INTERNATIONAL PACIFIC

HALIBUT COMMISSION

Effects of historical discard mortality in non-directed fisheries (bycatch)

Agenda item 3.3

IPHC-2019-SRB015-12

Purpose

To provide the Scientific Review Board (SRB) with an analysis for review in response to the Commission's request:

- "*AM095–Rec.05 (para. 67) The Commission* ***RECOMMENDED*** *that the IPHC Secretariat expand upon the analysis completed in IPHC-2019-AM095-INF08 "Treatment and effects of Pacific halibut discard mortality (bycatch) in non-directed fisheries projected for 2019", to be reviewed by the SRB at its next meeting. The objective of this work is to estimate lost yield from bycatch of Pacific halibut in non-directed fisheries for the years of 1991-2018.*"

Background

- Lost yield vs. yield gain (lb to lb) – trading sources of mortality ('Fisheries Footprint')

- Depends on: Growth, mortality, selectivity (of each component), discard mortality rates, overall fishing intensity, age structure of the population

Previous studies

Study	Rate
Adlerstein 1993, 1994	1.0-3.3 (Gear and season specific)
Sullivan et al. 1994	1.7
Clark and Hare 1998	1.12 for 1995
Hare and Clark 2007	1.40, 1.58
Hare and Williams 2013	1.14
IPHC-2019-AM095-INF07,INF08	1.25-1.29 (projected for 2019-2021)

Methods

- Numerical evaluation of using the preliminary 2019 ensemble

- Equilibrium model for reference point evaluation (IPHC-2019-SRB015-11) with 'generic' directed fishery and discard mortality in non-directed fisheries selectivity

Iterative ensemble approach (I)

- Set all parameters to MLEs
- Turn of estimation
- Set discard mortality in non-directed fisheries in one year (1992 to 2018) to 0.0
- Increase directed fishery (landings and discard mortality) by α (set to a starting value of 1.0 or previous year's estimate)
- Recalculate time series (using MLEs, not re-estimated)

Iterative ensemble approach (II)

- Using the variance in SPR from the original MLEs, calculate the ensemble median SPR with adjusted discard mortality in non-directed fisheries and directed fishery mortality

- Compare the median to the original estimate of SPR

- Repeat iteration by adjusting α until original and ensemble SPR values match (to three decimal places)

- Calculate the difference in commercial mortality before and after iterations to determine yield gain

- Divide by original discard mortality in non-directed fisheries to get yield gain rate (lb/lb)

Spatial distribution of yield gain

- Transfer all O26 discard mortality in non-directed fisheries to the directed fishery in the IPHC Regulatory Area in which it occurred
- Scale all directed fishery mortality in proportion to account for U26

→ This approach is consistent with the current IPHC harvest strategy
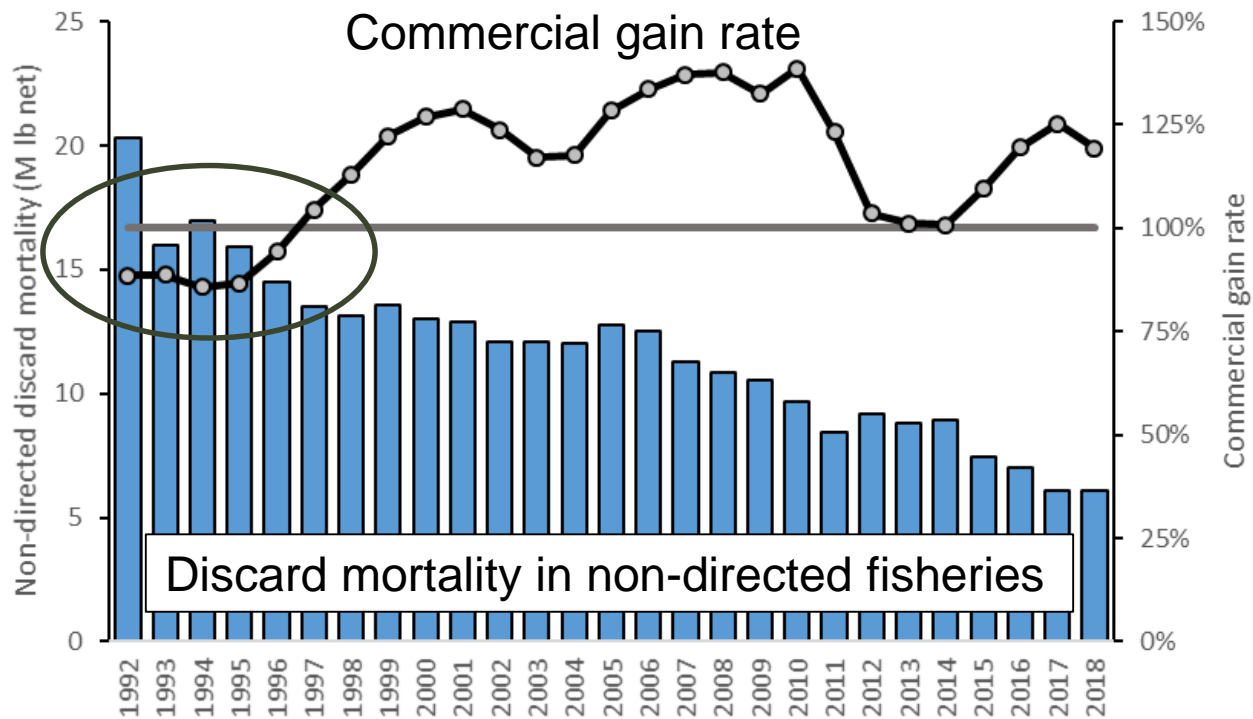
Results (ensemble)

- Discard mortality in non-directed fisheries (Table 1) ranged from 20.29 Mlb (1992) to 6.06 Mlb (2018)

Results (ensemble)

Avg: 115%
Range: 86-139%

Commercial gain rate

Discard mortality in non-directed fisheries

International Pacific Halibut Commission

Results (ensemble)

- Distribution (Table 4):

	2A	2B	2C	3A	3B	4A	4B	4CDE
Non-directed discard mortality	3.7%	3.7%	1.3%	22.8%	11.1%	12.4%	5.3%	39.7%
Yield gain	3.7%	8.7%	5.4%	28.0%	13.5%	8.4%	5.7%	26.4%

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Equilibrium model

- Parameterized after the 2018 stock assessment
- Hold SPR at a constant value (0.46)
- Compare the yield across a range of allocation scenarios (100% directed to 100% non-directed)
- Does not include discard mortality for the directed commercial fishery

Results (equilibrium model)

Scenario	Directed fishery F	Non-directed F	Relative yield	Gain rate
1	100%	0%	1.00	--
2	80%	20%	0.83	121%
3	40%	60%	0.73	137%
4	0%	100%	0.69	144%

Discussion

- There is no constant gain rate
- This analysis is *not* a replay of history, it is a sequential analysis of each individual year
- The analysis assumes no distributional feedback beyond the patterns actually observed. Evaluation of 'downstream effects' caused by ontogenetic movement would require a spatial model.
- The trade-off in yield among sectors is part of a management strategy, and may be best evaluated as part of the MSE
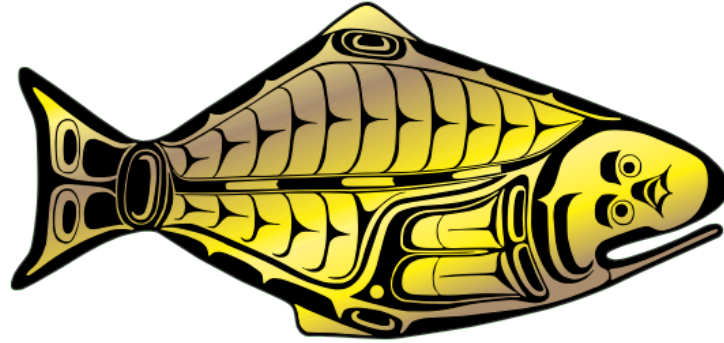
Recommendations

That the SRB:

- **NOTE** paper IPHC-2019-SRB015-12 which provides an analysis of the effects of historical discard mortality in non-directed fisheries (bycatch) on yields to the directed fisheries
- **REQUEST** any modifications or additions necessary to provide for further consideration of this topic by the Commission during upcoming Sessions of the IPHC Interim and Annual Meetings.

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