INTERNATIONAL PACIFIC HALIBUT COMMISSION

IPHC Fishery-Independent Setline Survey (FISS) and commercial data modelling

Agenda items 5.3-5.5

IPHC-2021-RAB022-07

(R. Webster)

Topics

1. Modelling of IPHC length-weight data
2. Review of IPHC hook competition standardization (document only)
3. Accounting for the effects of whale depredation on the FISS

1. Modelling of IPHC length-weight data

- The IPHC and other agencies sampling Pacific halibut use a standard length-weight relationship to estimate Pacific halibut weight from length when direct weight measurements are not recorded.
- This relationship was estimated in 1926 from 454 fish captured in IPHC Regulatory Area 2B
- A review by Clark (1991) showed that the relationship still held up well
- In recent years there has been evidence that this historical relationship is biased, with weight being overestimated on average
  - Pacific halibut appear to have become thinner since the relationship was estimated

IPHC data sources

- Since 2015, the IPHC commercial sampling program has collected dockside weight data on Pacific halibut
- Since 2019, FISS charter vessels have been equipped with motion-compensated scales with the goal of weighing all captured Pacific halibut
- These data allow us to obtain contemporary estimates of the length-weight relationship, and examine variation in the relationship over time and space

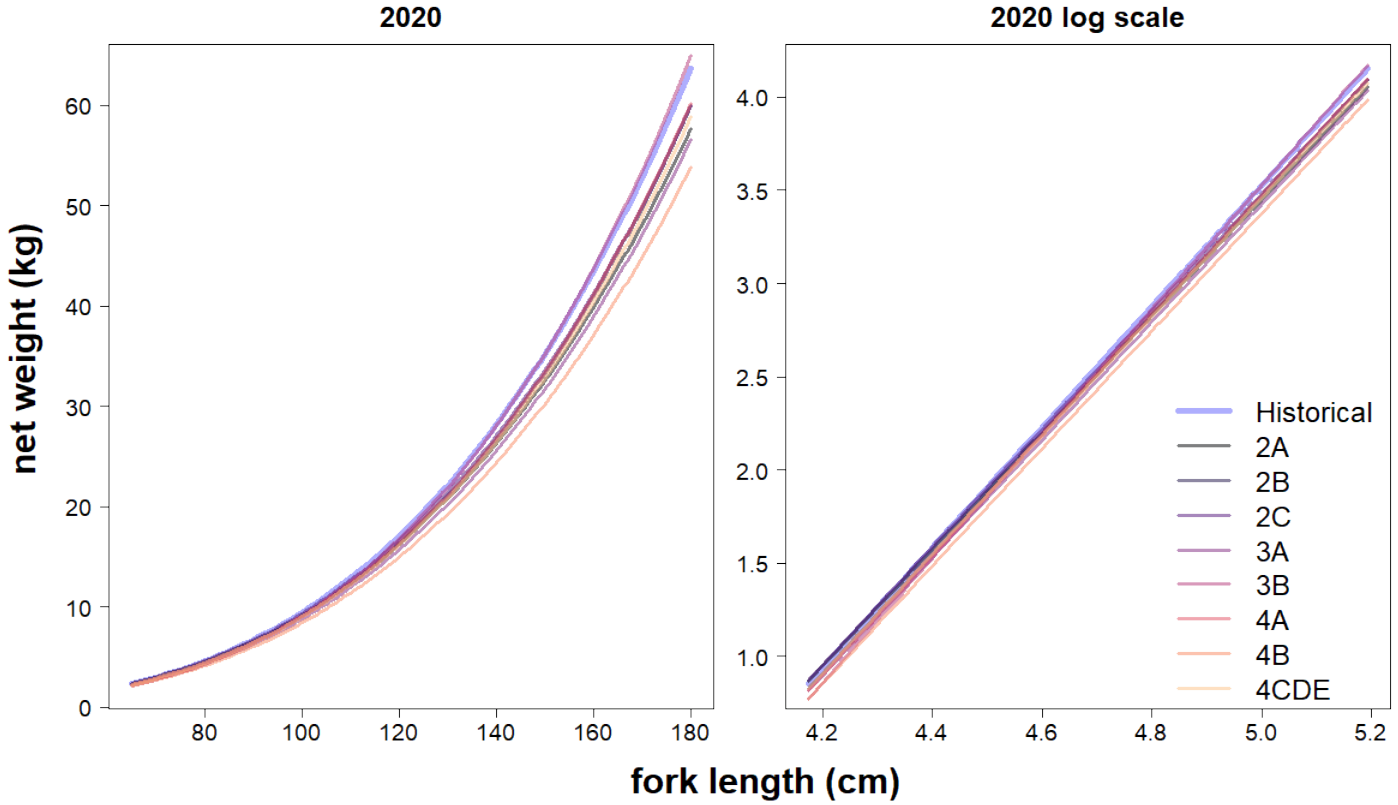
Weight measures and conversion multipliers

Weight	Definition	Multiplier to convert to net weight	Notes
Round FISS (U32)	Head-on, not gutted, no ice and slime	0.75	
Gross (vessel weight)	Head-on, gutted, with ice and slime	0.8624	Assumes 10% head weight and 2% shrinkage, or 12% head, and 2% ice and slime
Dressed (vessel weight) FISS (O32)	Head-on, gutted, no ice and slime	0.88	Assumes 10% head weight and 2% shrinkage, or 12% head only
Gross (dock weight) Commercial (O32) FISS (some O32)	Head-on, gutted, with ice and slime	0.882 or 0.88	Assumes 10% head weight and 2% ice and slime; deductions either additive (10+2=12% in 2A and 2B) or multiplicative (1-0.9*0.98=0.118 or 11.8% in Alaska)
Dressed (dock weight) Commercial (O32)	Head-on, no ice and slime (washed)	0.9	Assumes 10% head weight
Net	Head-off, gutted, no ice and slime (washed)	1	

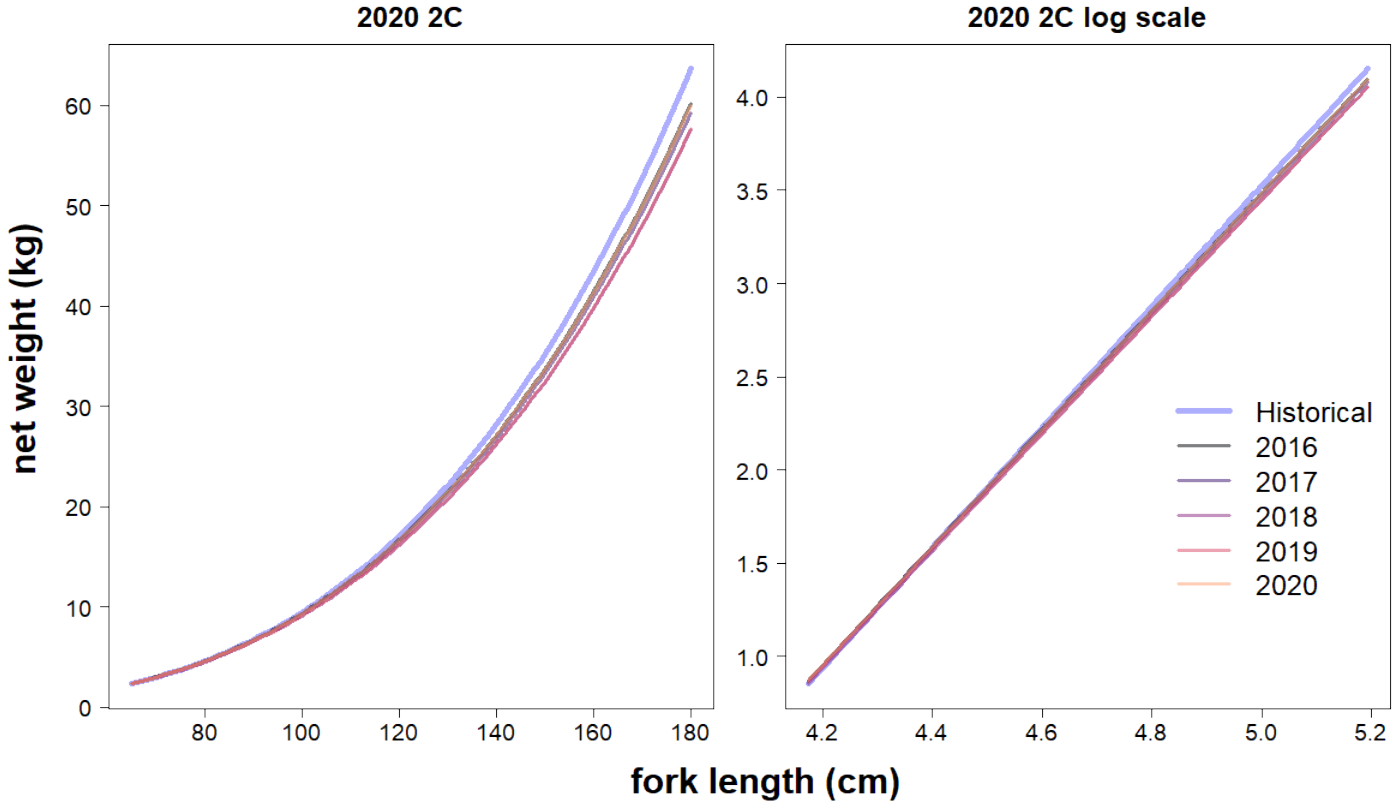
Commercial length-net weight

- We fitted linear models on the log scale to estimate the parameters of the length-net weight relationship from commercial sampling data

Estimated length-net weight relationships by IPHC Regulatory Area, 2020 (commercial data)



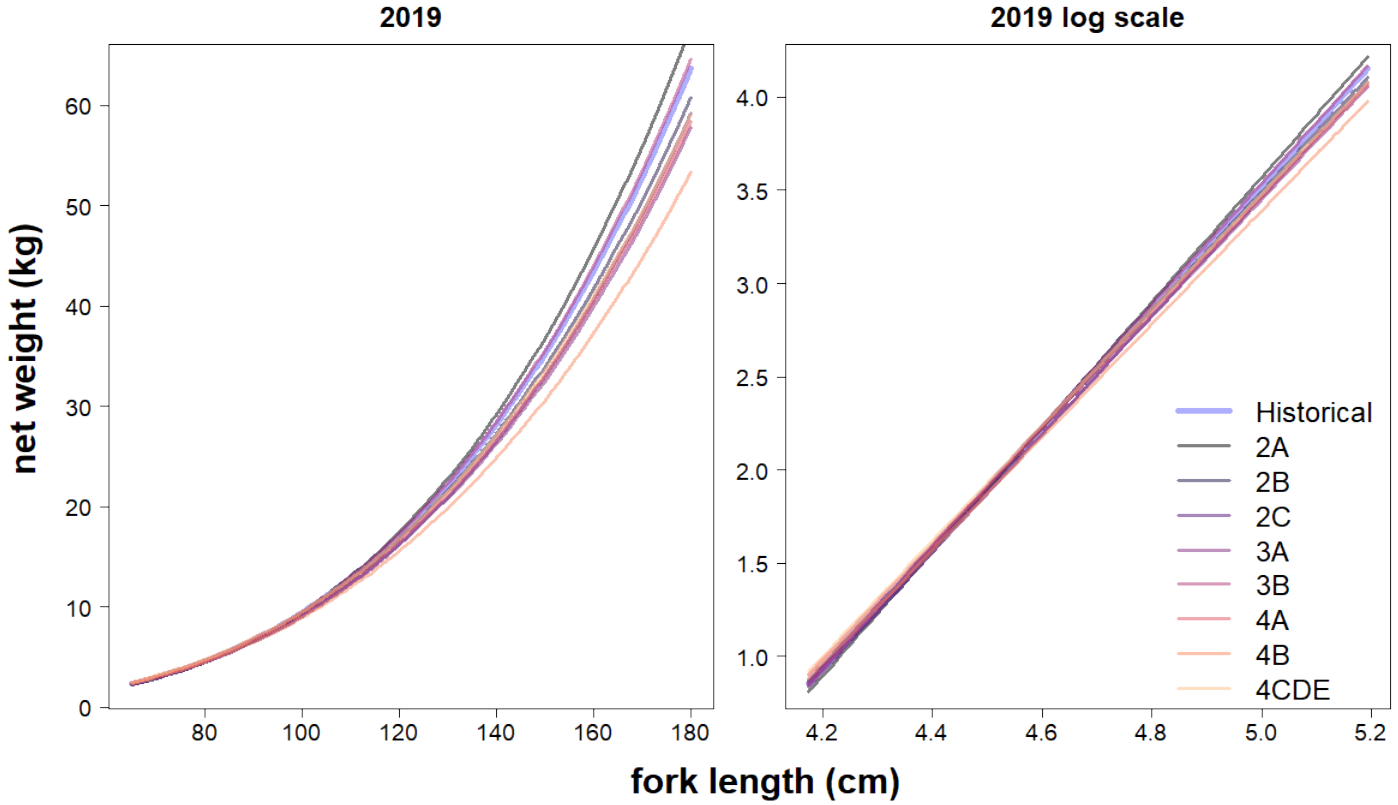
Estimated length-net weight relationships for IPHC Regulatory Area 2C by year (commercial data)



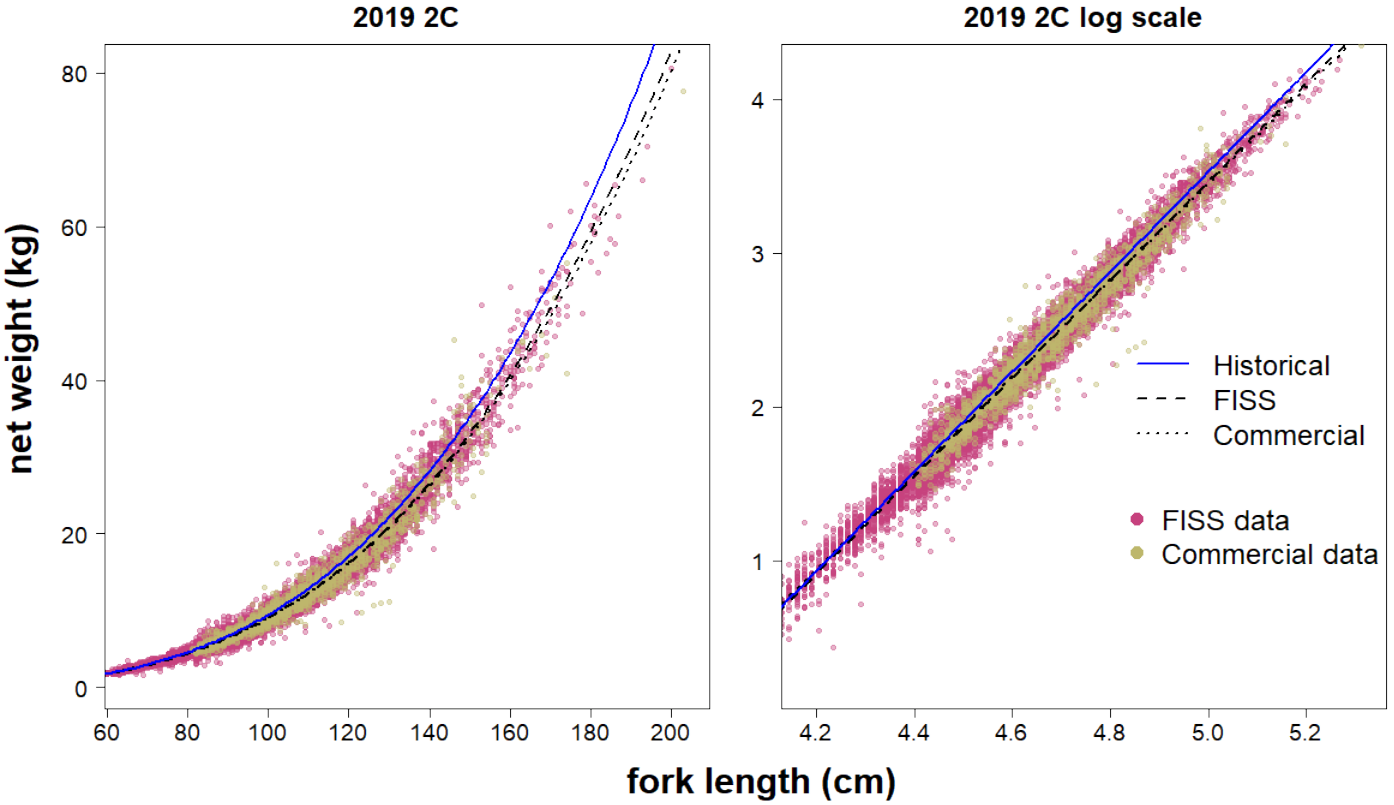
FISS length-net weight

- As with commercial data, linear models were fitted to estimated parameters of the length-net weight relationship
  - Data from two years to date only: little information on year-to-year variation
- U32 fish with both round and dressed weight recorded in 2019 were used to estimate a round-dressed weight relationship for use in subsequent years

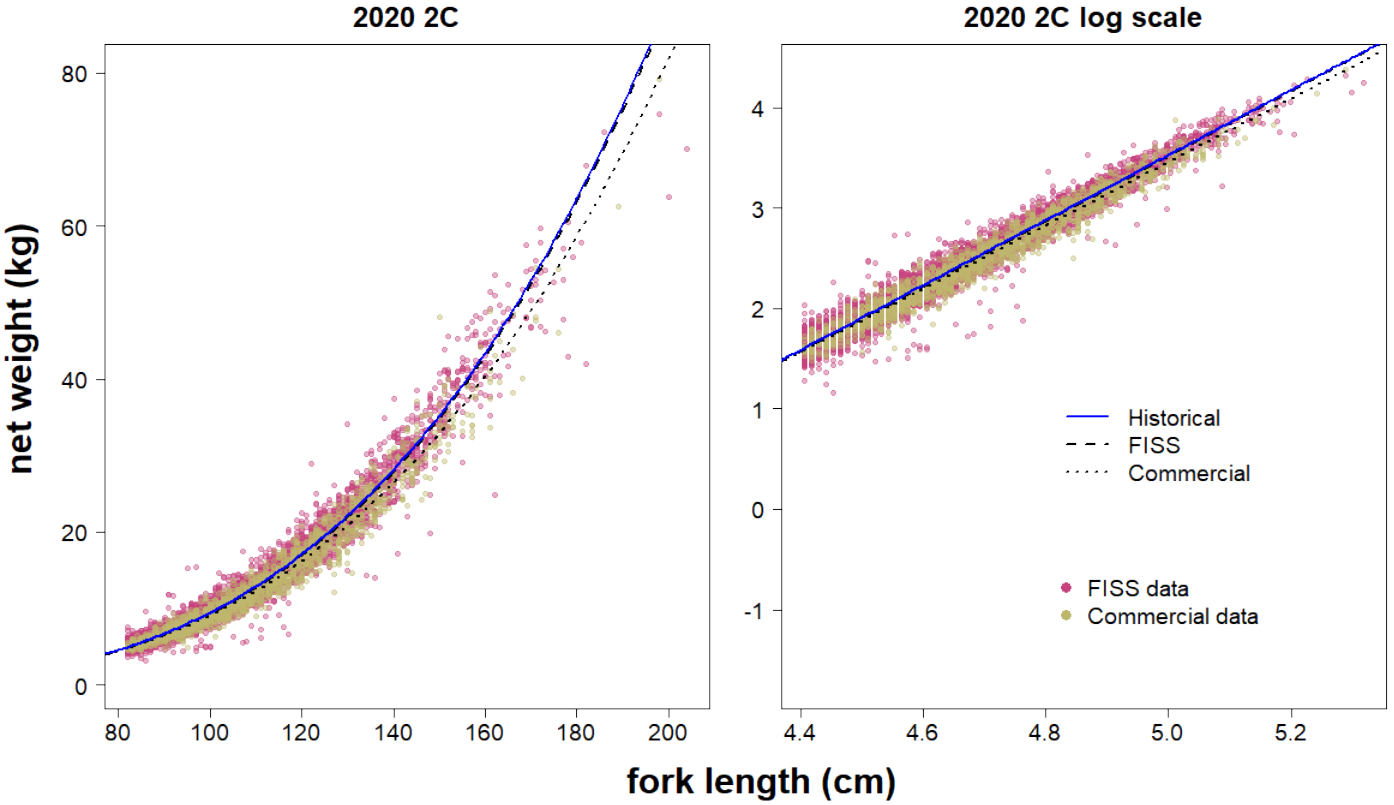
Estimated length-net weight relationships by IPHC Regulatory Area, 2019 (FISS data)



Comparison of commercial and FISS relationships, 2C in 2019



Comparison of commercial and FISS relationships, 2C in 2020



Comparison of commercial and FISS relationships

- Commercial data is collected throughout the fishing season (March-November) but is limited to fishing grounds
- FISS data is limited to the summer survey period, but is more spatially extensive within each sampled region
- We fitted two models to the combined commercial and FISS data:
  - Model 1: Fitting a single relationship to all data
  - Model 2: Allows parameters to differ between the two data sources
- Models fitted for 2019 and 2020 data only
  - 2020 FISS only sampled core areas, 2B, 2C, 3A and eastern 3B
- Compared predicted mean weights with observed mean weights to help understand potential for bias in model estimates

Comparison of commercial and FISS relationships

- Model 2 produced mean net weights within 1% of observed means of both commercial and FISS data for each year and IPHC Regulatory Area
- In almost all cases, Model 1 produced mean net weights within 2% of observed means
- The historical relationship had differences between predicted and observed means ranging from 1.1% to 10.7% for commercial data, and −1.7% to 5.5% for FISS data.

Discussion

- Using linear models fitted to contemporary data is likely to reduce bias in weight estimates relative to estimates from the historical relationship
- Model 1 is simpler and does not require users (e.g., other agency staff) to make a choice of which data source (commercial or FISS) most closely resembles their own
  - Estimated from combined data sources, so represents a blend of spatially extensive (FISS) and temporally extensive (commercial) samples: more generally applicable

Discussion

- Given apparent temporal stability (2016-20) and spatial variability, we recommend:
  - Providing curves to non-IPHC users estimated from (at least) three years' worth of combined data from commercial and FISS sources for each IPHC Regulatory Area (so 2019-21 at present)
  - Re-evaluating the relationships annually as additional years of data are collected and updating if necessary

Outstanding data needs

- At present we lack data to validate the assumed round to net weight conversion for O32 fish
  - We can obtain this be making two measurements (round and dressed) on a sample of O32 FISS fish
- We have no data to validate adjustment factors for ice and slime, despite collecting commercial weight samples since 2015

3. Accounting for the effects of whale depredation on the FISS

- The presence of sperm whales and orcas during the fishing and hauling of FISS sets can lead to such sets being designated as ineffective for the use in analyses due to the potential impact on recorded catch rates Pacific halibut of depredation
- The criteria for ineffectiveness, which were strengthened in 2019, are as follows:
  - Sperm whales: a sperm whale is spotted within 3 nmi of the boat while hauling gear
  - Orcas: a set has more than 1 lips-only Pacific halibut or a set has other observations of orca feeding on Pacific halibut
- These criteria were designed to minimize the potential for including biased data in the annual indices.

Accounting for the effects of whale depredation on the FISS

- Sperm whales have been found to depredate cryptically on the gear at large distances from the vessel, while orcas generally leave clear evidence of depredation or are observed in the act.
- Coastwide, from 2010-2020, 1.4-3.0% of all sets fished included sperm whales or orcas as a reason for ineffectiveness (see https://www.iphc.int/data/fiss-performance).
- However, the impacts can be greater for a given area and year.
  - IPHC Regulatory Area 3A has had up to 6% of sets affected by whales (mainly sperm whales);
  - IPHC Regulatory Area 4A is the area most affected by orca encounters, with over 10% of sets affected in some years, and 12% of sets during the 2014 FISS expansion (the only time some of these stations were fished prior to 2021)

IPHC Regulatory Area 4A

- Area most affected by marine mammal interactions:
  - 139 orca-affected sets since 1993
  - 3 sperm whale-affected sets
  - In some years >10% of sets are affected by orcas
- Space-time model estimates that O32 WPUE on affected sets is 51% (95% CI: 43-60%) of unaffected sets.

IPHC Regulatory Area 3A

- Area most affected by sperm whale interactions:
  - 116 sperm whale-affected sets since 1993
  - 29 orca-affected sets
  - 18 sets affected by both species
  - In some years >10% of sets are affected by orcas
- Space-time model estimates:
  - O32 WPUE on sperm whale-affected sets is 86% (95% CI: 75-99%) of unaffected sets
  - O32 WPUE on orca-affected sets is 84% (68-104%) of unaffected sets

Recommendations

That the Research Advisory Board:

1) **NOTE** paper IPHC-2021-RAB022-07.1 that presents methods for revised the length-net weight relationships from FISS and commercial sampling data

2) **NOTE** paper IPHC-2021-RAB022-07.2 that presents an overview of the IPHC standardization for hook competition on FISS sets.

3) **NOTE** paper IPHC-2021-RAB022-07.3 that presents estimates of the effects of whale interactions on FISS catch rates through the space-time modelling.

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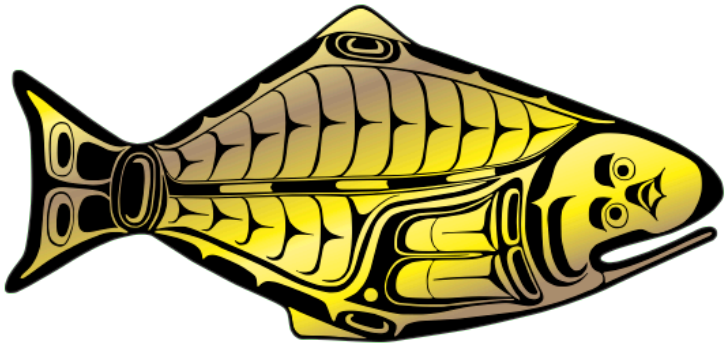

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