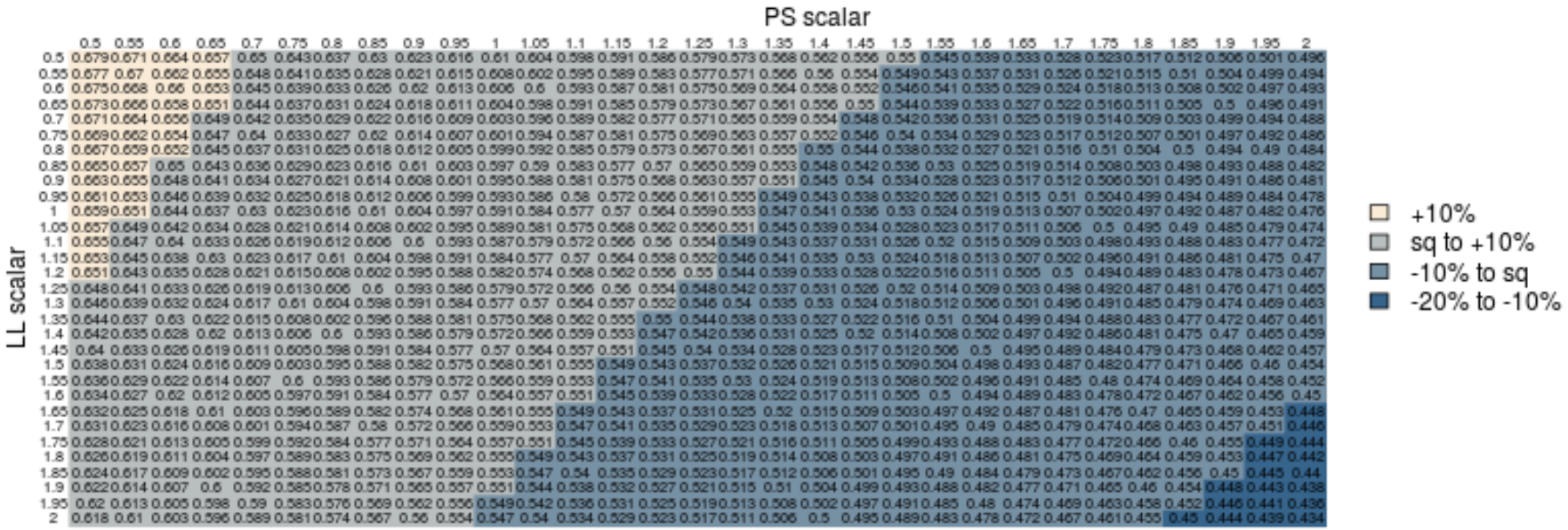

Figure 5. Yellowfin equilibrium stock depletion levels ($SB/SB_{F=0}$) resulting under the different purse seine (across) and longline (down) scalars (relative to 2016-18 levels), under the assumption that 'recent' recruitment levels continue into the future. Values indicate equilibrium depletion levels resulting under fishery conditions. Shading indicates depletions relative to average stock depletion levels over the period 2012-15 ('sq'; $55\%SB_{F=0}$), consistent with CMM 2018-01.

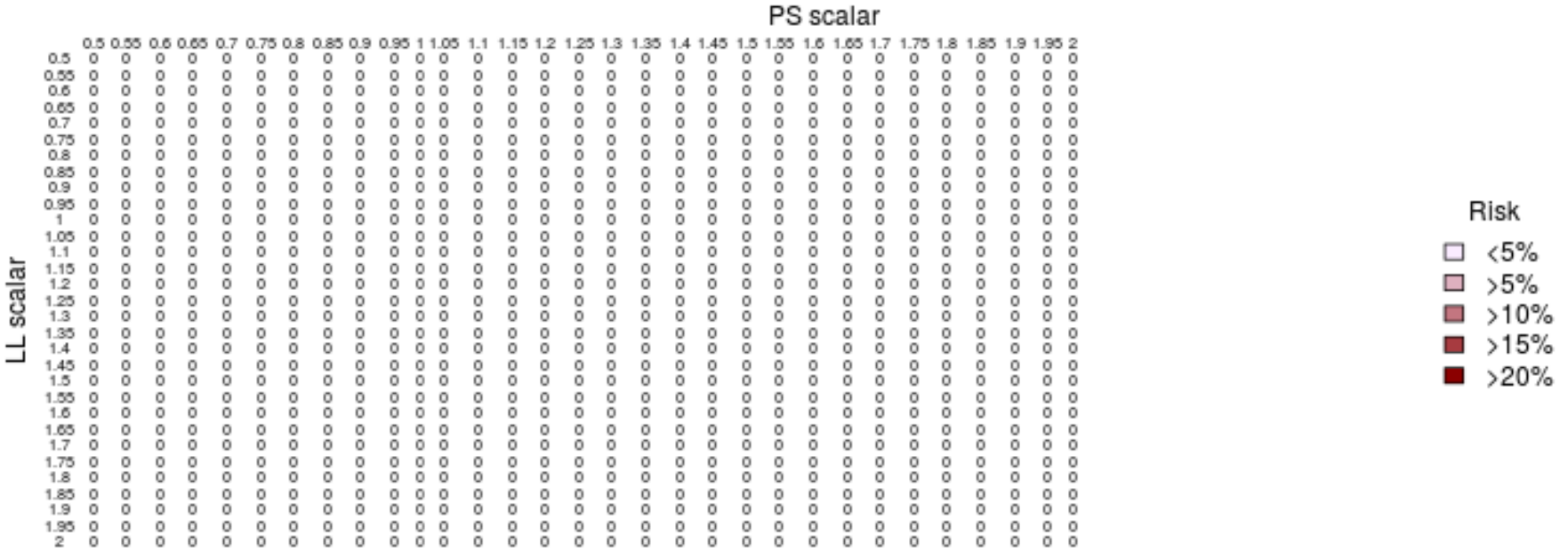

Figure 6. Risk that the yellowfin stock depletion levels ($SB/SB_{F=0}$) resulting under the different purse seine (across) and longline (down) scalars (relative to 2016-18 levels), under the assumption that 'recent' recruitment levels continue into the future, will fall below the limit reference point. Values indicate the risk level under those fishery conditions, shading indicates those risk levels relative to 5%, 10%, 15% and 20%.

Appendix 1. Summary of SC16 requests related to CMM 2018-01

79. To provide additional information to the Commission on options for CMM-2018-01, SC16 recommends that the Scientific Services Provider provide to the Commission as early as reasonable, the following:

1) Any updates to SC15-MI-WP01, "minimum target reference points for WCPO yellowfin and bigeye tuna consistent with alternative LRP risk levels, and multispecies implications," and the following additions to the deterministic projections in Figure 3a and 3b for bigeye tuna (and to Figures 2a and 2b for yellowfin tuna if possible) (as in the original paper, the PS scalar should scale overall PS fishing effort, including both associated and unassociated fishing effort):
   a) Inclusion on the x axis (PS scalar) and y axis (LL scalar) of the absolute quantities that correspond to the scalars (for PS scalar, numbers of both associated sets and unassociated sets, and for LL scalar, longline catch in mt).
   b) Inclusion on the x axis and y axis of the expected fishery impact of the sector on SSB (SB2045/SBF=0) that correspond to the scalars, assuming the other sectors' (e.g., pole-and-line and other) impacts are as they were in 2013-2015, on average.
   c) Extension of the ranges of the x and y axes to scalars as high as 2.0 (from 1.5).
   d) Indications of the expected PS scalars for the purse seine management regime under CMM 2018-01.
2) One or more tables showing as long a time series as possible, of fishery impact on WCPO bigeye tuna SSB, by fishery sector (for just the diagnostic case, and including at a minimum: longline, purse seine associated, purse seine unassociated, pole-and-line, and other).