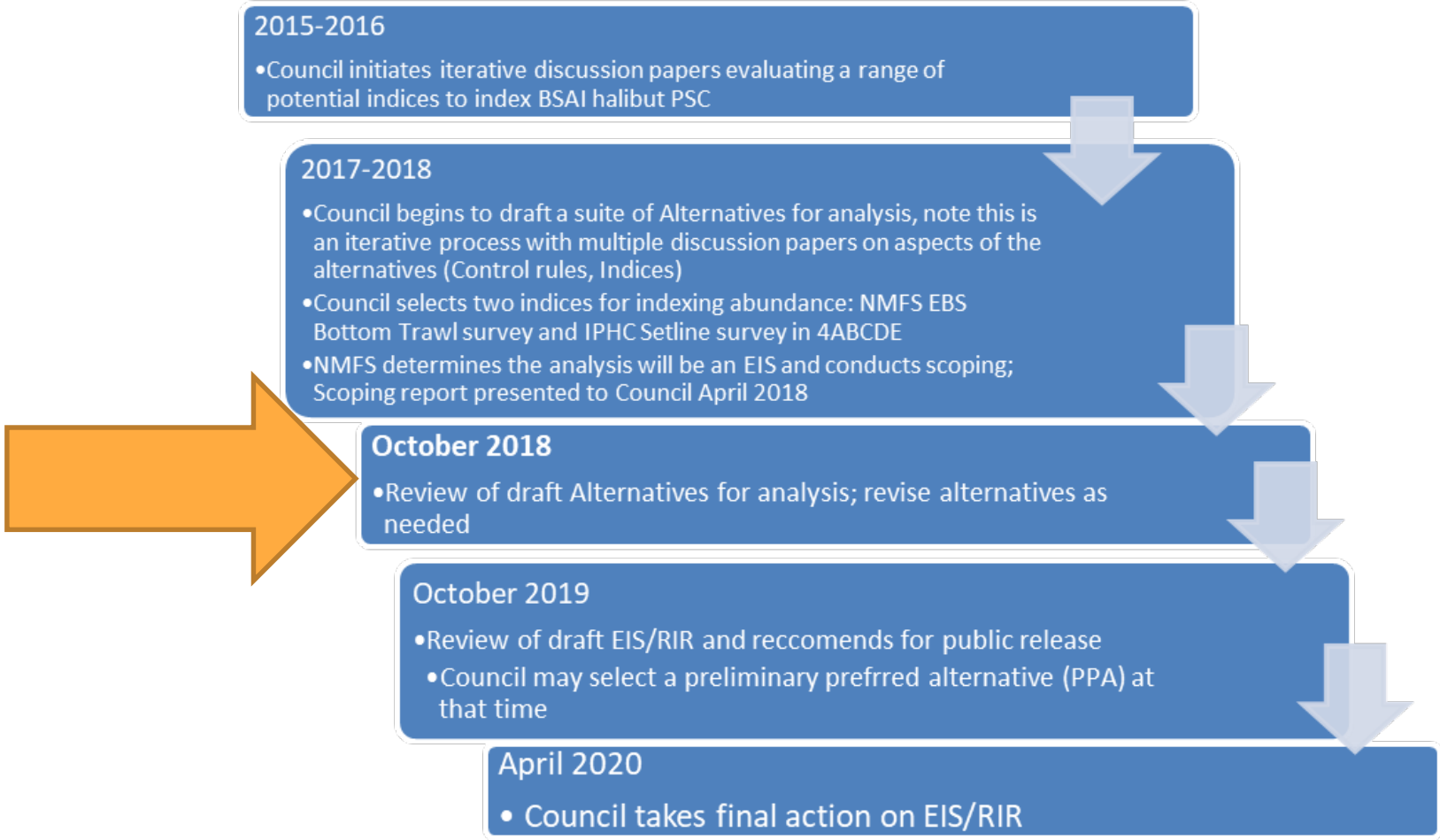


C-6 BSAI Halibut ABM

October 2018 Council meeting

Actions to date by Council on BSAI Halibut ABM PSC limits and projected future timeline



Alternatives

Alternative 1 (Status Quo)

Current
PSC limit

Amendment 80 cooperatives

1,745 t

BSAI trawl limited access fisheries

745 t

Longline fisheries

710 t

CDQ fisheries

315 t

TOTAL

3,515 t

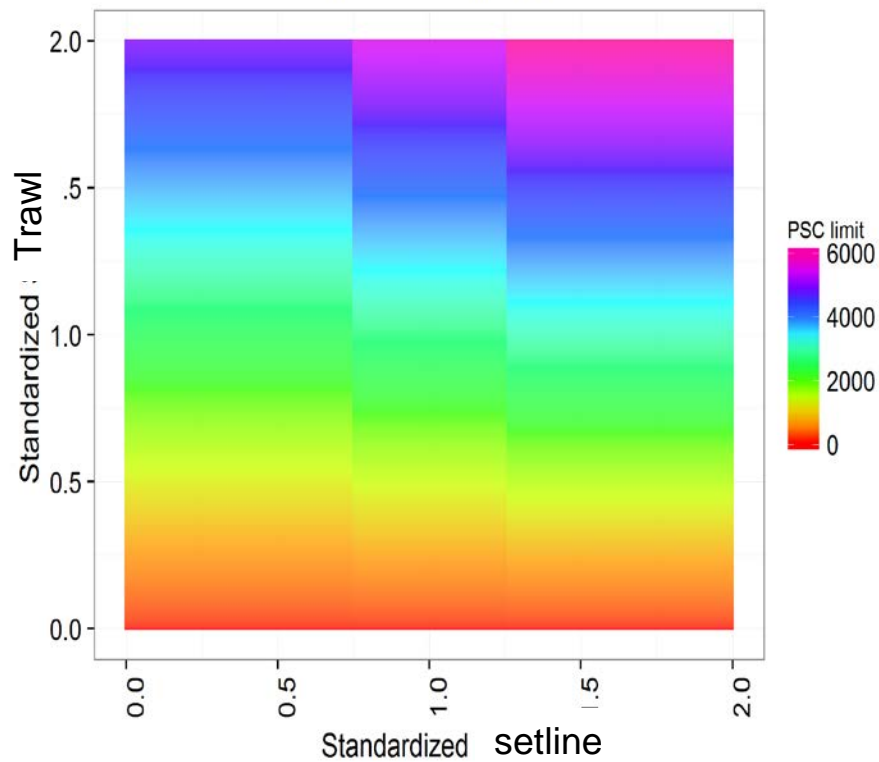
Alternative 2:

**Index trawl PSC limit to EBS trawl survey biomass. Index
longline PSC limit to setline survey biomass.**

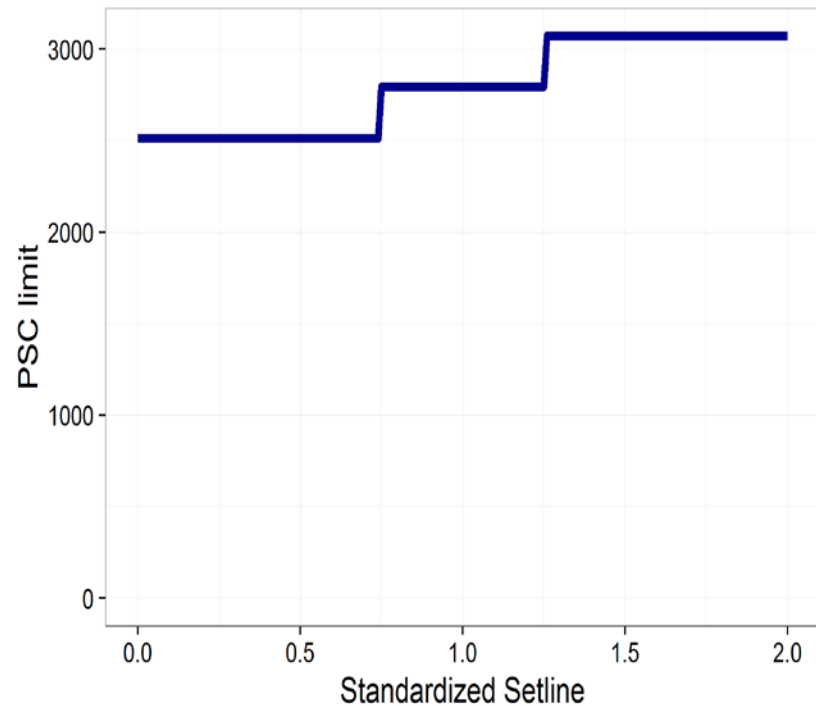
Alternatives 3, 4, 6

Index trawl gear PSC limit and fixed gear PSC limit to both EBS trawl survey (primary index for trawl, secondary index for longline) and setline survey (primary index for longline, secondary index for trawl).

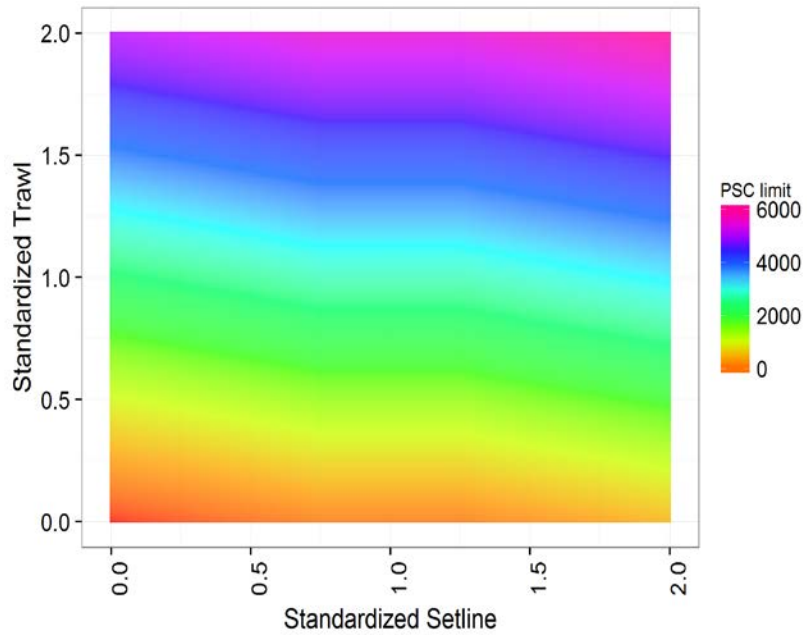
Trawl PSC Alternative 4



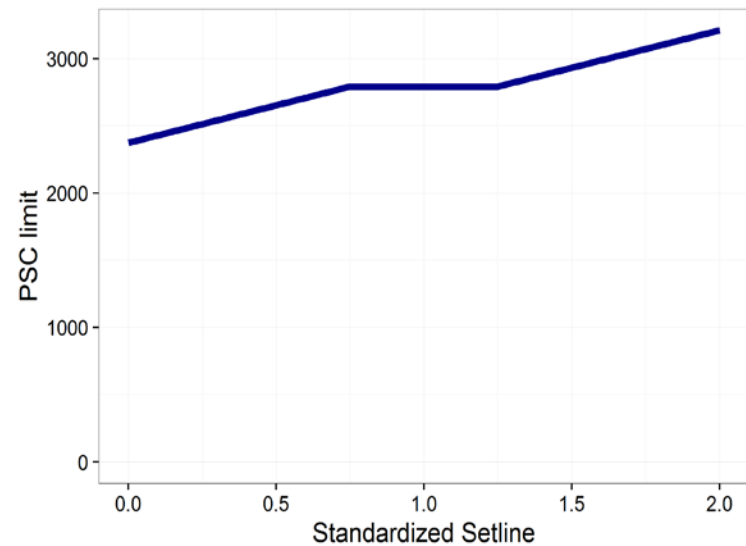
Cross-section at trawl index = 1 (Alt 4)



Trawl PSC Alternative 6



Cross-section at trawl index = 1 (Alt 6)

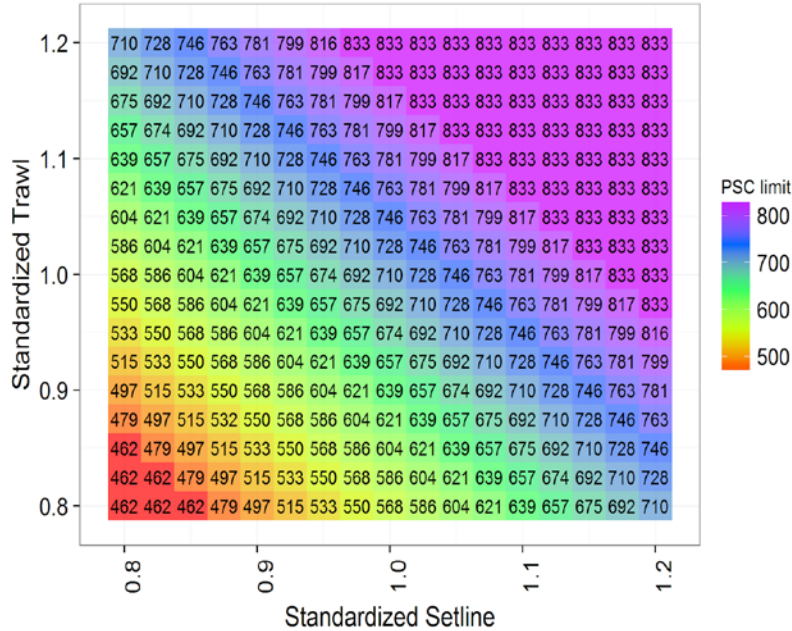


Background to understand the historical examples

- Examples shown only for Alt 4 because Alt 3 and Alt 4 are equivalent under our conditions
- It is impossible to make scenarios to directly compare Alt 4 and Alt 6, but we show what we did to standardize the scenarios to the extent possible
- Alternative 5 is not included in examples: further clarification needed

**Alternative 5 (Fixed gear only):
Index fixed gear PSC to combination of IPHC
Area 4 all sizes survey and EBS shelf trawl
survey.**

LL PSC Alternative 5 (w/floors and ceilings)



Standardized EBS Shelf Trawl Survey

		>1.1	<1.1 and >= 0.5	<0.5
Standardized IPHC All Sizes Setline Survey	> 1.1	PSC limit = Ceiling	PSC limit = Ceiling	Does PSC limit equal the Ceiling or the Floor?
	<1.1 and >= 0.5	PSC limit = Ceiling	PSC limit = Starting Point	PSC limit = Floor
	<0.5	Does PSC limit equal the Ceiling or the Floor?	PSC limit = Floor	PSC limit = Floor

Historical Examples of Alternatives 2, 4, and 6

Element	Option	Value
Element 2 (Alts 2-6)	Option 4	3,515 t
Starting Point		(2016 PSC Limit)
Element 3 (Alts 2-6)	Option 2	4,426 t
Maximum PSC Limit (ceiling)		(2015 PSC Limit)
Element 4 (Alts 2-6)	Option 2	2,354 t
Minimum PSC Limit (floor)		(2016 PSC usage)
Element 5 (Alts 4,6 only)	Option 1	High = 2 nd highest value of time series (1998- 2016)
Values for 2 nd Index		Low = 2 nd lowest value of time series (1998-2016)
Element 6 (Alts 4,6 only)	Option 1	High = 1.5
Multiplier for 2 nd Index	Option 2	Low = 0.5

Alternative 3 and Alternative 4

Both: Index trawl gear PSC and fixed gear PSC to both EBS trawl survey (primary index for trawl, secondary index for longline) and setline survey (primary index for longline, secondary index for trawl).

Alternative 3:

The secondary index modifies a multiplier on the starting point of the control rule when the secondary index is in a “high state” or a “low state” (e.g., the PSC is multiplied by 1.1 when the secondary index is at a “high” value and by 0.9 when the secondary index is a “low” value).

Alternative 4: The secondary index modifies the multiplier on the final PSC limit after the primary index is applied when the secondary index is in a “high state” or a “low state”

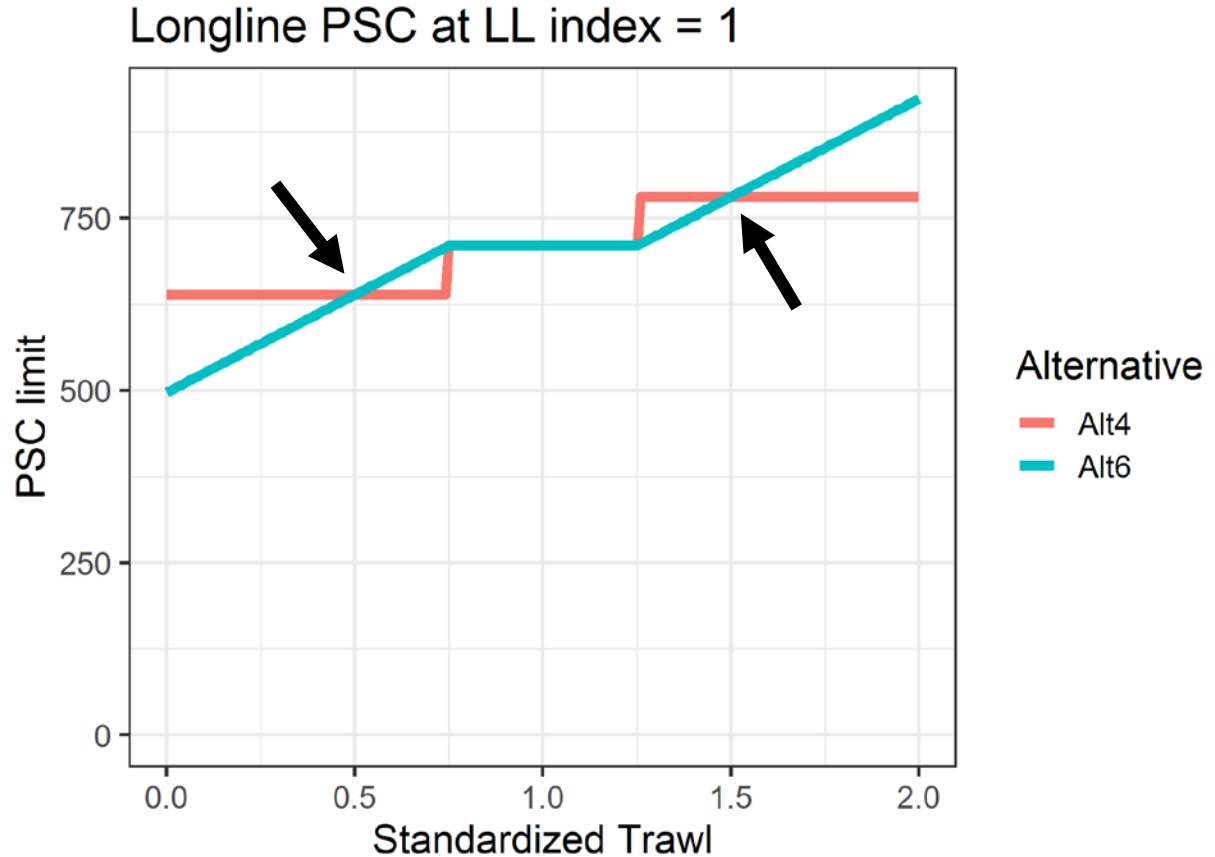
Alternatives 3 and 4 are the same under our conditions, which are:

- Slope set to 1.0 (as requested) means:
 - % change in index results in same % change in PSC limit
- The primary index is standardized to its 2016 value and the starting point is the 2016 PSC limit

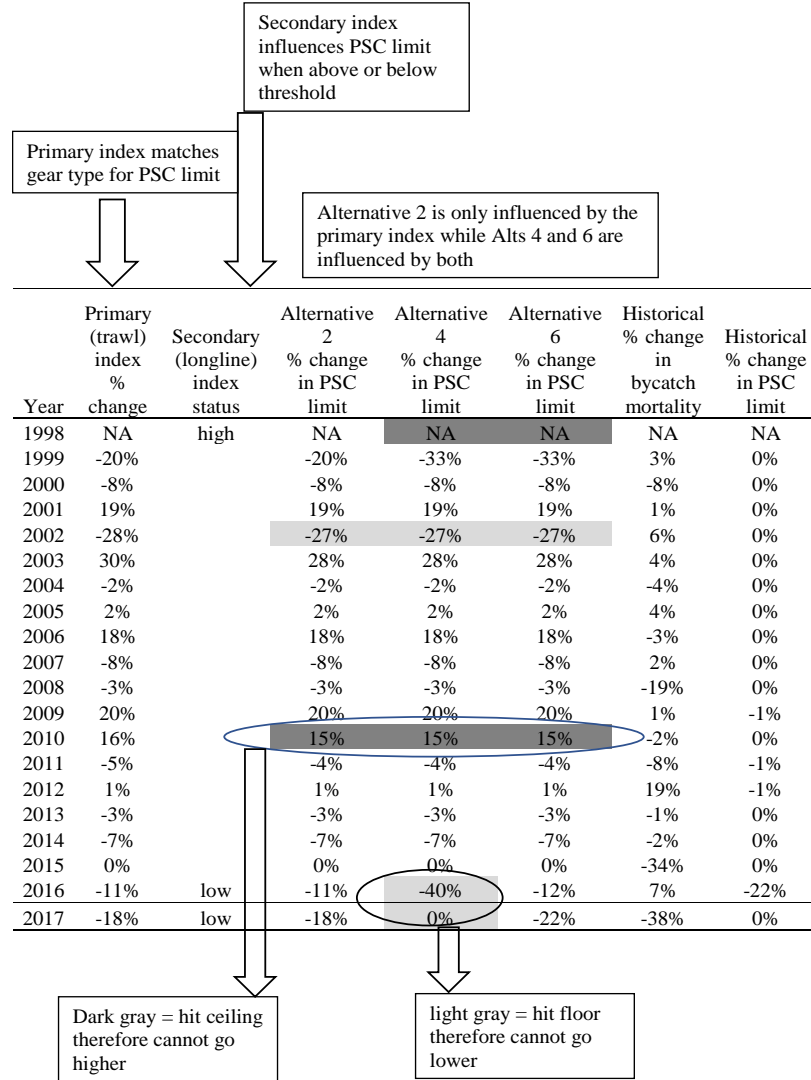
Comparing Alternatives 4 and 6

Arbitrary choices for multipliers to illustrate alternatives 4 and 6

- Breakpoints at 25% above/below
- Multiplier for alternative adjusts PSC limit by 1.1 or 0.9
- Alts 4 and 6 intersect when 50% above/below primary index



Historical Examples



Base case: trawl, comparing Alts 2, 4, and 6

Year	Primary	Secondary				Historical									
	(trawl) index % change	(longline) index status	Alternative 2 % change in PSC limit	Alternative 4 % change in PSC limit	Alternative 6 % change in PSC limit	% change in bycatch mortality	Historical % change in PSC limit	Primary	Secondary	Alternative 2	Alternative 4	Alternative 6	Historical	Historical	
								Year	(trawl) index	(longline) index	PSC limit	PSC limit	PSC limit	bycatch mortality	PSC limit
1998	NA	high	NA	NA	NA	NA	NA	1998	161,256	18,179	2,943	3,532	3,532	3,379	3,734
1999	-20%		-20%	-33%	-33%	3%	0%	1999	129,116	15,850	2,356	2,356	2,356	3,481	3,734
2000	-8%		-8%	-8%	-8%	-8%	0%	2000	118,677	15,867	2,166	2,166	2,166	3,208	3,734
2001	19%		19%	19%	19%	1%	0%	2001	141,219	13,441	2,577	2,577	2,577	3,245	3,734
2002	-28%		-27%	-27%	-27%	6%	0%	2002	101,706	11,815	1,879	1,879	1,879	3,423	3,734
2003	30%		28%	28%	28%	4%	0%	2003	132,151	10,609	2,412	2,412	2,412	3,545	3,734
2004	-2%		-2%	-2%	-2%	-4%	0%	2004	130,075	9,773	2,374	2,374	2,374	3,402	3,734
2005	2%		2%	2%	2%	4%	0%	2005	132,518	9,344	2,418	2,418	2,418	3,552	3,734
2006	18%		18%	18%	18%	-3%	0%	2006	155,964	9,643	2,846	2,846	2,846	3,457	3,734
2007	-8%		-8%	-8%	-8%	2%	0%	2007	143,903	9,525	2,626	2,626	2,626	3,526	3,734
2008	-3%		-3%	-3%	-3%	-19%	0%	2008	140,247	10,109	2,559	2,559	2,559	2,843	3,734
2009	20%		20%	20%	20%	1%	-1%	2009	168,102	9,700	3,068	3,068	3,068	2,885	3,693
2010	16%		15%	15%	15%	-2%	0%	2010	195,535	9,009	3,532	3,532	3,532	2,823	3,684
2011	-5%		-4%	-4%	-4%	-8%	-1%	2011	186,666	8,561	3,407	3,407	3,407	2,611	3,634
2012	1%		1%	1%	1%	19%	-1%	2012	189,000	8,267	3,449	3,449	3,449	3,117	3,593
2013	-3%		-3%	-3%	-3%	-1%	0%	2013	183,989	7,868	3,358	3,358	3,358	3,080	3,593
2014	-7%		-7%	-7%	-7%	-2%	0%	2014	171,427	7,872	3,128	3,128	3,128	3,029	3,593
2015	0%		0%	0%	0%	-34%	0%	2015	172,237	8,021	3,143	3,143	3,143	1,999	3,593
2016	-11%	low	-11%	-40%	-14%	7%	-22%	2016	153,704	7,665	2,805	1,879	2,697	2,132	2,805
2017	-18%	low	-18%	0%	-30%	-17%	0%	2017	126,684	6,976	2,312	1,879	1,879	1,324	2,805

Base case: trawl, comparing Alts 2, 4, and 6

Year	Primary (trawl)	Secondary (longline)	Historical			% change in bycatch mortality	Historical % change in PSC limit								
	index % change	index status	Alternative 2 % change in PSC limit	Alternative 4 % change in PSC limit	Alternative 6 % change in PSC limit			Year	Primary (trawl) index	Secondary (longline) index	Alternative 2 PSC limit	Alternative 4 PSC limit	Alternative 6 PSC limit	Historical bycatch mortality	Historical PSC limit
1998	NA	high	NA	NA	NA	NA	NA	1998	161,256	18,179	2,943	3,532	3,532	3,379	3,734
1999	-20%		-20%	-33%	-33%	3%	0%	1999	129,116	15,850	2,356	2,356	2,356	3,481	3,734
2000	-8%		-8%	-8%	-8%	-8%	0%	2000	118,677	15,867	2,166	2,166	2,166	3,208	3,734
2001	19%		19%	19%	19%	1%	0%	2001	141,219	13,441	2,577	2,577	2,577	3,245	3,734
2002	-28%		-27%	-27%	-27%	6%	0%	2002	101,706	11,815	1,879	1,879	1,879	3,423	3,734
2003	30%		28%	28%	28%	4%	0%	2003	132,151	10,609	2,412	2,412	2,412	3,545	3,734
2004	-2%		-2%	-2%	-2%	-4%	0%	2004	130,075	9,773	2,374	2,374	2,374	3,402	3,734
2005	2%		2%	2%	2%	4%	0%	2005	132,518	9,344	2,418	2,418	2,418	3,552	3,734
2006	18%		18%	18%	18%	-3%	0%	2006	155,964	9,643	2,846	2,846	2,846	3,457	3,734
2007	-8%		-8%	-8%	-8%	2%	0%	2007	143,903	9,525	2,626	2,626	2,626	3,526	3,734
2008	-3%		-3%	-3%	-3%	-19%	0%	2008	140,247	10,109	2,559	2,559	2,559	2,843	3,734
2009	20%		20%	20%	20%	1%	-1%	2009	168,102	9,700	3,068	3,068	3,068	2,885	3,693
2010	16%		15%	15%	15%	-2%	0%	2010	195,535	9,009	3,532	3,532	3,532	2,823	3,684
2011	-5%		-4%	-4%	-4%	-8%	-1%	2011	186,666	8,561	3,407	3,407	3,407	2,611	3,634
2012	1%		1%	1%	1%	19%	-1%	2012	189,000	8,267	3,449	3,449	3,449	3,117	3,593
2013	-3%		-3%	-3%	-3%	-1%	0%	2013	183,989	7,868	3,358	3,358	3,358	3,080	3,593
2014	-7%		-7%	-7%	-7%	2%	0%	2014	171,427	7,872	3,128	3,128	3,128	3,029	3,593
2015	0%		0%	0%	0%	-34%	0%	2015	172,237	8,021	3,143	3,143	3,143	1,999	3,593
2016	-11%	low	-11%	-40%	-14%	7%	-22%	2016	153,704	7,665	2,805	1,879	2,697	2,132	2,805
2017	-18%	low	-18%	0%	-30%	-17%	0%	2017	126,684	6,976	2,312	1,879	1,879	1,324	2,805

Base case: trawl, comparing Alts 2, 4, and 6

Year	Primary (trawl) index % change	Secondary (longline) index status	Alternative 2 % change in PSC limit	Alternative 4 % change in PSC limit	Alternative 6 % change in PSC limit	Historical % change in bycatch mortality	Historical % change in PSC limit
2015	0%		0%	0%	0%	-34%	0%
2016	-11%	low	-11%	-40%	-14%	7%	-22%
2017	-18%	low	-18%	0%	-30%	-17%	0%

Year	Primary (trawl) index	Secondary (longline) index	Alternative 2 PSC limit	Alternative 4 PSC limit	Alternative 6 PSC limit	Historical bycatch mortality	Historical PSC limit
2015	172,237	8,021	3,143	3,143	3,143	1,999	3,593
2016	153,704	7,665	2,805	1,879	2,697	2,132	2,805
2017	126,684	6,976	2,312	1,879	1,879	1,324	2,805

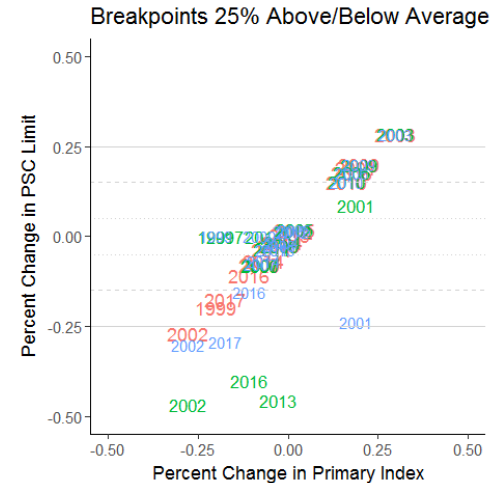
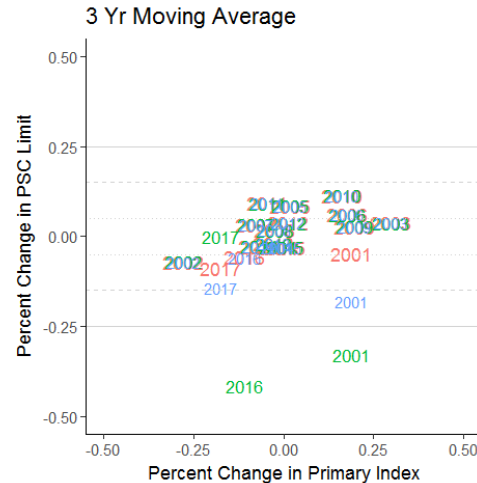
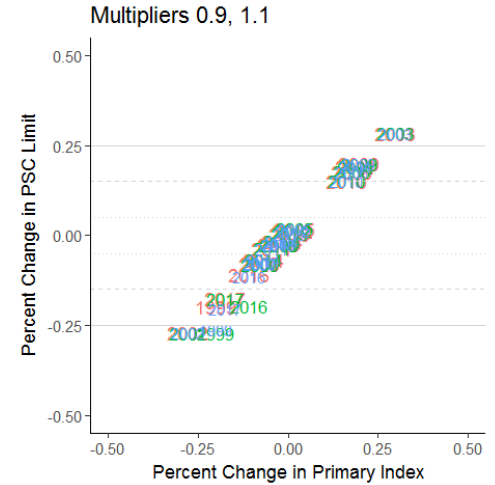
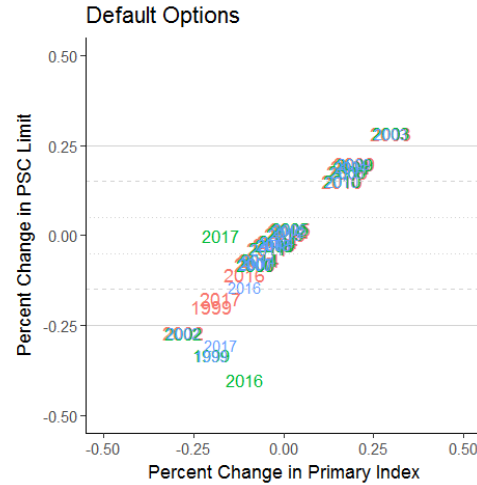
Base case: longline, comparing Alts 2, 4, and 6

Year	Primary (longline) index % change	Secondary (trawl) index status	Alternative			Historical		Primary (longline) index	Secondary (trawl) index	Alternative			Historical	
			2 % change in PSC limit	4 % change in PSC limit	6 % change in PSC limit	in bycatch mortality	% change in PSC limit			2 PSC limit	4 PSC limit	6 PSC limit	bycatch mortality	PSC limit
1998	NA		NA	NA	NA	NA	NA	18,179	161,256	894	894	894	777	833
1999	-13%		0%	0%	0%	-25%	0%	15,850	129,116	894	894	894	582	832
2000	0%		0%	0%	0%	43%	0%	15,867	118,677	894	894	894	834	833
2001	-15%		0%	0%	0%	0%	0%	13,441	141,219	894	894	894	834	833
2002	-12%	low	0%	-39%	0%	-23%	0%	11,815	101,706	894	547	894	640	833
2003	-10%		0%	63%	0%	3%	0%	10,609	132,151	894	894	894	657	833
2004	-8%		0%	0%	0%	-20%	0%	9,773	130,075	894	894	894	524	833
2005	-4%		-3%	-3%	-3%	21%	0%	9,344	132,518	866	866	866	635	833
2006	3%		3%	3%	3%	-24%	0%	9,643	155,964	893	893	893	484	833
2007	-1%		-1%	-1%	-1%	8%	0%	9,525	143,903	882	882	882	525	833
2008	6%		1%	1%	1%	27%	0%	10,109	140,247	894	894	894	668	833
2009	-4%		0%	0%	0%	0%	0%	9,700	168,102	894	894	894	667	832
2010	-7%	high	-7%	0%	0%	-11%	0%	9,009	195,535	835	894	894	595	832
2011	-5%		-5%	-11%	-11%	-6%	0%	8,561	186,666	793	793	793	561	832
2012	-3%		-3%	-3%	-3%	11%	0%	8,267	189,000	766	766	766	623	832
2013	-5%		-5%	-5%	-5%	-15%	0%	7,868	183,989	729	729	729	527	832
2014	0%		0%	0%	0%	-16%	0%	7,872	171,427	729	729	729	442	832
2015	2%		2%	2%	2%	-28%	0%	8,021	172,237	743	743	743	318	832
2016	-4%		-4%	-4%	-4%	-30%	-15%	7,665	153,704	710	710	710	222	710
2017	-9%		-9%	-9%	-9%	-14%	0%	6,976	126,684	646	646	646	191	710

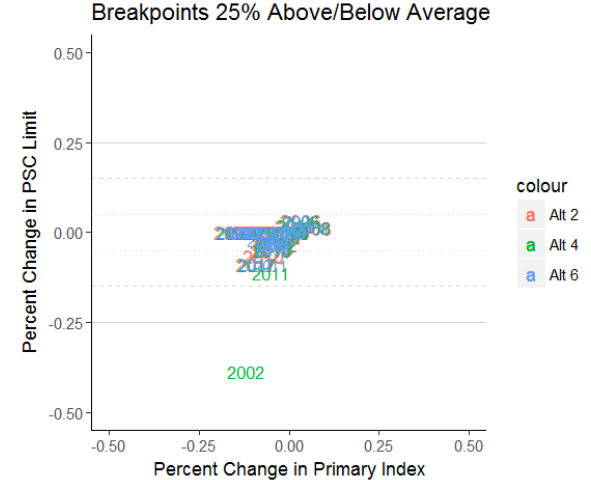
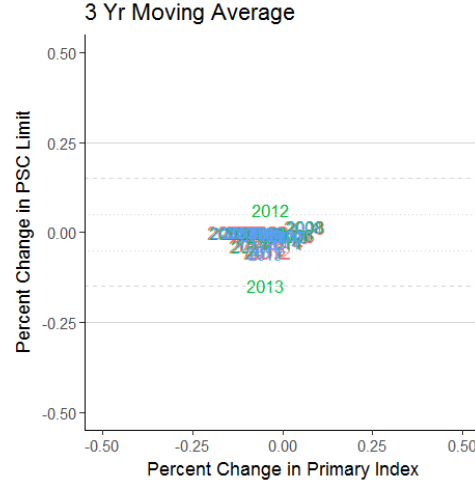
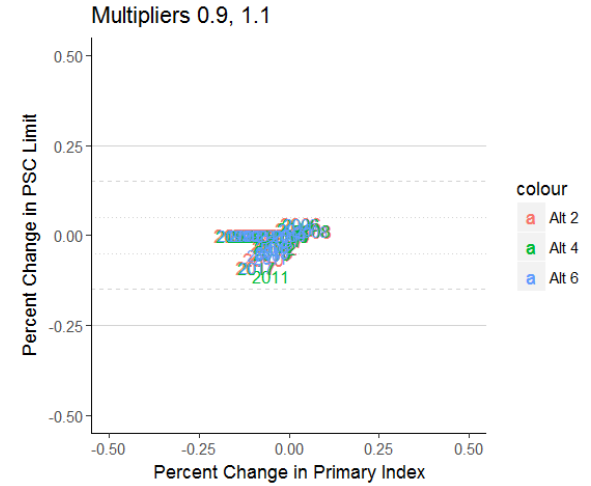
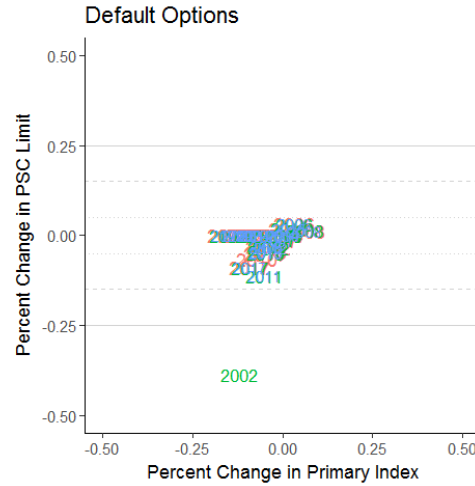
Exploring additional scenarios:

- A 3-year moving average used for the indices
- Multipliers when secondary index is in a high or low state are 0.9 and 1.1 (instead of 0.5 and 1.5)
- Breakpoints defining when the secondary index is in a low or high state are 25% above or below the average value for the index (instead of the 2nd highest and lowest values of the index)

Percent change from the previous year in the trawl index vs percent change from the previous year in PSC limit for trawl sector



Percent change from the previous year in the longline index vs percent change from the previous year in PSC limit for longline sector



Year of reference (standardized)

Table 2-4 The trawl index, the PSC limits for trawl gear corresponding to Alternatives 2, 4, and 6, and historical trawl bycatch mortality and PSC limits.

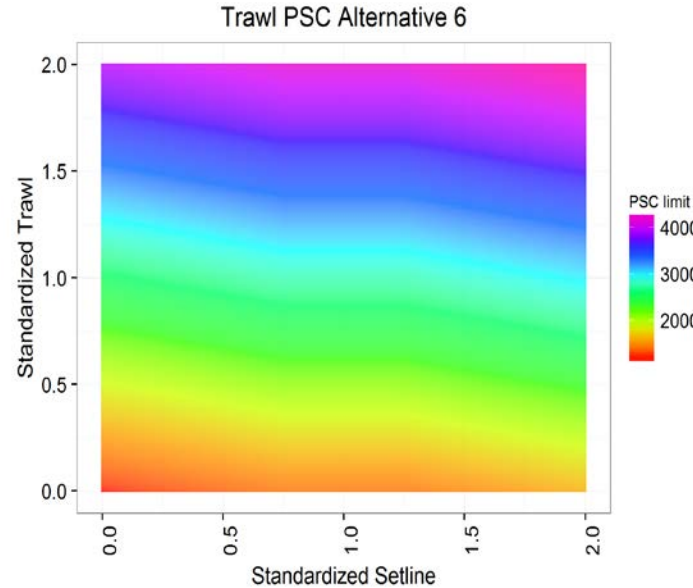
Year	Primary (trawl) index	Secondary (longline) index	Alternative 2 PSC limit	Alternative 4 PSC limit	Alternative 6 PSC limit	Historical bycatch mortality	Historical PSC limit
1998	161,256	18,179	2,943	3,532	3,532	3,379	3,734
1999	129,116	15,850	2,356	2,356	2,356	3,481	3,734
2014	171,427	7,872	3,128	3,128	3,128	3,029	3,593
2015	172,237	8,021	3,143	3,143	3,143	1,999	3,593
2016	153,704	7,665	2,805	1,879	2,697	2,132	2,805

Starting point



Point of interest (for standardization)

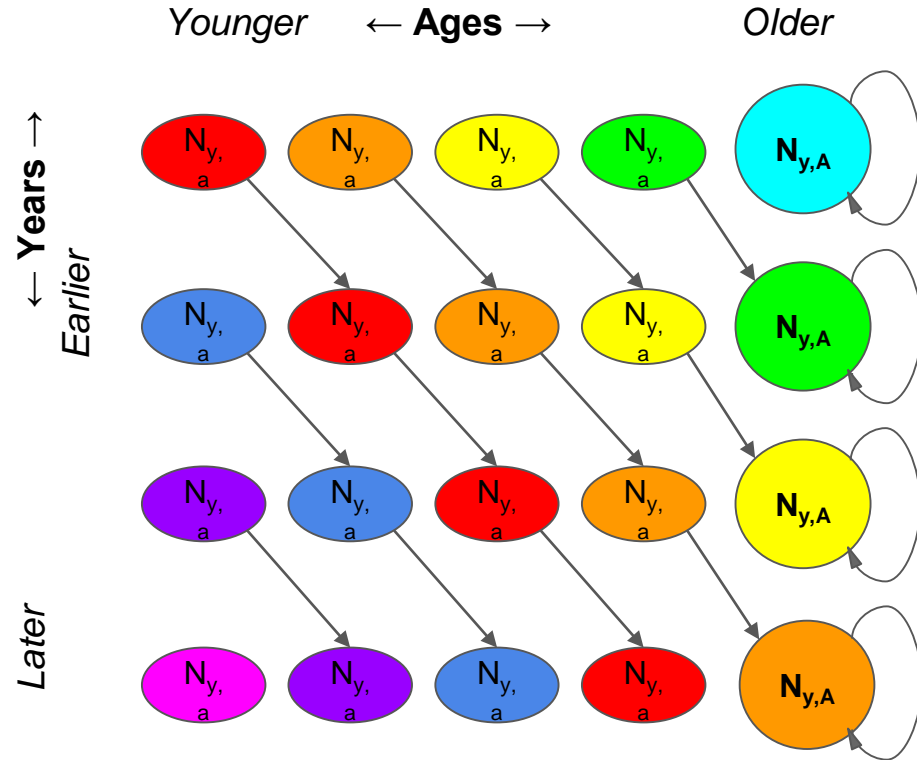
- The primary index is standardized so that the starting point is realized in 2016
 - Without influence from the secondary index, floors or ceilings
- The secondary index determines breakpoints
 - e.g., 25% below/above average
 - The same years will be above/below those breakpoints regardless of how it is standardized



Simulation Model for Halibut ABM

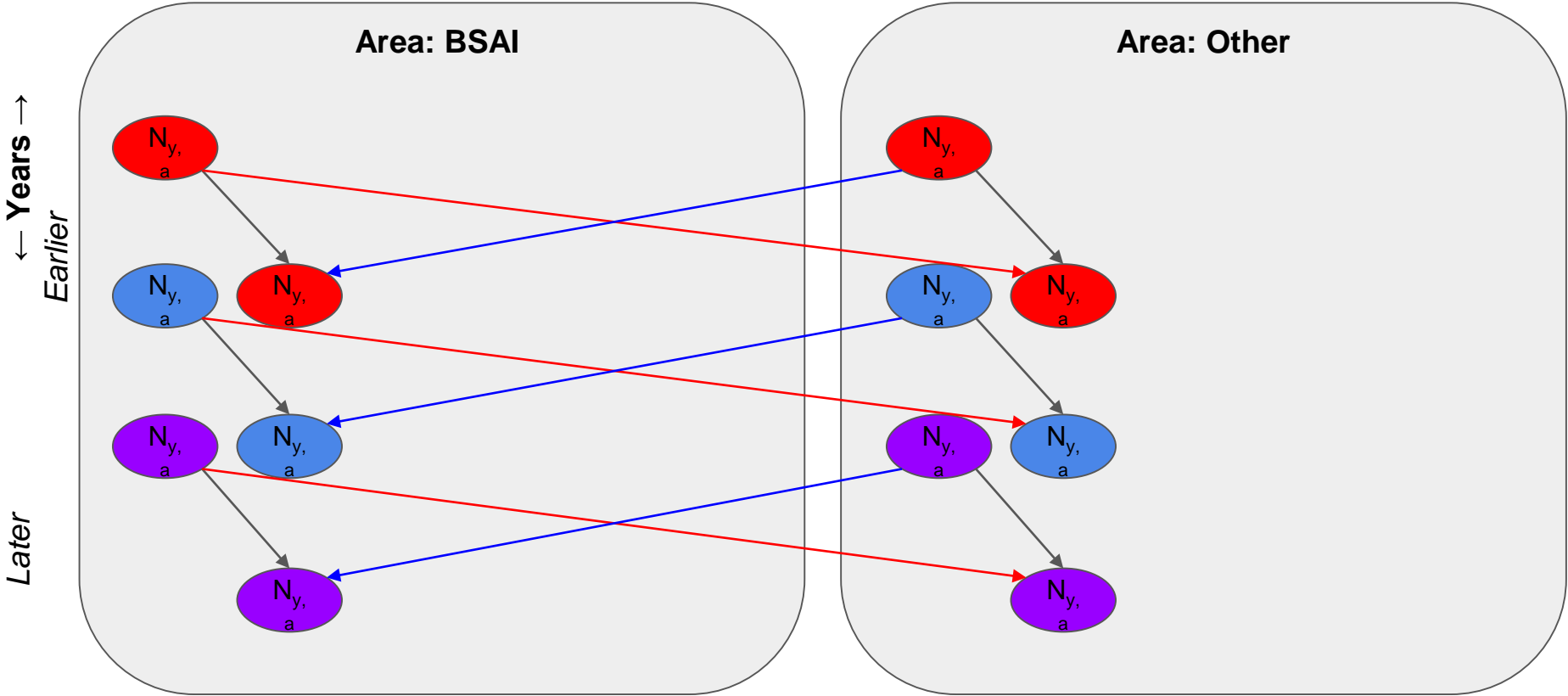
Operating Model (OM) Overview

- Sex and age-structured
- 2 Areas
 - BSAI region (4ABCDE)
 - Remaining regions in aggregate
- Common recruitment
 - Distributed among areas
- 3 Gear types (Selectivity and F_t)
 - Directed Fishery, PSC Trawl, PSC Longline
 - Gear-specific Selectivity
- Age-specific movement between areas



Movement Among Areas

Survival
Movement **Out** of BSAI
Movement **Into** BSAI



Sources of Simulation Model *Variation*

- Current
 - Variation in recruitment
- Potential
 - Temporal variation in weight at age
 - Temporal variation in mean recruitment (periodic, PDO-like)

Simulation model uncertainties

- Recruitment distribution between two areas
- Migration rates between two areas
- Changes in weight-at-age
- Recruitment regime (e.g. high or low recruitment)

Future Work Plan for OM

- Identify (realistic and stable) values for parameters describing
 - Recruitment distribution
 - Movement among areas
- Define selectivity and fishing processes for all gears (within areas)
- Quantify TCEY -> FCEY pathway and harvest allocation procedure
- Add estimation (model) uncertainty to the management process
- Add weight-at-age scenarios
- Add recruitment regime scenarios or periodic regime shifts

Recommendations

Alternative/Element /Option	Recommendation	Rationale
Alternative 3	Remove	Redundant with Alternative 4
Alternative 6 (NEW)	Add	Similar framework as Alt 4 but with less abrupt transitions.
Element 1 (Alternatives 2- 6)	Move to an option that applies to all alternatives	Not a required for formulating the control rule and is applied after the PSC limit is calculated.
Alternative 5	Need dimensions of look up table. Need clarification on general intent of alternative	Consider removing Alternative 5 or clarify details noted in Section 2.4.5.
Alternative 5 Element 1	Clarify overlap with Elements 1 and 4.	Overlapping elements of 1 and 4 would provide for 15 different alternatives just between these two provisions

Recommendations (continued)

Alternative/Element /Option	Recommendation	Rationale
All alternatives/elements/options	Need guidance of subset for analysis as currently unwieldy number of combinations of options.	Alternative 1, 2, 4, 5, and 6, along with the elements and options for each, results in more than 2000 combinations
Alternatives 2,4,5,6	Need direction on relative proportion of trawl and non-trawl CDQ allocation	Previous PSC limits were set to CDQ allocation as a sector and not by gear type. Usage by gear could inform this (Section 2.1)
Alternative 4	Remove Option 2 Element 5 which modifies PSC limit above and below average value of index	Received criticism from SSC (April 2018) and Council discussions on potential for volatile changes to PSC limits from previous year due to an index always at a high or low value and never at average [note this may still be desirable for alternative 6]

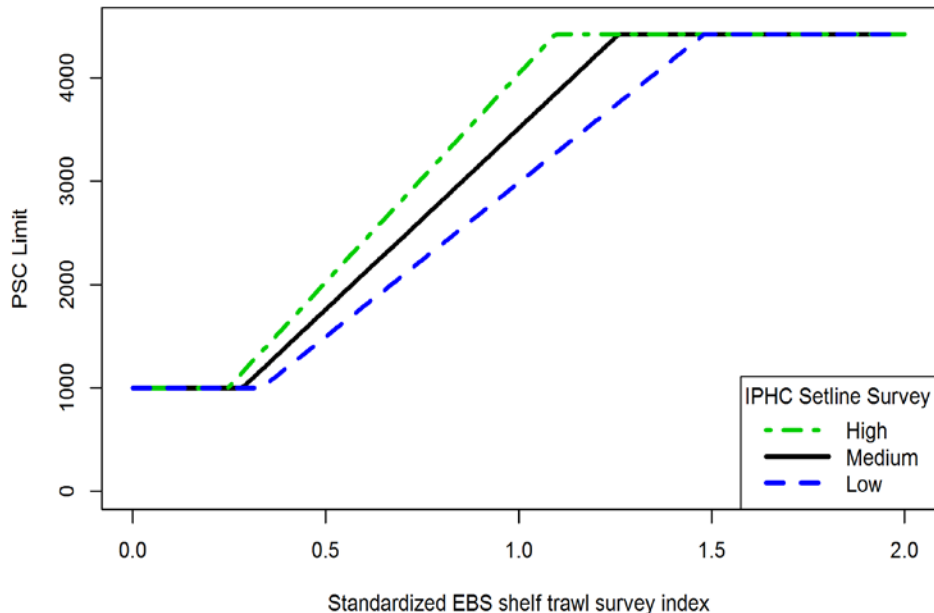
End

Recommendations

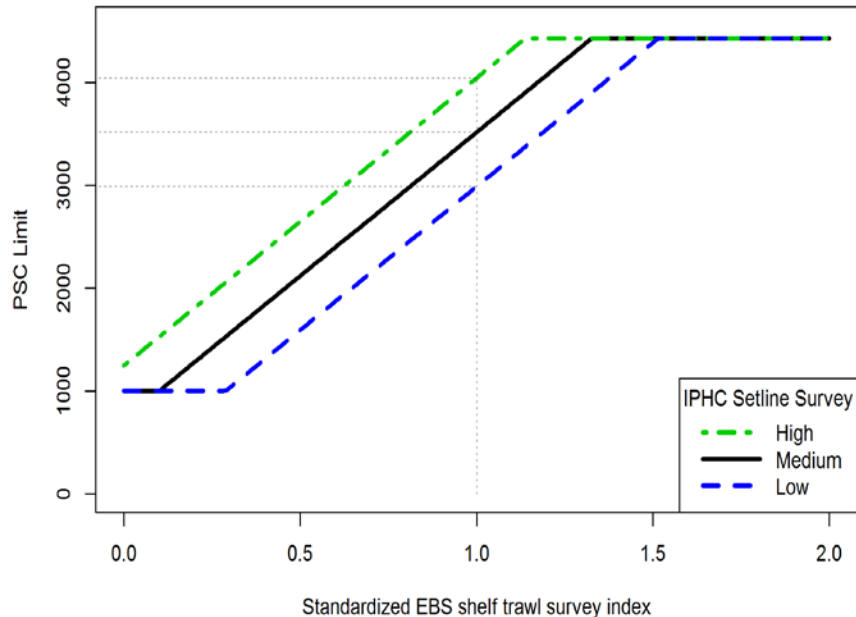
Alternative/Element/Option	Recommendation	Rationale
Alternative 3	Remove	As discussed in Section 2.3, this is redundant with Alternative 4 and the formulation of Alternative 4 is the recommended approach
Alternative 6 (NEW)	Add	Rationale provided in Section 2.5 and Appendix II. Provides similar framework as Alt 4 but with less abrupt transitions.
Element 1 (Alternatives 2- 6)	Move to an option that applies to all alternatives	This element is not a required element for formulating the control rule and is applied after the PSC limit is calculated. It would be cleaner to have this outside of the specific elements and options for the Alternatives and have it as an option that can be applied to any alternative for inter-annual stability as desired
Alternative 5	Need dimensions of look up table. Need clarification on general intent of alternative	No details were provided on dimensionality of look up table. Consider removing Alternative 5 or clarify details noted in Section 2.4.5.
Alternative 5 Element 1	Clarify overlap with Elements 1 and 4.	Overlapping elements of 1 and 4 would provide for 15 different alternatives just between these two provisions (3 floors and 5 different mechanisms for moving to the floor outside of the actual look up table)
All alternatives/elements/options	Need guidance of subset for analysis as currently unwieldy number of combinations of options. Workgroup will provide a strawman approach at the October Council meeting	Alternative 1, 2, 4, 5, and 6, along with the elements and options for each, results in a total of 2,881 different combinations. Just for the 4 elements of alternative 2, there are 144 combinations of options.
Alternatives 2,4,5,6	Need direction on relative proportion of trawl and non-trawl CDQ allocation	Previous PSC limits were set to CDQ allocation as a sector and not by gear type. Under all alternatives, except Alternative 1, the PSC limit is calculated by gear type (first) then allocated to sector. Usage by gear could inform this (Section 2.1)
Alternatives 4 and 6	Remove Option 2 Element 5 which modifies PSC limit above and below average value of index	Received criticism from SSC (April 2018) and Council discussions on potential for volatile changes to PSC limits from previous year due to an index always at a high or low value and never at average

Alternative 3 and Alternative 4

Multiplier influences the starting point and slope (final PSC limit)



Multiplier influences the starting point only



Alternatives 3 and 4 are the same under our conditions

- 1:1 % change in index: % change in PSC limit (a slope of 1)
- The primary index is standardized to its 2016 value and the starting point is the 2016 PSC limit.

Therefore, Alternative 2 is a linear control rule passing through the point

$$\left(I_y, \frac{PSC_{y+1}}{X} \right) = (1, 1)$$

The diagram illustrates the point $(1, 1)$ in a coordinate system. Three teal arrows point to the components of the point: one from the label "Index in year y" to the first coordinate I_y , one from "PSC in year y+1" to the fraction $\frac{PSC_{y+1}}{X}$, and one from "Starting point" to the second coordinate 1 .

Note that the y-axis scale here is relative to the starting point

Alternatives 3 and 4 are the same under our conditions

So we have: $(I_y, \frac{PSC_{y+1}}{X}) = (1, 1)$

Alternatives 3 and 4 are the same under our conditions

So we have: $(I_y, \frac{PSC_{y+1}}{X}) = (1, 1)$

- Stating Alternative 2 using point-slope form for a line $(y - y_1) = a(x - x_1)$:

$$\frac{PSC_{y+1}}{X} - 1 = a(I_y - 1)$$

Alternatives 3 and 4 are the same under our conditions

So we have: $(I_y, \frac{PSC_{y+1}}{X}) = (1, 1)$

- Stating Alternative 2 using point-slope form for a line $(y - y_1) = a(x - x_1)$:

$$\frac{PSC_{y+1}}{X} - 1 = a(I_y - 1)$$

- Rearranging into slope-intercept form $(y = ax + b)$:

$$\frac{PSC_{y+1}}{X} = aI_y + (1 - a)$$

Alternatives 3 and 4 are the same under our conditions

So we have: $(I_y, \frac{PSC_{y+1}}{X}) = (1, 1)$

- Stating Alternative 2 using point-slope form for a line $(y - y_1) = a(x - x_1)$:

$$\frac{PSC_{y+1}}{X} - 1 = a(I_y - 1)$$

- Rearranging into slope-intercept form $(y = ax + b)$:

$$\frac{PSC_{y+1}}{X} = aI_y + (1 - a)$$

$a = 1$, and $b = 1 - a = 0$ and so Alternative 2 is:

$$\frac{PSC_{y+1}}{X} = I_y$$

Alternatives 3 and 4 are the same under our conditions

Alternative 2 is:

$$\frac{PSC_{y+1}}{X} = I_y$$

Alternatives 3 and 4 are the same under our conditions

Alternative 2 is:

$$\frac{PSC_{y+1}}{X} = I_y$$

Alternative 3 is like Alt 2, but applies a multiplier to the starting point:

$$PSC_{y+1} = I_y(mX)$$

Alternatives 3 and 4 are the same under our conditions

Alternative 2 is:

$$\frac{PSC_{y+1}}{X} = I_y$$

Alternative 3 is like Alt 2, but applies a multiplier to the starting point:

$$PSC_{y+1} = I_y(mX)$$

Alternative 4 is like Alt 2, but applies a multiplier to the PSC:

$$PSC_{y+1} = m(I_y X)$$

And Alternative 3 = Alternative 4.