INTERNATIONAL PACIFIC HALIBUT COMMISSION

Update on the development of the 2021 stock assessment

Agenda item 5.1

IPHC-2021-SRB019-06

Topics

- Assessment process
  - Software updates
- SRB requests
- Preliminary data updates

Recent assessments

- 2019: Full assessment
  - Independent and SRB review
  - Standard data updates (fishery and FISS)
  - New data source: 2017-2018 commercial sex-ratio at age
- 2020: Update
  - Standard data updates (fishery and FISS) + 2019 commercial sex-ratio at age
  - New data source: recreational sex-ratios at age
- 2021: Update
  - Standard data updates (fishery and FISS) + 2020 commercial sex-ratio at age

2021 Model development

- Updating software:
  - Stock synthesis 3.30.16.02 (For SRB018)
  - Stock synthesis 3.30.17.00 (August)
    - Identical model results, but run-times now back to 3.30.15.xx speeds!
- No other structural changes to the models

SRB requests at SRB018

SRB018 Req.4 (para. 24):

> *“The SRB REQUESTED an analysis of annual surplus production and the fraction of that production harvested.”*

Surplus production

- 5 methods considered:
  1) Fitting surplus production models directly to survey indices
  2) ‘Standard’ surplus production based on all-ages biomass and fishing mortality
  3) Same calculation using Spawning biomass
  4) Decision table results presented each year
  5) Model-free ‘empirical harvest rates’ provided each year

1) Surplus production models (2014)

- Recruitment dynamics drive productivity
- Weak S-R relationship
- Survey index 1993+
- Useful exercise, but limited direct utility

2) ‘Standard’ surplus production (*S*)

- Based on assessment-estimated biomass (*B*) and all-ages catch (*C*) in each year (*y*):

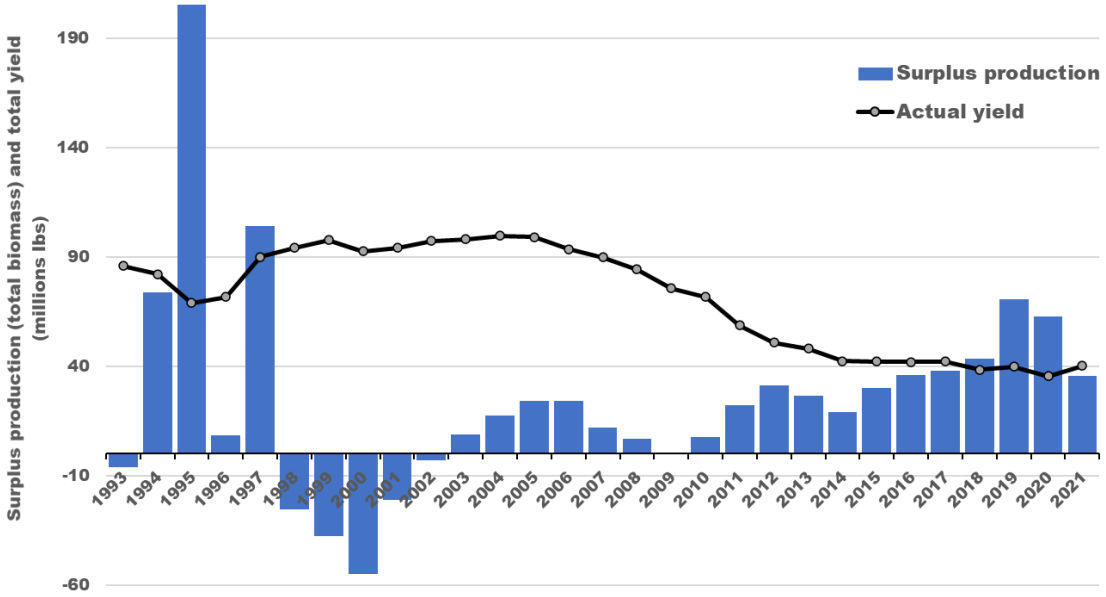
$$S_{y-1} = B_y - B_{y-1} + C_{y-1}$$

Defining ‘biomass’ is challenging due to multiple fleets with differing and time-varying selectivity (this is why we dropped the concept of ‘exploitable biomass’ several years ago in favor of SPR).

In addition, the IPHC’s interim management procedure is not intended to stabilize the biomass at any specific level.

2) ‘Standard’ surplus production

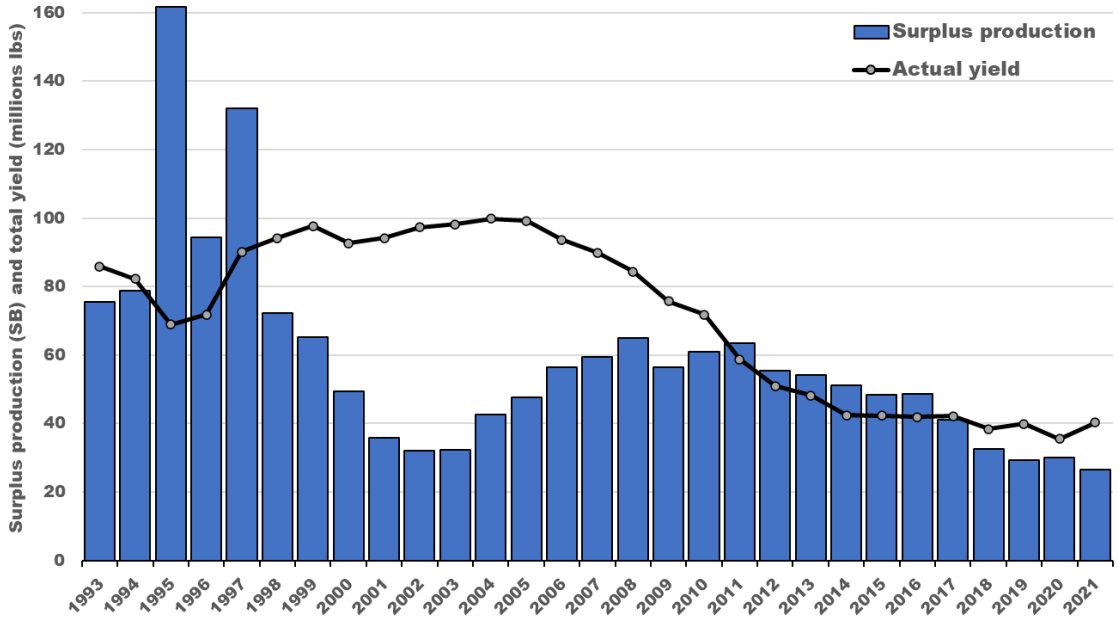
- All ages biomass:



Period of declining total biomass (from historically high levels) very clear.

3) ‘Standard’ surplus production

- Spawning biomass:



More consistent with reference points, same period of stock decline evident.

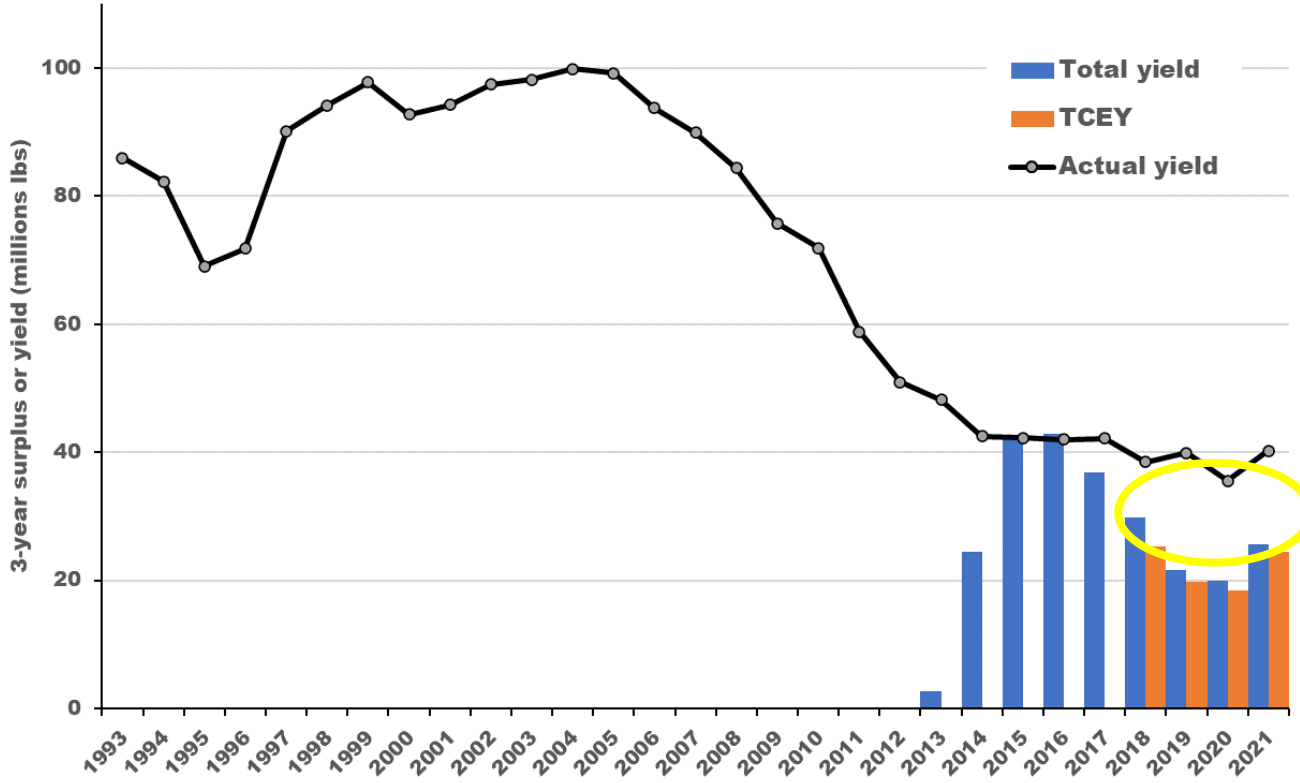
4) Surplus production – Decision table

- The yield that would produce a 50% chance of the same or greater spawning biomass after 3 years

2021 Alternative				3-Year Surplus		Status quo		*Reference $F_{43\%}$*					
Total mortality (M lb)			0.0	25.7	36.8	37.9	39.1	40.3	41.5	42.9	44.1	61.3	
TCEY (M lb)			0.0	24.4	35.5	36.6	37.8	39.0	40.3	41.6	42.8	60.0	
2021 fishing intensity			$F_{100\%}$	$F_{58\%}$	$F_{46\%}$	$F_{45\%}$	$F_{44\%}$	$F_{43\%}$	$F_{42\%}$	$F_{41\%}$	$F_{40\%}$	$F_{30\%}$	
Fishing intensity interval			--	39-76%	29-65%	29-64%	28-63%	27-62%	26-61%	26-60%	25-59%	18-49%	
Stock Trend (spawning biomass)	in 2022	is less than 2021	<1	42	61	62	64	65	66	67	69	82	a
		is 5% less than 2021	<1	7	32	34	36	39	41	44	46	66	b
	in 2023	is less than 2021	<1	51	62	63	64	65	66	67	69	81	c
		is 5% less than 2021	<1	32	53	54	55	56	57	59	59	74	d
	in 2024	is less than 2021	<1	50	60	61	62	63	64	66	67	80	e
		is 5% less than 2021	<1	40	55	56	57	57	58	59	60	74	f
Stock Status (Spawning biomass)	in 2022	is less than 30%	29	35	39	40	40	41	41	42	42	47	g
		is less than 20%	<1	<1	<1	<1	1	1	1	1	1	4	h
	in 2023	is less than 30%	23	32	39	40	40	41	42	43	43	49	i
		is less than 20%	<1	<1	2	2	3	3	4	5	5	19	j
	in 2024	is less than 30%	12	29	38	39	40	41	42	43	44	50	k
		is less than 20%	<1	<1	4	5	6	8	9	10	12	25	l

4) Surplus production – Decision table

(As calculated in each year's assessment)



Indicates a high probability of decrease in SB

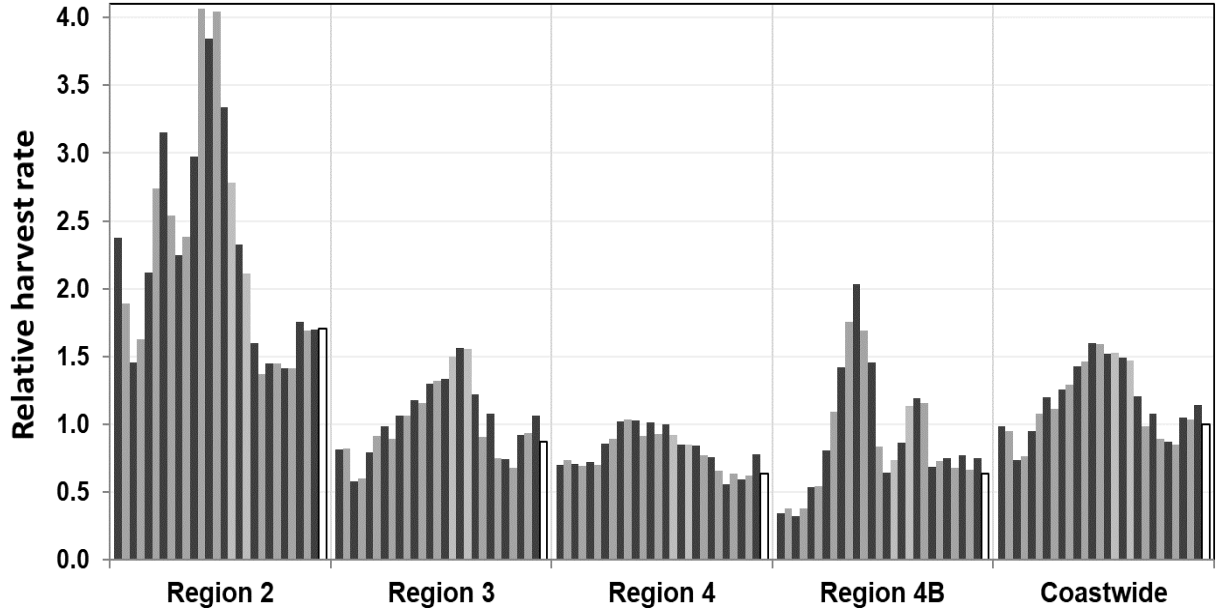
5) Empirical harvest rates (*U*)

- Model-free evaluation of yield vs production by year (*y*) and Biological Region (*r*)
- Assuming catchability is constant, catch (*C*), survey index (*I*) and an arbitrary constant (*k*) are all that is required:

$$\widehat{U}_{y,r} = \frac{C_{y,r}}{I_{y,r}} k$$

5) Empirical harvest rates (*U*)

- Constant (*k*) is selected so that the coastwide value in the terminal year is 1.0



Surplus production conclusions

- Information provides clear results that yield exceeded annual production in the early 2000s, and again in the most recent 4 years.
- Recently, the choice to ‘fish down’ the stock using F46% (2017-2020) and then F43% (2021) has been explicit, and informed by MSE analyses

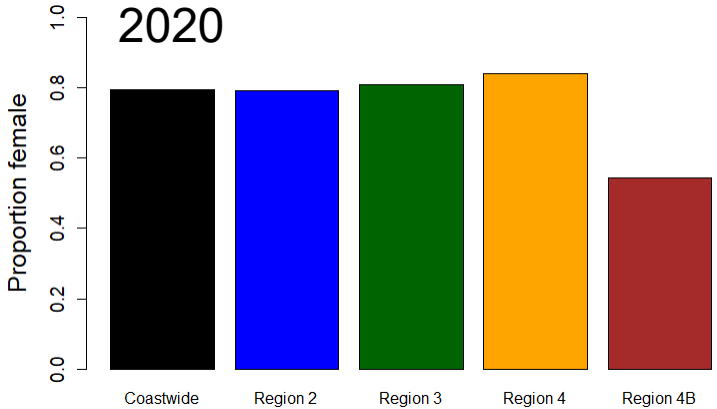
Preliminary data updates

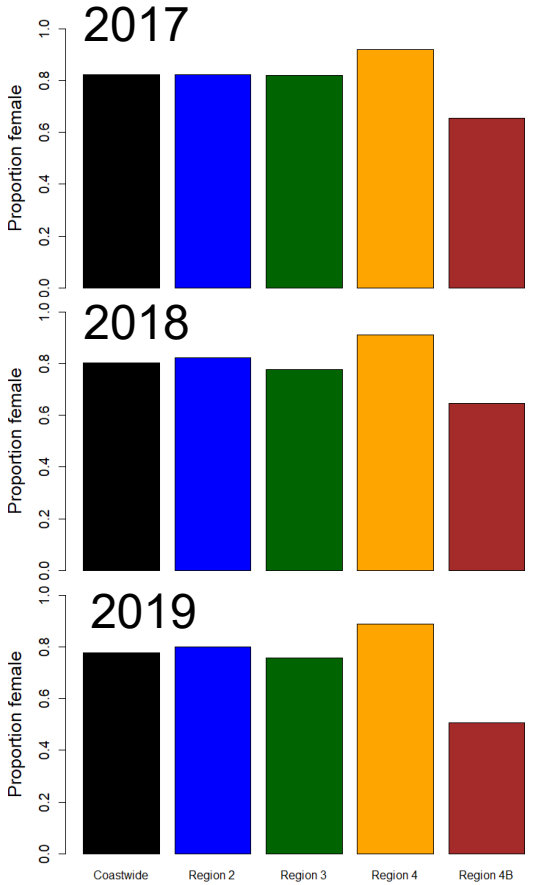
- 2020 Commercial fishery sex ratios at age completed in August 2021

Preliminary data updates

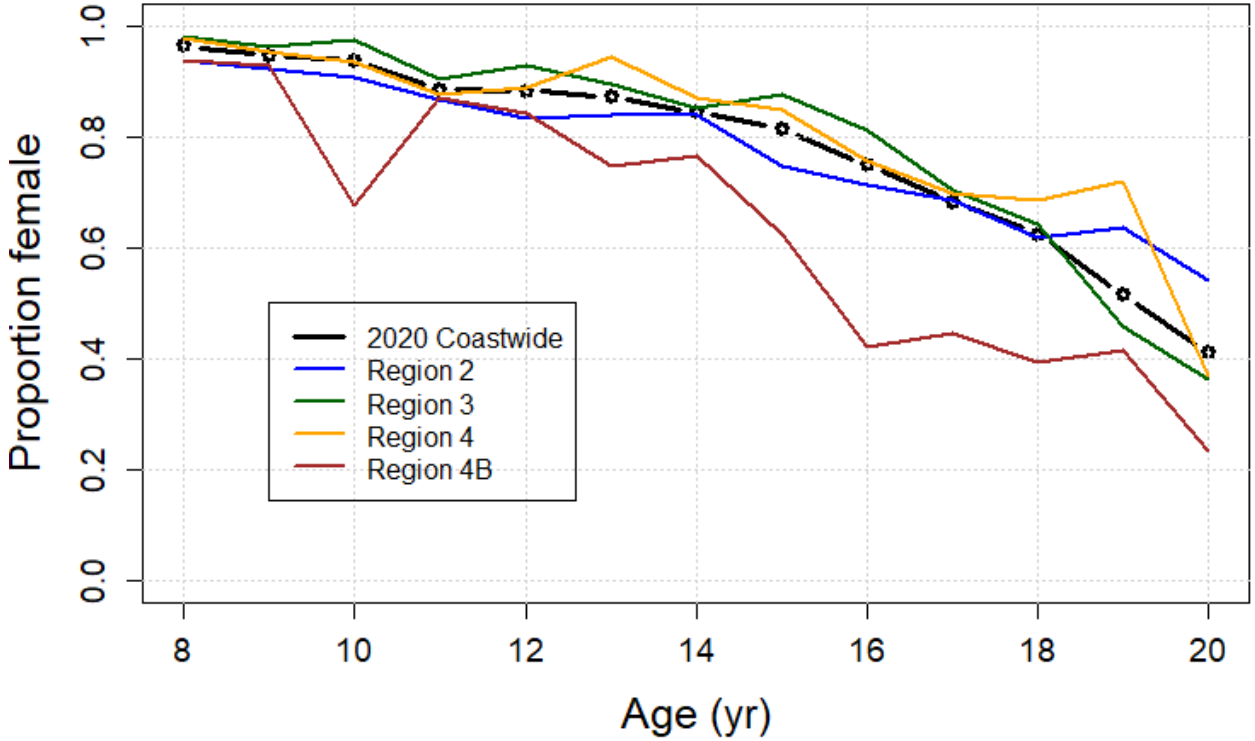
Commercial sex-ratios

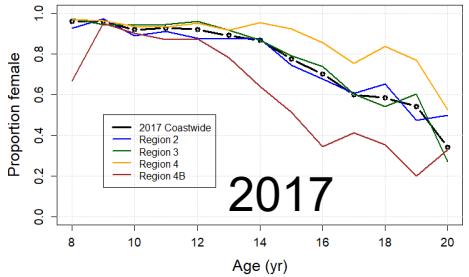
	Coastwide % female	Region 2	Region 3	Region 4	Region 4B
2017	82%	82%	82%	92%	65%
2018	80%	82%	78%	91%	65%
2019	78%	80%	76%	89%	51%
2020	80%	79%	81%	84%	54%

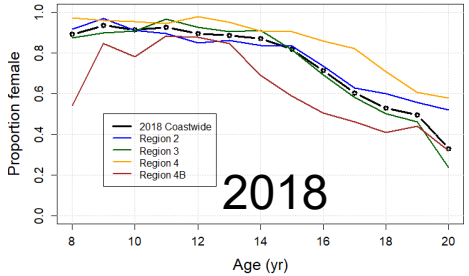


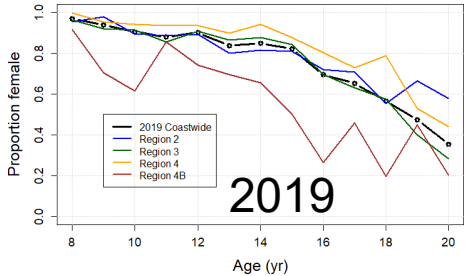


Commercial sex-ratios









Preliminary data updates

- Commercial fishery whale depredation analysis is still in process

Standard data in the 2021 assessment

1) Modelled trend information including the 2021 FISS in all IPHC Regulatory Areas.
2) Age, length, individual weight, and average weight-at-age estimates from the 2021 FISS.
3) 2021 (and a small amount of 2020) Directed commercial fishery logbook trend information from all IPHC Regulatory Areas.
4) 2021 Directed commercial fishery biological sampling (age, length, individual weight, and average weight-at-age) from all IPHC Regulatory Areas.
5) Biological information (lengths and/or ages) from non-directed discards (all IPHC Regulatory Areas) and the recreational fishery (IPHC Regulatory Area 3A only) from 2020.
6) Updated mortality estimates from all sources for 2020 (where preliminary values were used) and estimates for all sources in 2021.

Recommendation/s

That the SRB:

a) **NOTE** paper IPHC-2021-SRB019-06 which provides a response to requests from SRB018 and an update on model development for 2021.

b) **RECOMMEND** any further changes to be included in the final 2021 stock assessment.

c) **REQUEST** any further analyses to be provided at SRB020, June 2022.

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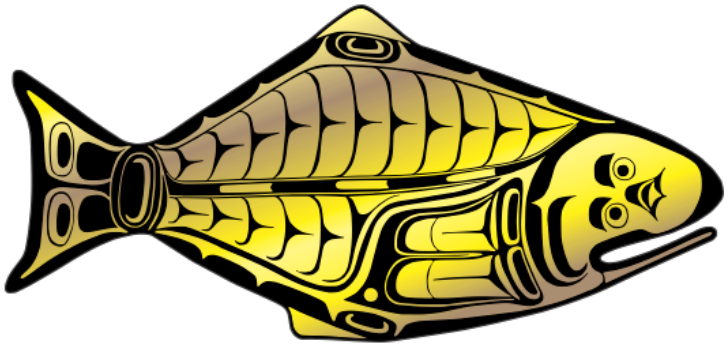

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