Establishing BSAI Pacific halibut prohibited species catch limits using abundance-based management (ABM)

D-1

April 2018 Council meeting

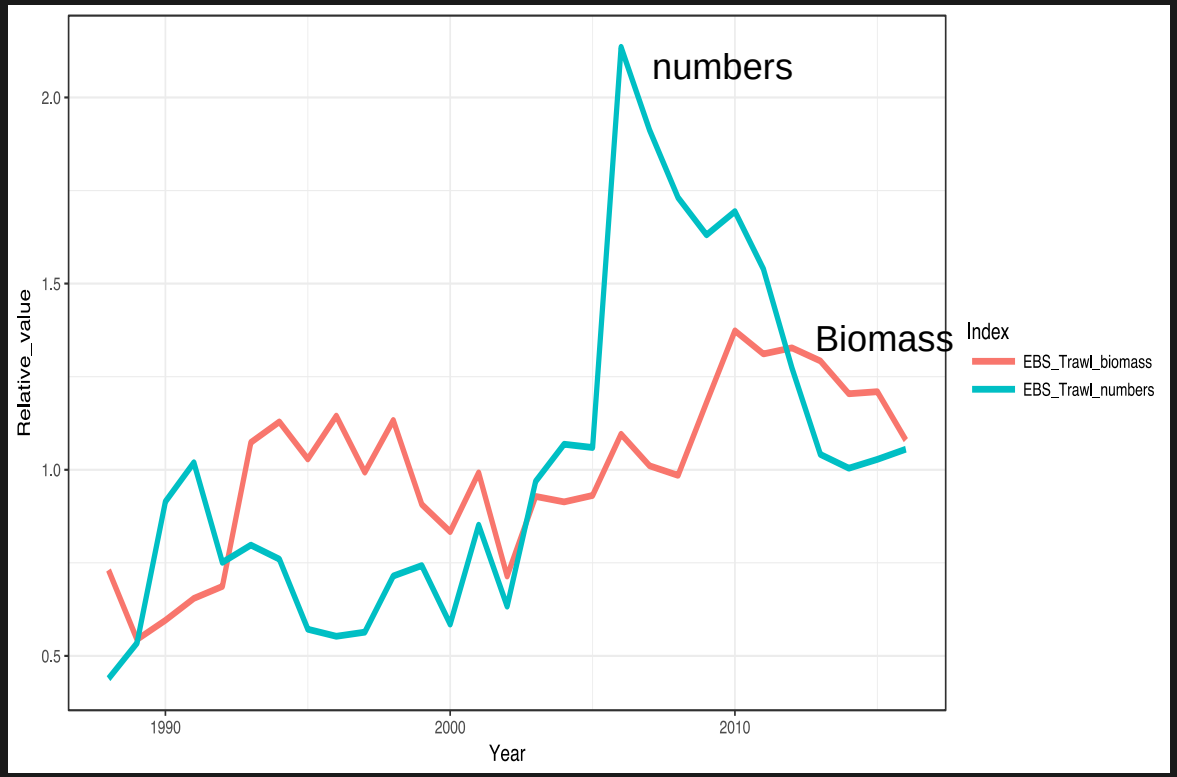
Overview of Council Action in October

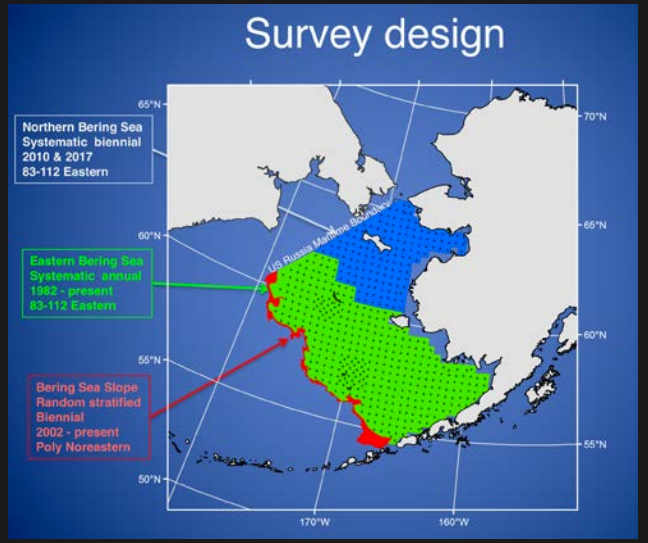
- **Revised purpose and need**
- **Requested WG develop strawmen alternatives and evaluate control rule combinations**
- **Discuss tradeoffs of control rules and features as related to Council’s objectives**
- **Refined elements and options**

Overview of Council Objectives

1. Halibut PSC limits should be indexed to halibut abundance
2. Halibut spawning stock biomass should be protected especially at lower levels of abundance
3. There should be flexibility provided to avoid unnecessarily constraining the groundfish fishery particularly when halibut abundance is high
4. Provide for directed halibut fishing operations in the Bering Sea.
5. Provide for some stability in PSC limits on an inter-annual basis.

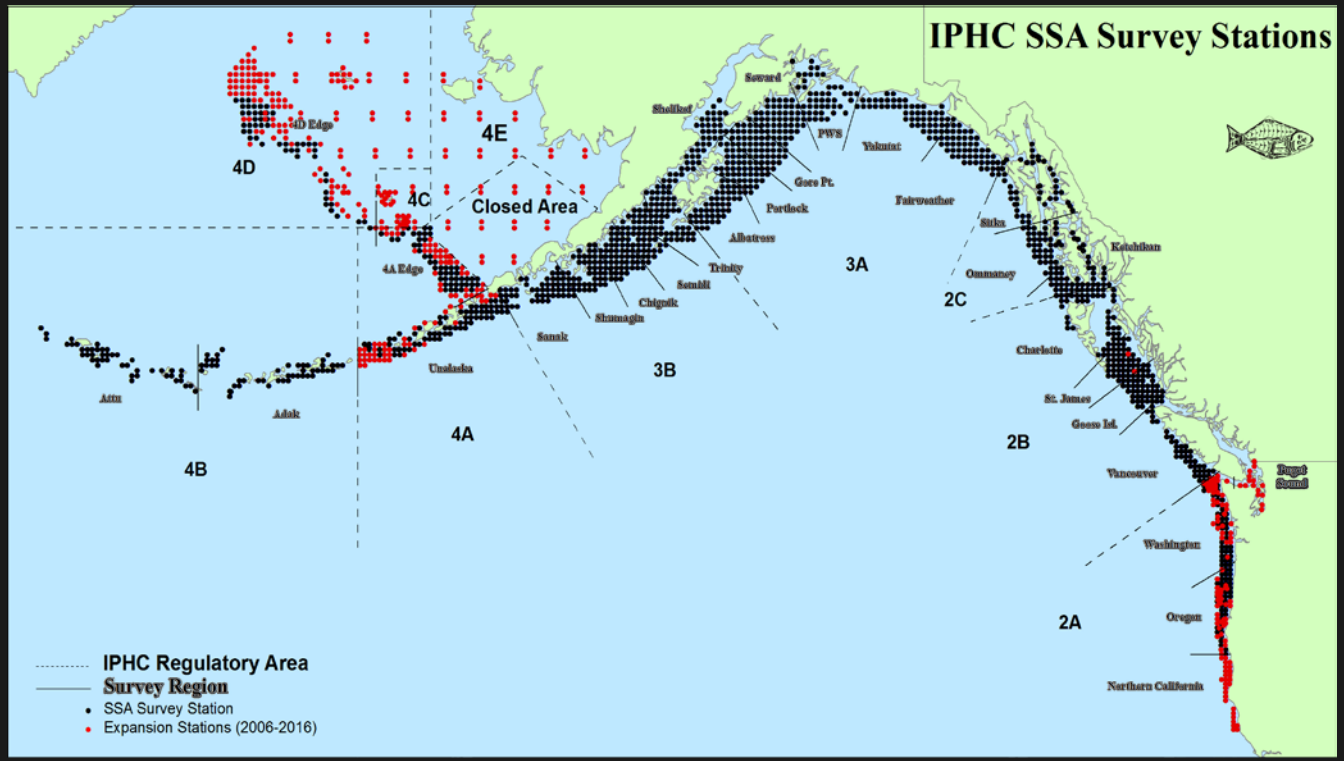
AFSC EBS trawl survey





EBS trawl survey	Inappropriate index for commercial directed halibut as catches smaller sizes of fish
	Good proxy for size composition of bycatch of halibut in the groundfish trawl fisheries in the Bering Sea
	Potentially good proxy for groundfish longline fisheries in the Bering sea
	Good index for halibut abundance in the Bering Sea

IPHC Setline survey



IPHC setline survey

Good proxy for directed fishery encounters

Poor proxy for trawl bycatch in groundfish fisheries

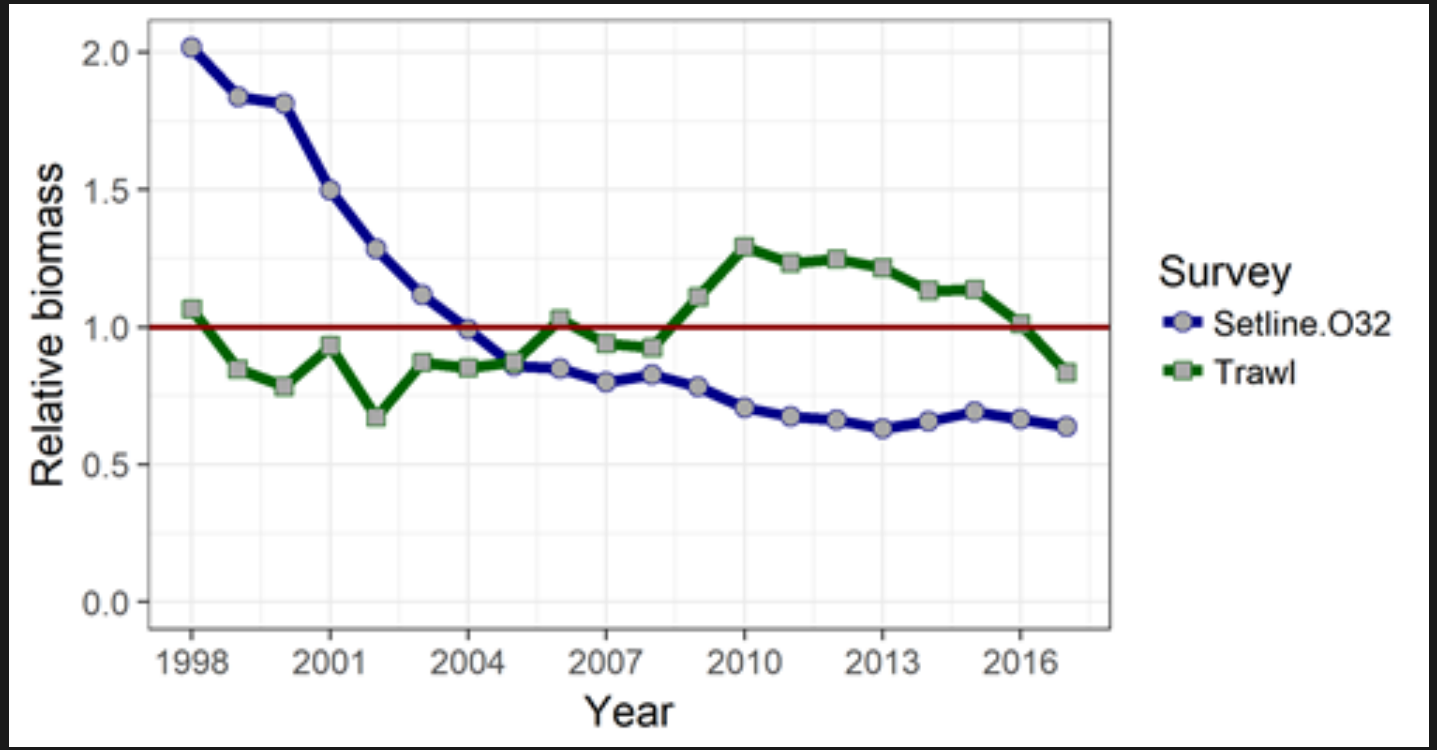
Possibly good proxy for size composition of halibut bycatch in the groundfish longline fisheries

Good index for halibut abundance in the Bering Sea (Area 4ABCDE)

Index Recommendations (October)

- **EBS shelf bottom trawl survey**
- **IPHC Area 4ABCCDE setline survey (SLS)**
- **Include separately and/or in combination along with a control rule.**

Strawman ABMs



ABM 1 (baseline):

- PSC is indexed to the EBS trawl survey for a single PSC limit, then allocated to gear/sector according to the status quo allocation
- BASELINE for contrast only to show behavior of control rules in more simplified basis than with ABMs 2,3,4
- NOTE: THIS DOES NOT REPRESENT STATUS QUO FOR NEPA ANALYSIS

ABM 2

- PSC is indexed to the EBS trawl survey and setline survey for 4ABCDE for a single PSC limit (Option 1 from October motion)
- Allocated to gear/sector according to the status quo allocation.
- Considered in multiple papers previously

ABM 3

- **Separate PSC limits by gear type** (Option 2 from October motion)
- Trawl PSC is indexed to the trawl to EBS trawl survey.
- Longline PSC is indexed to the setline survey for 4ABCDE.

ABM 4 Index to both EBS Trawl and Setline in 4ABCDE

- Separate PSC limits by gear type
  - For trawl gear:
    - Trawl survey forms the primary index
    - Setline survey for 4ABCDE forms secondary index
  - For Fixed gear
    - Setline survey forms the primary index
    - Trawl survey forms secondary index

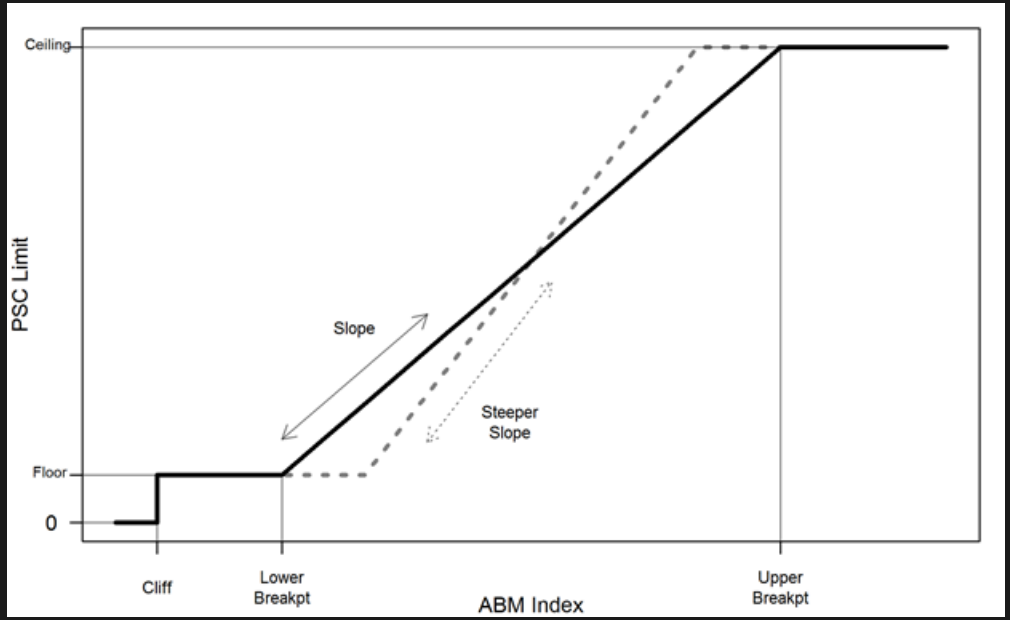
Control Rule Options

Slope: Responsiveness of control rule. Steep slope means bigger changes with changes in the index. A slope of 1 means % change in index = same % change in PSC limit.

Cliff: the index value at which no PSC would be allowed anymore

Floor: PSC limit when the index below a lower breakpoint value

Ceiling: PSC limit when the index is above an upper breakpoint value



Revised Elements and Options p20-21

- **(Revised) Element 1: PSC Limit responsiveness to abundance changes**
  - **Option 1: PSC limit varies proportionally with change in abundance index (1:0.5): slope = 0.5 (LoResponse for ABM 1 only option)**
  - **Option 2: PSC limit varies proportionally with change in abundance index (1:1): slope = 1 (default)**
  - **Option 3: PSC limit varies proportionally with change in abundance index (1:2): slope = 2 (HiResponse for ABM 1 only option)**

- **(Revised) Element 2 Starting point for PSC limit**
  - **Option 1. 10% below 2016 PSC use (2,119 t)**
  - **Option 2. 2016 PSC use (2,354 t)**
  - **Option 3. 2016 PSC limit (3,515 t) default**
  - **Option 4. 10% above 2016 PSC limit (3,867 t)**
  - **Option 5. Additional value within range of Options 1-4**

Revised Elements and Options, Continued

- **(Revised) Element 3 Maximum PSC limit (ceiling)**
  - **Option 1. 2016 PSC limit (3,515 t)**
  - **Option 2. 2015 PSC limit (4,426 t) default**
  - **Option 3. No ceiling**
  - **Option 4. Additional value to be selected**

- **(Revised) Element 4 Minimum PSC limit (floor)**
  - **Option 1. No floor (PSC goes to 0)**
  - **Option 2. 2016 use (2,354 t) default**
  - **Option 3. Additional value to be selected**

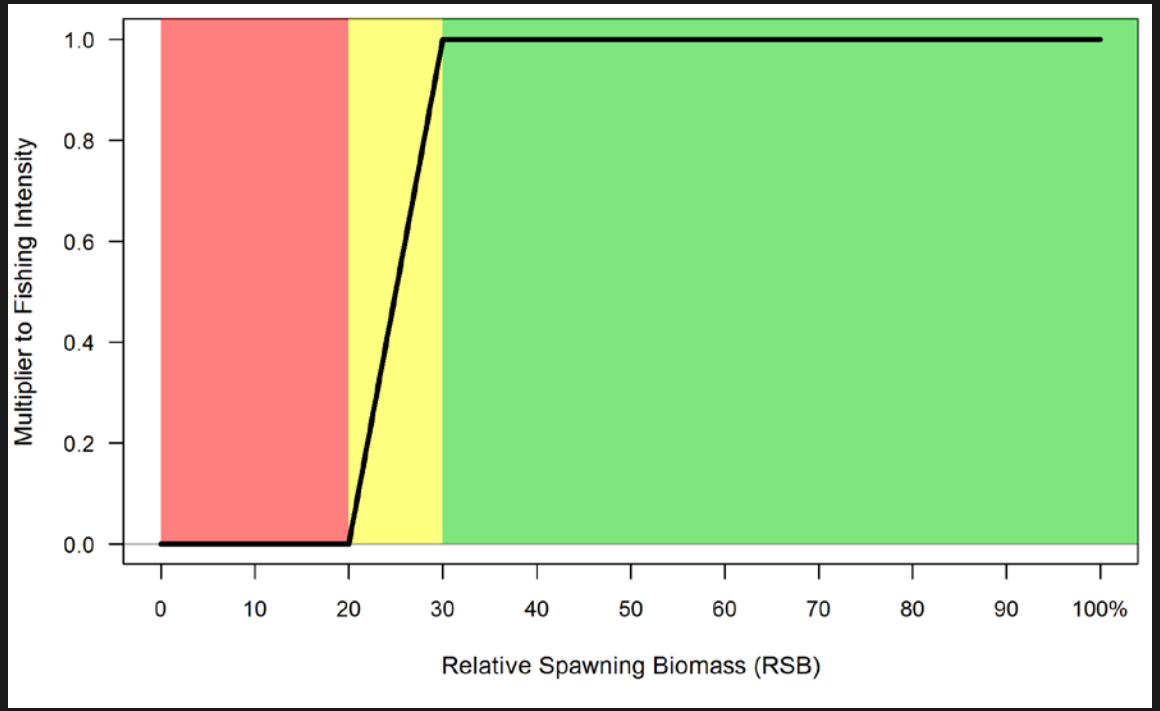
Revised Elements and Options: Element 5 is different from the others

- (Revised) Element 5 Additional features in the control rule
  - Option 1. A lookup table with a defined resolution for each axis
  - Option 2. IPHC Control Rule – PSC limit goes to zero at 20% stock status
  - Option 3. The O26:U26 ratio defines different states of the control rule

The options in Element 5 were not used in the examples provided here because the details of Options 1 and 3 have not been determined, and the IPHC control rule has never been invoked.

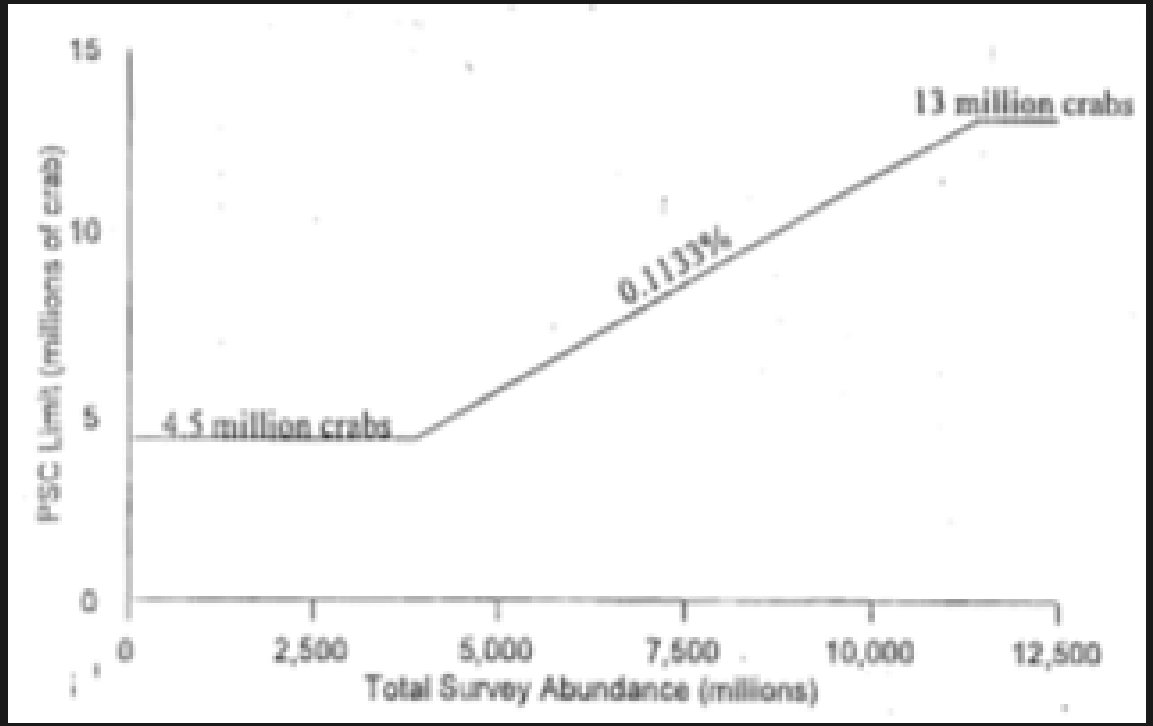
IPHC 30:20 control rule

- Fishing Intensity is reduced when stock status is less than 30% of B0
- Fishing intensity is zero when stock status is less than 20% of B0



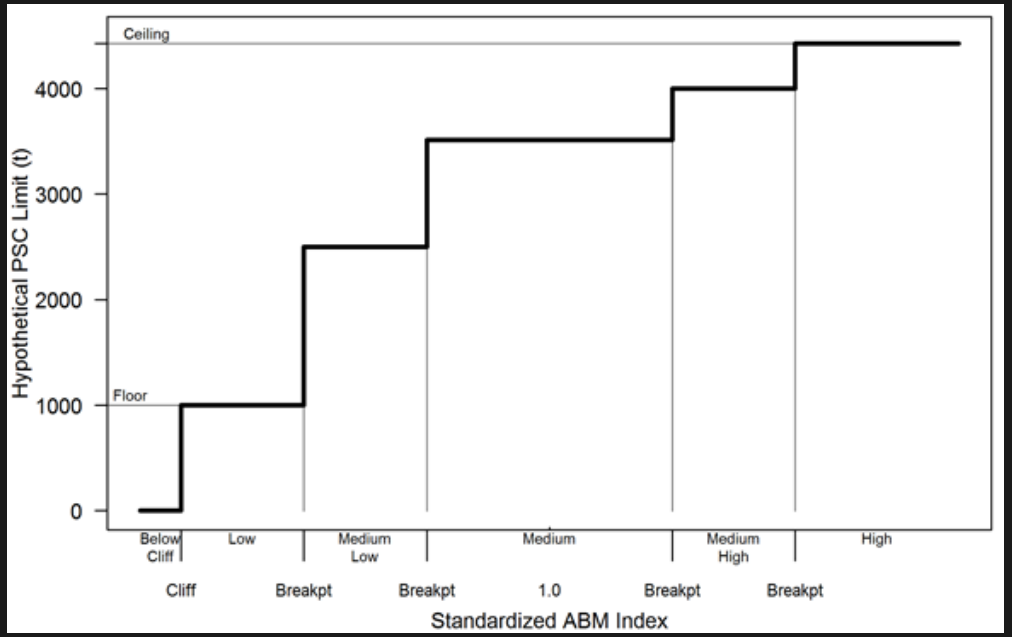
Snow Crab Control Rule

- **One-dimensional**: only one index is used
- **Linear**: a straight line between the floor and the ceiling
- **Continuous**: An unbroken line between the floor and the ceiling

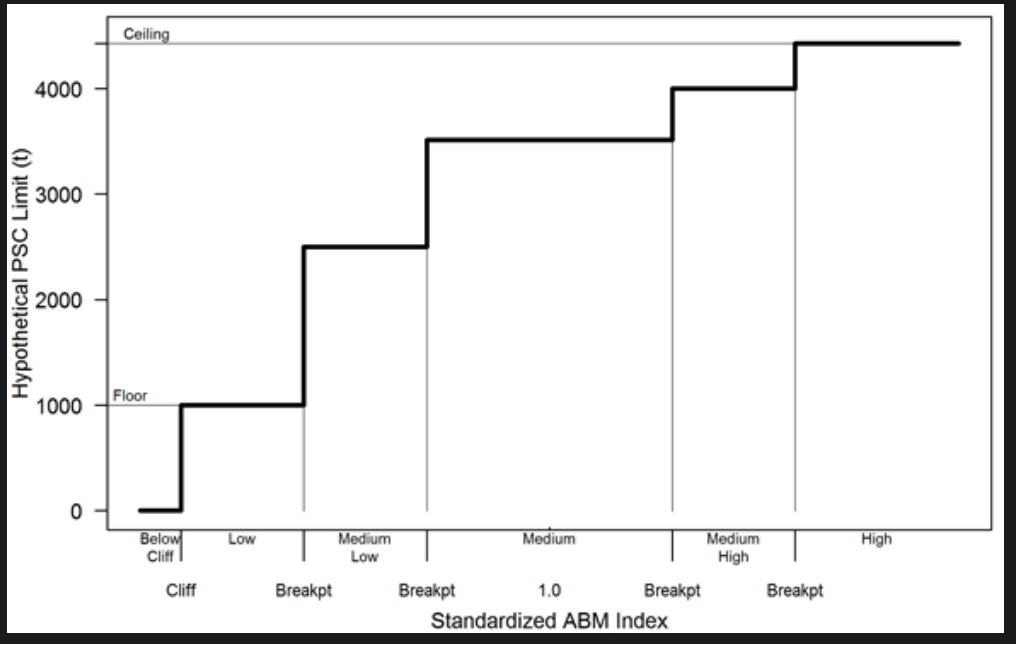


Hypothetical stair-step control rule

- **One-dimensional**: only one index is used
- **Not Continuous**: breakpoints between the floor and the ceiling where the line shifts to a new line
- Multiple flat lines



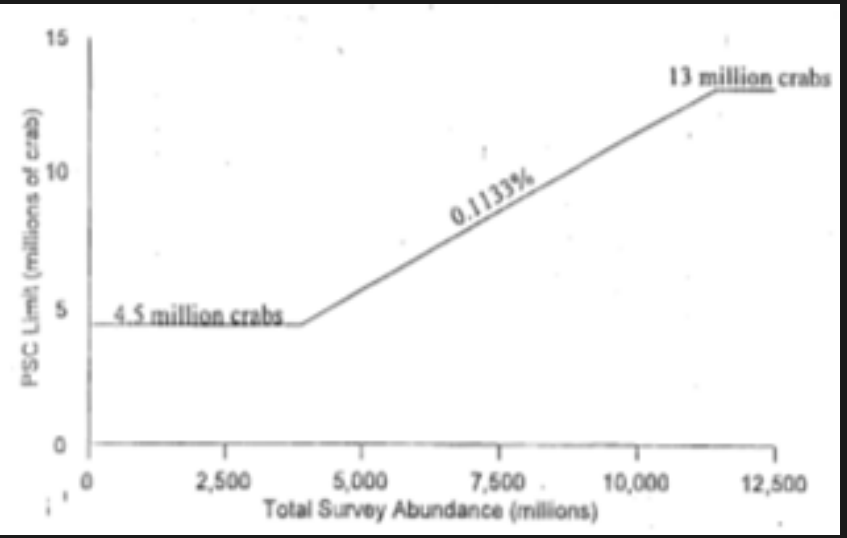
Same stair-step control rule can be presented as a lookup table



Arbitrary Index Classification	Below Cliff	Low	Medium Low	Medium	Medium High	High
Hypothetical PSC limit	0	1,000	2,500	3,515	4,000	4,426

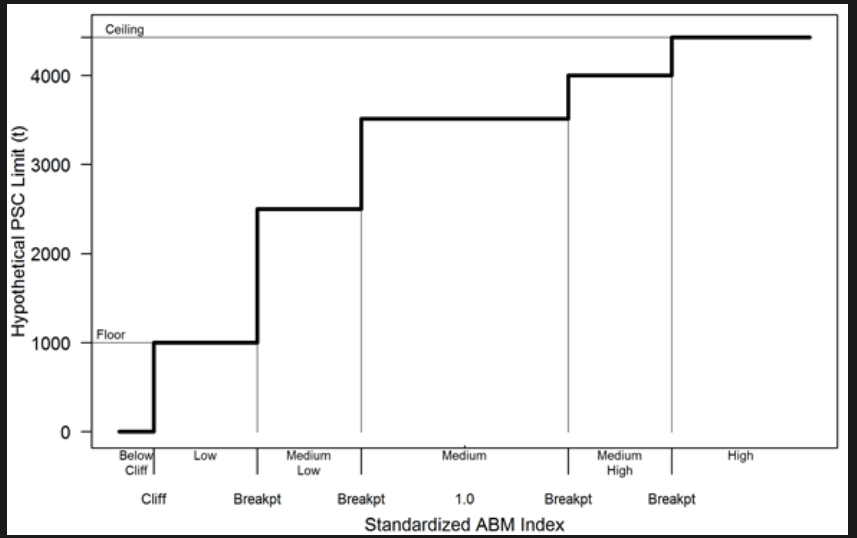
Continuous, linear rule:

- PSC limit will change at least a little bit each year with changes in index
- Small changes in index = small changes in PSC limit



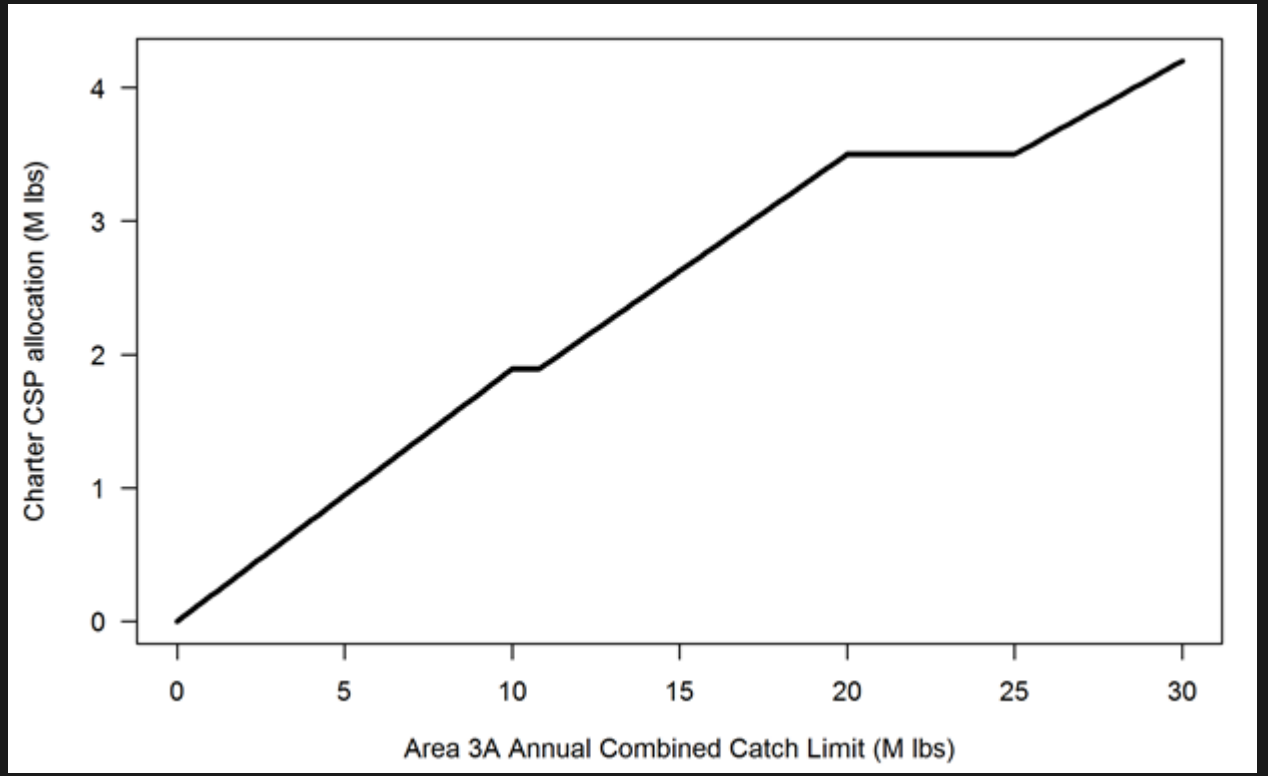
Stair-step rule:

- PSC limit will be the same within larger ranges of index value
- Small changes in index could mean EITHER no change to PSC or larger change to PSC



Hybrid control rule

- **One-dimensional**: only one index is used
- **Not Continuous**: breakpoints between the floor and the ceiling where the line shifts to a new line
- Multiple distinct linear pieces



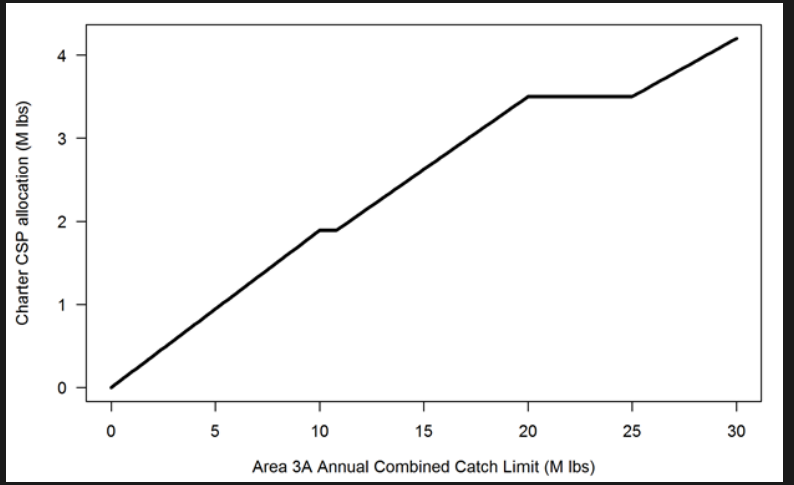
Pros and cons of a hybrid control rule

Advantages:

- Can specify breakpoints as for the stair step control rule
- Changes in PSC between the breakpoints are more smooth and resemble continuous linear rule

Drawbacks:

- Must specify breakpoints and responsiveness of rule between each breakpoint, rather than just responsiveness (linear continuous) or just breakpoints (stair step)



Multi-dimensional control rules

- **Multi-dimensional**: More than one index is used
- Can be a **look-up table** (not continuous): breakpoints between floors and the ceilings

			EBS shelf trawl survey index				
		Below Cliff	Low	Medium Low	Medium	Medium High	High
IPHC setline survey index in Area 4ABCDE	High						
	Medium						
	Low						

OR

- Can be **continuous:** an infinitely large look-up table,visualize as a 3-d plot

Considerations for multi-dimensional vs. one-dimensional control rules

- Can use information from EBS trawl survey and IPHC setline survey at once
- Can use EBS trawl survey for trawl PSC, but still consider the IPHC setline survey (and vice versa)

			EBS shelf trawl survey index				
		Below Cliff	Low	Medium Low	Medium	Medium High	High
IPHC setline survey index in Area 4ABCDE	High						
	Medium						
	Low						

- More decision points: need to specify specify how indices will work together in addition to specifying options for each element, breakpoints for both indices for stair-step option

Multi-dimensional control rules: hypothetical lookup table examples

Set to level of index that is most constraining

Customization possible: for low levels of **trawl survey**, PSC is set to “very low”

Policy decision; may want to consider biology to define “low”, “medium”, and “high” for each index

		EBS shelf trawl survey index		
		Low	***Medium***	***High***
IPHC setline survey index in Area 4ABCDE	***High***	Very Low 500	Medium 3,515	High 4,426
	Medium	Very Low 500	Medium 3,515	Medium 3,515
	Low	Very Low 500	Low 1,000	Low 1,000

Multi-dimensional control rules: hypothetical lookup table examples

Set to level of index that is most constraining

Customization possible: for low levels of **setline survey** PSC is set to “very low”

Policy decision; may want to consider biology to define “low”, “medium”, and “high” for each index

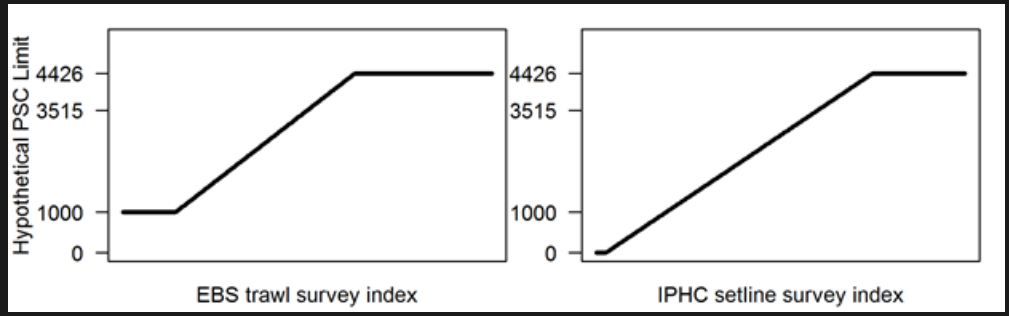
		EBS shelf trawl survey index		
		Low	***Medium***	***High***
IPHC setline survey index in Area 4ABCDE	***High***	Low 1,000	Medium 3,515	High 4,426
	Medium	Low 1,000	Medium 3,515	Medium 3,515
	Low	Very Low 500	Very Low 500	Very Low 500

Multi-dimensional: hypothetical continuous version

Continuous version of lookup table on the last slide

Set to level of index that is most constraining

For low levels of setline survey PSC is set to “very low” in this example



Multi-dimensional lookup table vs continuous

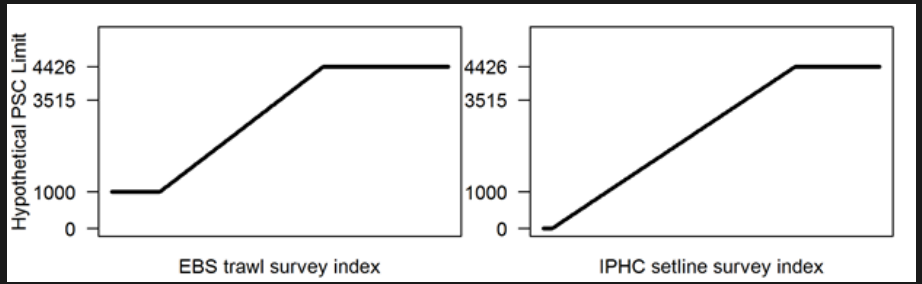
Lookup table:

- Need to define breakpoints for both indices and number of breakpoints
- PSC limit will be the same within larger ranges of index value
- Small changes both indices could mean EITHER no change to PSC or larger change to PSC

		EBS shelf trawl survey index		
		Low	*Medium*	*High*
IPHC setline survey index in Area 4ABCDE	*High*	Low 1,000	Medium 3,515	High 4,426
	Medium	Low 1,000	Medium 3,515	Medium 3,515
	Low	Very Low 500	Very Low 500	Very Low 500

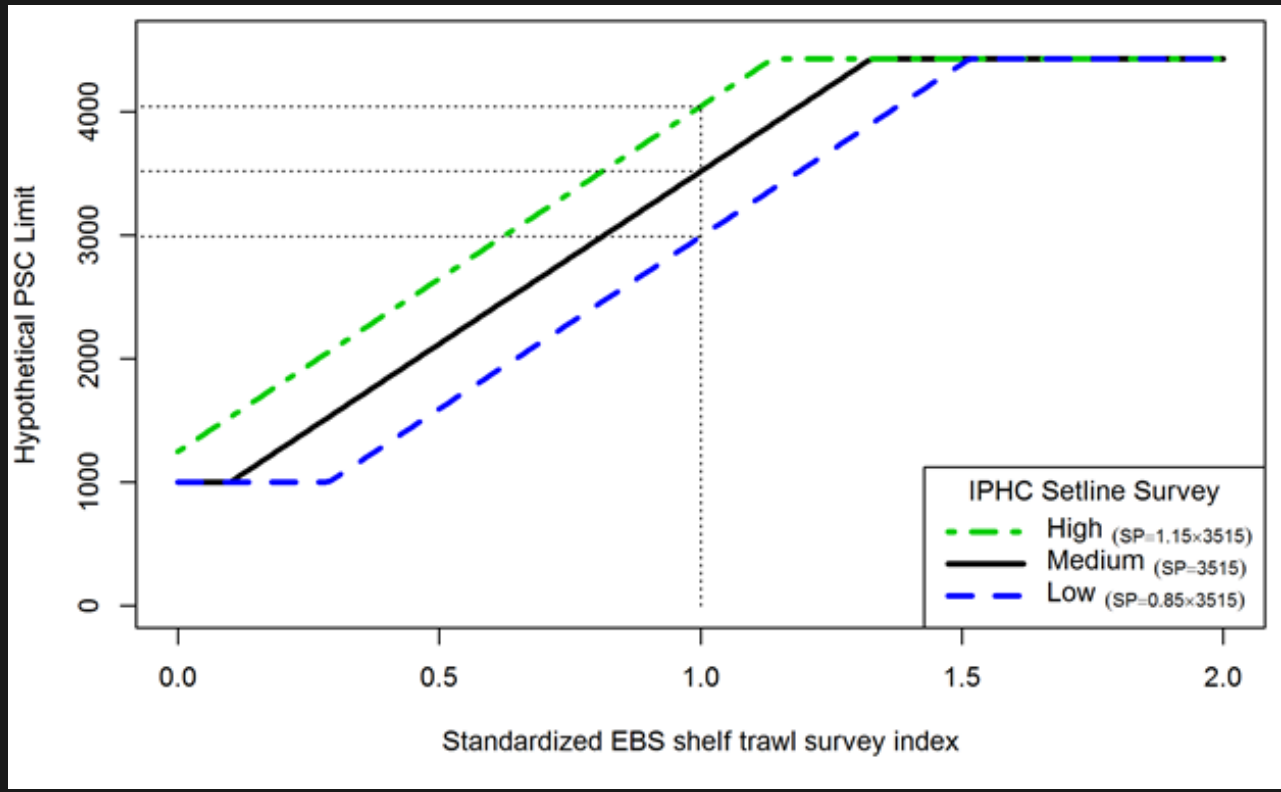
Continuous:

- PSC limit will change at least a little bit each year with changes in indices
- Small changes in both indices = small changes in PSC limit



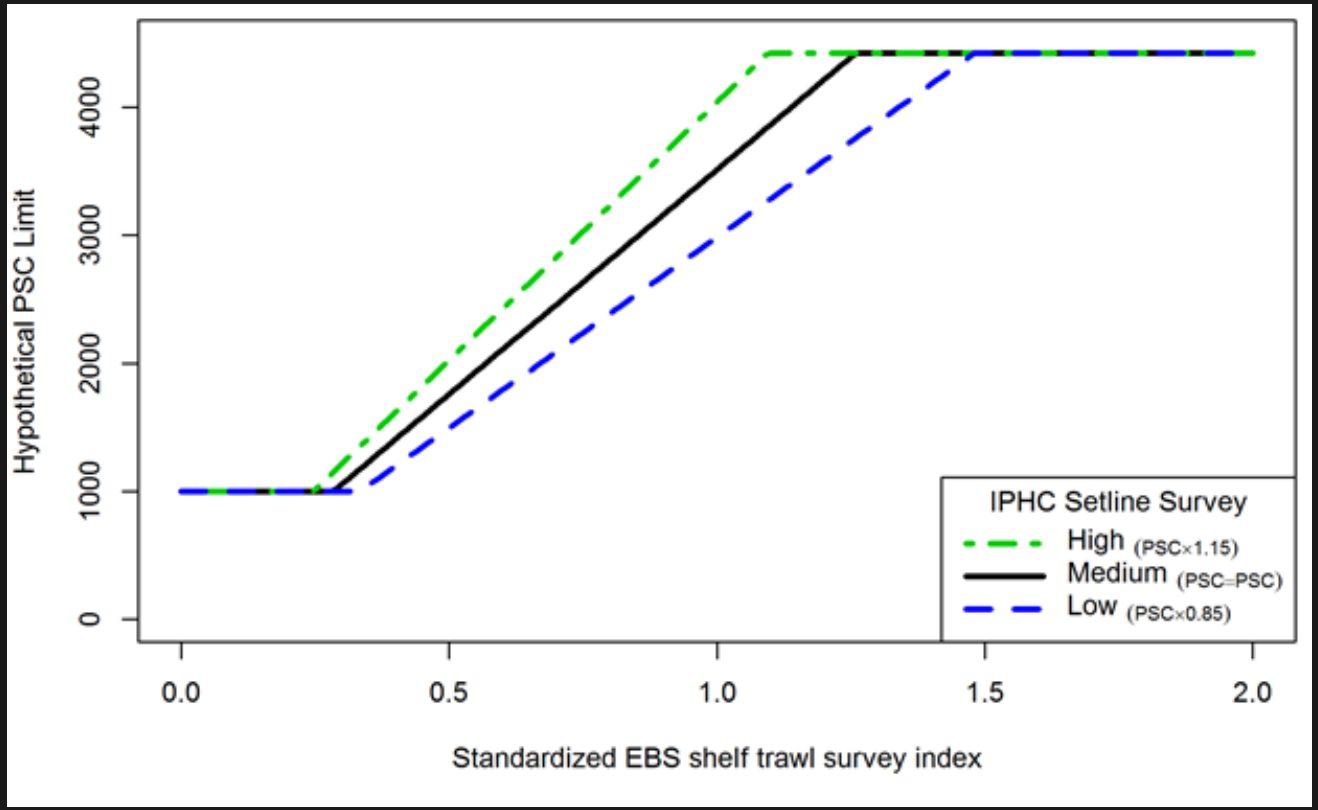
Primary index and secondary index application

- Line shifts depending on IPHC setline in 4ABCDE
- Starting point 15% higher or lower depending on setline index



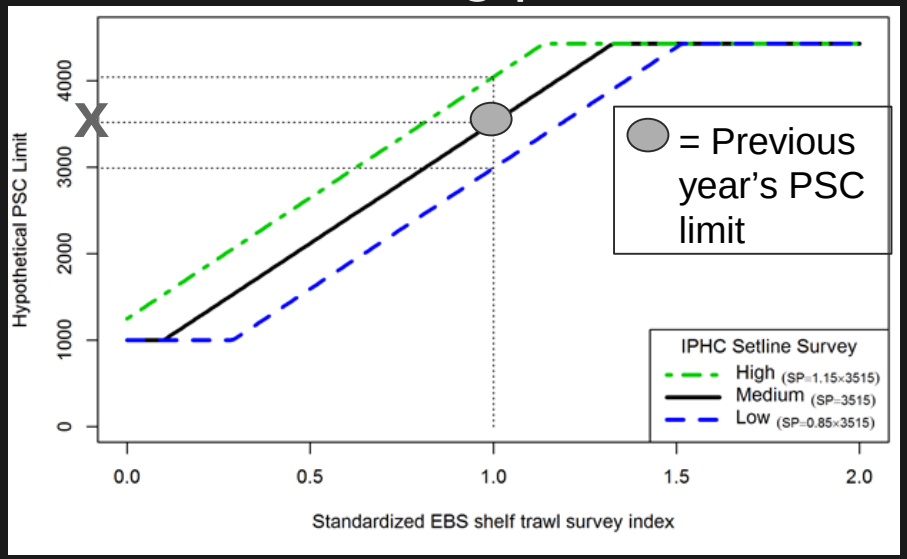
Primary index and secondary index application

- Final PSC limit adjusted when IPHC setline survey is high or low
- This adjustment changes the slope and starting point at the same time

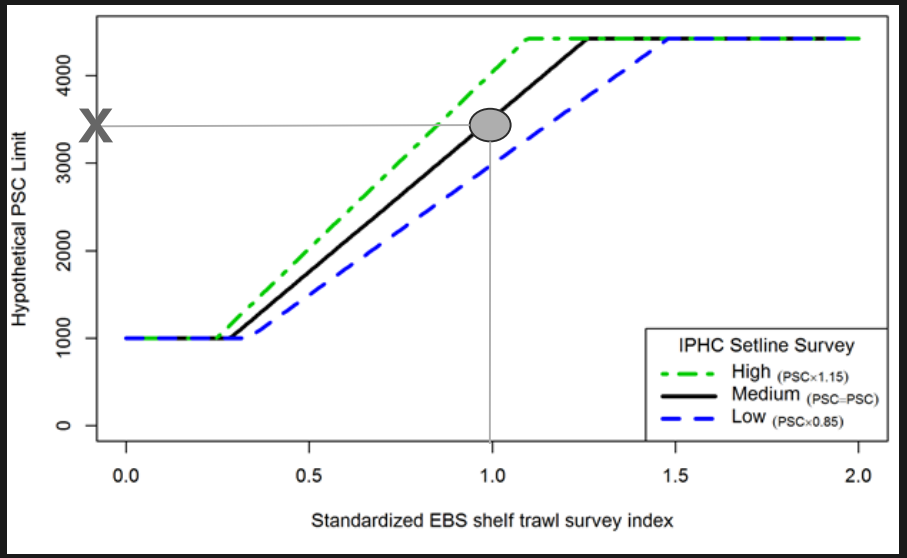


Primary index stays the same, secondary low

Setline survey shifts starting point

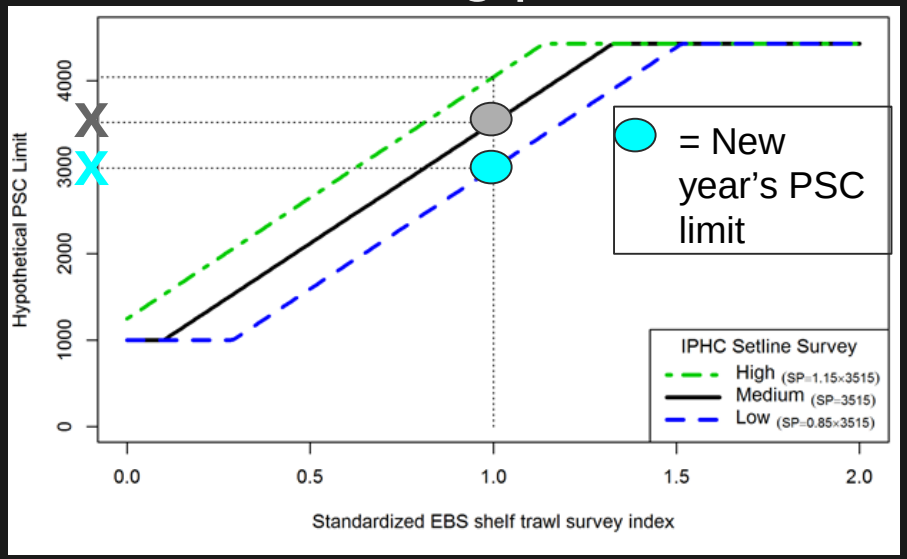


Setline survey shifts final PSC limit

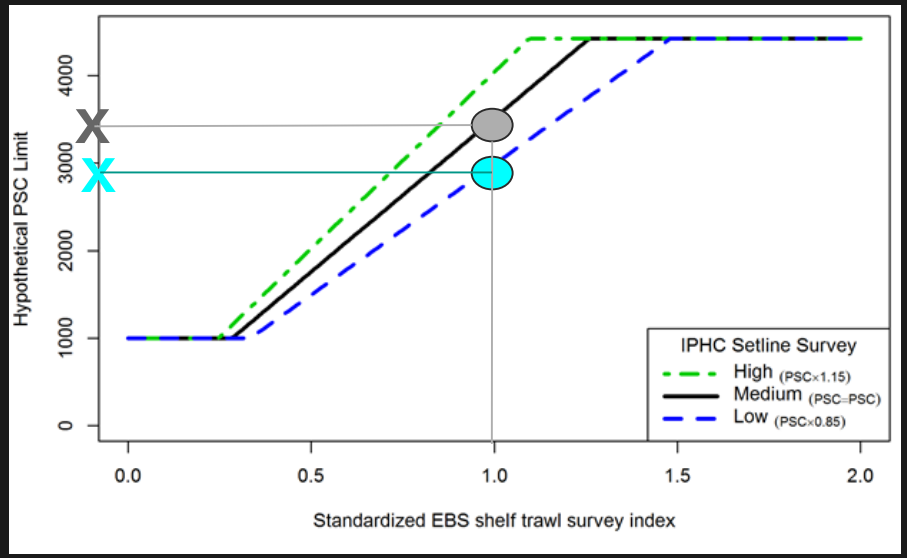


Primary index stays the same, secondary low

Setline survey shifts starting point

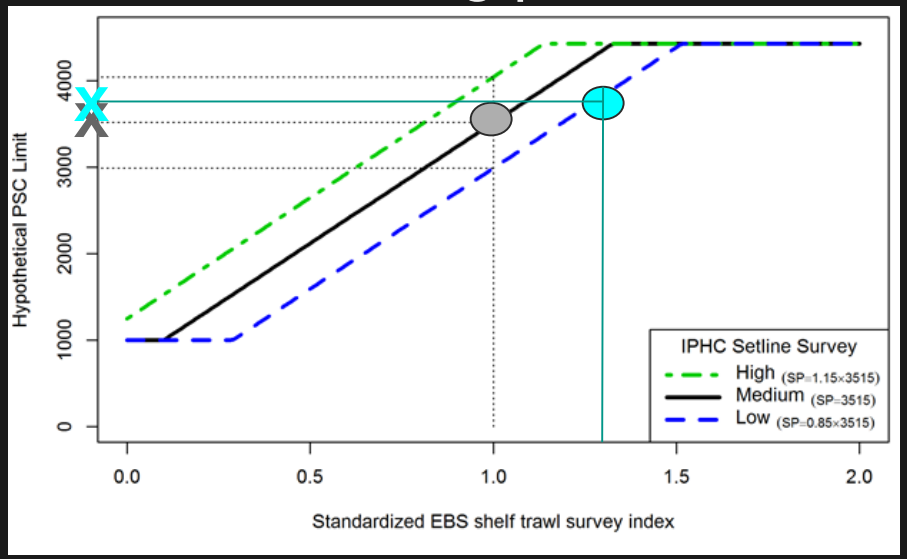


Setline survey shifts final PSC limit

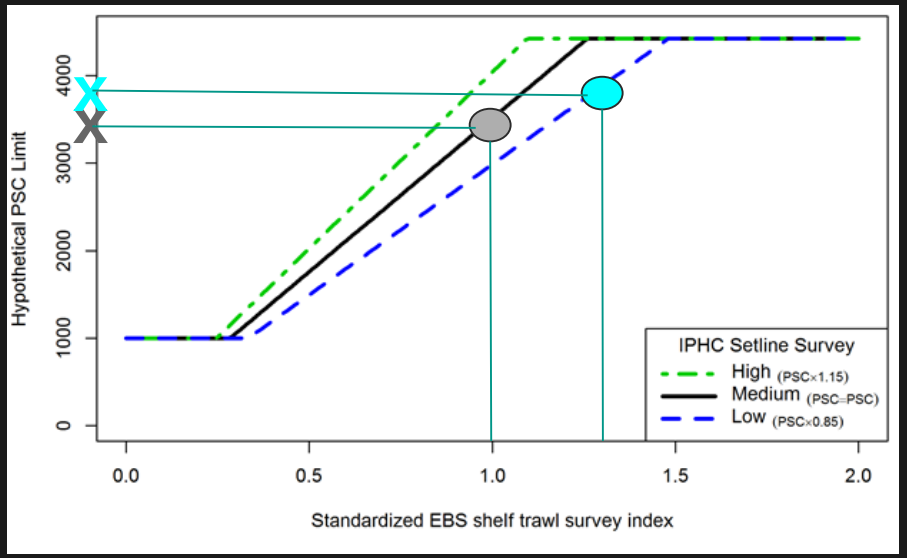


Primary index increases, secondary low

Setline survey shifts starting point

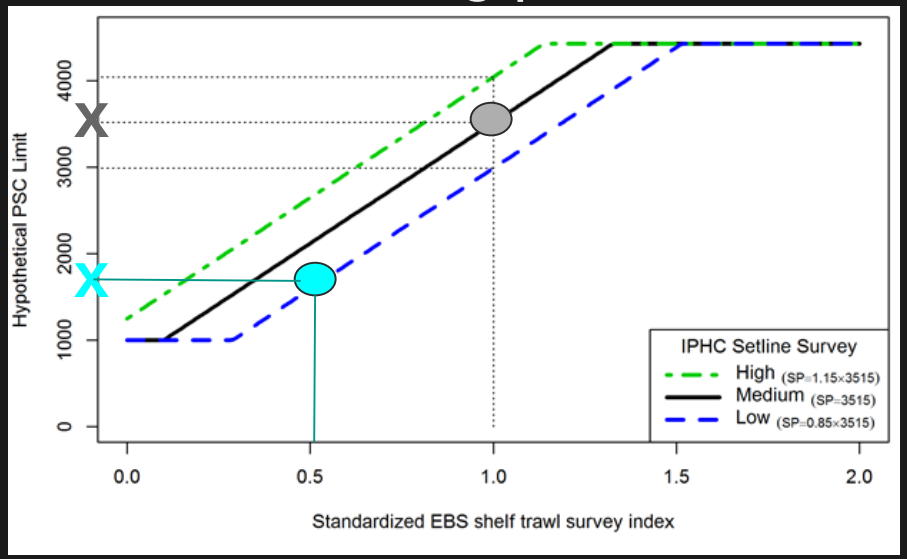


Setline survey shifts final PSC limit

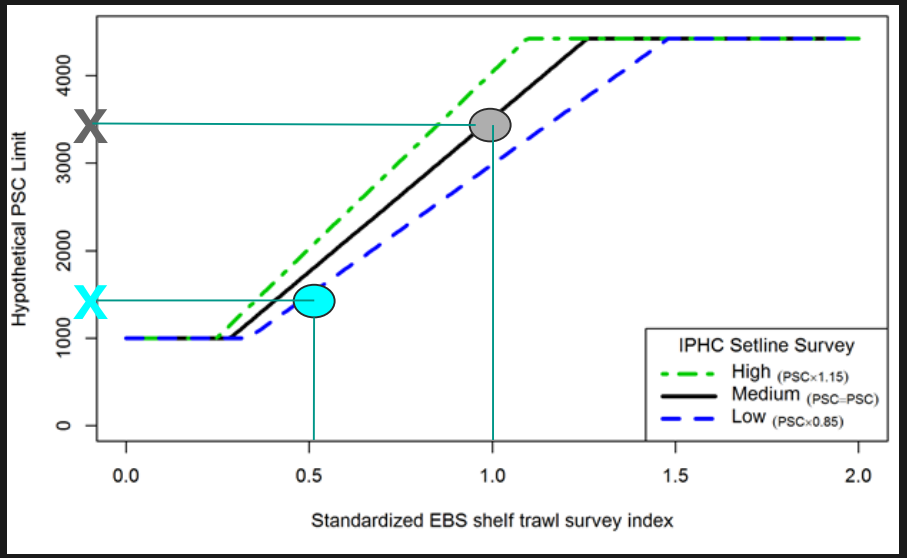


Primary index decreases, secondary low

Setline survey shifts starting point

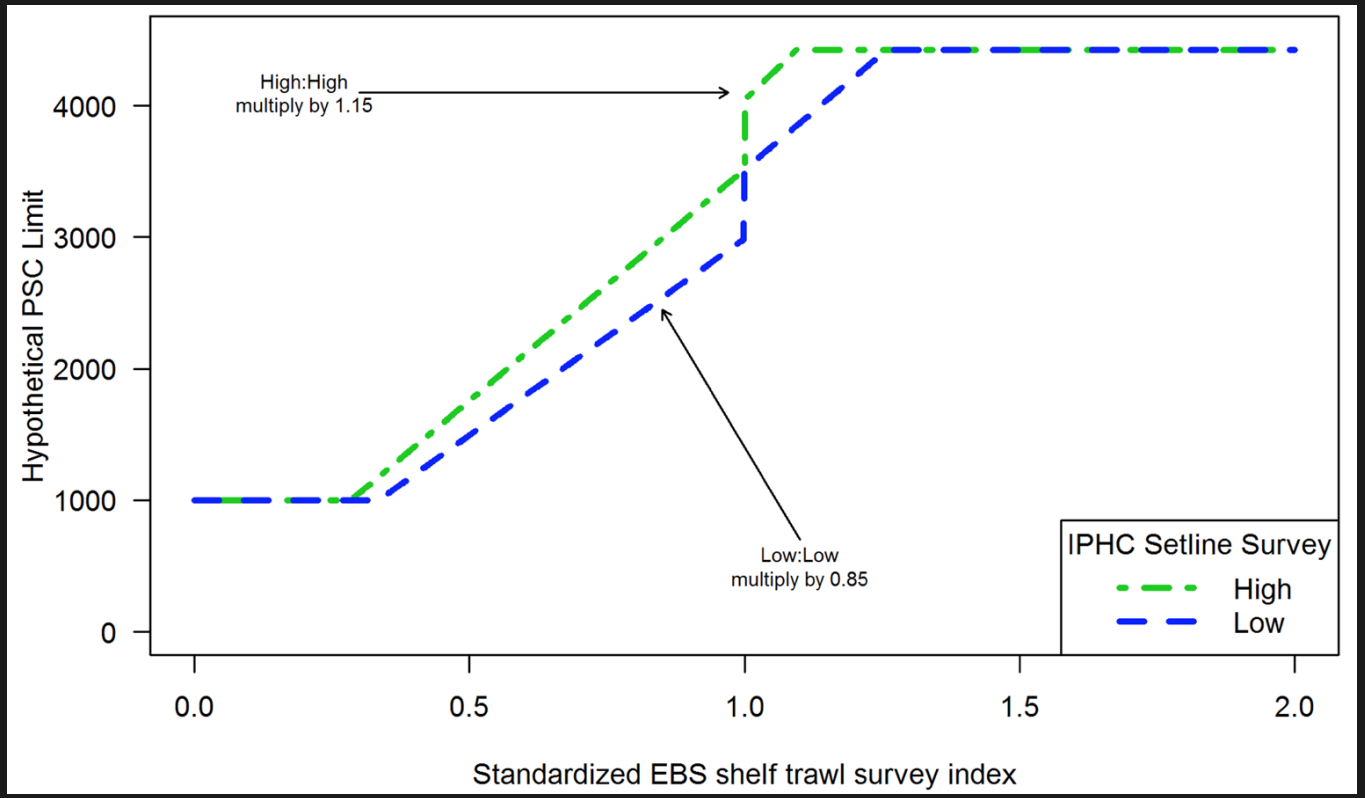


Setline survey shifts final PSC limit

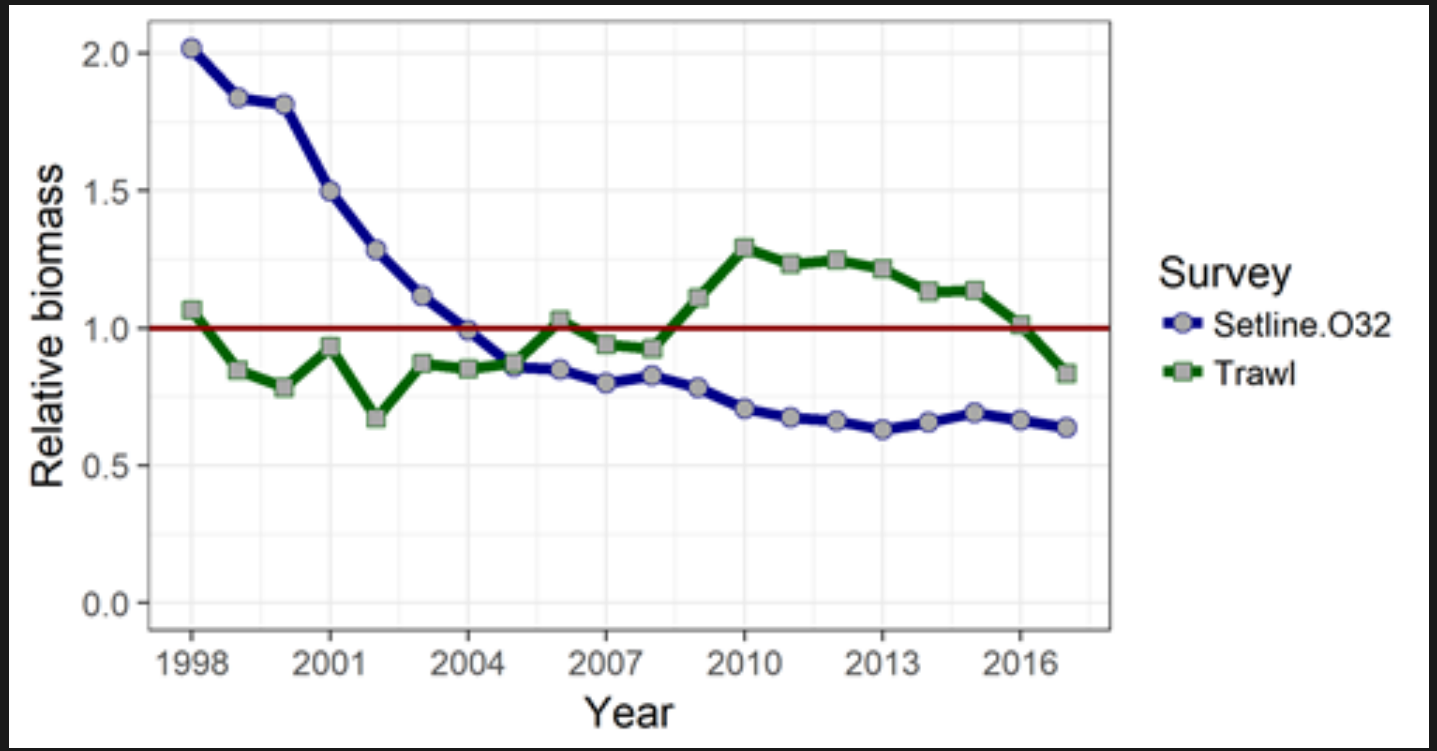


Primary index and secondary index application (e.g. ABM 4)

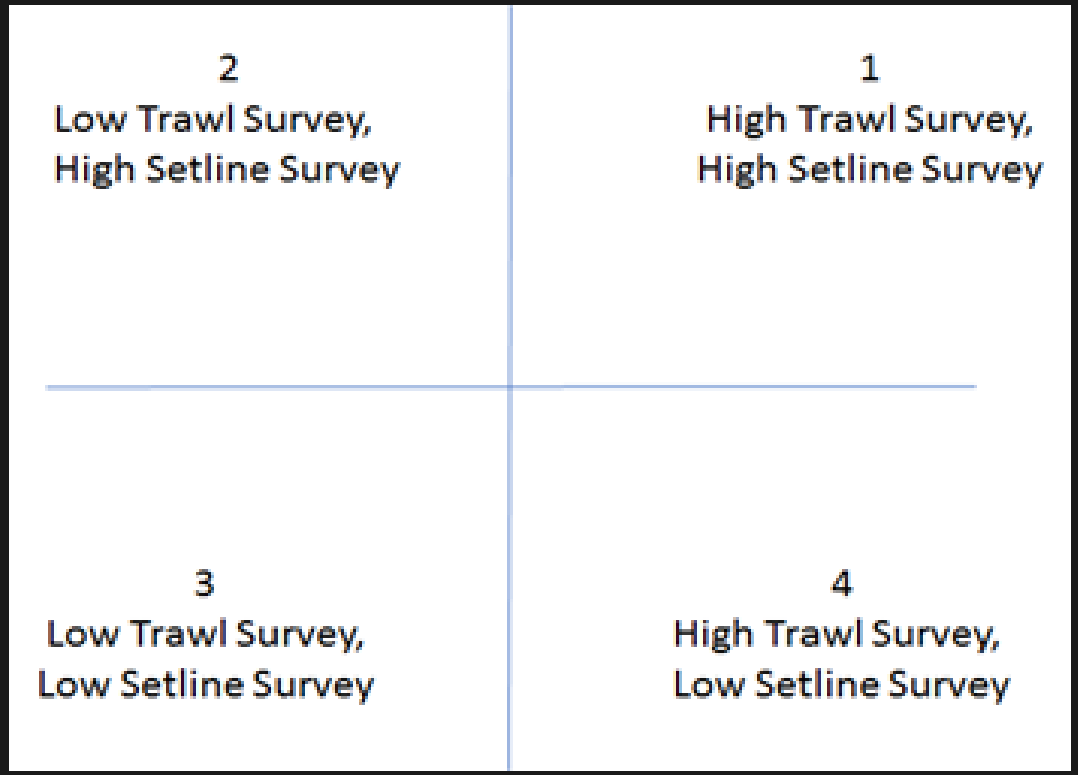
- PSC adjusted when the two surveys both show the same signal (both high or both low)



Preliminary analysis of control rule features through strawmen ABMs (ABM1, ABM3, ABM4)

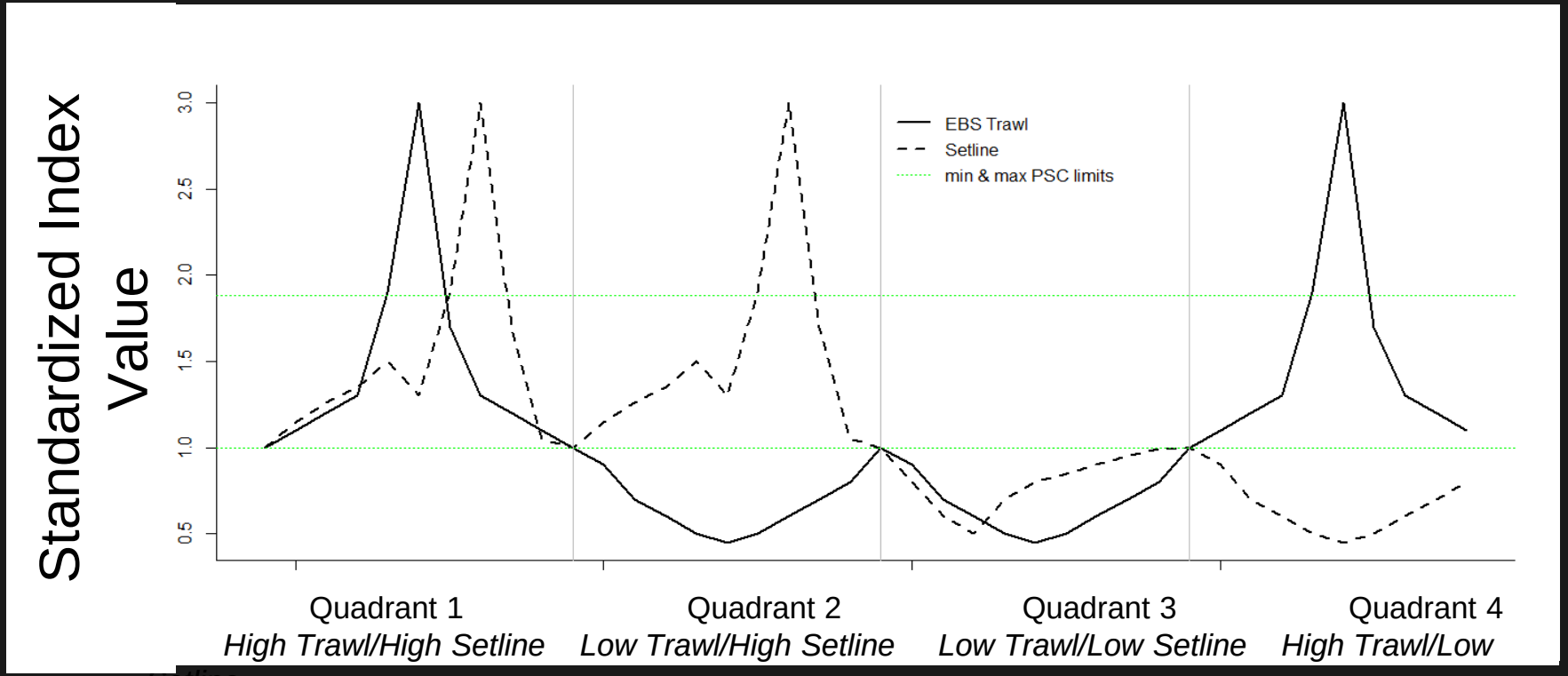


Four quadrants for considering ABMs that use two indices (EBS trawl survey and IPHC setline survey)



Scenarios using hypothetical indices

- Meant to demonstrate extremes
- What happens when ceilings and floors are exceeded?



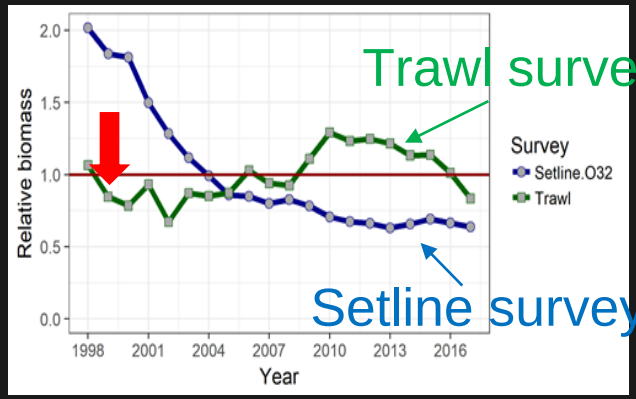
Default Historical and hypothetical scenarios

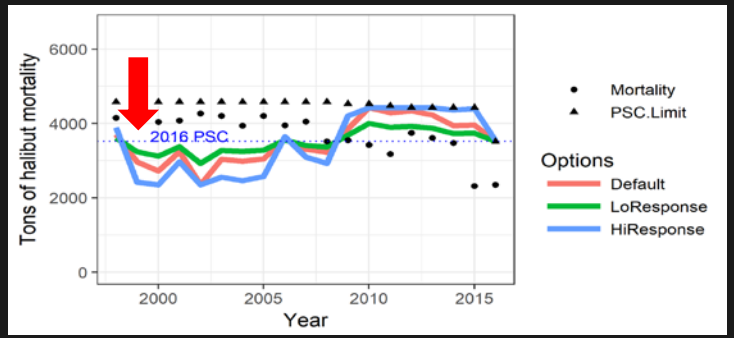
- Used historical survey values averaged over the period 1998-2016 in calculations of control rules
- Default ceiling = 4,426 t (2015 PSC limit)
- Default floor = 2,354 t (2016 PSC use)

ABM -1 baseline

- Index single PSC to EBS trawl survey then allocate to gear/sector according to status quo allocation.
- Baseline example to demonstrate simply how control rule behaves under various Options in Elements 1,2,3,4

Figure 13: ABM 1 Sensitivity to responsiveness (slope) (Control rule based on EBS trawl survey only)



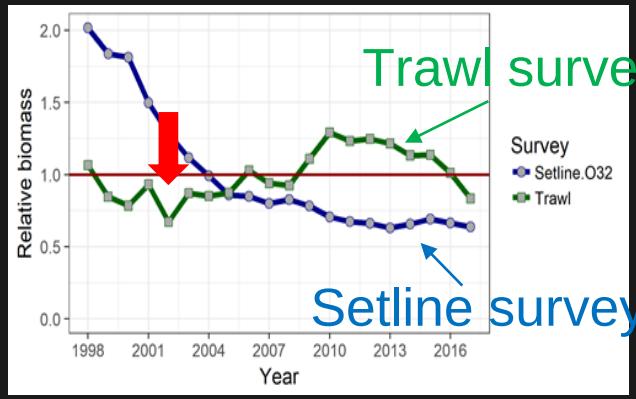


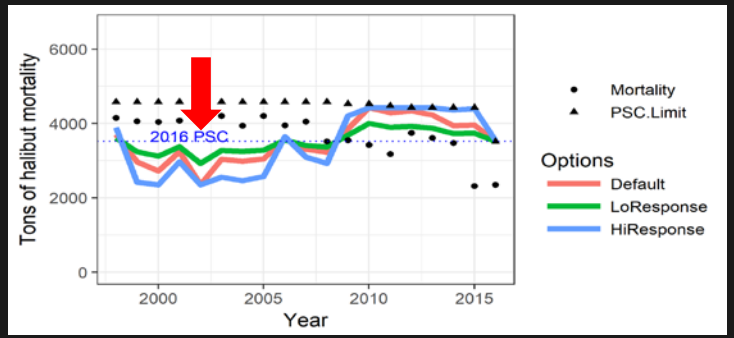
1999

Index	Default Slope=1	Low Slope=0.5	High Slope=2
-20%	-20%	-10%	-40%
	2,966 t	3,240 t	2,416 t

PSC Limits

Figure 13: ABM 1 Sensitivity to responsiveness (slope) (Control rule based on EBS trawl survey only)





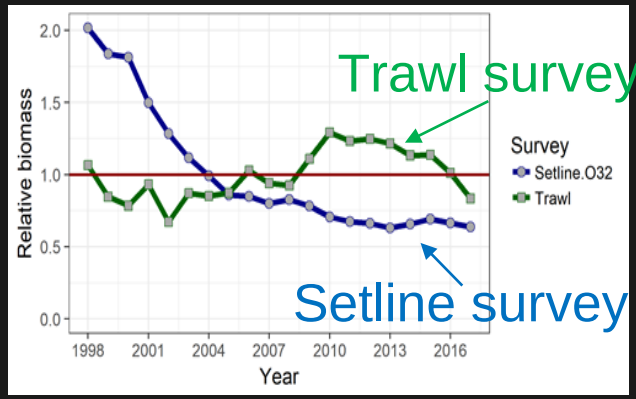
2002

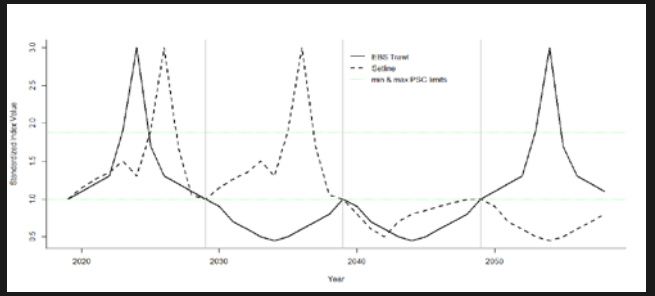
Index	Default Slope=1	Low Slope=0.5	High Slope=2
-28%	-27%	-14%	-21%
	2,354 t	2,926 t	2,354 t

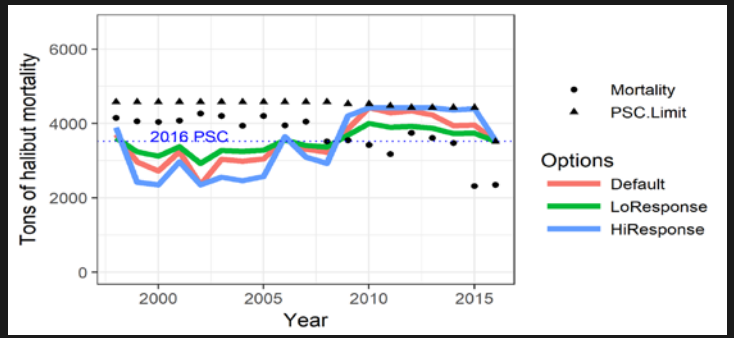
PSC Limits

Default and high responsiveness options hit the floor (PSC limit = 2,354 t)

Figure 13: ABM 1 Sensitivity to responsiveness (Control rule based on EBS trawl survey only)







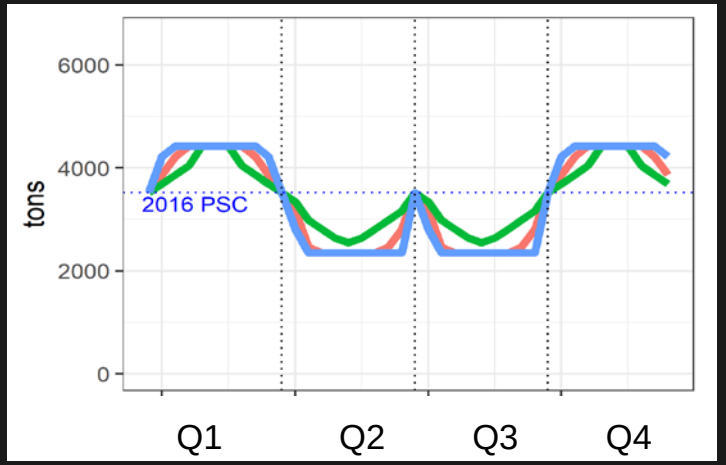
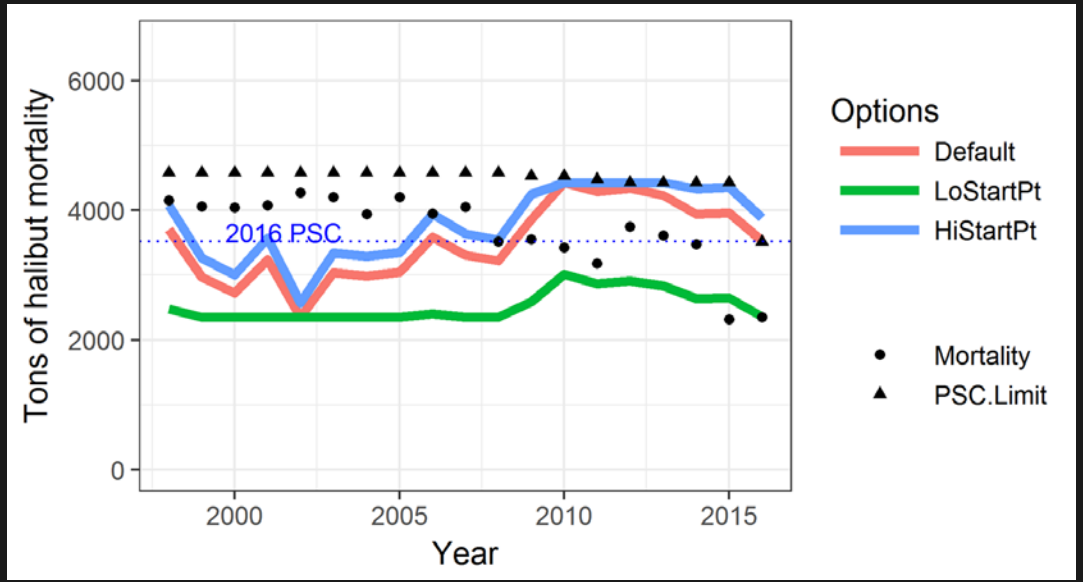


Figure 14: ABM 1 Sensitivity to starting point (Control rule based on EBS trawl survey only)



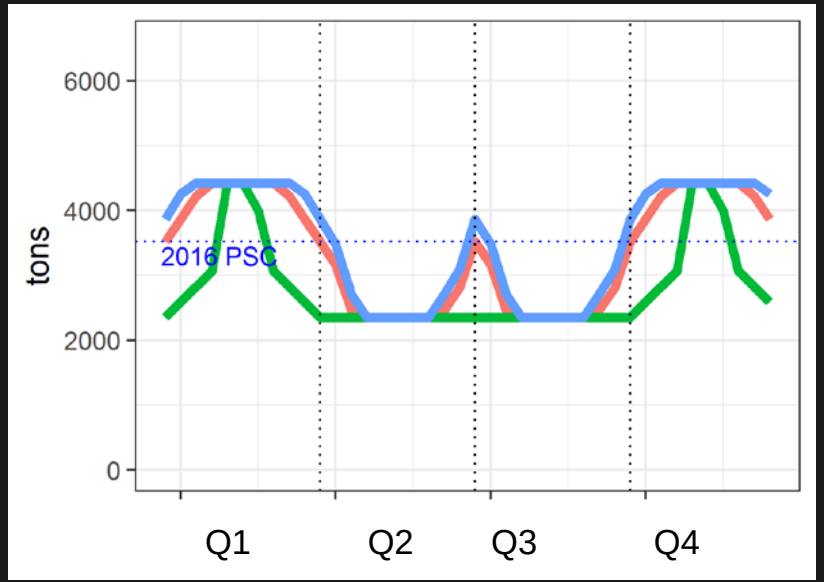
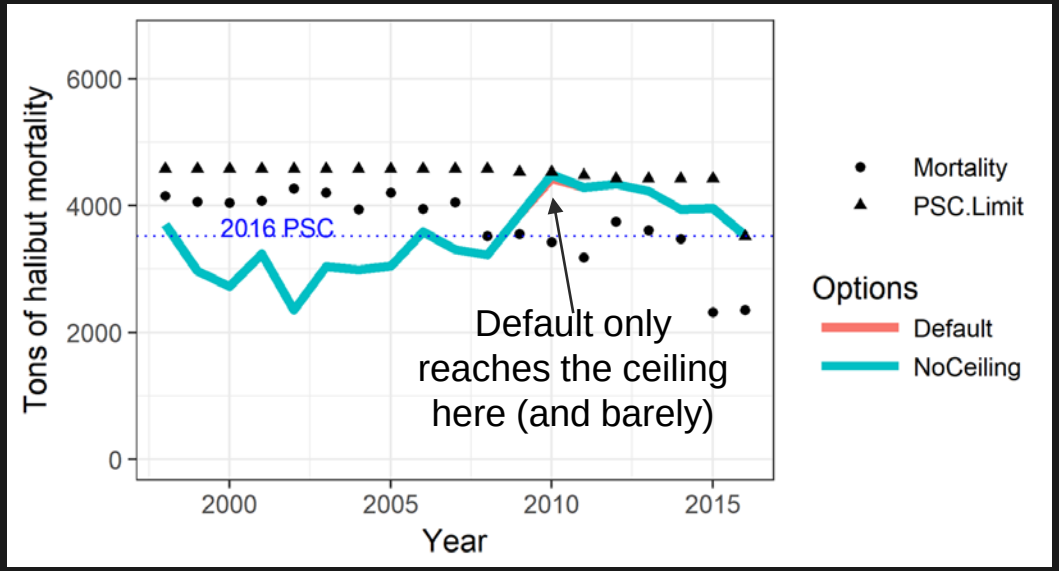
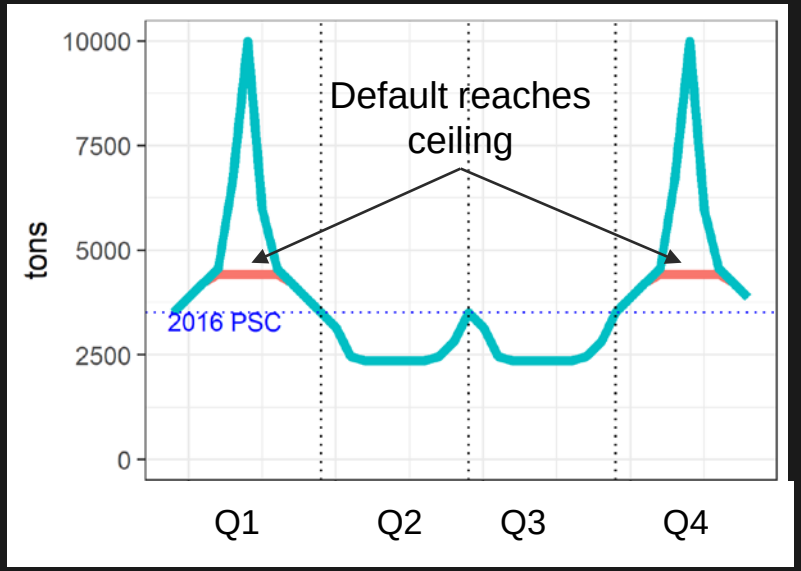


Figure 15: ABM 1 Sensitivity to Ceiling (Control rule based on EBS trawl survey only)





ABM 3

Index trawl PSC to EBS trawl survey.

Index longline PSC to setline survey in 4ABCDE

ABM 4 Index to both EBS Trawl and Setline in 4ABCDE

- Separate PSC limits by gear type
  - For trawl gear:
    - Trawl survey forms the primary index
    - Setline survey for 4ABCDE forms secondary index
  - For Fixed gear
    - Setline survey forms the primary index
    - Trawl survey forms secondary index

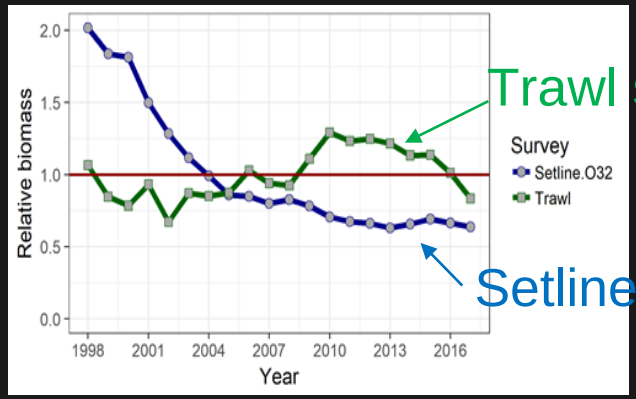
Secondary index modifies the final PSC when primary and secondary index either **both above or both below** average values (in this example)

- PSC multiplied by 1.1 (both indices above average values) and by 0.9 (both indices below average values).
- Minimum PSC (floor) and maximum PSC (ceiling) = final step PSC never exceeds these values.

Default Historical and hypothetical scenarios

- Starting point: the PSC limit when the **primary index is at its average value** over the period 1998-2016.
- In some previous examples the starting point was the PSC limit when the **primary index was at its 2016 value**
- The EBS trawl survey was at its average value in 2016
- The IPHC setline survey was at 63% of its average value in 2016

Figure 17: Comparison of ABM1, ABM3, and ABM4 for Trawl Sector



Trawl survey

Setline survey

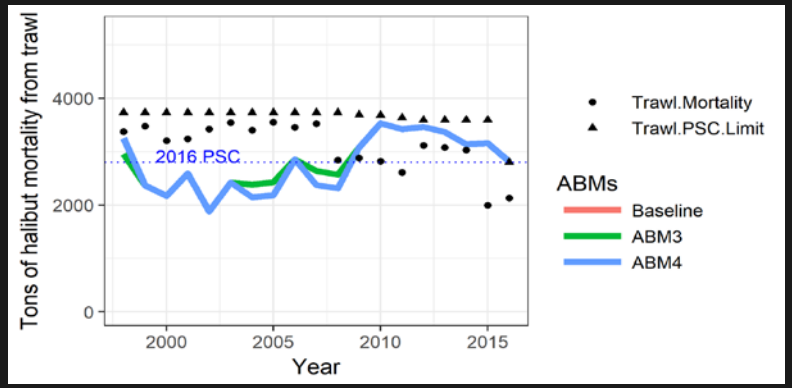
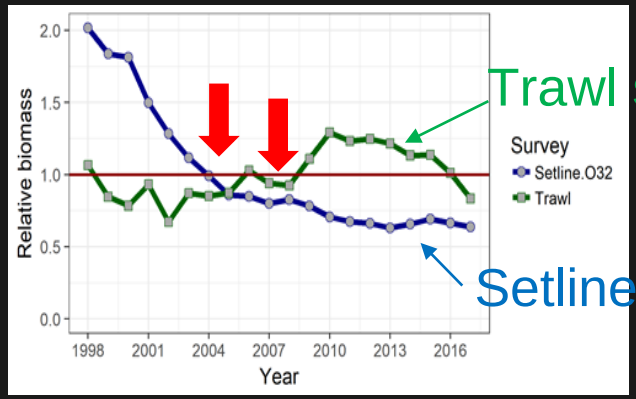


Figure 17: Comparison of ABM1, ABM3, and ABM4 for Trawl Sector

ABM 1 and ABM 3 are identical for trawl



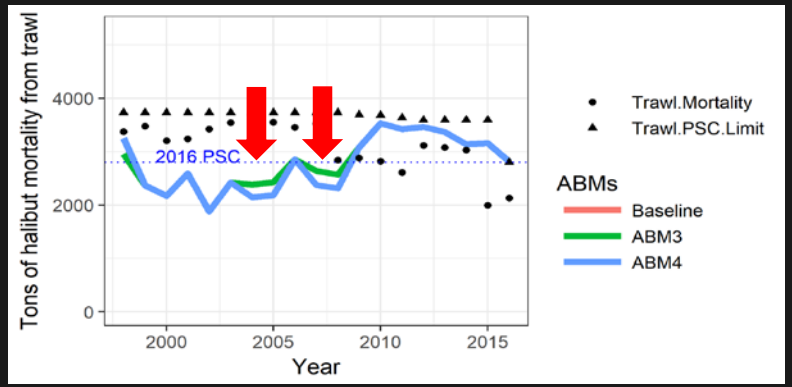
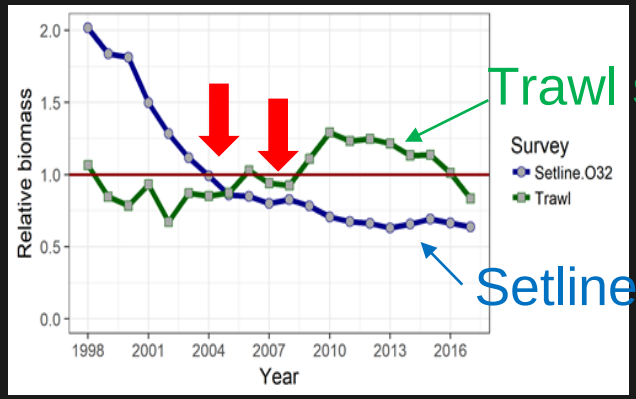


Figure 17: Comparison of ABM1, ABM3, and ABM4 for Trawl Sector



Trawl survey

Setline survey

ABM 1 and ABM 3 are identical for trawl

2007:

	EBS shelf survey	IPHC setline survey	ABM 1	ABM 3	ABM 4
% Change	-8%	-6%	-8%	-8%	-17%
Value	94% of average	78% of average	2,638 t	2,638 t	2,374 t

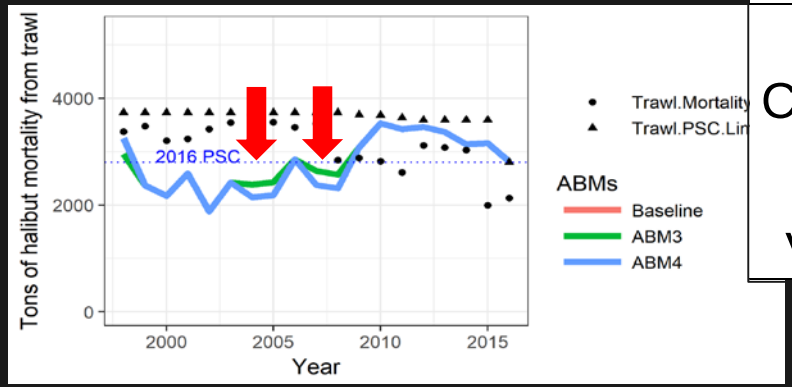
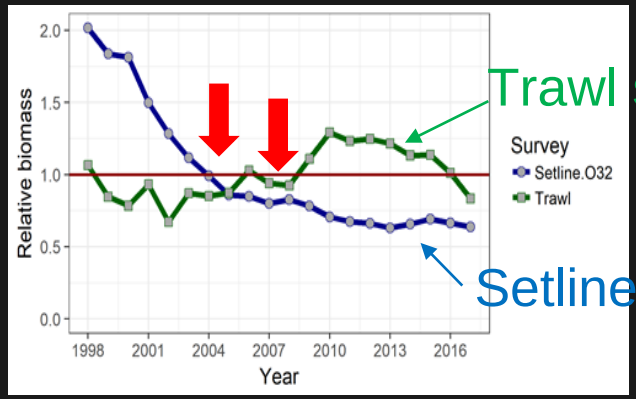
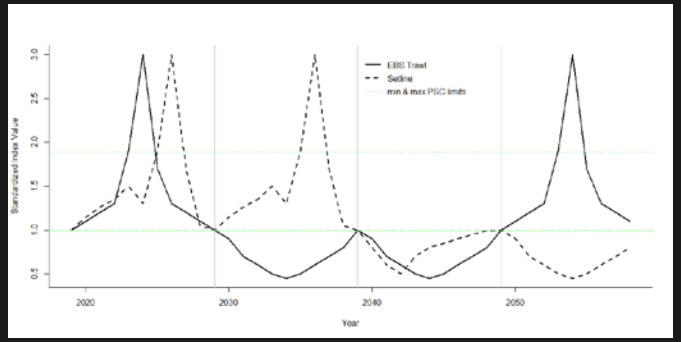
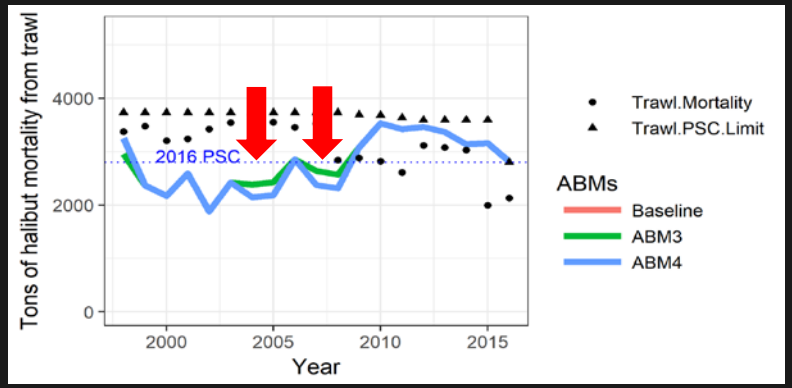


Figure 17: Comparison of ABM1, ABM3, and ABM4 for Trawl Sector







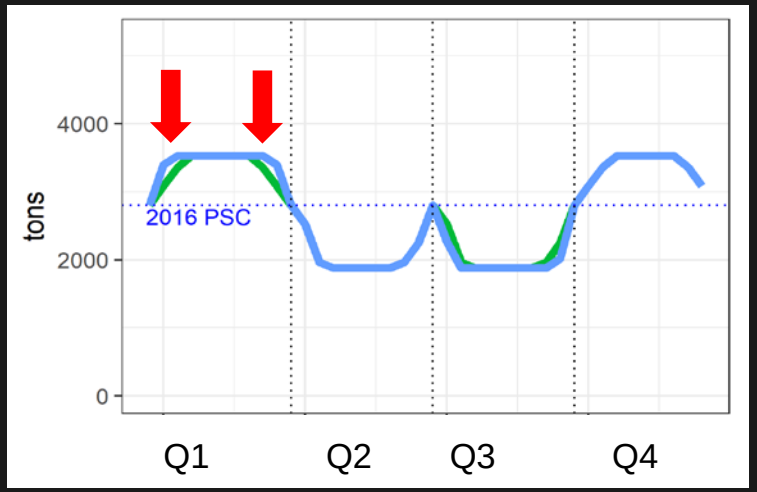
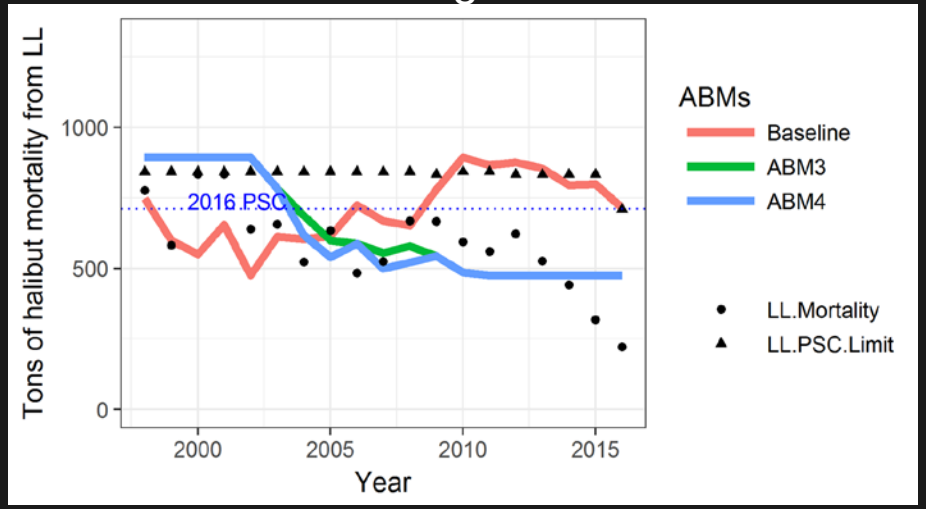


Figure 18: Comparison of ABM1, ABM3, and ABM4 for Longline Sector

- Starting point is 2016 limit allocated to longline (~20%), applied when survey at average value

Plot in paper: 2016 starting point occurs at average index value



New: Starting point occurs at 2016 index value

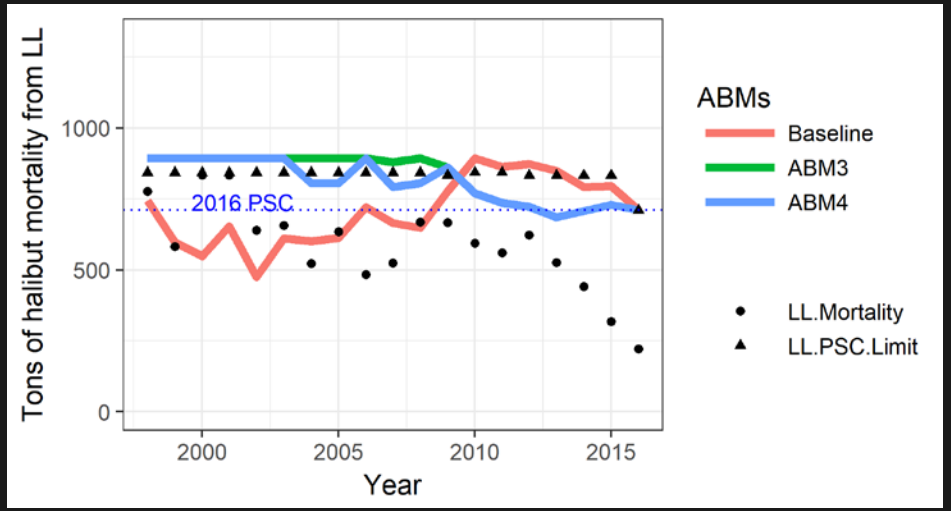
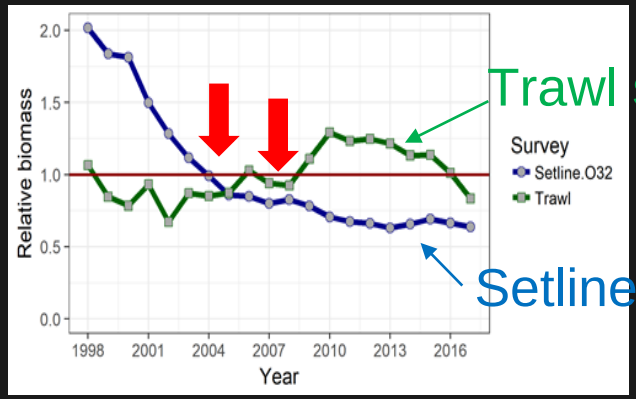
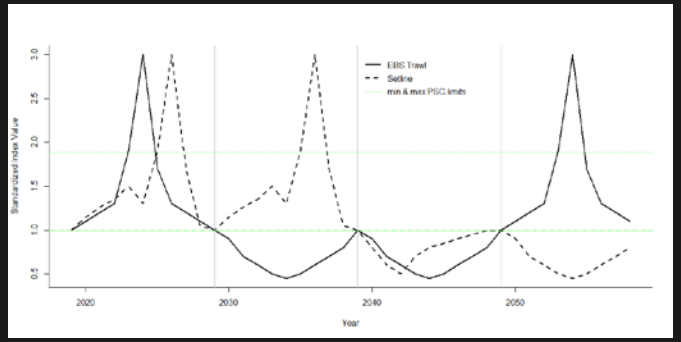
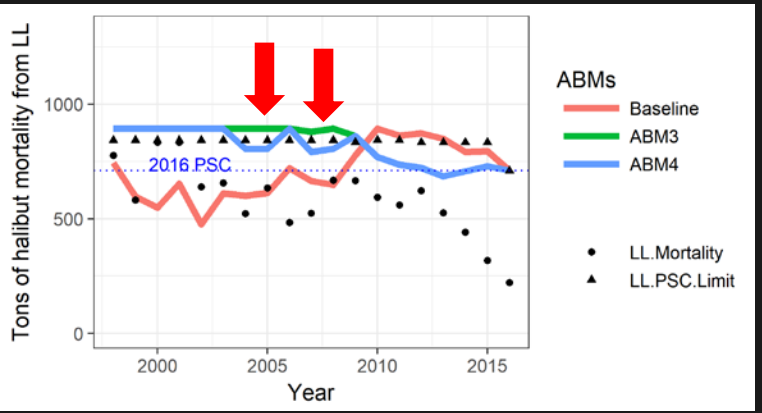


Figure 17: Comparison of ABM1, ABM3, and ABM4 for Trawl Sector







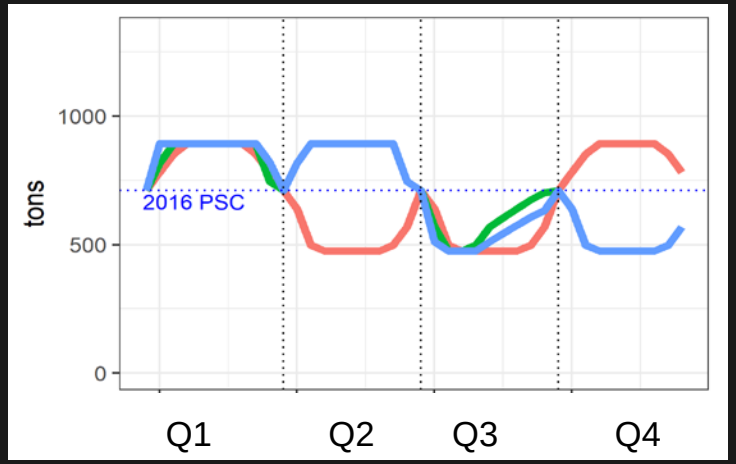
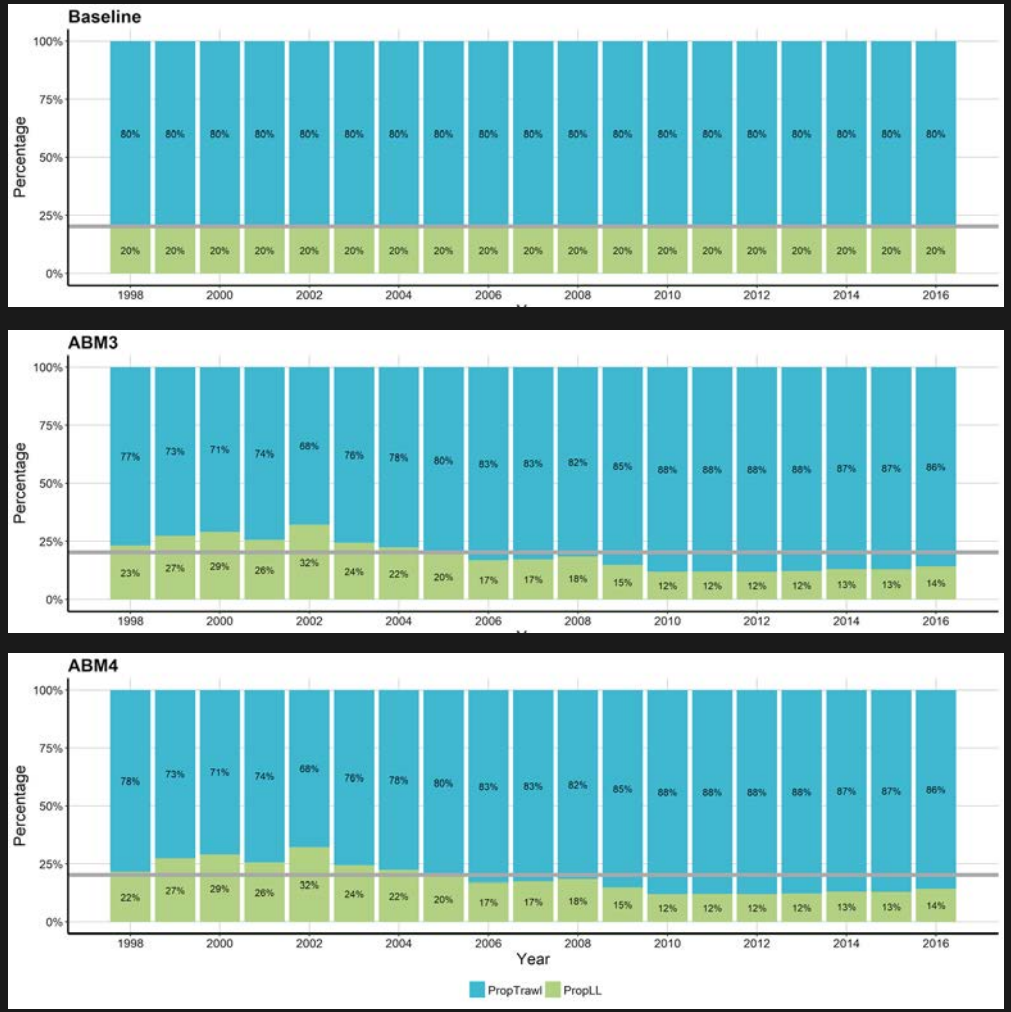


Figure 19: Proportional allocation of PSC limit between trawl and longline for historical indices

AMB 1

AMB 3

AMB 4

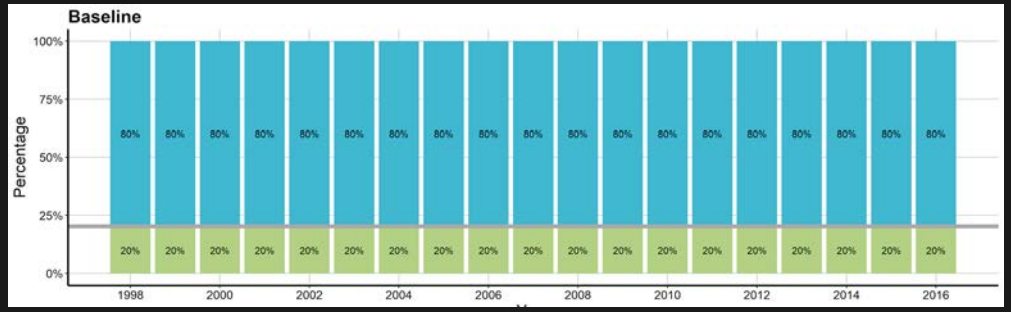


New plots:

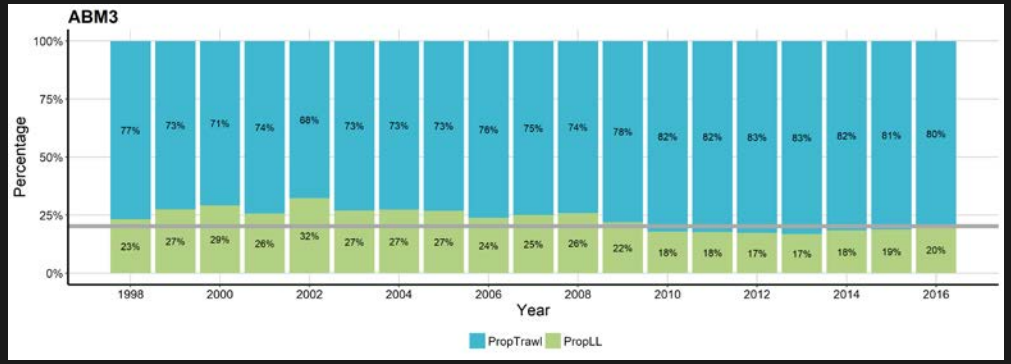
2016 starting point occurs at 2016 index value

Proportional allocation of PSC limit between trawl and longline for historical indices

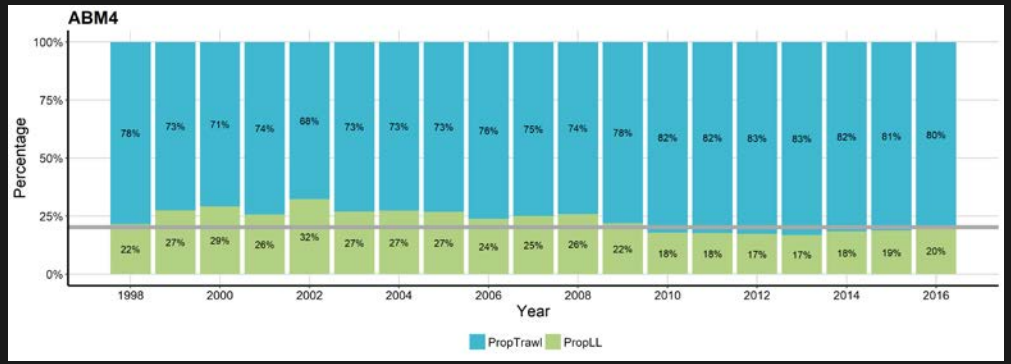
AMB 1



AMB 3



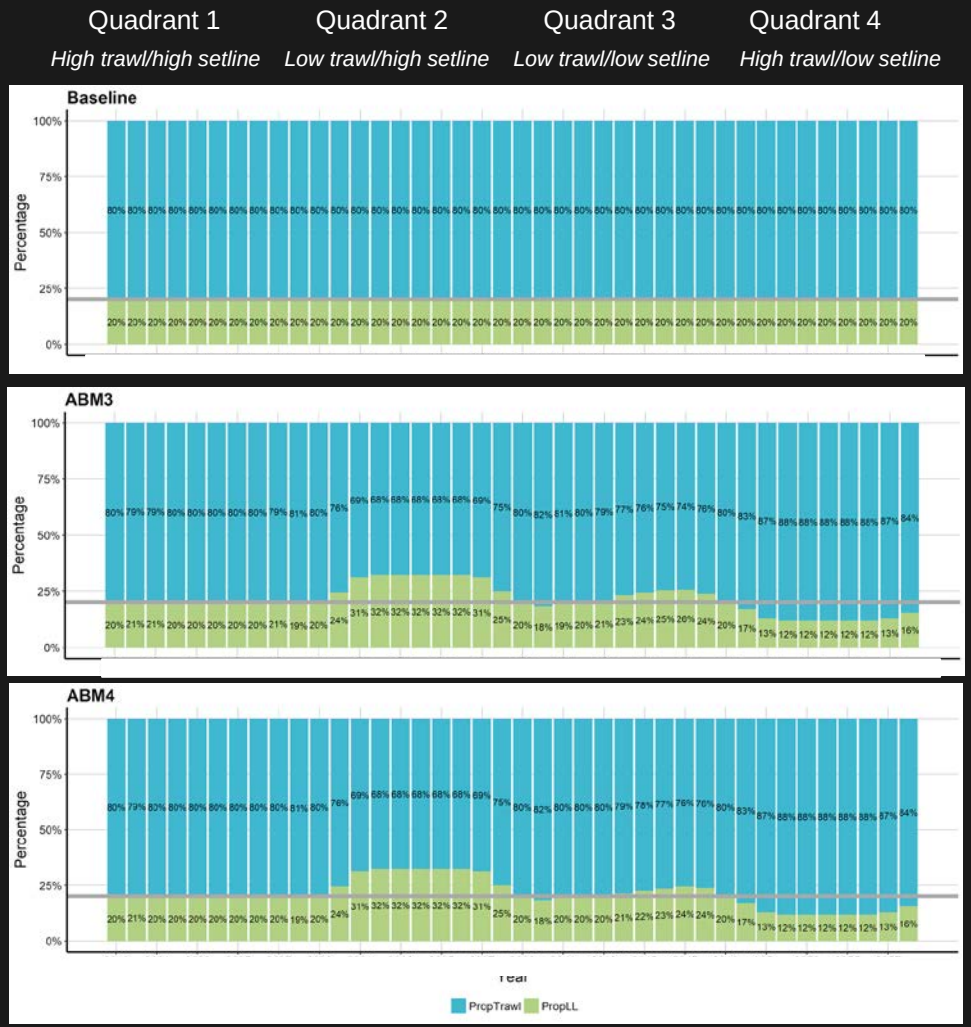
AMB 4



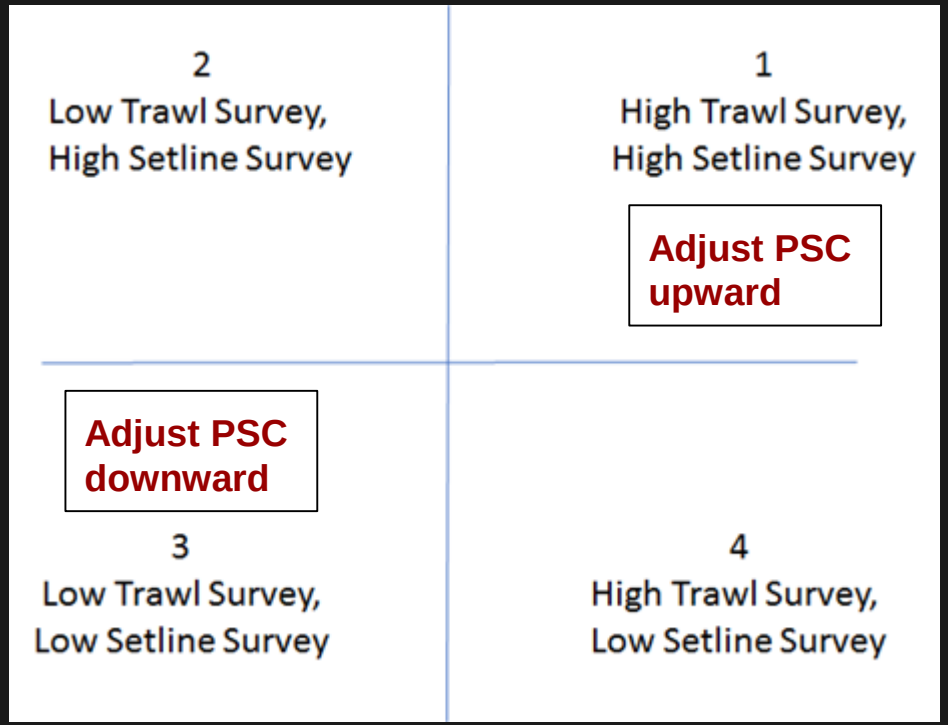
Take home point if using something like ABM 3 or 4:

What would you like for the proportional allocation between trawl and longline to be in an initial year of implementation?

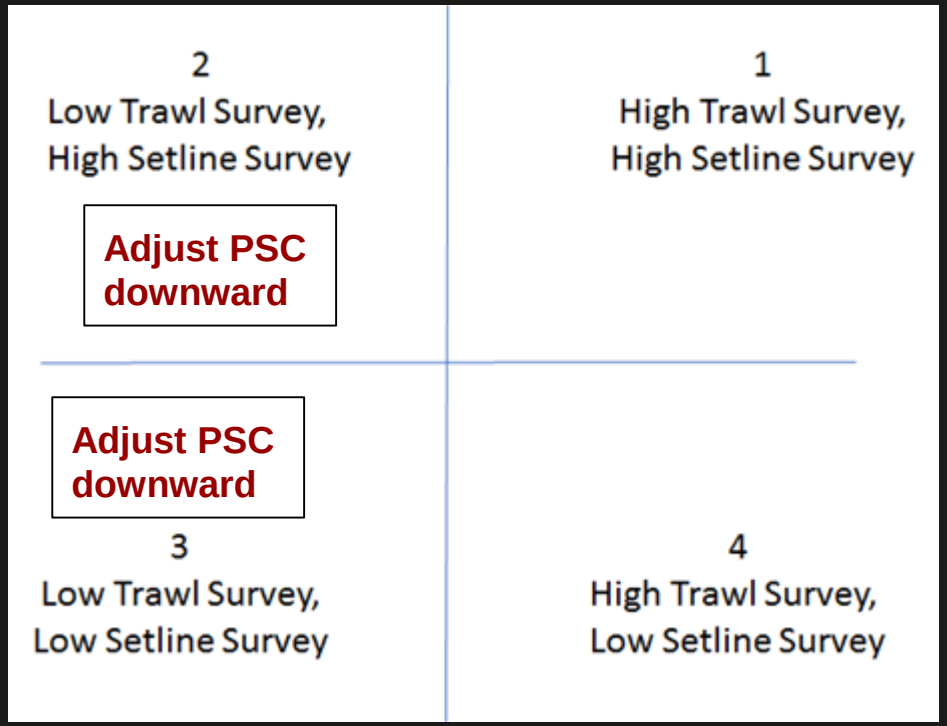
Figure 20: Proportional allocation of PSC limit between trawl and longline for hypothetical indices



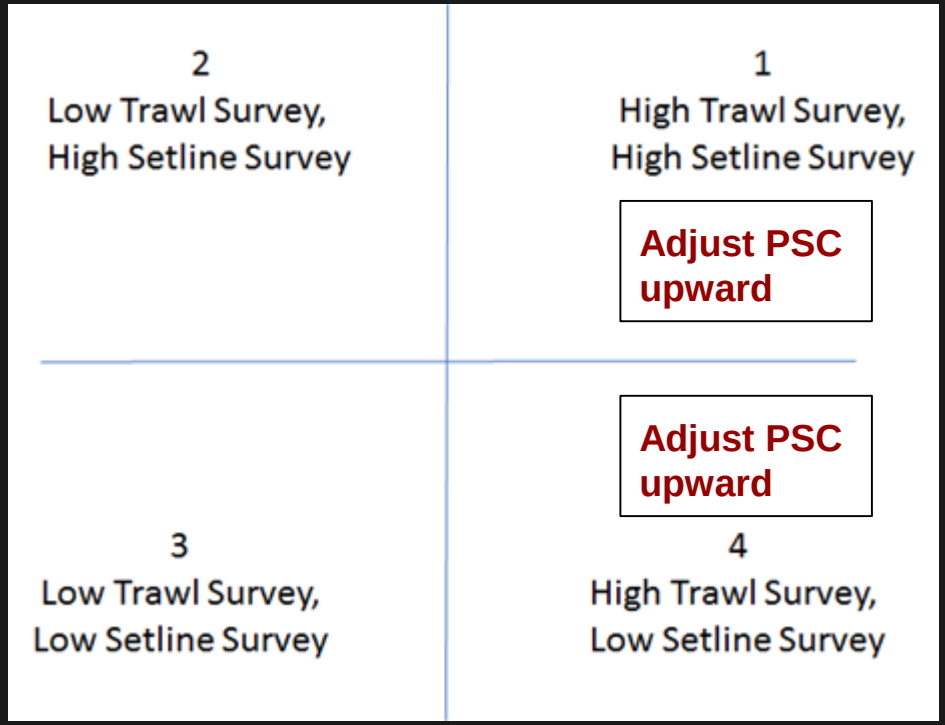
Quadrants and Objectives: ABM 4, Reinforcement of Information



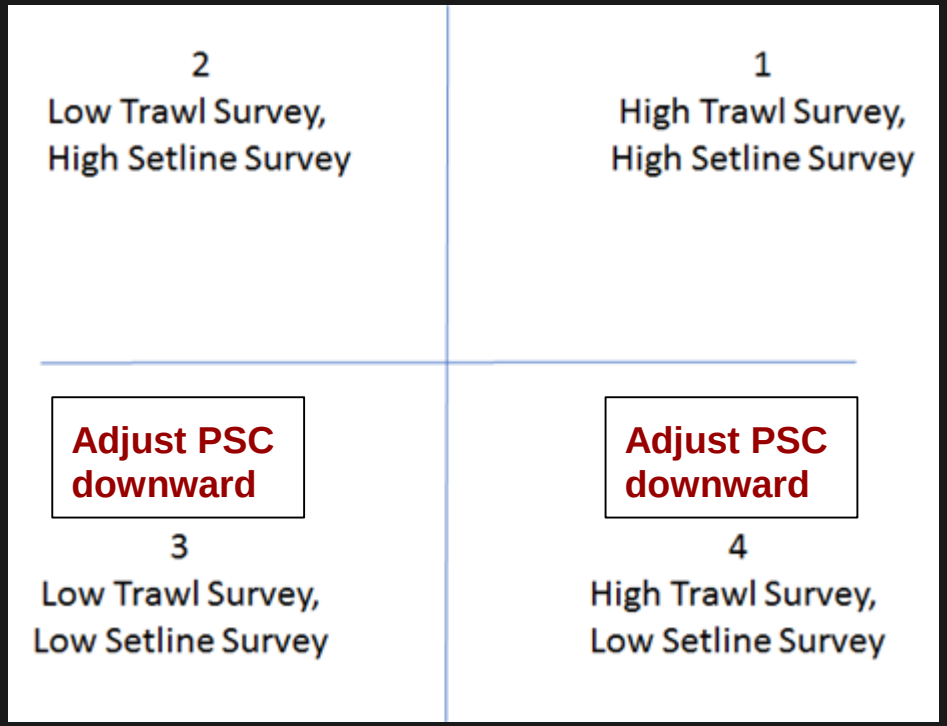
Objective #2: Spawning stock biomass should be protected particularly at low levels of abundance



Objective #3: Provide flexibility to avoid constraining the groundfish fisheries especially at high levels of halibut abundance



Objective #4: Provide for directed halibut fishing opportunities in the Bering Sea



Recommendations

- Use of the revised elements and options presented in Section 5 in construction of a suite of alternatives for analysis.

- Options for each element should be specific, and succinct. Otherwise, the number of alternatives will be numerous and cumbersome to evaluate.
- ABM options should have a continuous or smooth underlying response to changes in halibut abundance but could be applied as a continuous control rule or look-up table with the resolution determined by Council objectives on stability.

Recommendations, continued

Recommend the following range of possible methods for setting the PSC limit with one or more indices:

- Use two separate control rules, one for each index. The single PSC limit is determined from the combination of the output from the two control rules. This could be the sum of the two independent PSCs as determined by those control rules, or any other method.
- Use a control rule for one index, but features change depending on the other index (e.g., slope changes for EBS trawl survey index depending on the IPHC setline survey, the lookup table changes, or changes to the starting point).
- Use a multiplier on the PSC limit for specific combinations of index levels (i.e., specific cells).

End of Presentation

Allan’s stuff

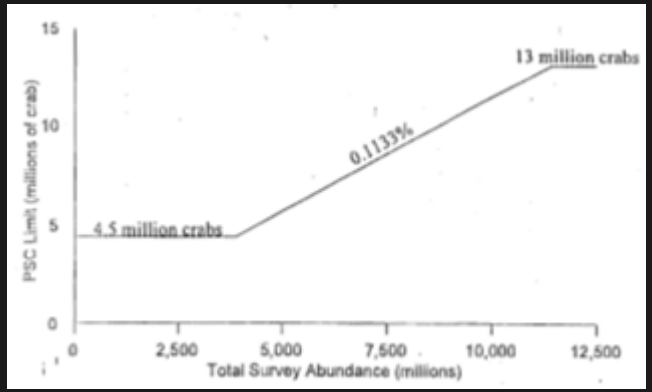
Slope:

Floor and ceiling:

Cliff:

Stability Provisions

Figure 2


15
10
5
0
PSC Limit (millions of crab)
13 million crabs
0.1133%
4.5 million crabs
0
2,500
5,000
7,500
10,000
12,500
Total Survey Abundance (millions)

Background relative to document

Diana noting updates, Council objectives and actions, strawmen ABMs, and control rules relative to objectives. Allan's notes:

1. Have we covered the options that the Council should consider when developing alternatives? For example, maximum annual percent change in PSC limit is not an option.
2. Are there any scientific arguments for choosing among the options. Following on Dana's comments, would linking EBS trawl survey index to trawl PSC limit and setline survey to setline PSC be scientifically defensible? Or does the fact that 71% of the bycatch mortality in 4CDE in 2017 was O26 halibut introduce a wrinkle?
3. If the Council will be developing alternatives at this meeting, does the SSC have any advice for how the ABM WG should analyze the alternatives? And, can they comment on the amount of time the WG should have to conduct that analysis.
4. Will Dana be the lead for the next review of the ABM document?

Table 2

Arbitrary Index Classification	Below Cliff	Low	Medium Low	Medium	Medium High	High
Hypothetical PSC limit	0	1,000	2,500	3,515	4,000	4,426

Figure 4

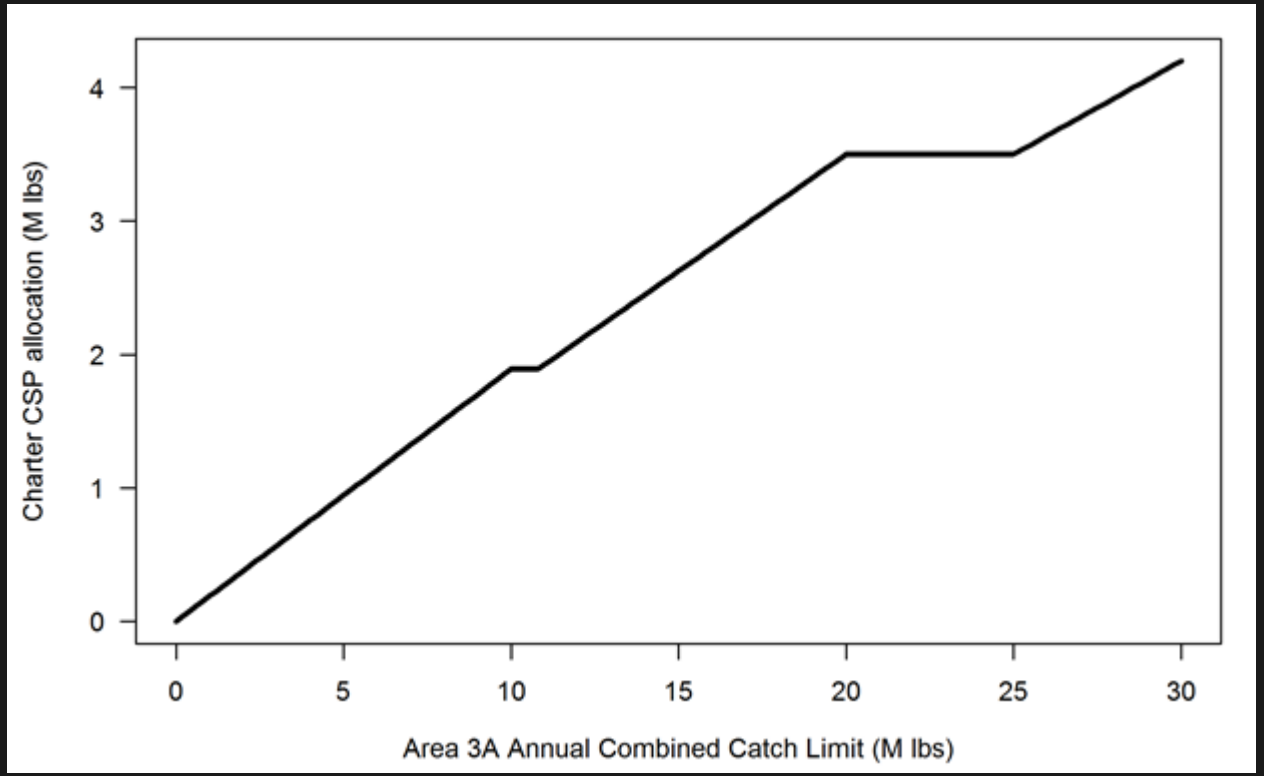

Charter CSP allocation (M lbs)
0
1
2
3
4
0
5
10
15
20
25
30
Area 3A Annual Combined Catch Limit (M lbs)

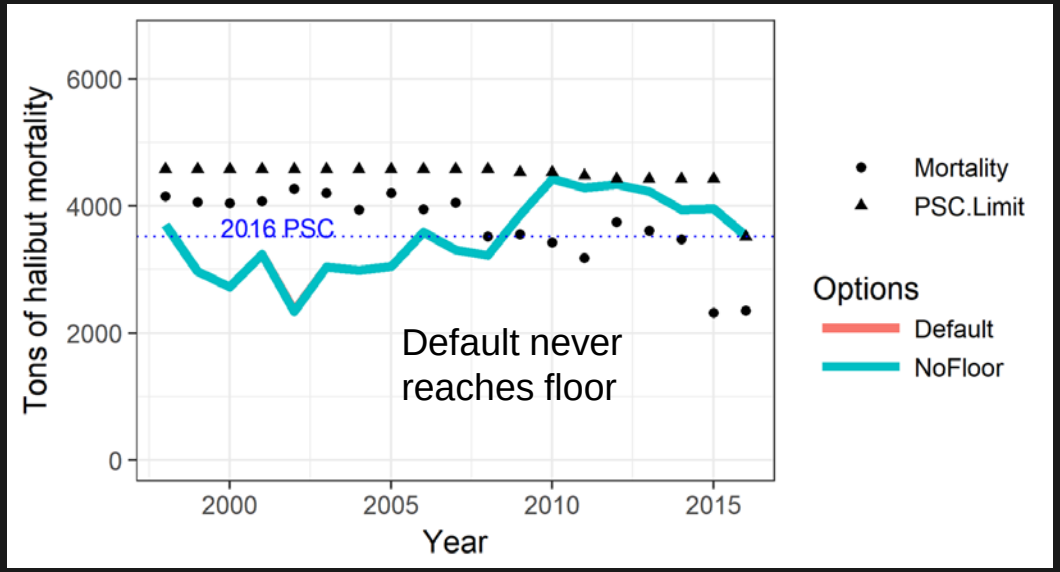
Table 3

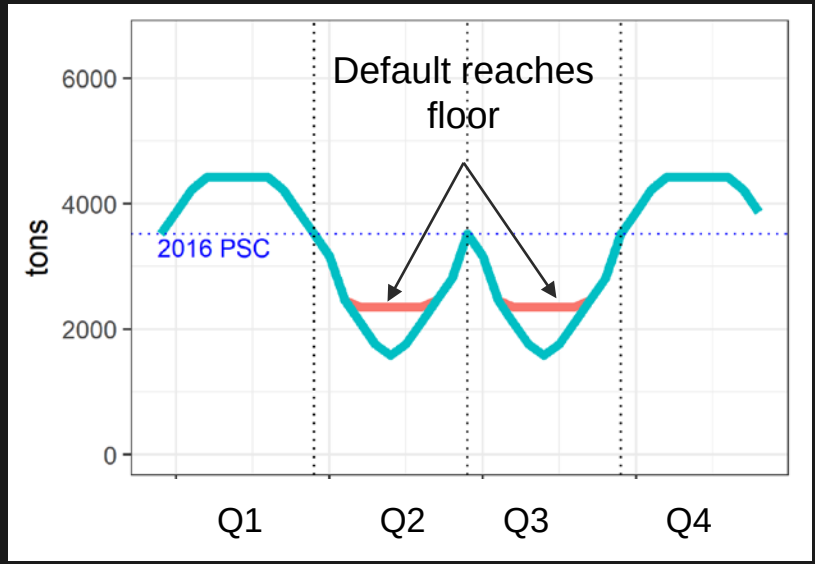
			EBS shelf trawl survey index					
		Below Cliff	Low	Medium Low	Medium	Medium High	High	
IPHC setline survey index in Area 4ABCDE	High							
	Medium							
	Low							

Lookup Table Options

Is anything on lookup tables needed for the SSC presentation?

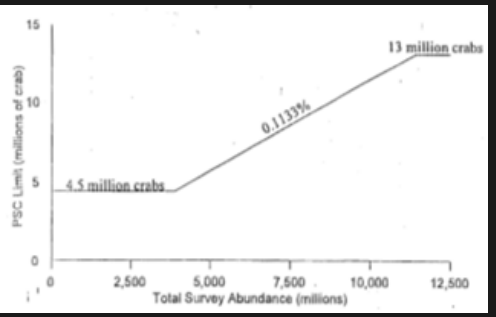
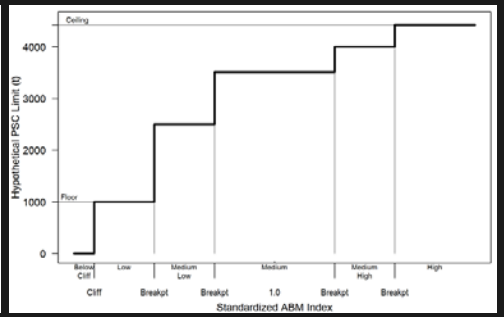
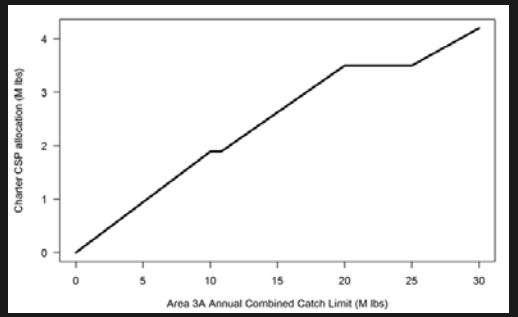
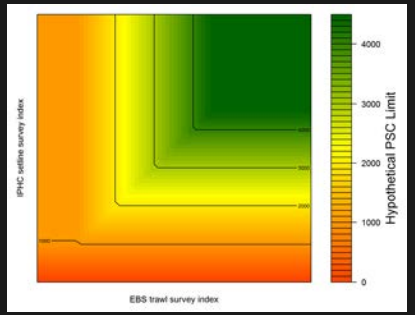
Figure 16: ABM 1 Sensitivity to Floor (Control rule based on EBS trawl survey only)





Discretizing the control rule into a lookup table

			Standardized EBS shelf trawl survey index (arbitrary range)					
		Multiplier on starting point	**Very-low (0.0–0.1)**	**Low (0.1–0.5)**	**Medium Low (0.5–0.8)**	**Medium (0.8–1.2)**	**Medium High (1.2–1.5)**	**High (>1.5)**
IPHC setline survey index in Area 4ABCDE	**High**	**1.15**	1,388	2,086	3,064	4,042	4,426	4,426
	Medium	**1.00**	1,000	1,559	2,537	3,515	4,426	4,426
	Low	**0.85**	1,000	1,032	2,010	2,988	3,966	4,426

Review of control rules

- One dimensional vs multidimensional
- Continuous vs. lookup table (stair step) vs. hybrid
  - Stair step and lookup table are the same thing, but two different ways of viewing the control rule