

# Adjusting Survey CPUE for Prior Removals

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**This presentation is intended to be complemented by a verbal interpretation. As such, it is offered here solely for informational purposes, and to allow some familiarity with the material prior to its formal presentation.**

## Recent work on survey timing

- Commercial catch near survey stations:
  - No evidence for an effect on station CPUE of nearby commercial catch prior to survey set.
  - Even if there were an effect, the effect on overall area CPUE would be very small.
  - This is because few stations have much, if any, commercial catch near them in the days leading up to the survey set.

## Recent work on survey timing

- Relationship between survey CPUE and proportion of catch removed prior to survey:
  - Data show no evidence of a relationship.
  - Data are highly variable: it is possible a relationship exists but is difficult to detect.

# Survey Timing

% of commercial catch taken prior to the mean survey date

Year	2A	2B	2C	3A	3B	4A	4B	4CDE
2004	86	50	65	63	53	28	50	5
2005	81	45	65	61	48	40	28	2
2006	88	53	60	61	56	32	52	6
2007	91	54	60	54	48	44	71	16

# Adjusting for removal of Ebio prior to survey

- Industry requested further work on ways to adjust for removals prior to the survey.
- Here we present an approach for discussion:
  - This work does not represent a recommendation by staff.

# Adjusting for removal of Ebio prior to survey

- **With some important assumptions**, we can adjust observed setline CPUEs to what they would have been if 50% of removals had been made prior to the survey.
- For removals greater than 50%, survey CPUE would be adjusted upwards.
- For removals less than 50%, survey CPUE would be adjusted downwards.

# Adjusting for removal of Ebio prior to survey

- CPUE at 50% removals can be written as an *adjustment factor* times observed CPUE:

$$CPUE_{50\%} = \left( \frac{1 - 0.5HR}{1 - pHR} \right) CPUE_{obs}$$

- The adjustment factor is a function of harvest rate ( $HR$ ) and the proportion of removals taken prior to the mean survey date ( $p$ ).

- $1 - 0.5HR$  is the proportion of Ebio remaining after 50% of the year's removals have been taken, e.g.,

$$HR = 0.20 \Rightarrow 0.5HR = 0.10 \Rightarrow$$

$$1 - 0.5HR = 0.9$$

- $1 - pHR$  is the proportion of Ebio remaining after 100p% of the year's removals have been taken, e.g.,

$$HR = 0.20, p = 0.75 \Rightarrow pHR = 0.15 \Rightarrow$$

$$1 - pHR = 0.85$$

- $0.9/0.85 = 1.06$ : **CPUE increases by 6%**

## More examples

- **$HR = 20\%$ ;  $p = 0.65$**

$$CPUE_{50\%} = 1.08 \times CPUE_{obs}$$

- **$HR = 50\%$ ;  $p = 0.85$**

$$CPUE_{50\%} = 1.30 \times CPUE_{obs}$$

- **$HR = 15\%$ ;  $p = 0.15$**

$$CPUE_{50\%} = 0.95 \times CPUE_{obs}$$

# Assumptions

- $p$  represents the proportion of all removals taken prior to the mean survey date.
- At present it is estimated from commercial removals only:
  - Assumes that temporal patterns of other removals are the same.
- We are working with agency staff to include sport removals and bycatch.

# Assumptions

- We also assume that survey CPUE is a good index of Ebio:
  - On average, a change in Ebio is reflected in the same relative change in CPUE.
  - Assumes equal catchability among regulatory areas and over time.

# Assumptions

- Other changes in area Ebio are assumed to follow the same pattern as changes due to fishery removals:
  - Recruitment
  - Growth
  - Migration
  - Natural mortality
- **Almost certainly not true**

# Effect on Apportionment\*

% change from survey CPUE apportionment without adjustments

Year	2A	2B	2C	3A	3B	4A	4B	4CDE
2004	17.2	-1.4	4.3	2.2	-0.4	-4.2	-2.7	-6.0
2005	19.0	-2.5	6.0	1.9	-0.4	-4.1	-3.8	-6.4
2006	19.0	-1.6	6.2	1.9	-0.9	-4.2	-2.8	-7.5
2007	22.9	-0.5	6.4	1.3	-0.9	-3.4	-1.6	-8.0

\* Apportionment is calculated using a weighted average of survey CPUE from the past three years.