Abundance based management alternatives for BSAI Pacific halibut PSC

C-7

Timeline / Council actions (in current discussion paper)

April 2016

- purpose and need statement
- explore weightings on IPHC stock assessment and EBS trawl survey
- public review workshop of paper prior to Council meeting in October

October 2016

- workshop on discussion paper (September 2016)
- 5 Objectives confirmed for action
- consider broader range of indices and BCRs (SSC 2d and 3d)
- develop draft performance metrics w/ public input

February 2017

- Public workshop to solicit input on draft Overarching goals, measurable objectives and associated performance metrics for analysis

April 2017

- Alternative development
  "Strawman" alternatives for illustration to aid selection of indices and control rules

Future meeting (2017 anticipated)

- Refinement of alternatives for analysis

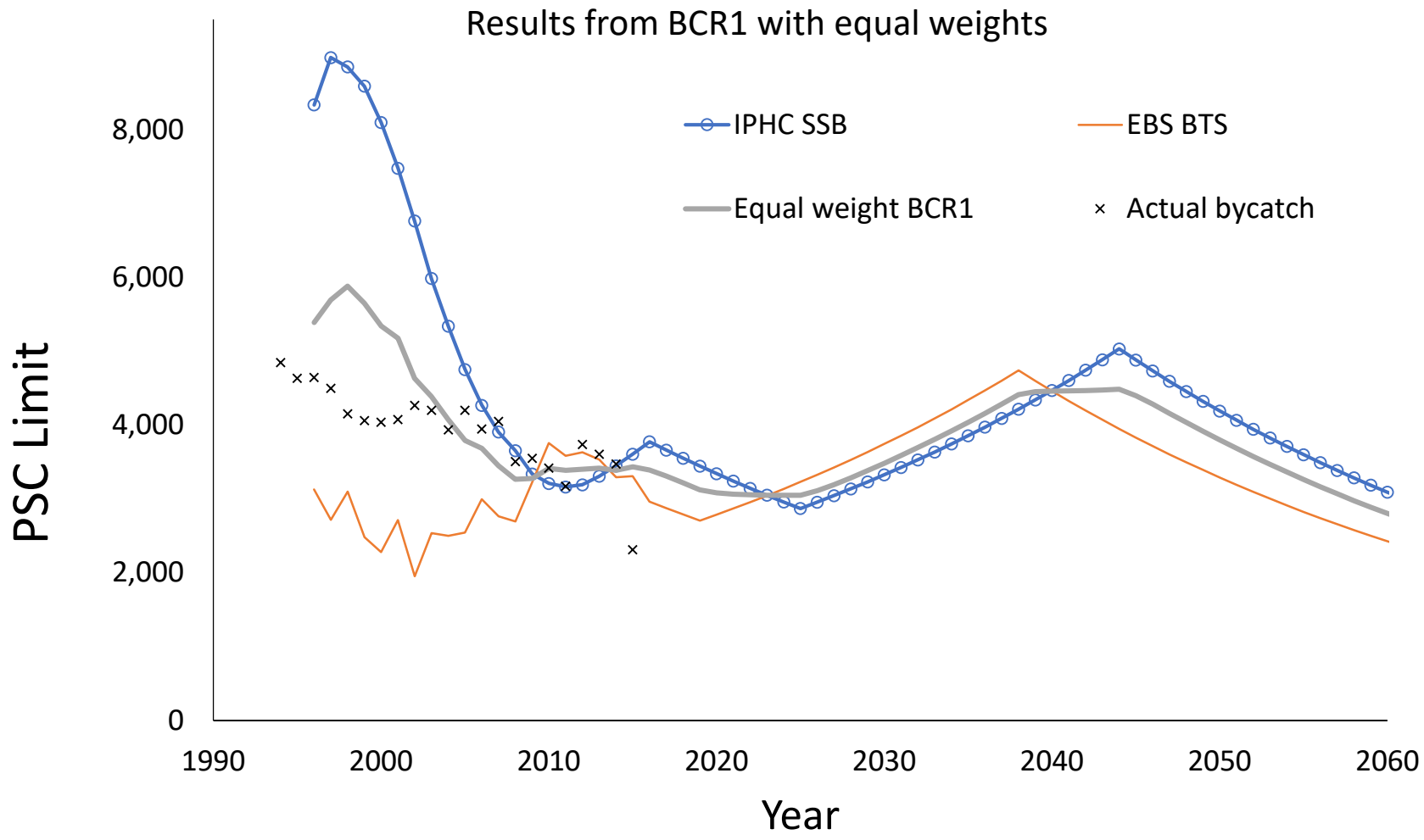
Recap from previous discussion papers and outcomes

April 2016 (last year):

- Potential indices to use
- PSC set to weighted combinations

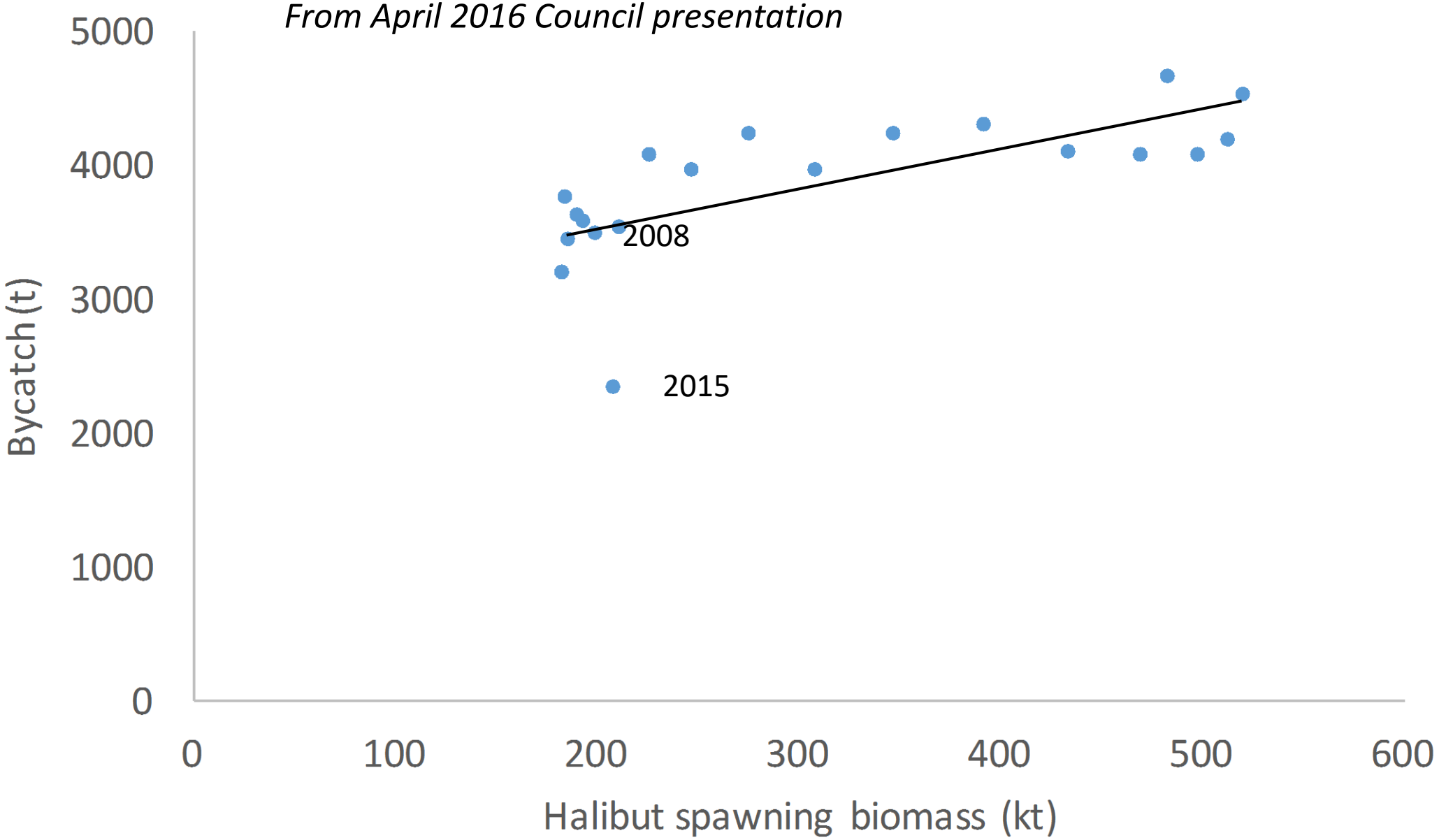
1. previous year PSC,
2. EBS trawl survey and
3. IPHC SSB trends

(BCR1, BCR2 etc in appendix)

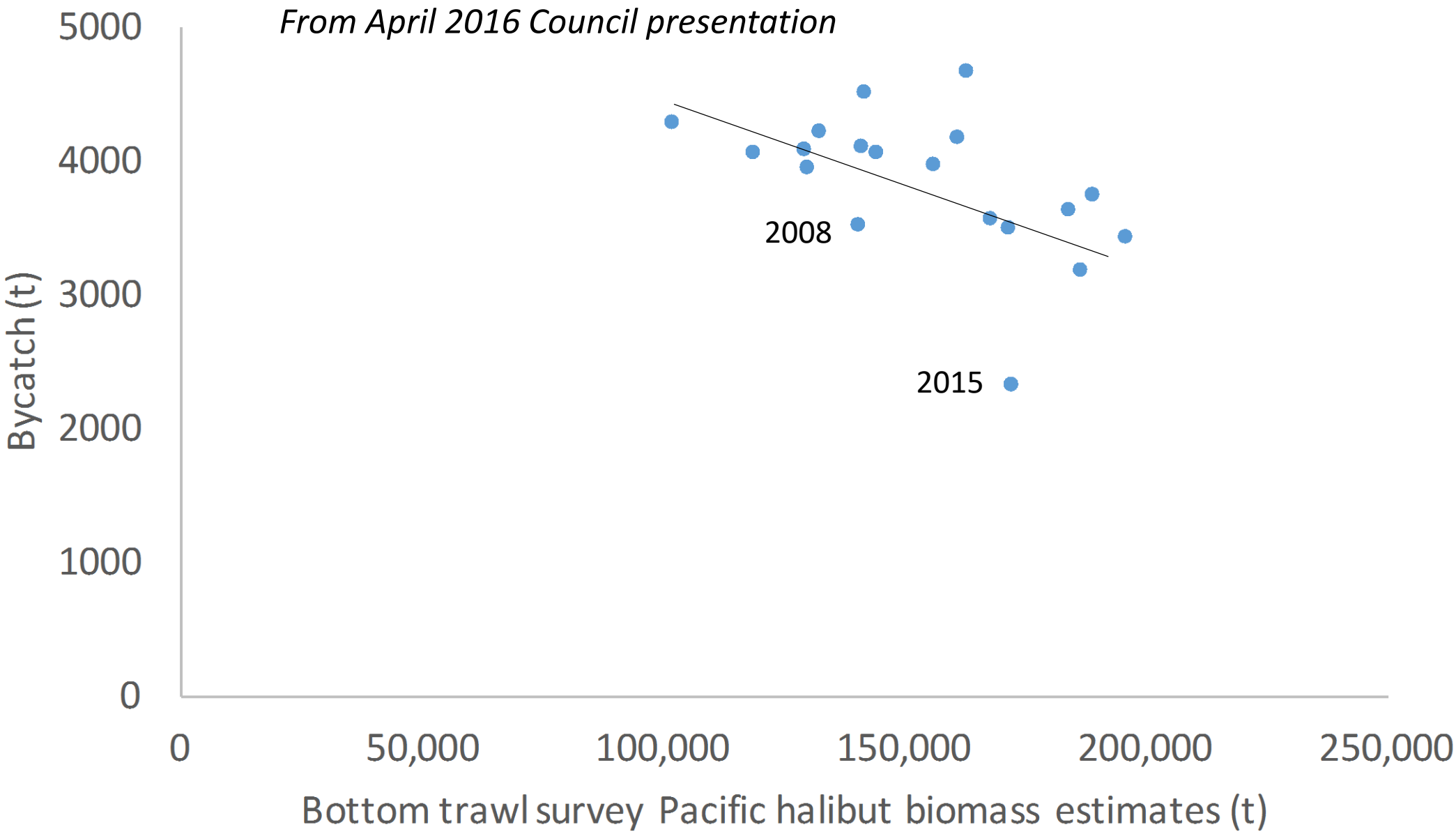


IPHC spawning biomass compared to bycatch

From April 2016 Council presentation



EBS Trawl survey biomass compared to bycatch



EBS Trawl survey biomass compared to bycatch

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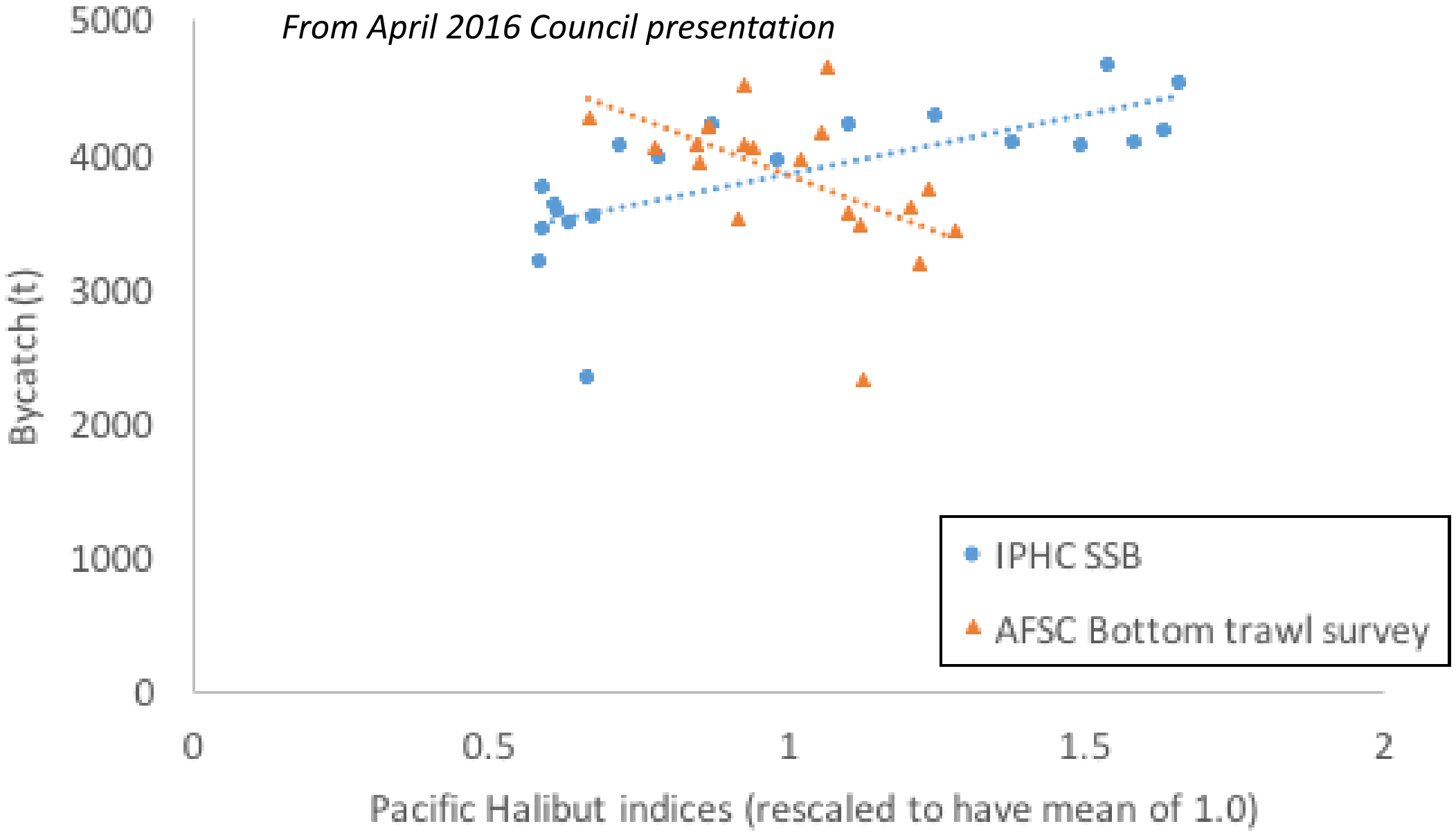
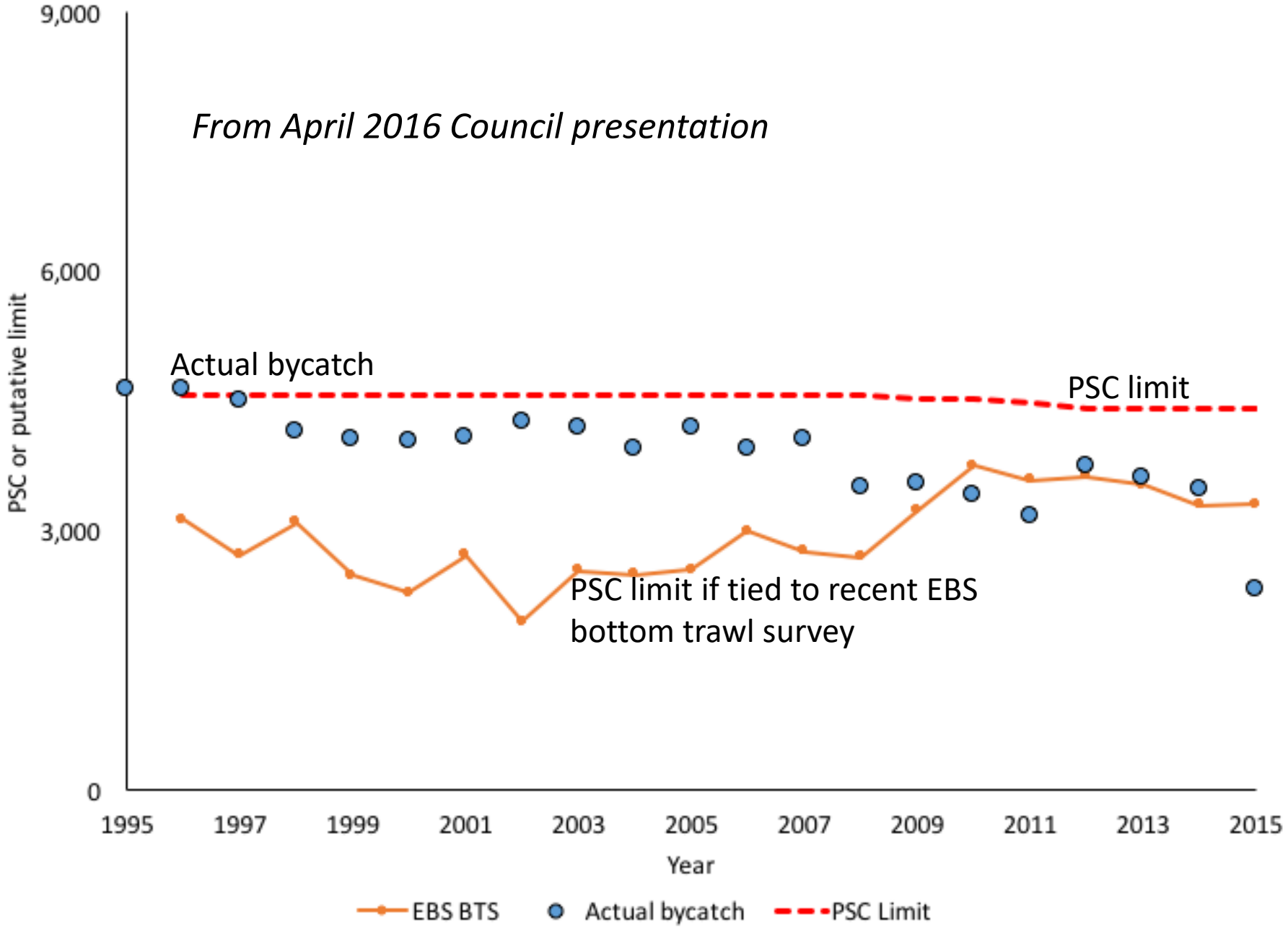
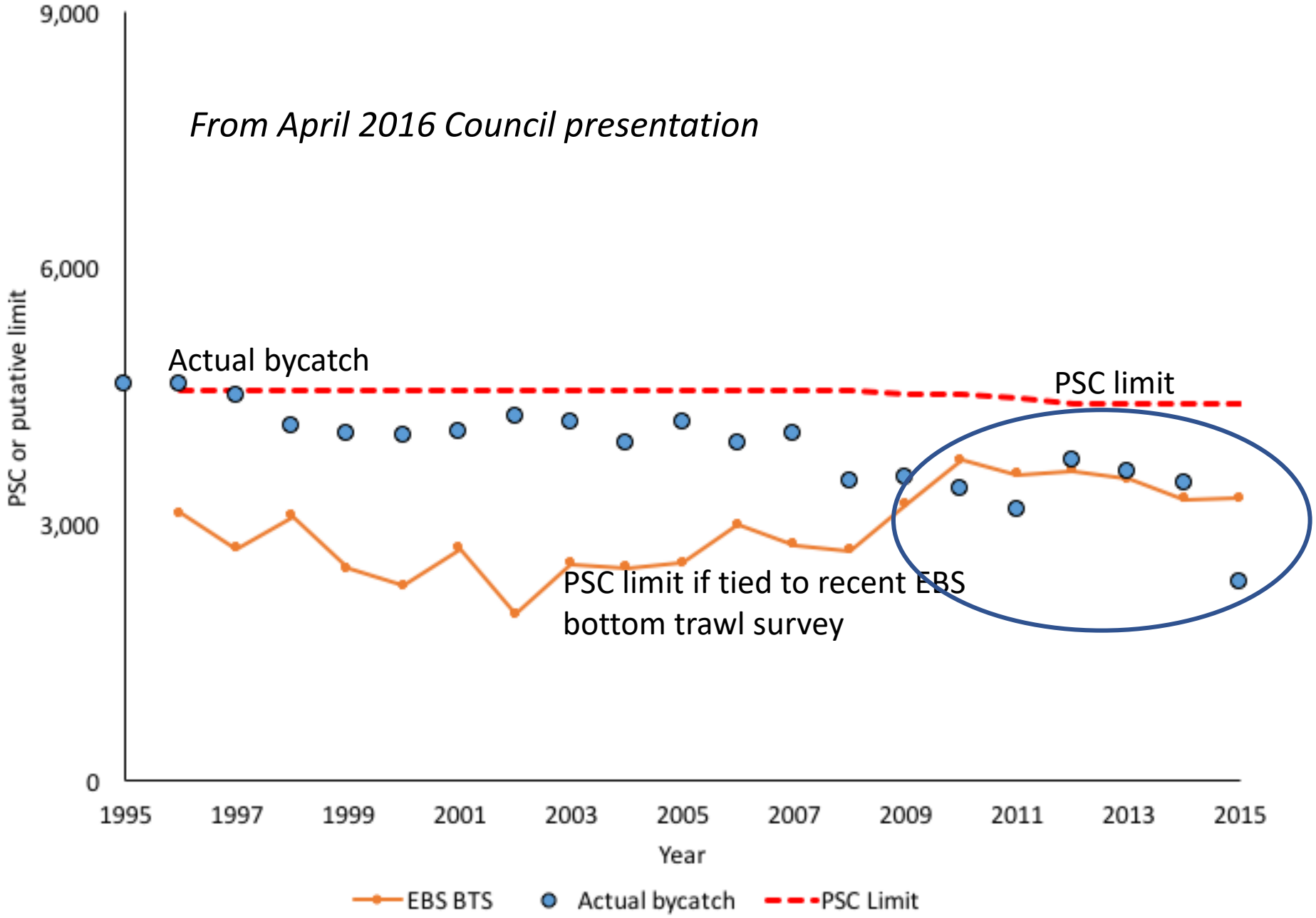



From April 2016 Council presentation
9,000
6,000
3,000
0
PSC or putative limit
Actual bycatch
PSC limit
PSC limit if tied to recent EBS bottom trawl survey
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
Year
EBS BTS
Actual bycatch
PSC Limit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PSC or putative limit
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PSC limit
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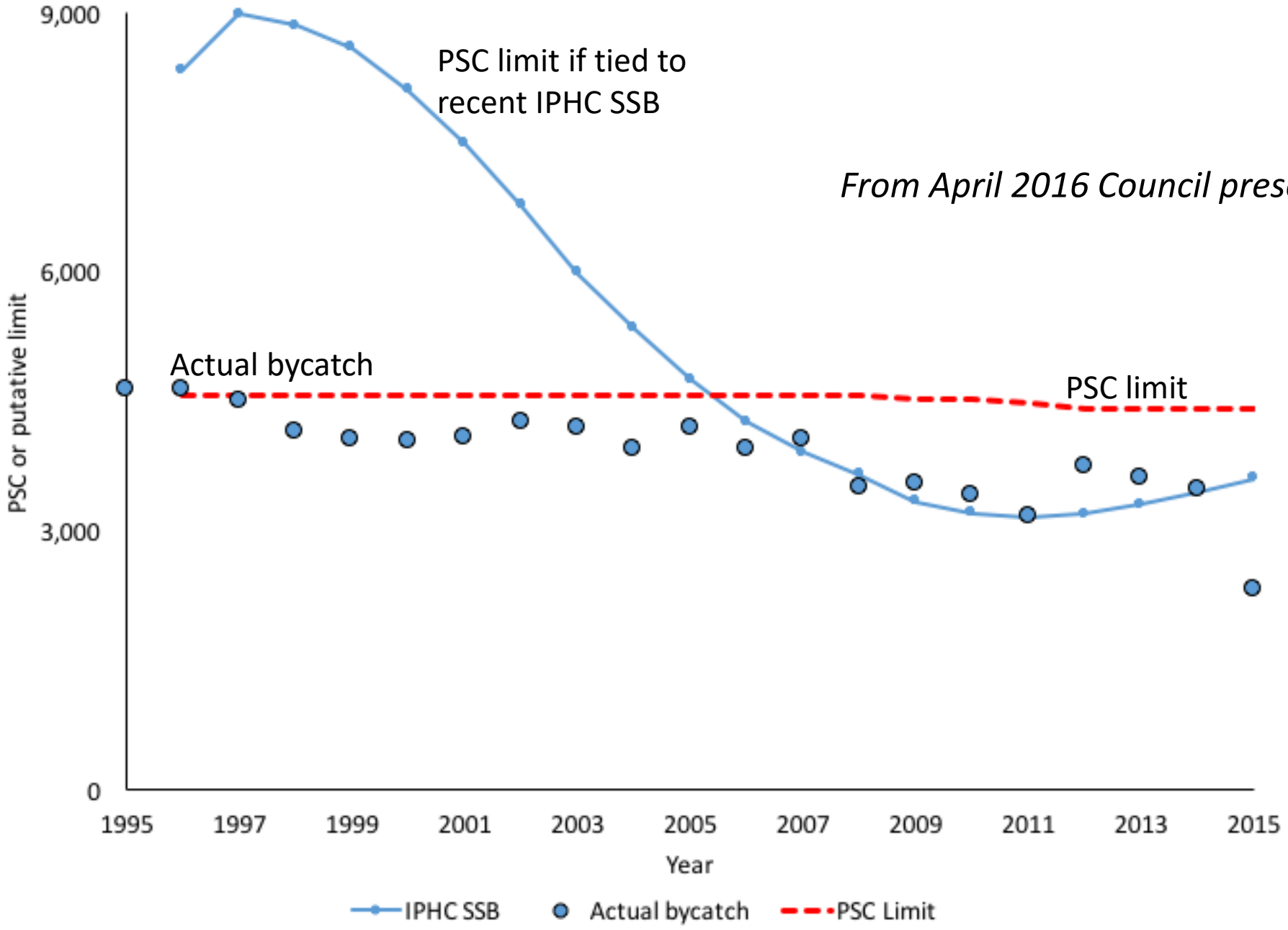
2007
2009
2011
2013
2015
Year
EBS BTS
Actual bycatch
PSC Limit

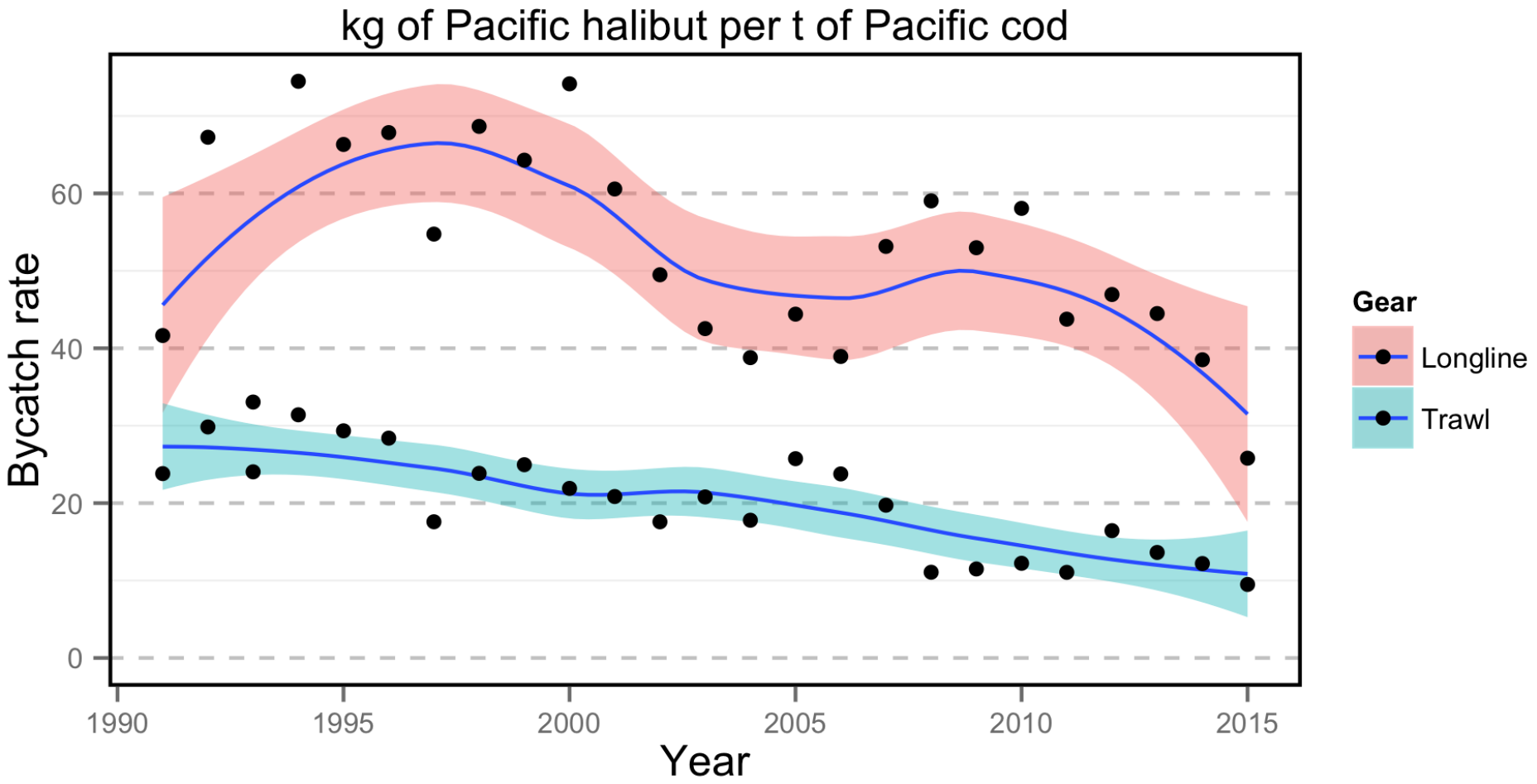


From April 2016 Council presentation

Previous presentations on fishery characteristics

From April 2016 discussion paper appendices

- Examined observer data
- Demonstrated sizes similar in survey and trawl fishery



April 2016 Council Motion

- Focus analysis on the use of the NMFS eastern Bering Sea shelf trawl survey and the biomass estimate from the IPHC stock assessment as potentially appropriate indices and explore a variety of assumptions on the appropriate weighting of indices, including using each index as a bookend.
- If time available, focus on potential advantages and challenges of incorporating additional surveys (e.g., the Bering Sea shelf, Aleutian Islands, NMFS Sablefish longline survey, and **Gulf of Alaska trawl surveys** to develop an Alaska-wide index of abundance), and the Integrated Model-based index approach outlined in Section 3.4 of the paper.
- Draft purpose and need

October 2016

- Candidate indices characterized
  - E.g., guiding principles
- Integrated index developed
- Control rule development
  - Features of CRs (floors, ceilings, slope, starting point)

Considerations

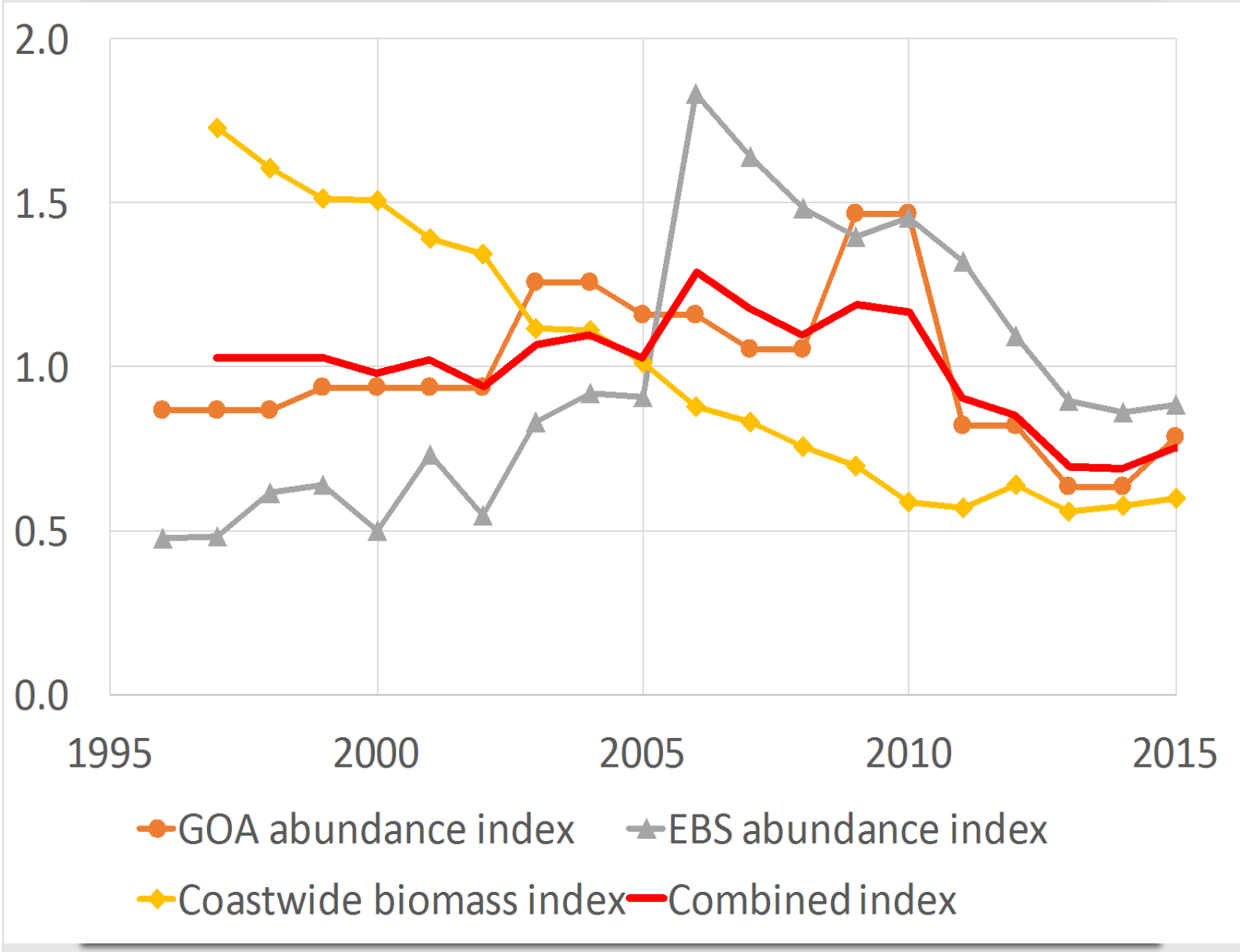
Indices

Abundance index	Addresses older and younger population components	Consideration of CW geographic range	Consideration of CW stock status	Addresses recruitment differences in BSAI and GOA	Timeliness of information	Accessibility
Individual survey indices						
IPHC Coastwide setline survey	No	Yes	Yes	No	Yes	Yes
EBS shelf trawl survey	No	No	No	No	Yes	Yes
Integrated approaches across multiple indices						
IPHC assessment	No	Yes	Yes	No	Yes	Yes
Geostatistical model	No	Partial (AK)	No	Yes	Yes	No
EBS shelf trawl survey with IPHC assessment	Yes	Yes	Yes	No	Yes	Yes
ABM 3 survey combined index (EBS shelf trawl, GOA trawl, IPHC setline)	Yes	Yes	Yes	Yes	Yes	Yes

October 2016

Features

- Addressed older and younger population components
- Considered the coastwide geographic range
- Considered the coastwide stock status
- Addressed recruitment differences in the BSAI and GOA
- Information to derive the index was available in a timely manner for Council harvest specifications
- Information to derive the index easily accessible



October 2016 Council Motion

- Develop performance metrics and quantitative tools to evaluate the tradeoffs between the competing objectives for this action
- Develop abundance indices and associated control rules
- Develop a broader suite of halibut abundance indices and control rules as outlined by the SSC.
  - Specifically, evaluate different indices that can be used to meet the Council's objectives, which could then be combined in a control rule or decision making framework.
- Evaluate developing control rules that could be combined in a 2-or 3-dimensional framework for setting PSC as outlined by the SSC
- Evaluate developing separate control rules for the hook and line and trawl fisheries that could be used to establish PSC limits

Council objectives from the Purpose and Need
Overarching goals

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

Current discussion paper

ABM = Abundance based management

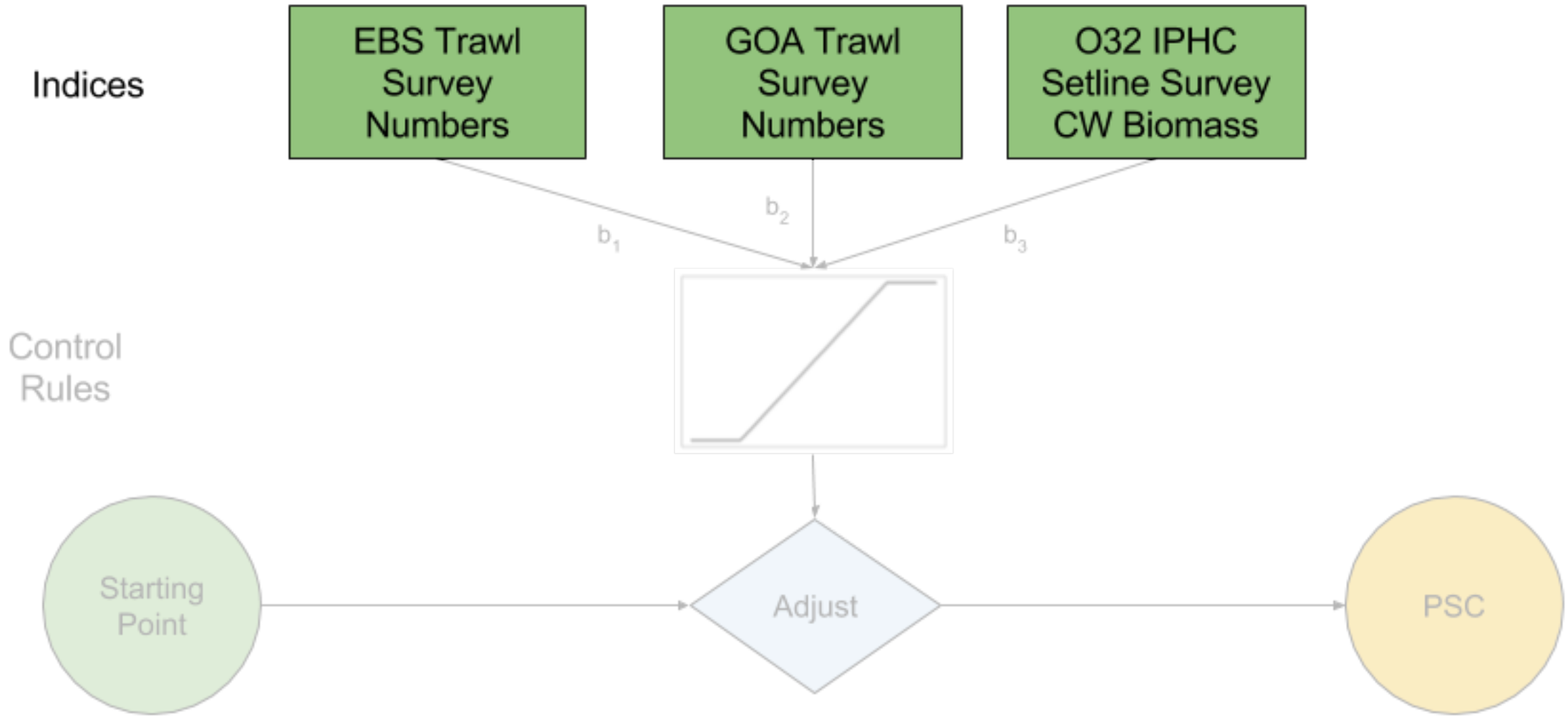
[for Pacific halibut PSC limits]

Document roadmap

Description of section as it relates to the development of ABM examples	Is this a general or detailed (computational) item?
Purpose and Need statement and 5 Objectives (also noted as 'overarching goals')	General used to guide formulations of ABM examples
Background on previous Council discussion papers and ABM considerations	General to provide context to multi-index/multi-control rule ABM examples
Principles used to develop and evaluate ABM examples	General (for list) General (as applied to individual ABM examples)
Framework for development of ABM examples	General: includes list of indices, description of what is a control rule
Strawman alternatives **ABM1, ABM2, ABM3, ABM4**	General description of indices within each ABM example
ABM examples	Detailed description of indices used and computational equations for the control rules applied
Comparison across the ABM1-ABM4 examples	Detailed based on Sections 3.1-3.4 computations

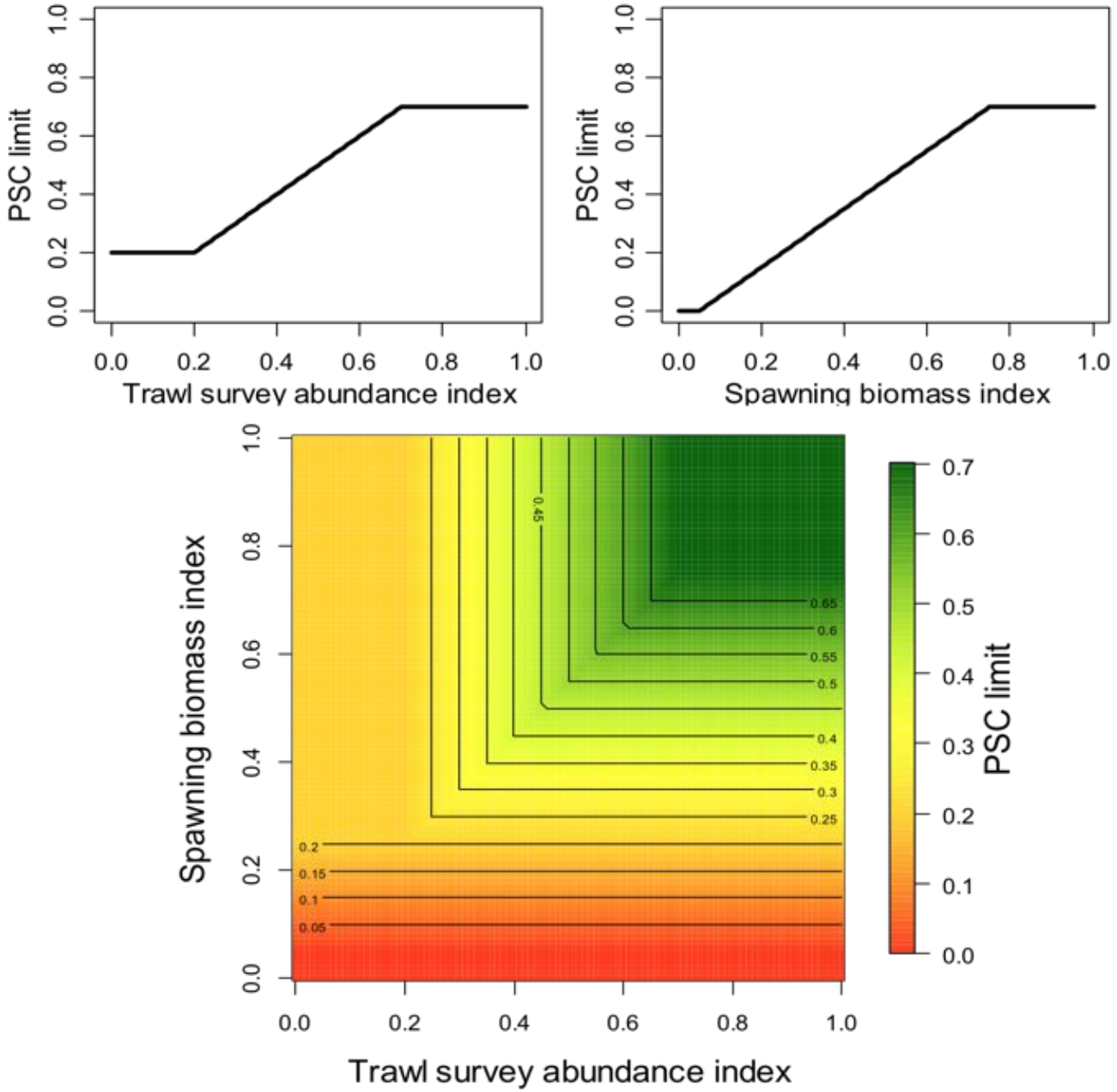
Indices and ABM index provided in October 2016

Schematic

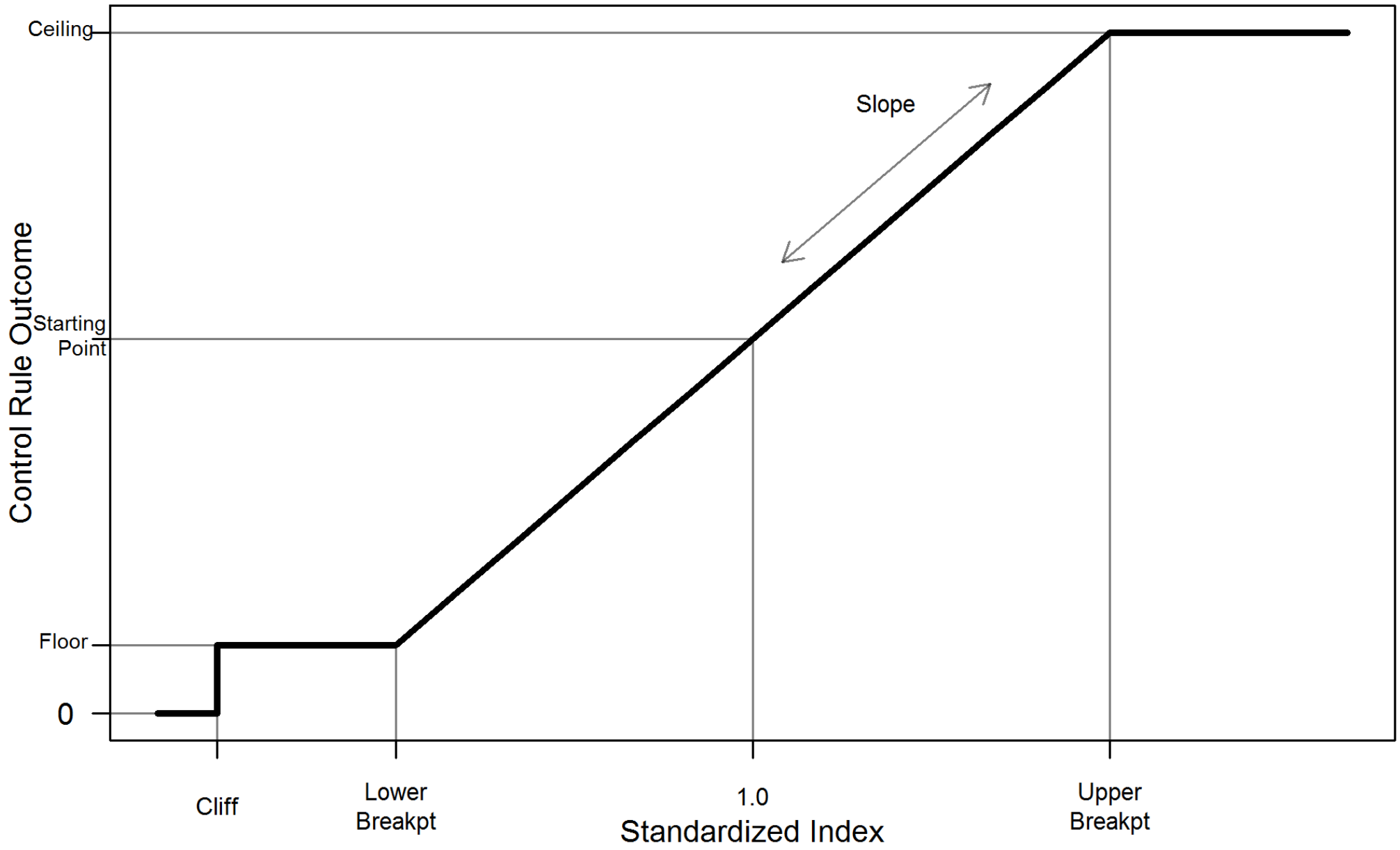


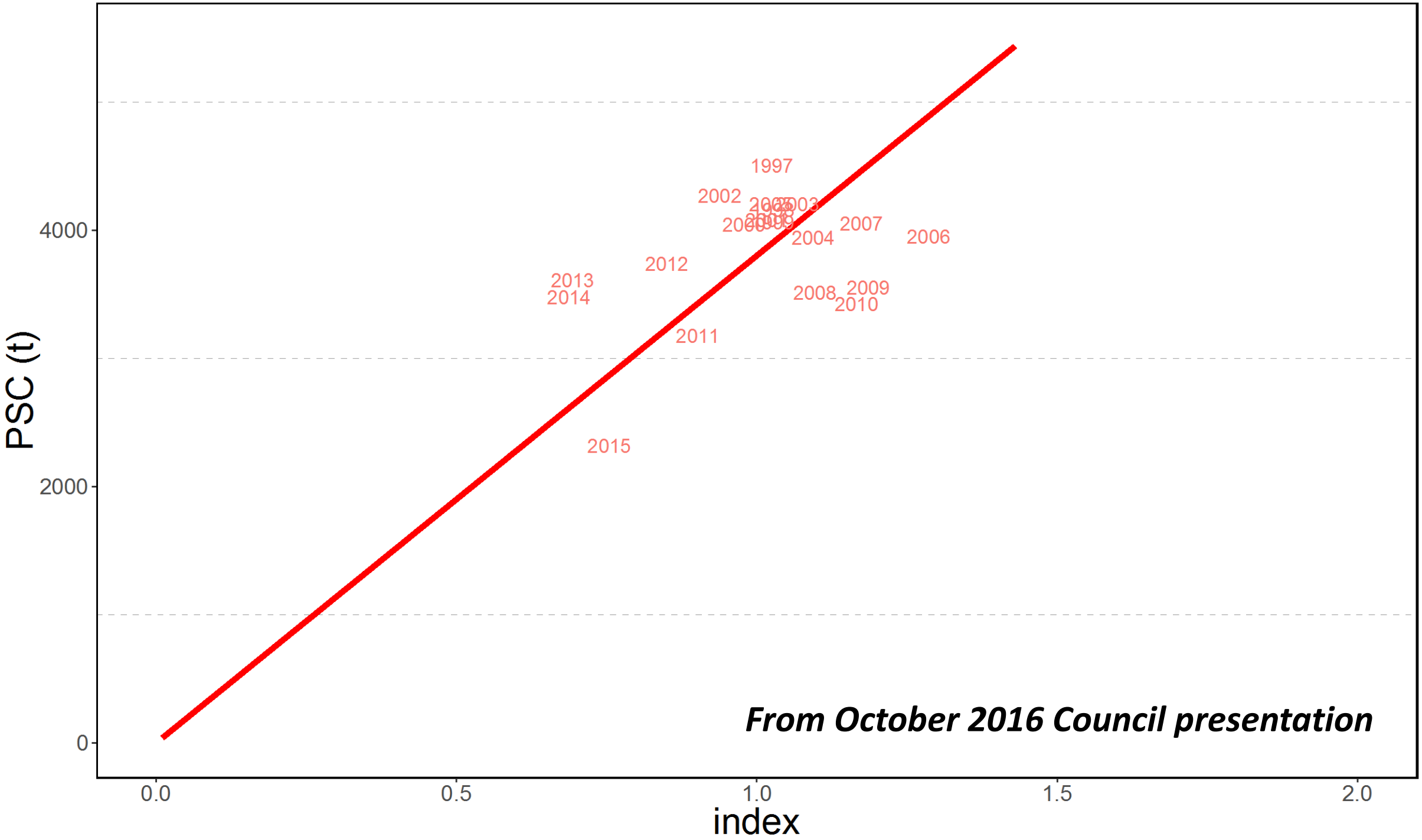
SSC feedback

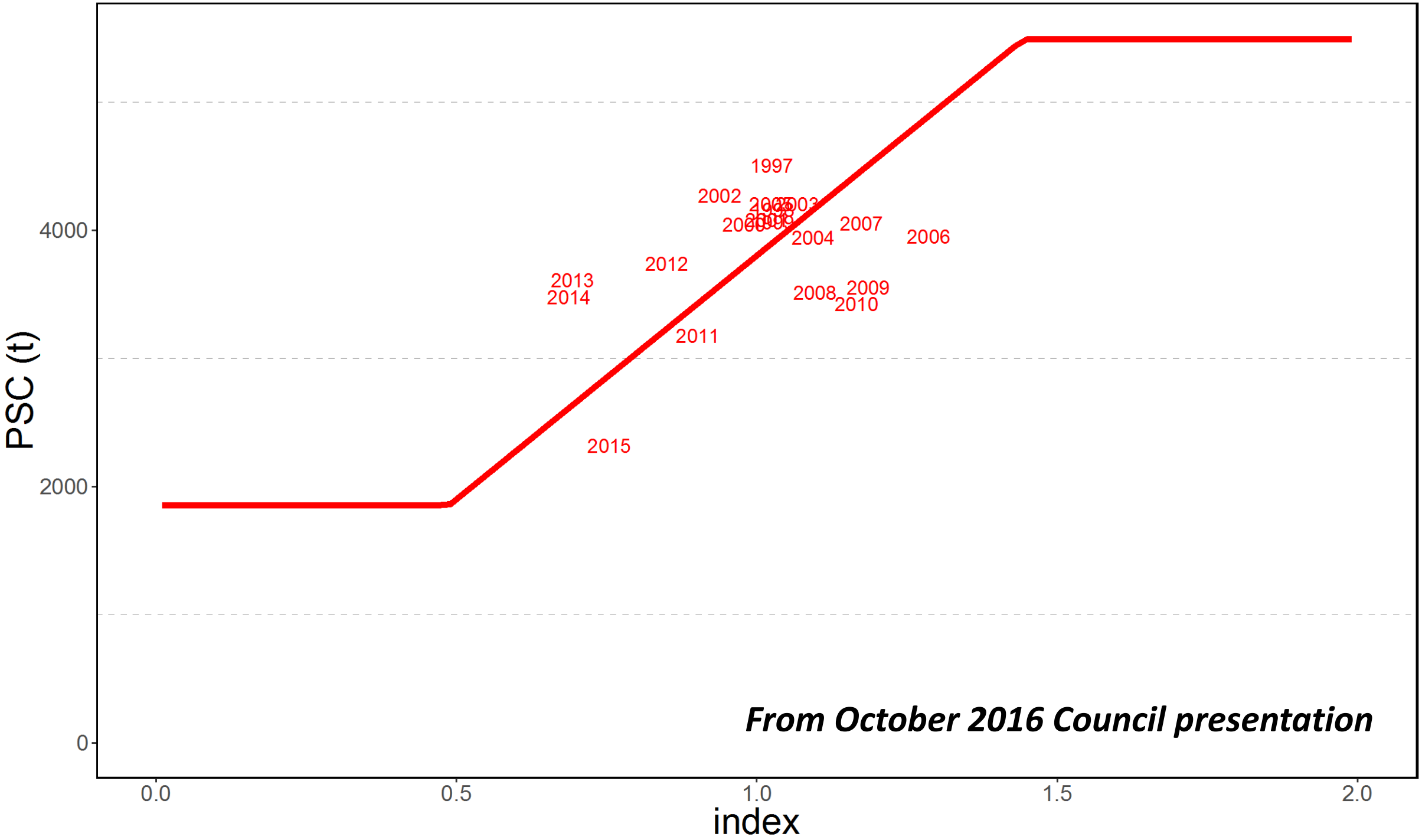
- Apply rules differently
- “Multi-dimensional”



Control rule illustrated




PSC (t)
4000
2000
0
0.0
0.5
1.0
1.5
2.0
index
1997
2002
2003
2007
2006
2004
2012
2013
2014
2008
2009
2010
2011
2015
From October 2016 Council presentation


PSC (t)
4000
2000
0
0.0
0.5
1.0
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index
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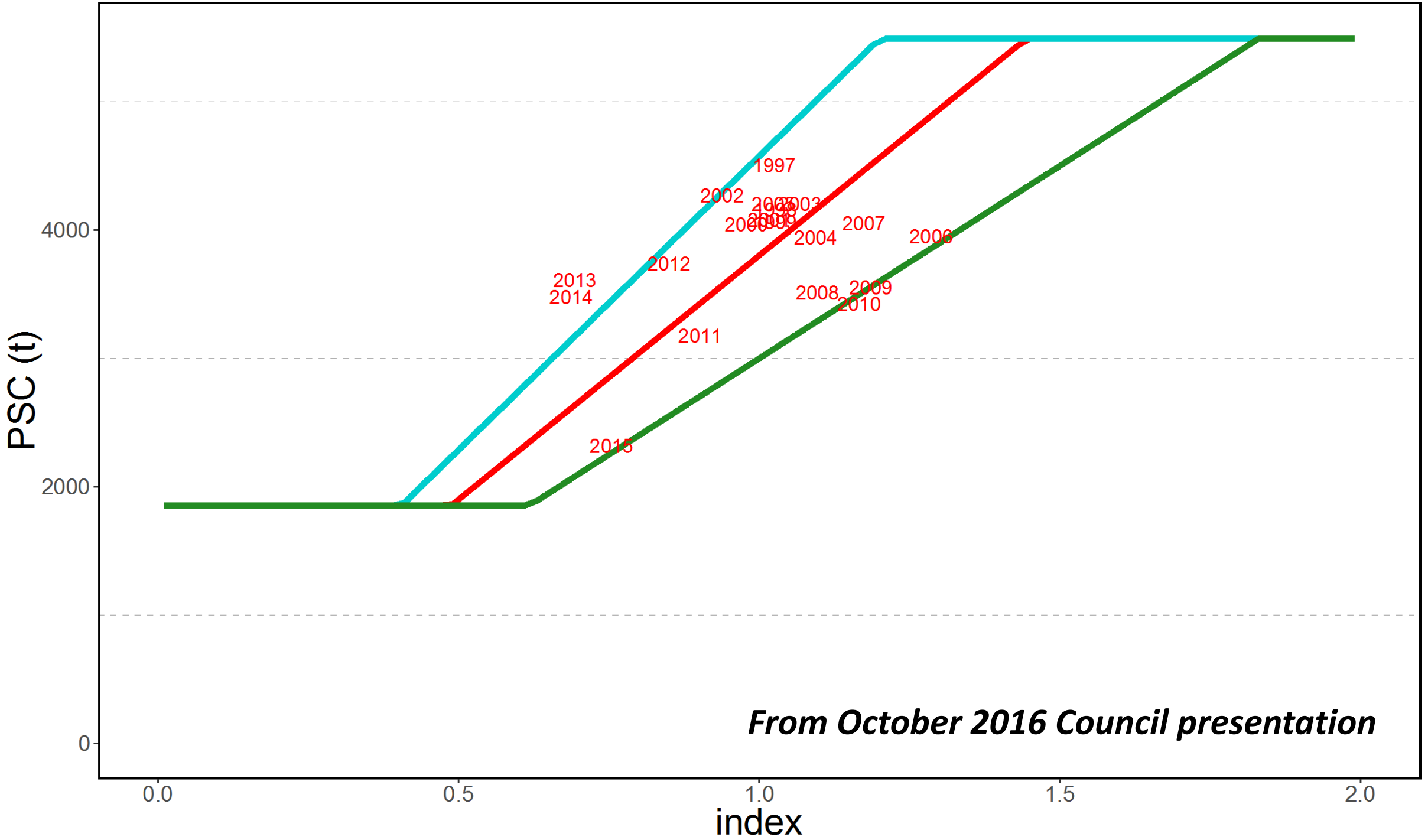
From October 2016 Council presentation


PSC (t)
4000
2000
0
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1.5
2.0
index
1997
2002
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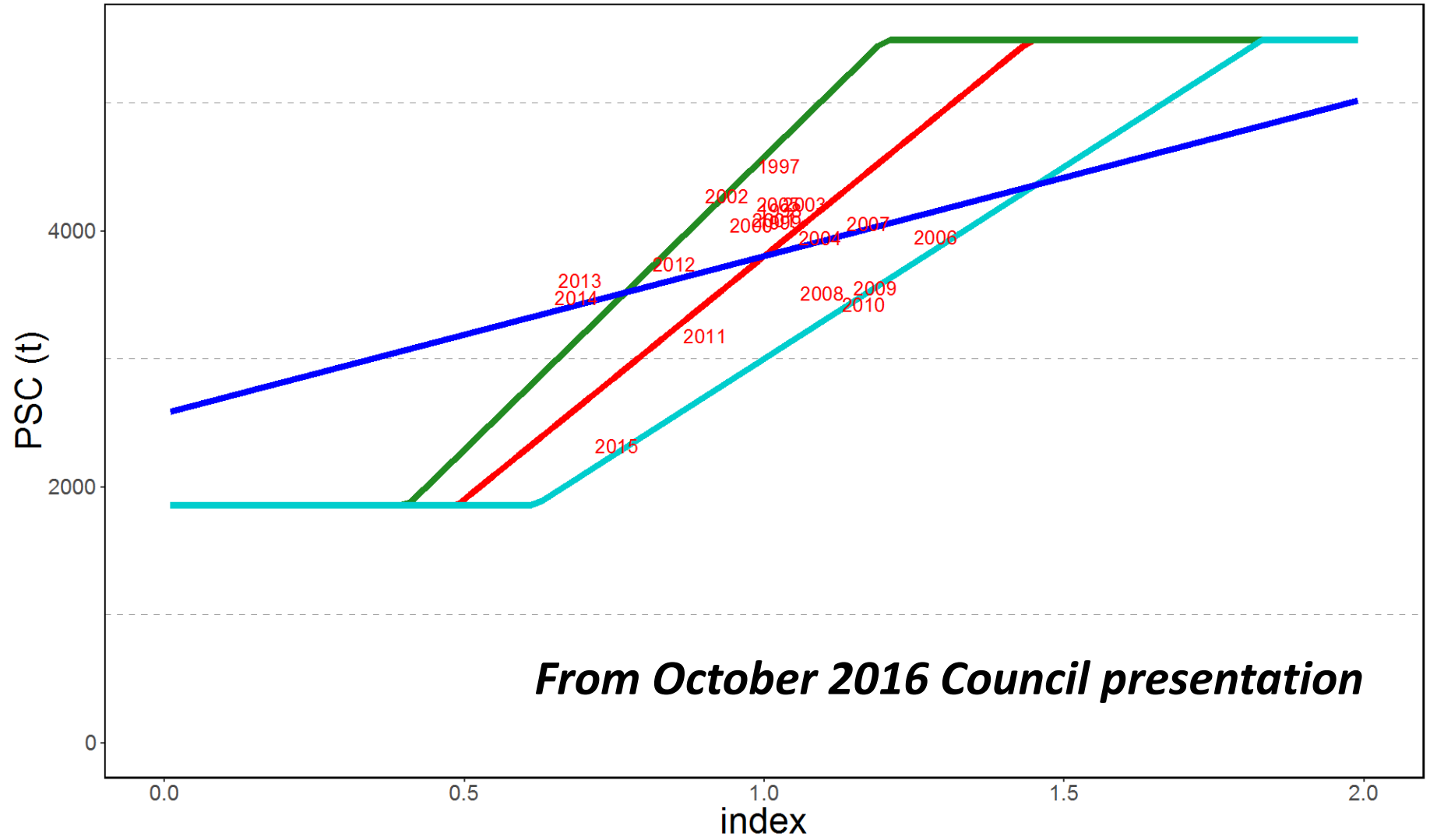
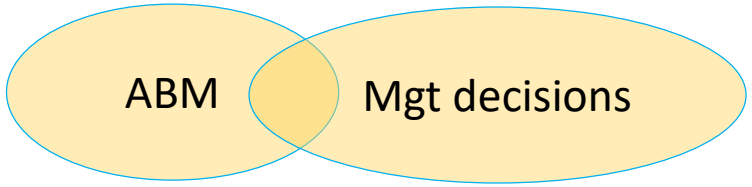
From October 2016 Council presentation

Can change slope of control rule to moderate changes in PSC limits



Principles and considerations used in developing strawman alternatives

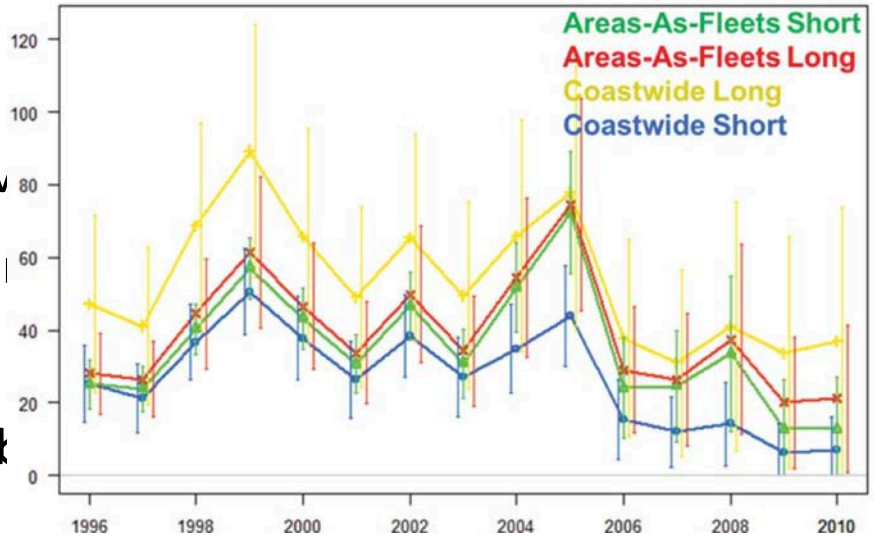
The ABM index should



1. **be independent of management decisions**
2. with control rules be **parsimonious, easy to understand and implement** in a timely manner
3. require **few assumptions**
4. consider **Pacific halibut recruitment** (e.g., smaller halibut) to ensure future healthy coastwide halibut spawning biomass
5. **consider O32 (or O26) Pacific halibut biomass** in the Bering Sea to provide for opportunity to the directed halibut fishery

Specific to data…

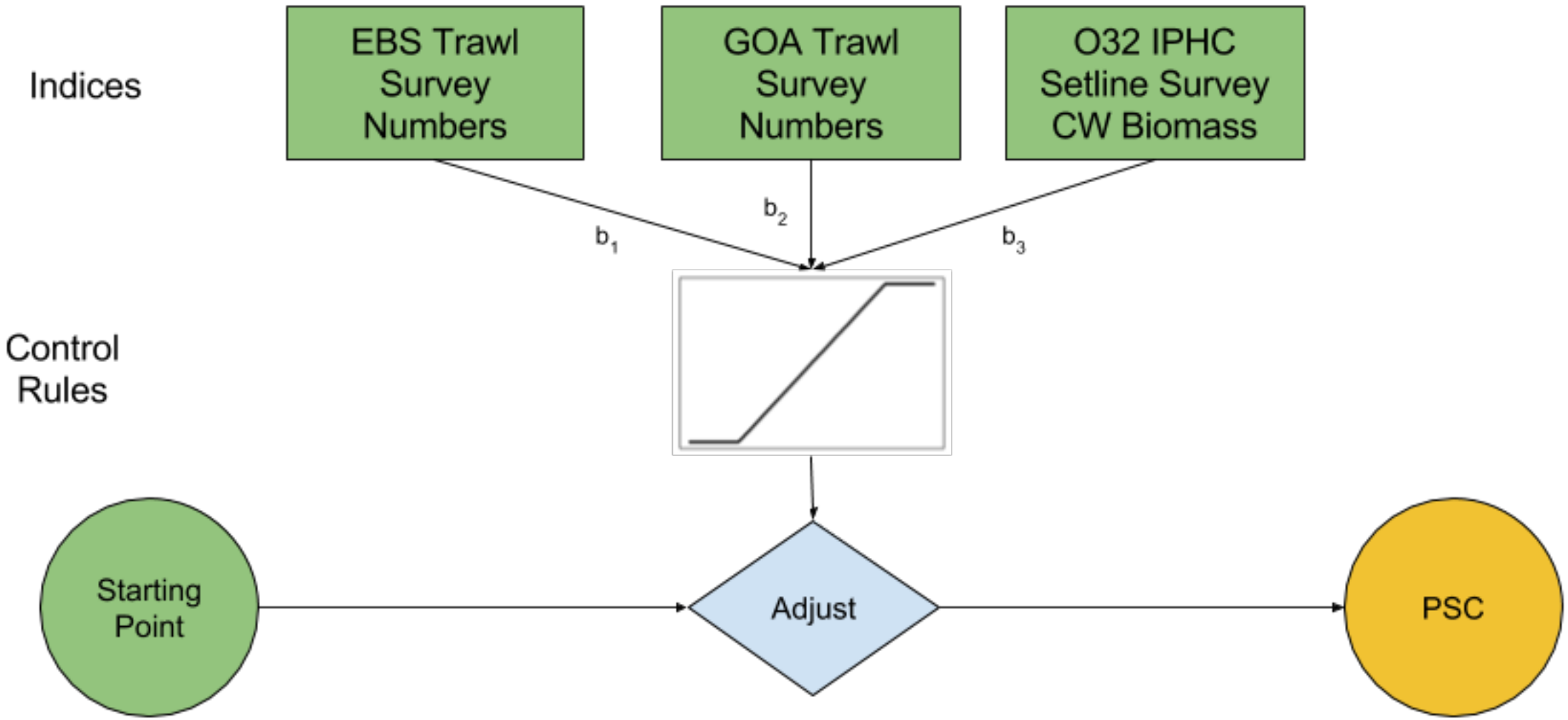
6. a **proxy for Pacific halibut spawning biomass** is the IPHC setline surv
7. **in each Regulatory Area,** the IPHC setline survey provides an O26 (o
8. for **coastwide spawning biomass**, the IPHC stock assessment
9. the PSC limit should **be responsive to changes in the total halibut ab** groundfish fisheries

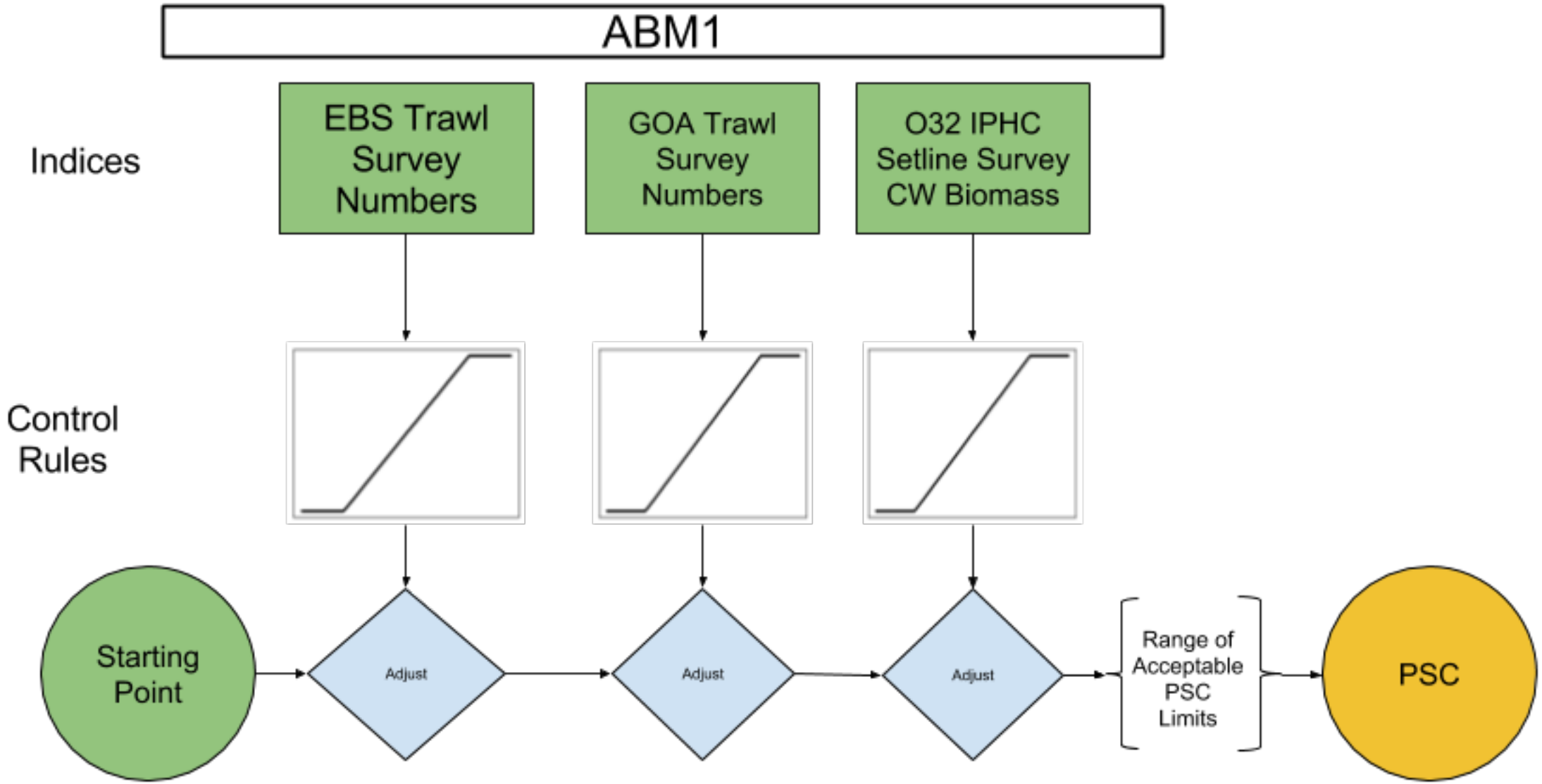


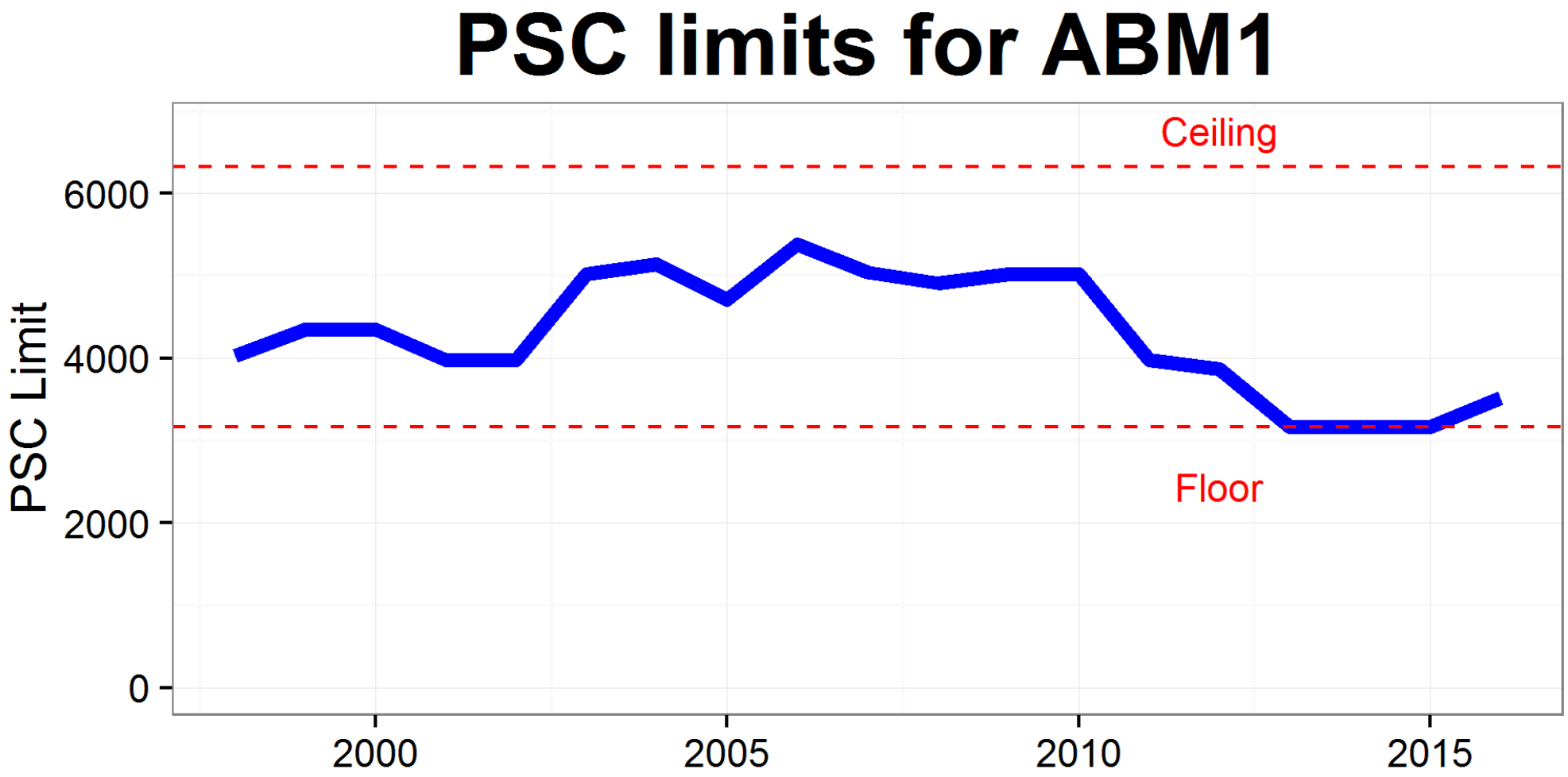
ABM 1: the integrated index (proposed in Oct) re-formulated into a multi-dimensional control rule

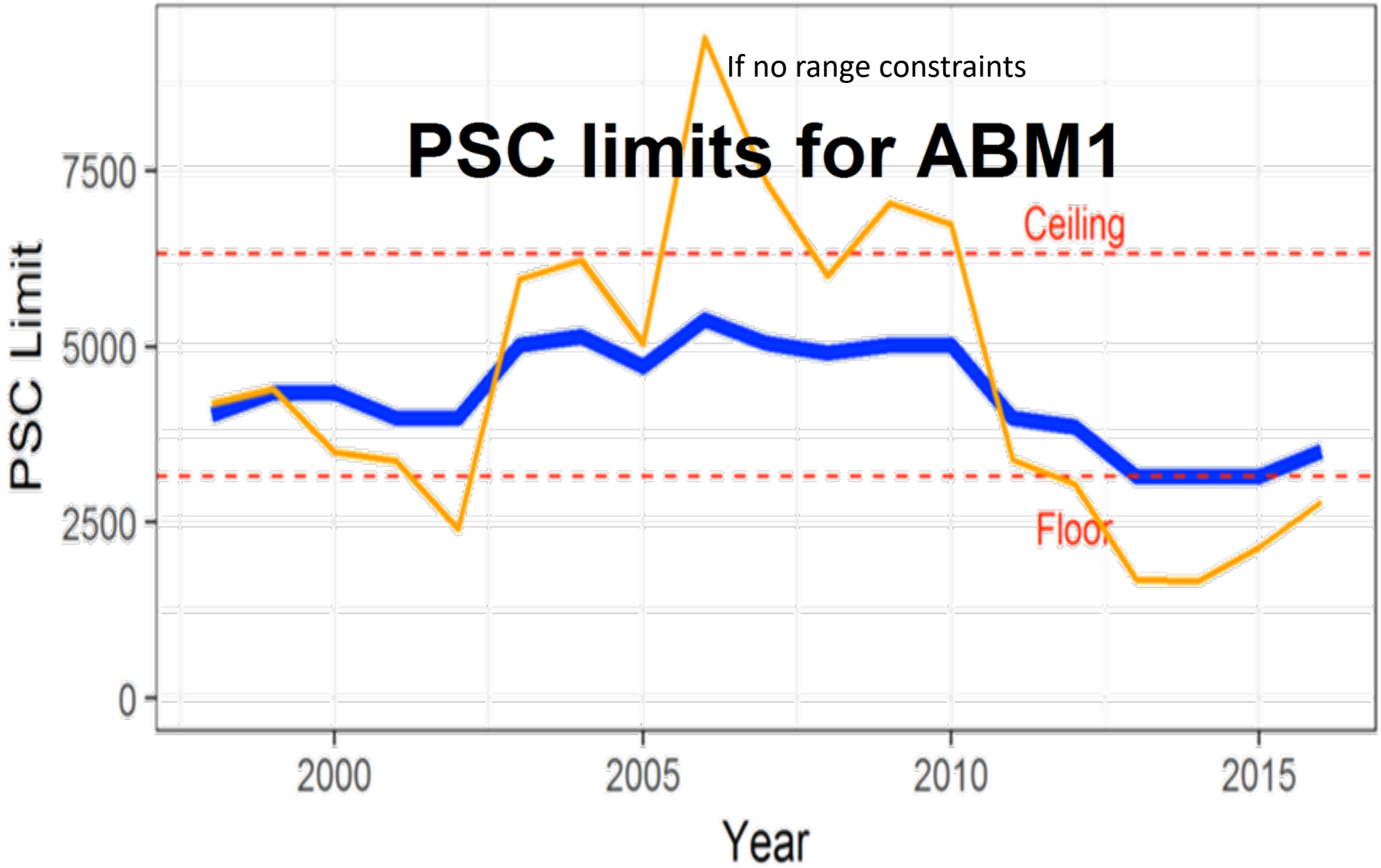
- EBS shelf trawl survey
  - Purpose: indexes halibut number available to the bycatch and directed fisheries in the EBS
- GOA trawl survey
  - Purpose: Indexes recruitment in the GOA and downstream success of young fish initially occurring in the EBS
- Coastwide O32 IPHC setline survey
  - Purpose: Indexes health of female spawning biomass; the O32 setline survey is dominated by female fish that are mostly mature

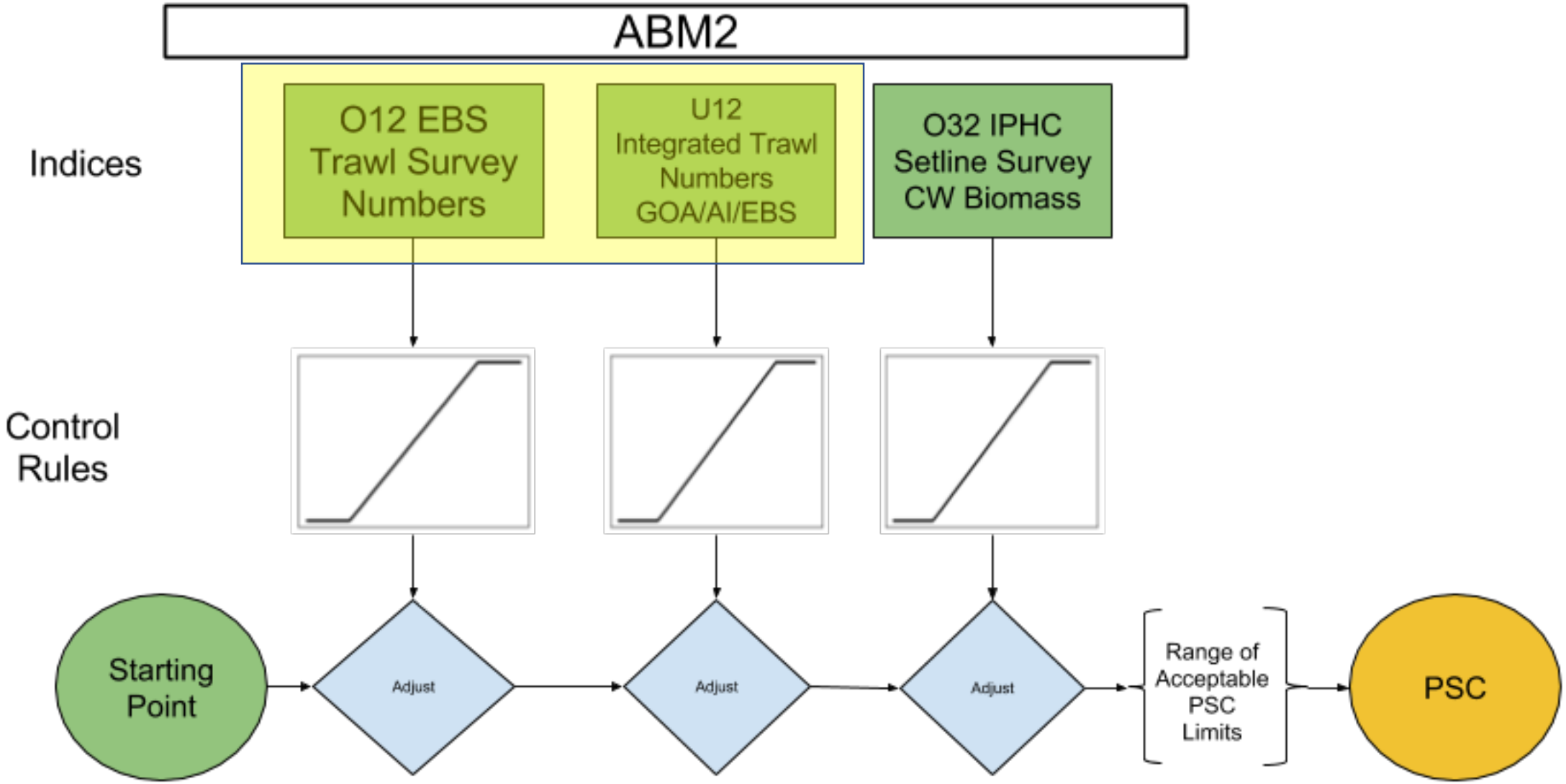
Review: Diagram of October 2016 ABM




ABM1
Indices
EBS Trawl Survey Numbers
GOA Trawl Survey Numbers
O32 IPHC Setline Survey CW Biomass
Control Rules
Starting Point
Adjust
Adjust
Adjust
Range of Acceptable PSC Limits
PSC


PSC limits for ABM1
Ceiling
Floor
PSC Limit
6000
4000
2000
0
2000
2005
2010
2015

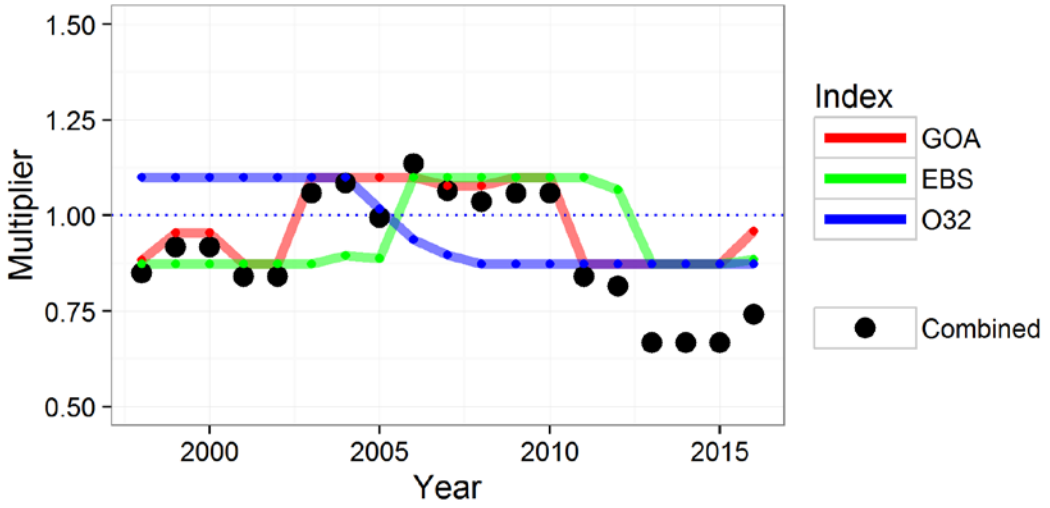

If no range constraints
PSC limits for ABM1
Ceiling
Floor
PSC Limit
7500
5000
2500
0
2000
2005
2010
2015
Year


ABM2
Indices
O12 EBS Trawl Survey Numbers
U12 Integrated Trawl Numbers GOA/AI/EBS
O32 IPHC Setline Survey CW Biomass
Control Rules
Starting Point
Adjust
Adjust
Adjust
Range of Acceptable PSC Limits
PSC

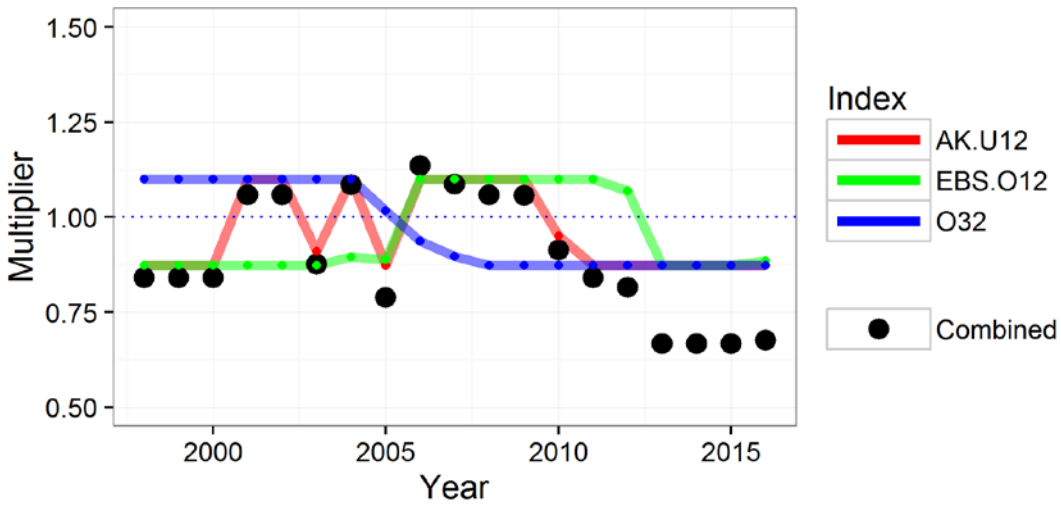
ABM 2: Explicitly accounting for young halibut

- “U12” GOA/AI/EBS trawl survey
  - Purpose: Indexes recruitment throughout AK
- “O12” EBS shelf trawl survey
  - Purpose: Account for all EBS halibut caught by trawl (accomplished along with U12 index)
- Coastwide O32 IPHC setline survey
  - Purpose: Indexes the health of female spawning biomass; the O32 setline survey is dominated by female fish that are mostly mature

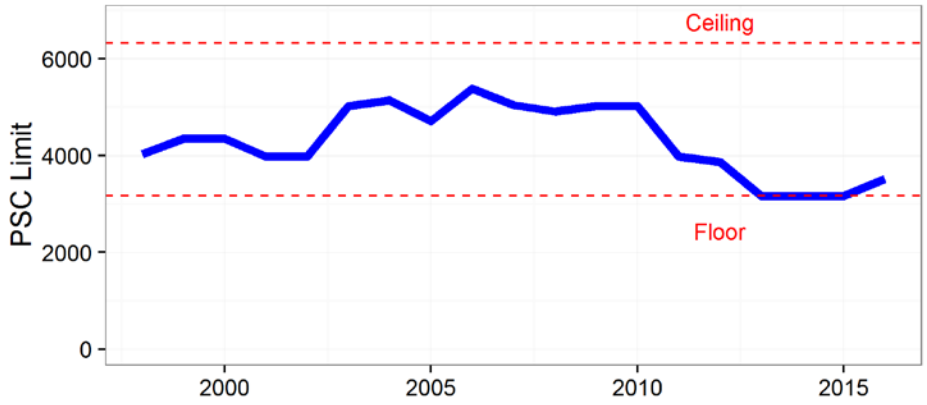
ABM1



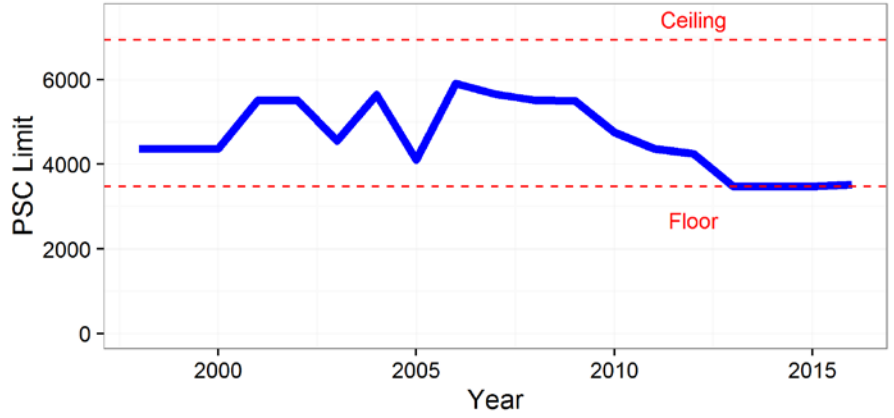
ABM2



PSC limits for ABM1

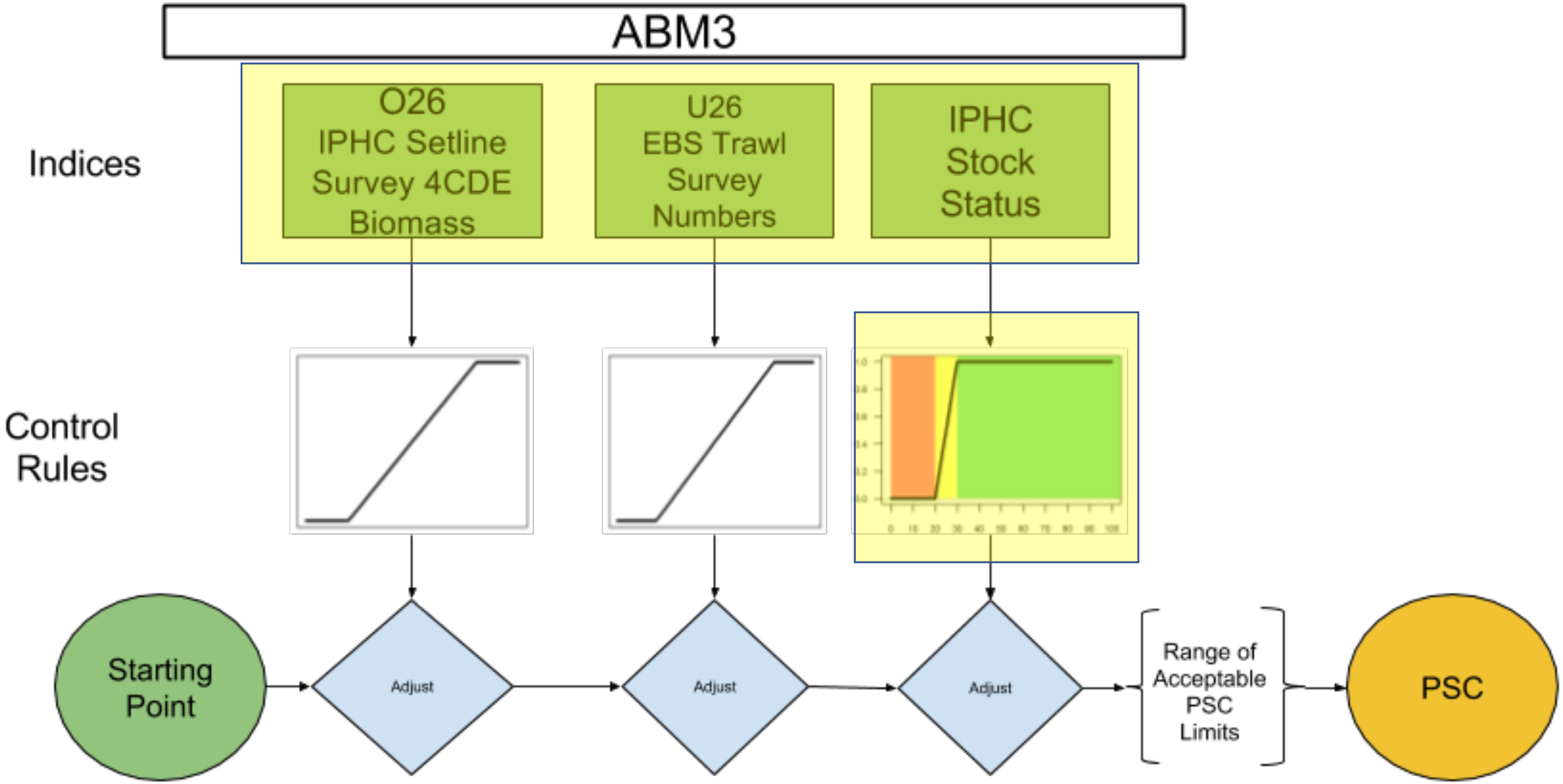


PSC limits for ABM2

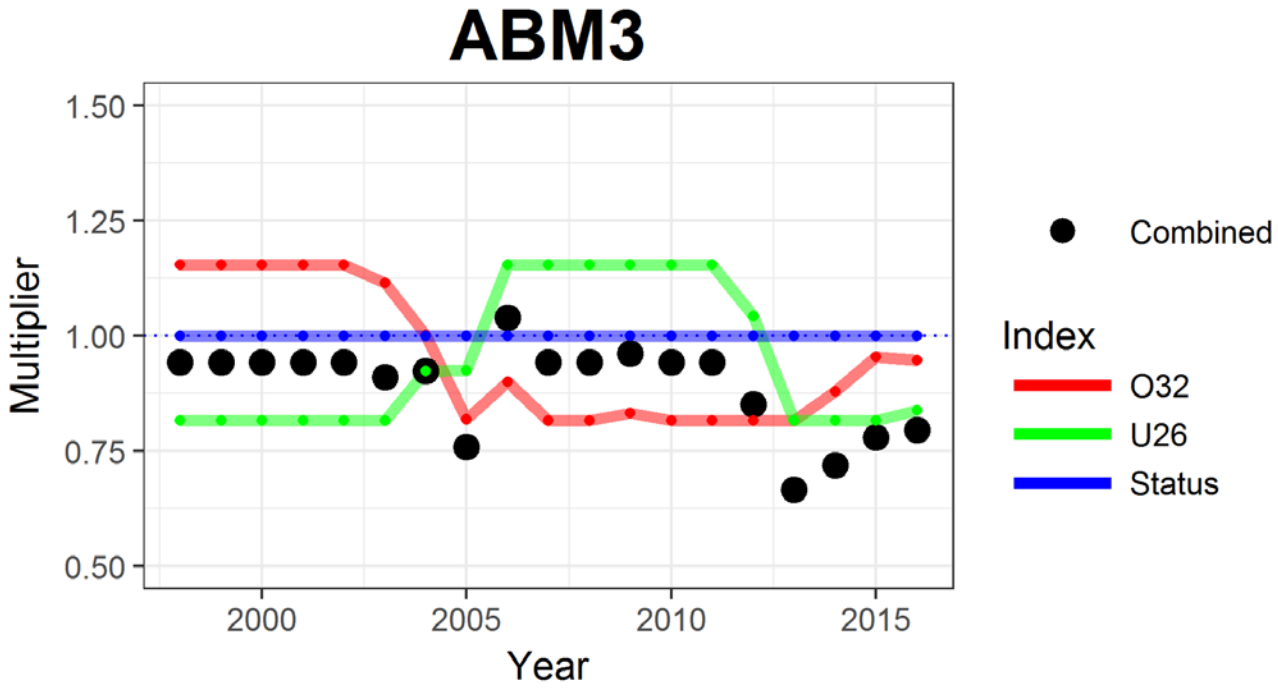


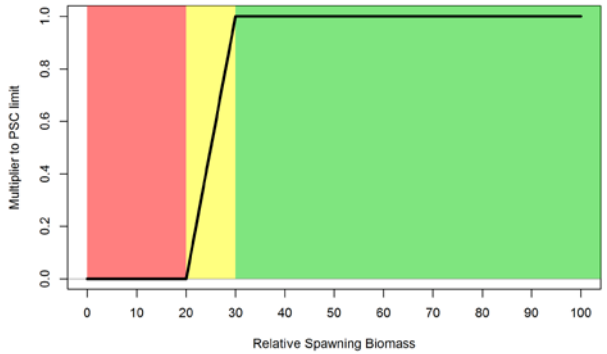
ABM3: Indices for three components

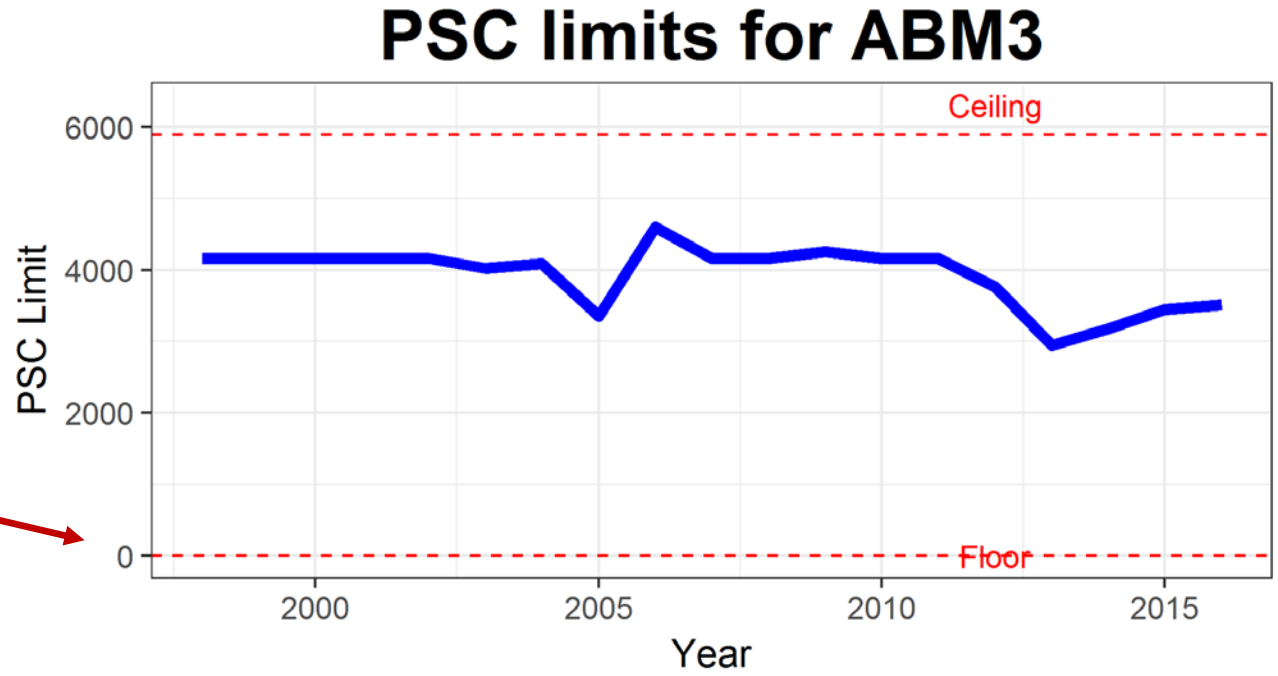
- Three indices used to deviate from starting point
  1. O26 IPHC Setline Survey 4CDE Biomass
     - Related to the goal to provide for directed fishery operations
  2. U26 EBS Trawl Survey Numbers
     - Related to goal to avoid constraining groundfish fisheries especially when halibut abundance is high
  3. IPHC stock status
     - Related to protect spawning biomass, especially at low levels
     - Uses a 30:20 control rule and adjusts the starting point downward only when <30%
     - Not averaged to a range of years, but relative to B_O
     - May want to be consistent with current IPHC management policy


ABM3
Indices
O26
IPHC Setline
Survey 4CDE
Biomass
U26
EBS Trawl
Survey
Numbers
IPHC
Stock
Status
Control
Rules
Starting
Point
Adjust
Adjust
Adjust
Range of
Acceptable
PSC
Limits
PSC

ABM3: Historical example







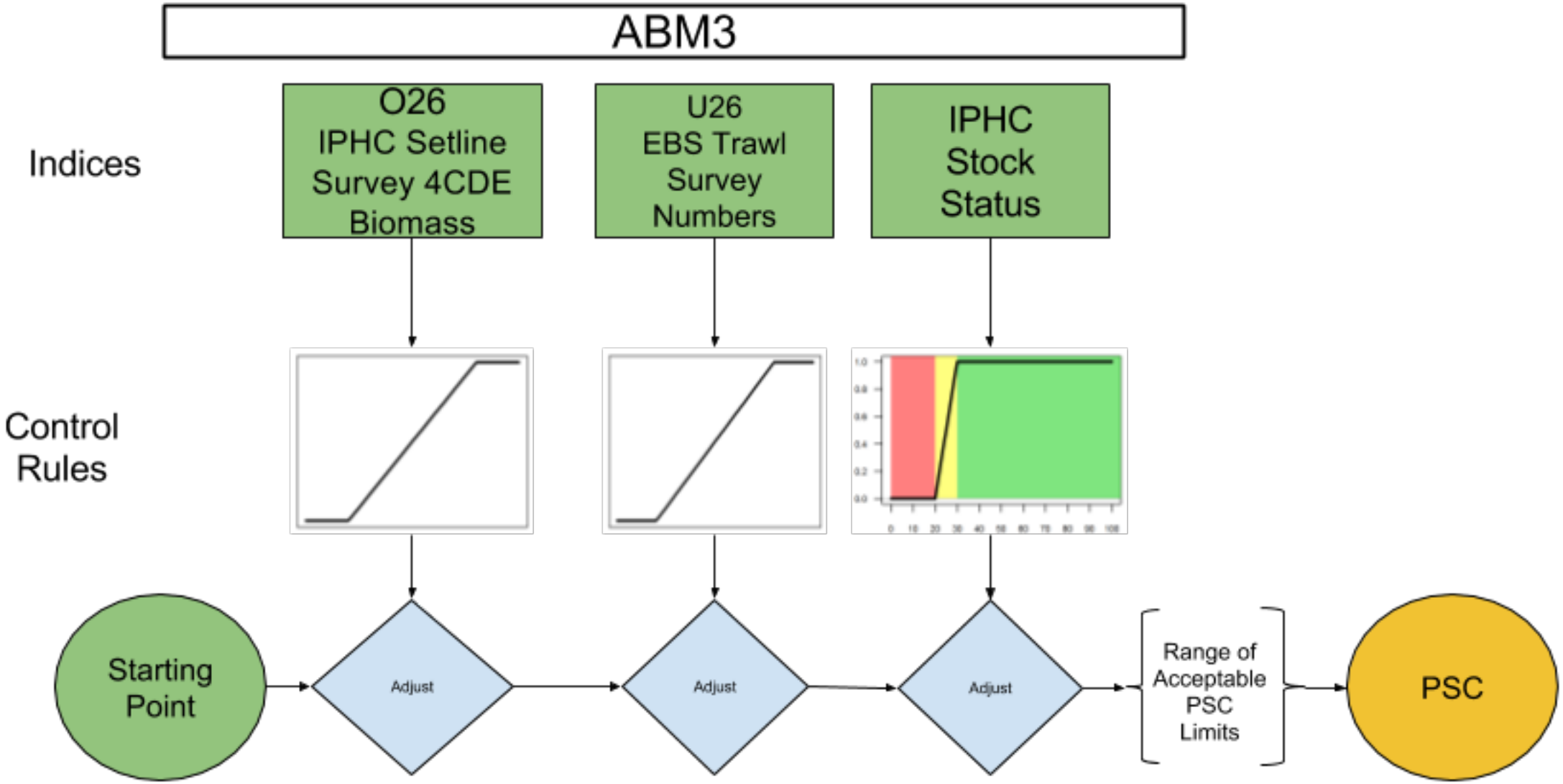
ABM4: Weighting with data

Three indices used to deviate from starting point

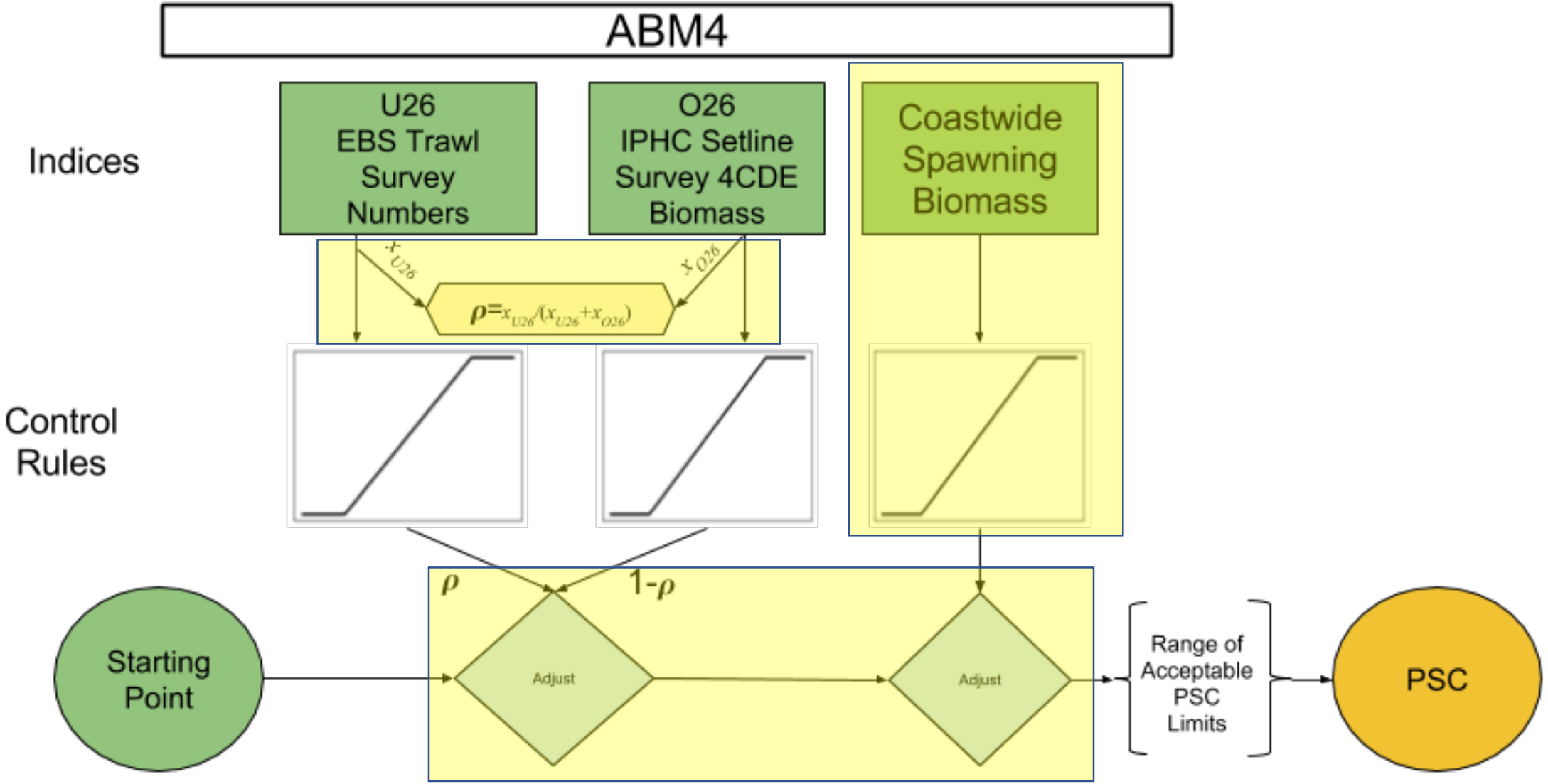
1. O26 IPHC Setline Survey 4CDE Biomass
   - Related to the goal to provide for directed fishery operations
2. U26 EBS Trawl Survey Numbers
   - Related to goal to avoid constraining groundfish fisheries especially when halibut abundance is high
- 1 and 2 are combined into a single multiplier with weighting determined from the proportion of U26 in the survey
  - It puts the weight onto the index of size that is most prevalent, and likely to be encountered by the trawl fishery
  - This could incorporate a control rule as well

3. IPHC stock assessment coastwide spawning biomass
   - Related to protect spawning biomass, especially at low levels

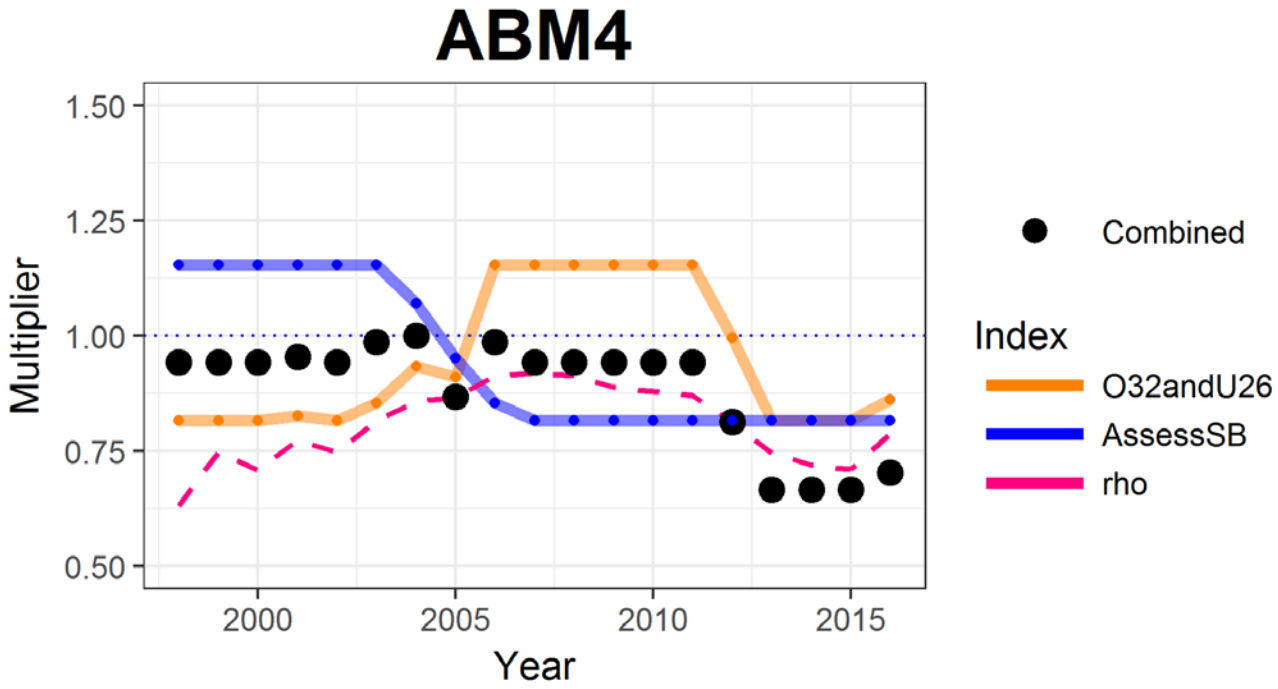
ABM3…

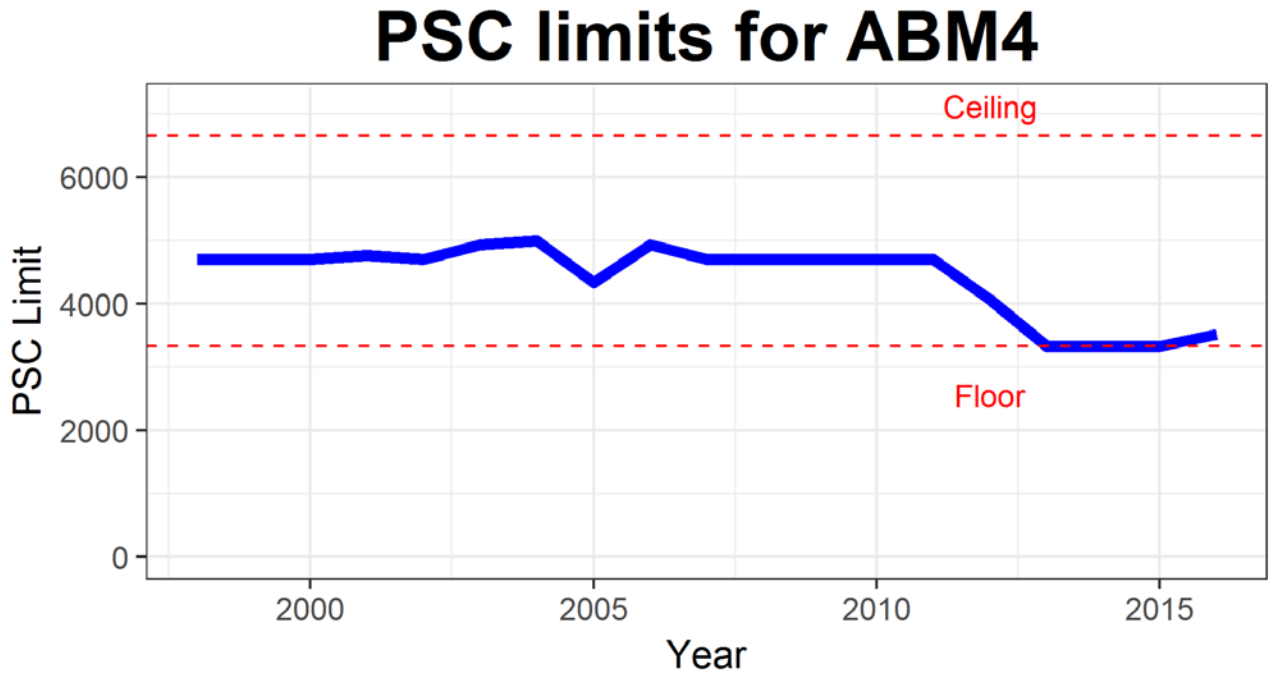

ABM3
Indices
O26
IPHC Setline
Survey 4CDE
Biomass
U26
EBS Trawl
Survey
Numbers
IPHC
Stock
Status
Control
Rules
Starting
Point
Adjust
Adjust
Adjust
Range of
Acceptable
PSC
Limits
PSC

ABM4


ABM4
Indices
U26
EBS Trawl
Survey
Numbers
O26
IPHC Setline
Survey 4CDE
Biomass
Coastwide
Spawning
Biomass
x_{U26}
x_{O26}
$\rho=x_{U26}/(x_{U26}+x_{O26})$
Control
Rules
ρ
1-ρ
Starting
Point
Adjust
Adjust
Range of
Acceptable
PSC
Limits
PSC

ABM4: Historical example





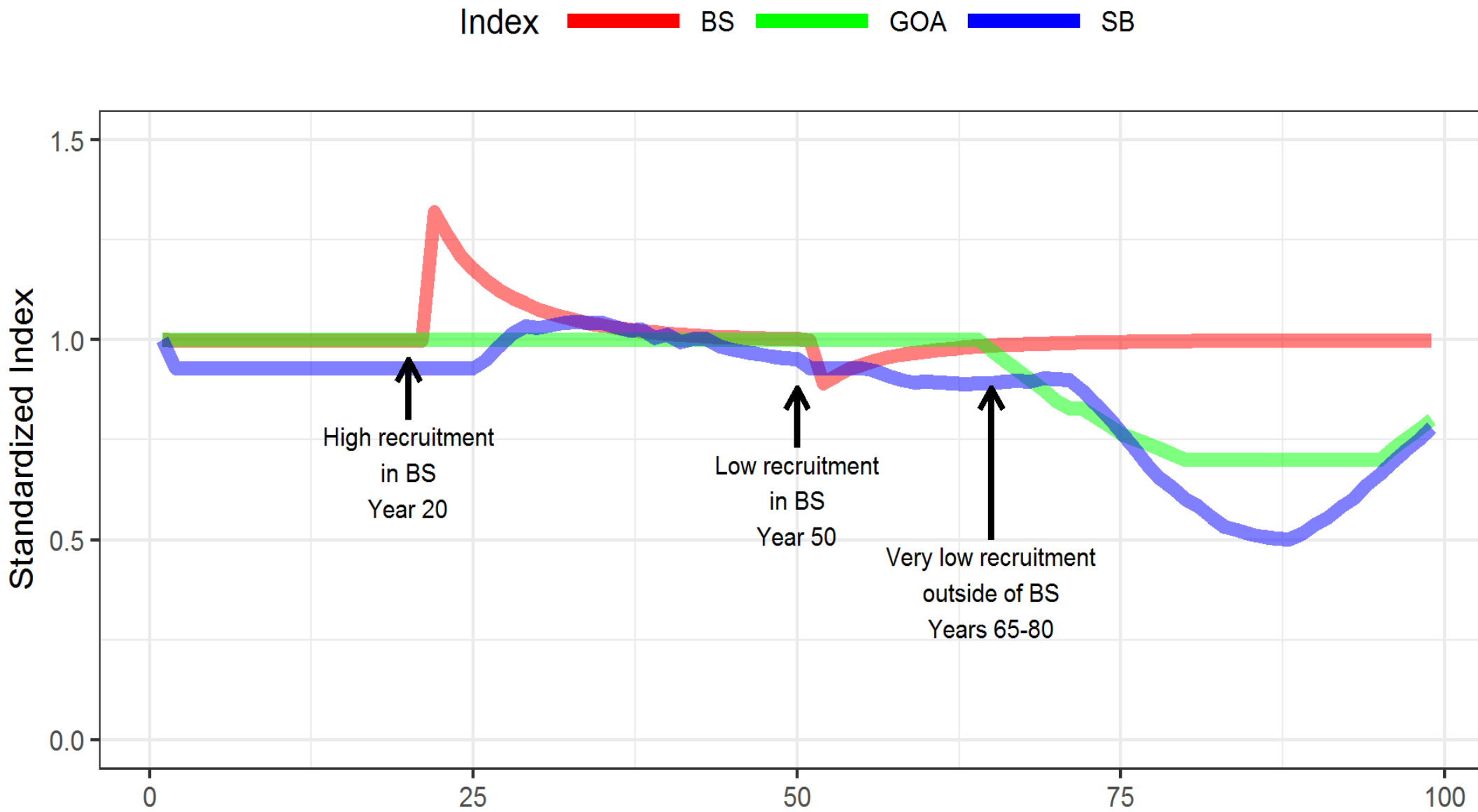
Summary of indices / features over strawman alts

	Strawman Alternatives			
Size Area Type	1	2	3	4
Total numbers in GOA trawl index	X			
Total numbers in EBS shelf trawl survey index	X			
O32 coastwide WPUE from the IPHC setline survey (space-time model)	X	X		
U12 recruitment index from GOA/AI/BS trawl VAST or simple sum		X		
O12 EBS shelf trawl survey		X		
IPHC stock status (function of IPHC SSB)			X	
O26 EBS setline survey index			X	X
U26 EBS shelf trawl survey index			X	X
SSB coastwide IPHC Stock assessment				X
U26 (EBS trawl survey) and O26 (EBS setline) dynamic weighting*				X

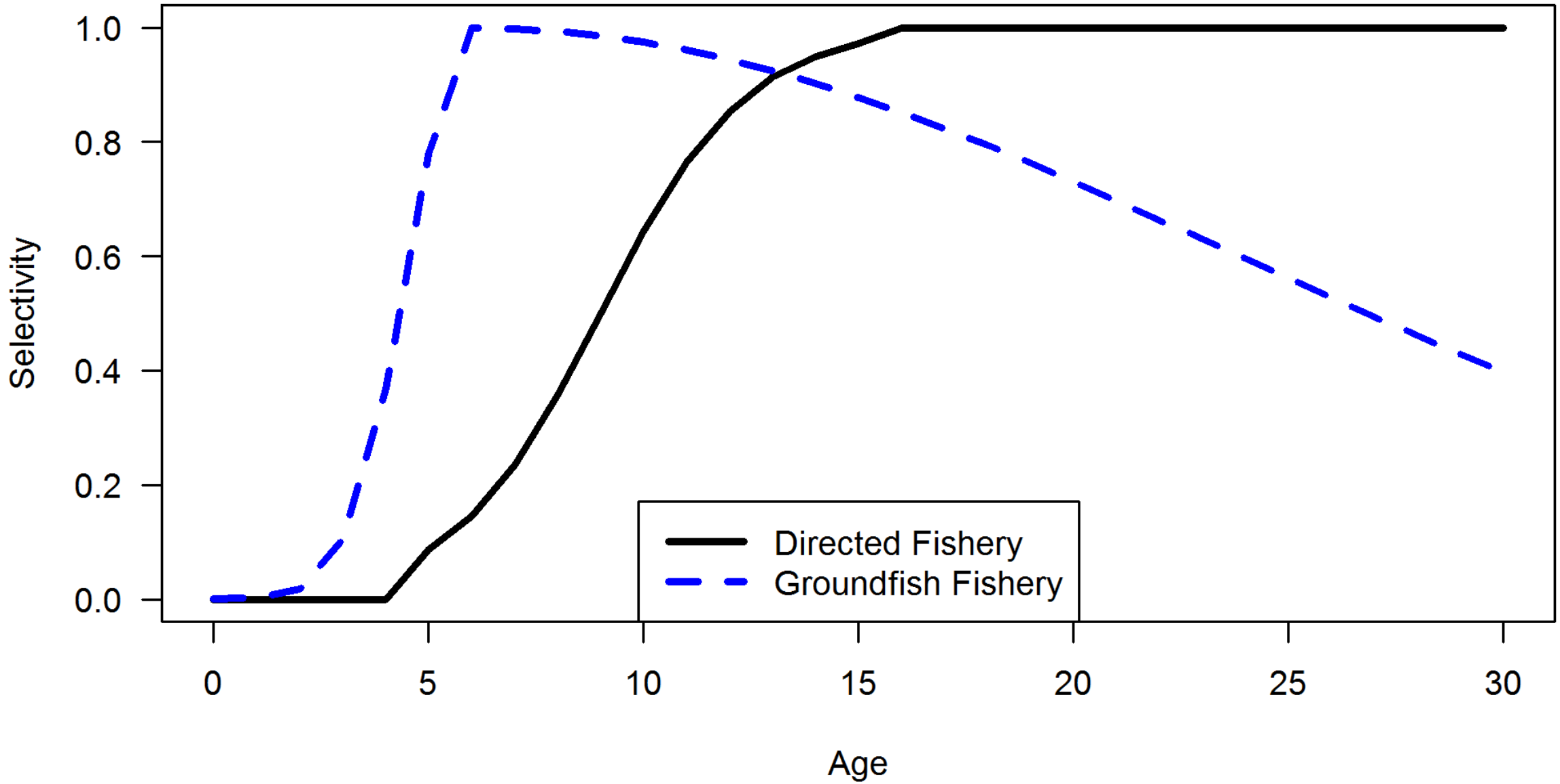
Appendix B. Simulation comparisons

- A very simple simulation of an age-structured population
- A “Bering Sea” area and an “outside” area (i.e., GOA)
  - GOA was not specifically modelled, but had a recruitment effect
  - Recruitment in BS didn’t affect GOA, but did affect coastwide spawning biomass
- To show the effects of recruitment events
- Indices are correlated approximately the way they should be and fishing affects each one
- A start to how a preliminary analysis could be done to better understand the indices and control rules
  - Needs more complexity, but not all of the complexity needed for a final analysis

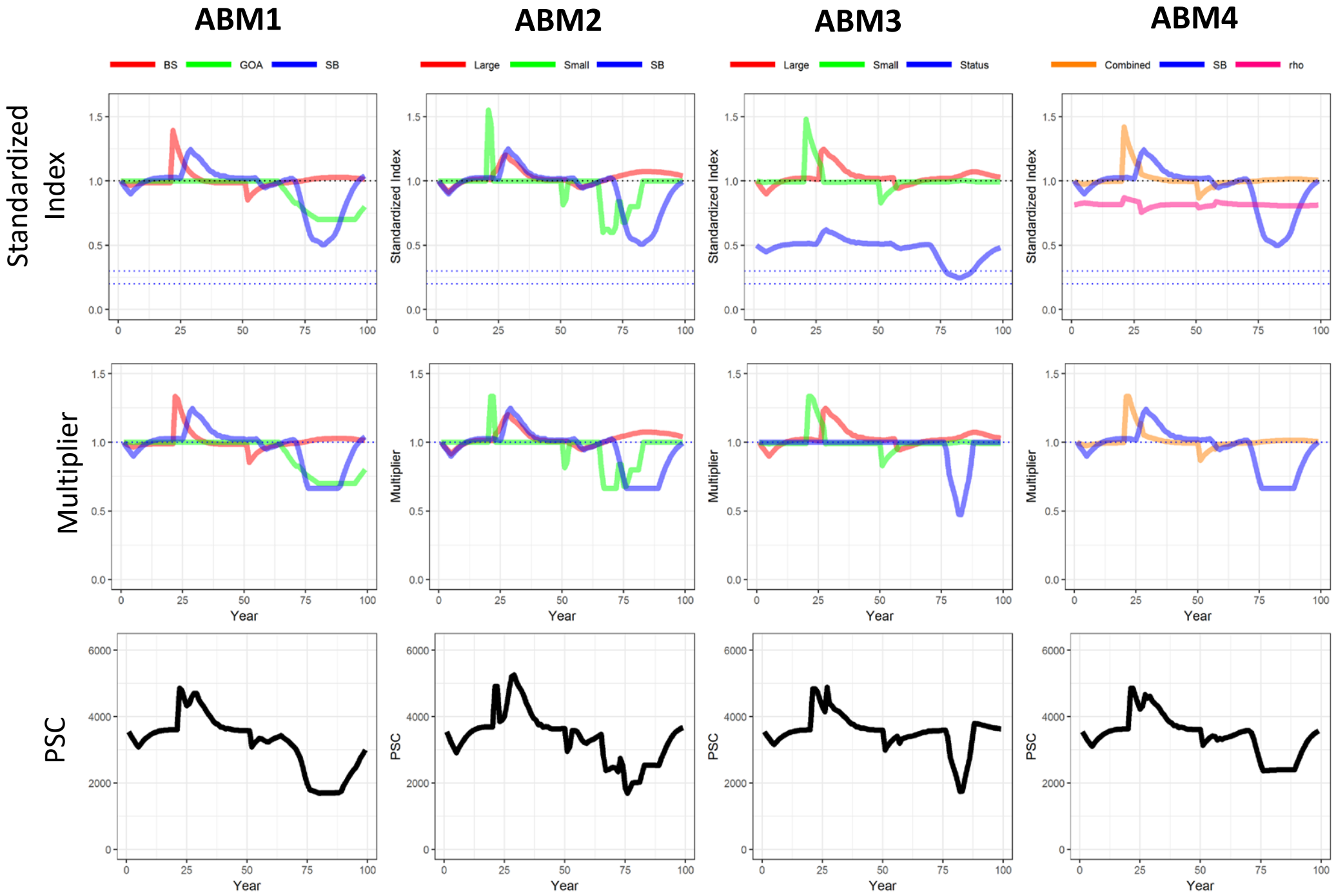
No Fishing Mortality



Selectivity



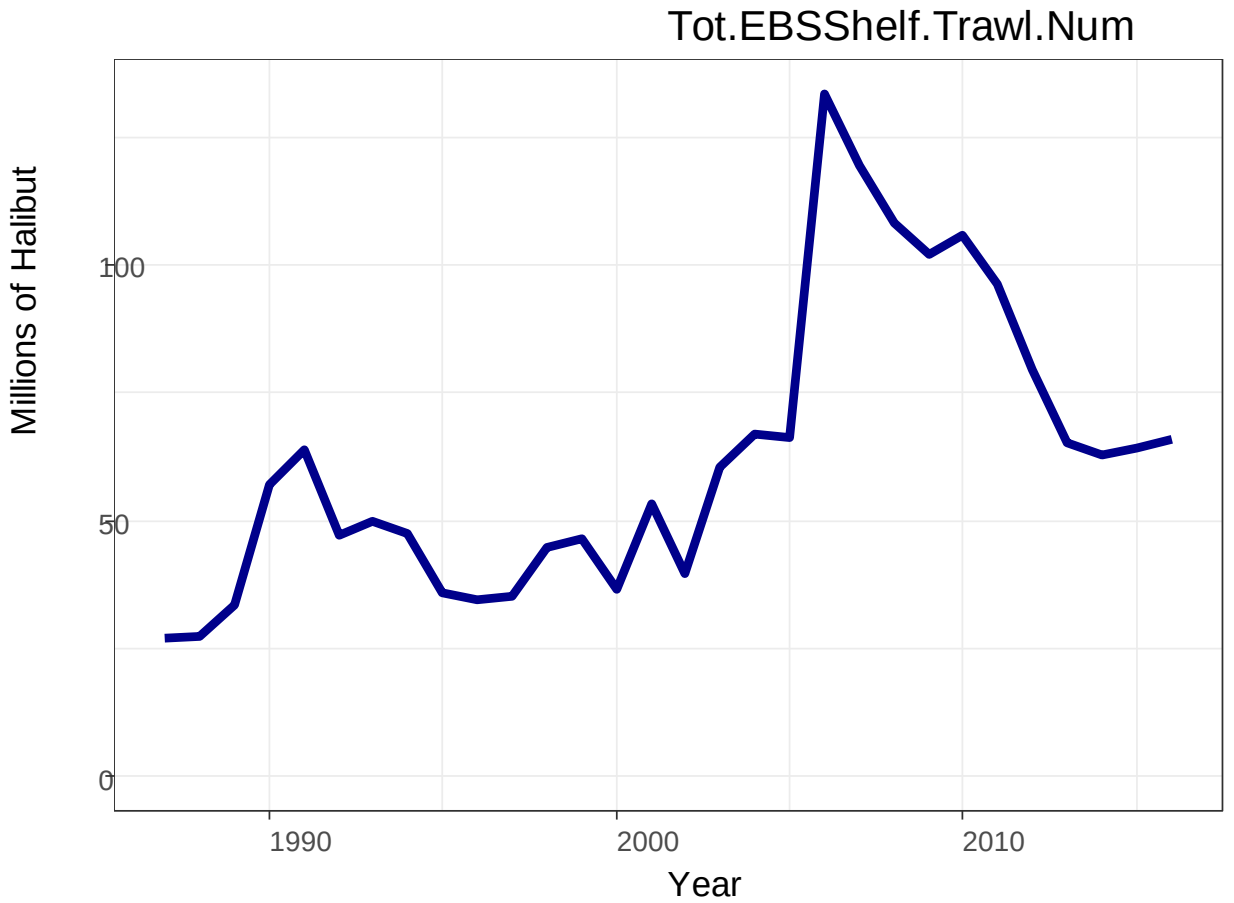
Simulations



An example abundance based management calculation for ABM1

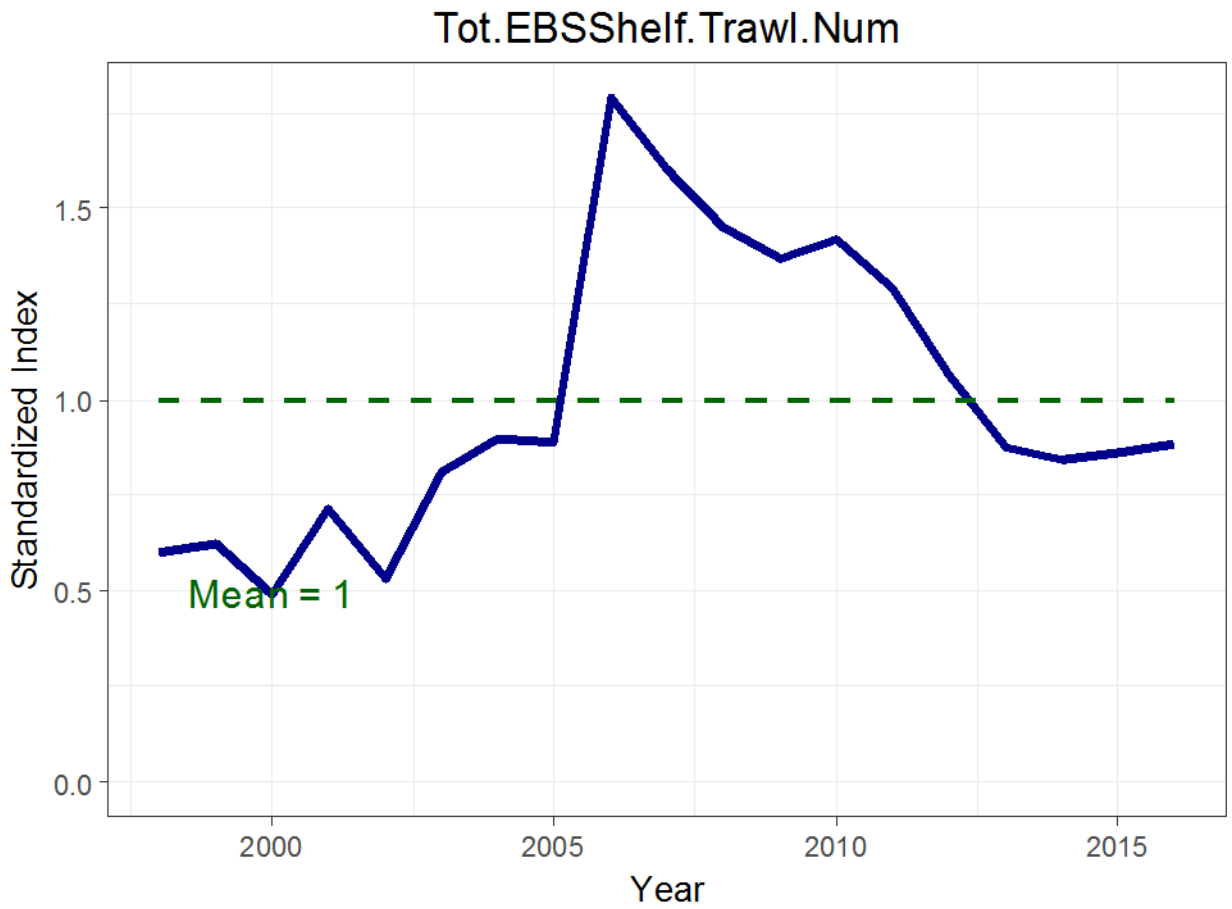
A raw index

- Obtain an index of abundance that relates to the halibut PSC limit such as the total EBS Shelf Trawl Numbers index shown below.



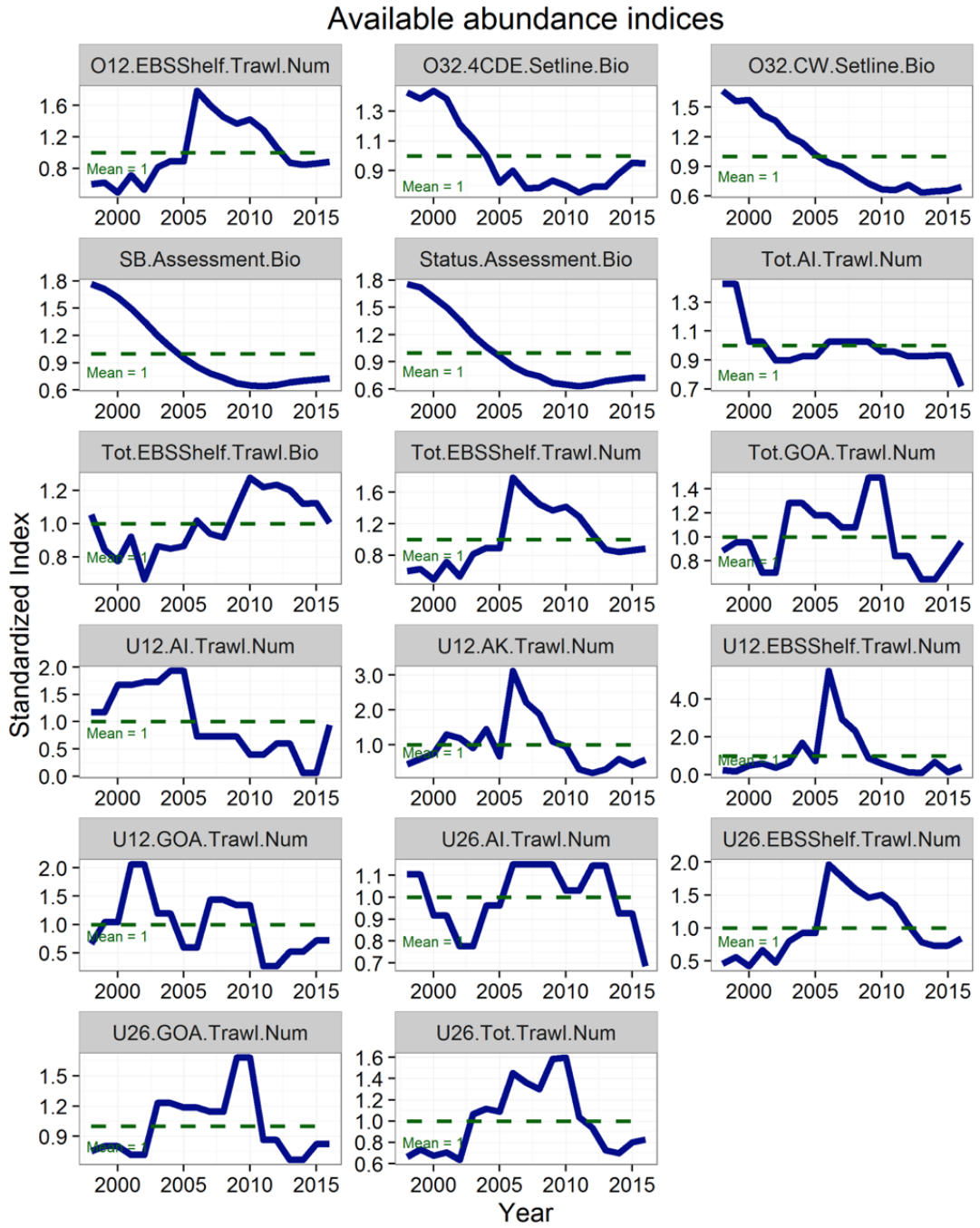
Standardizing an index

- 1998-2016 mean equals 1.0



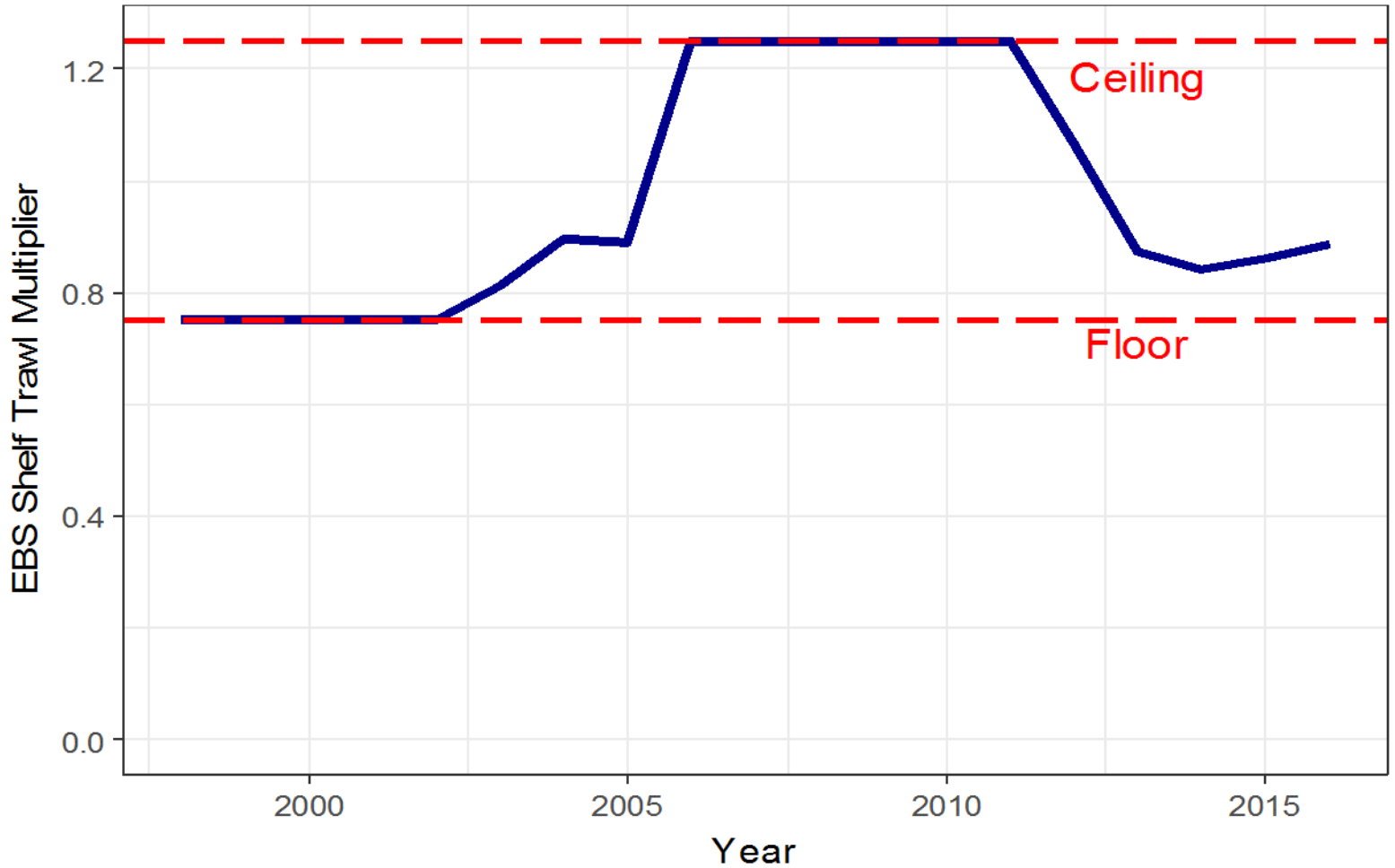
Variety of indices to standardize…

An example abundance based management calculation for ABM1



Range limits on multiplier

- Floor and ceiling also constrains multiplier (adjustment)

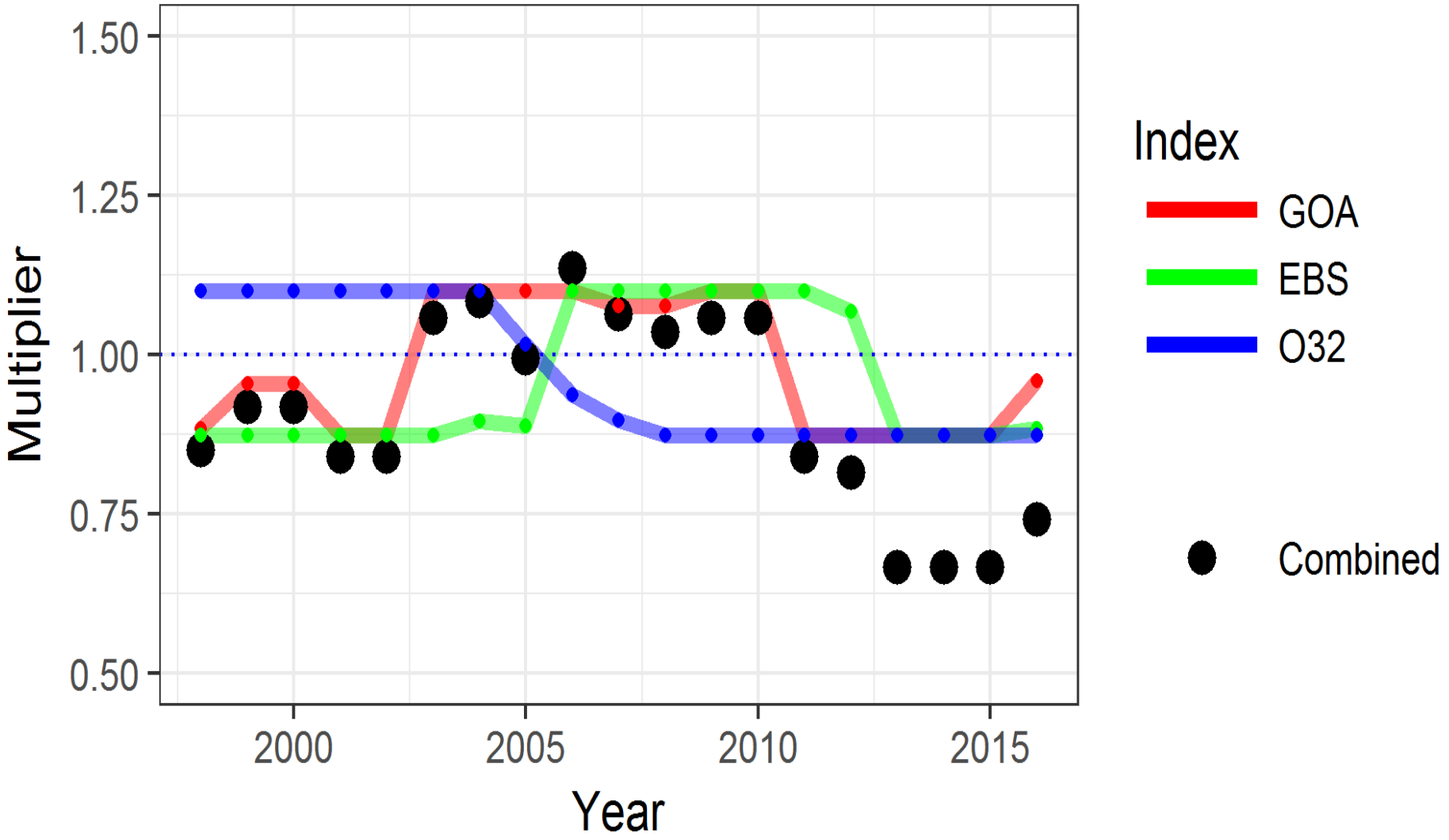


Add other indices

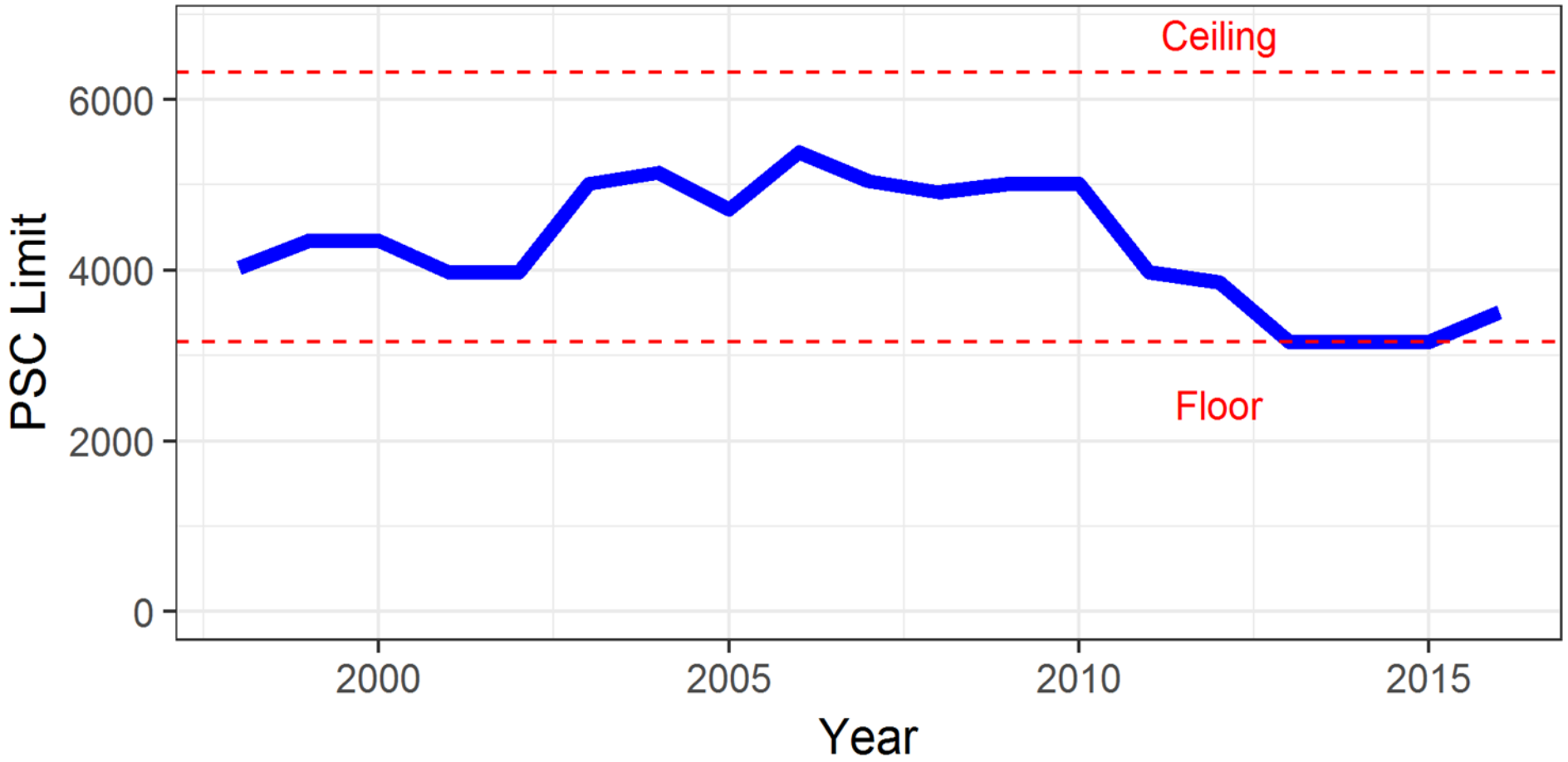
ABM1 uses

- EBS Trawl Survey
- GOA Trawl Survey
- O32 IPHC Setline Survey

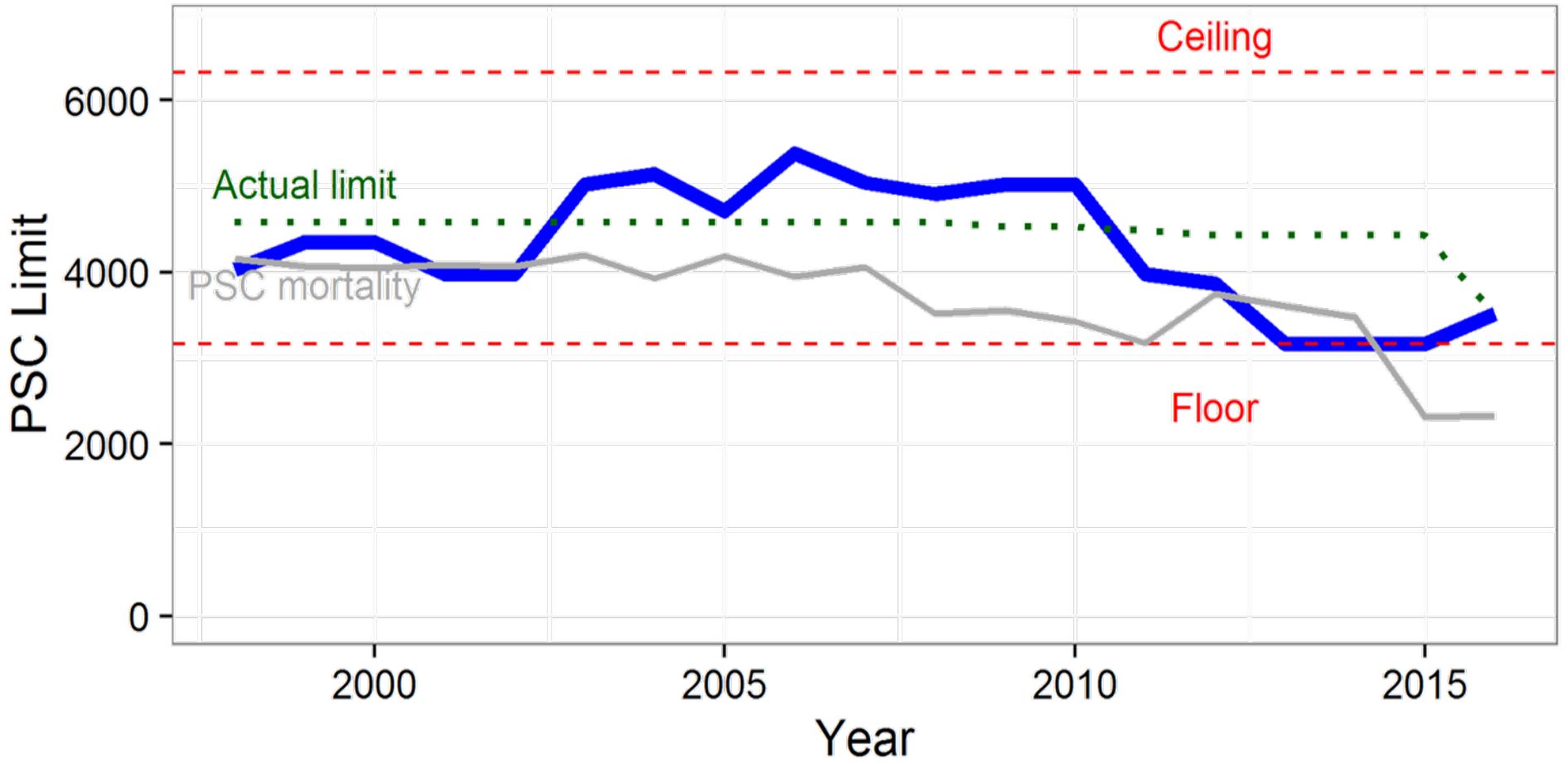
Three indices together form “Combined”



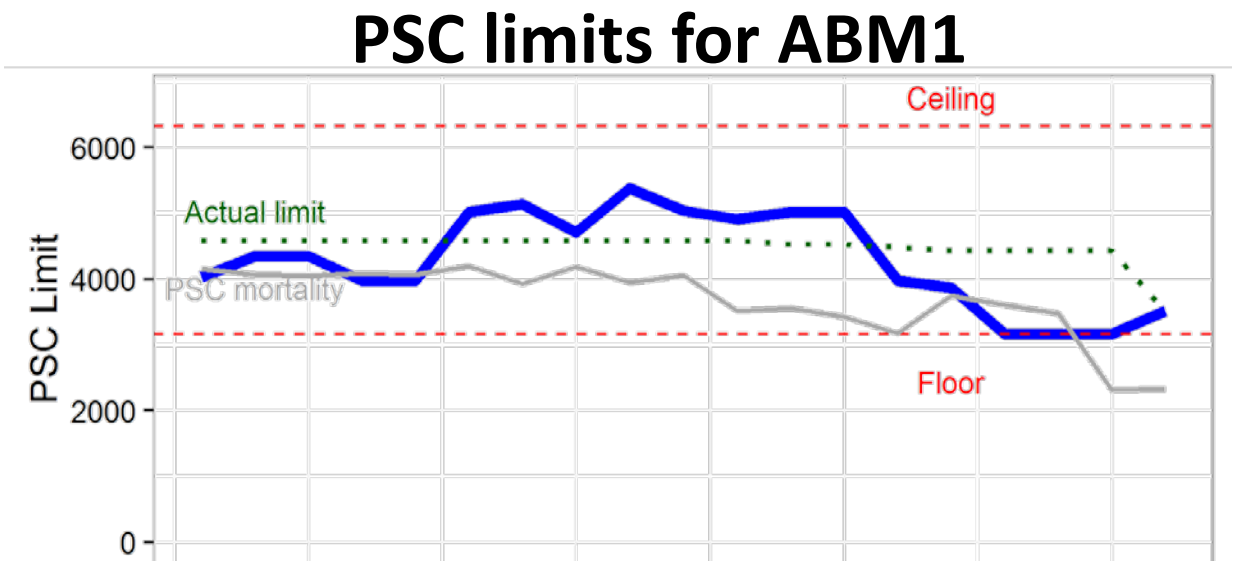
- ABM1 example tuned to 2016 yields the following PSC limits

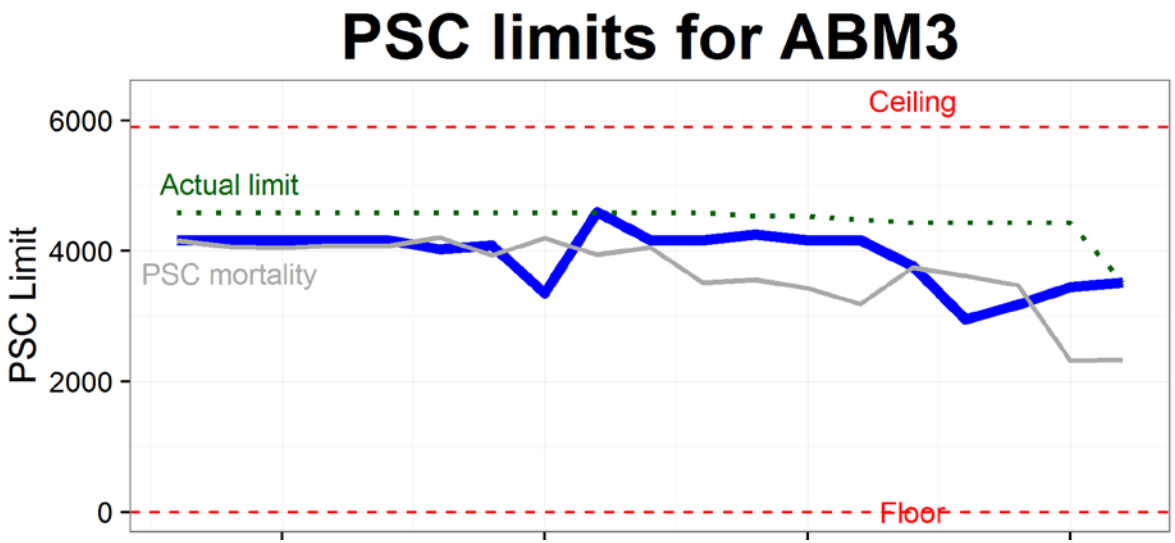


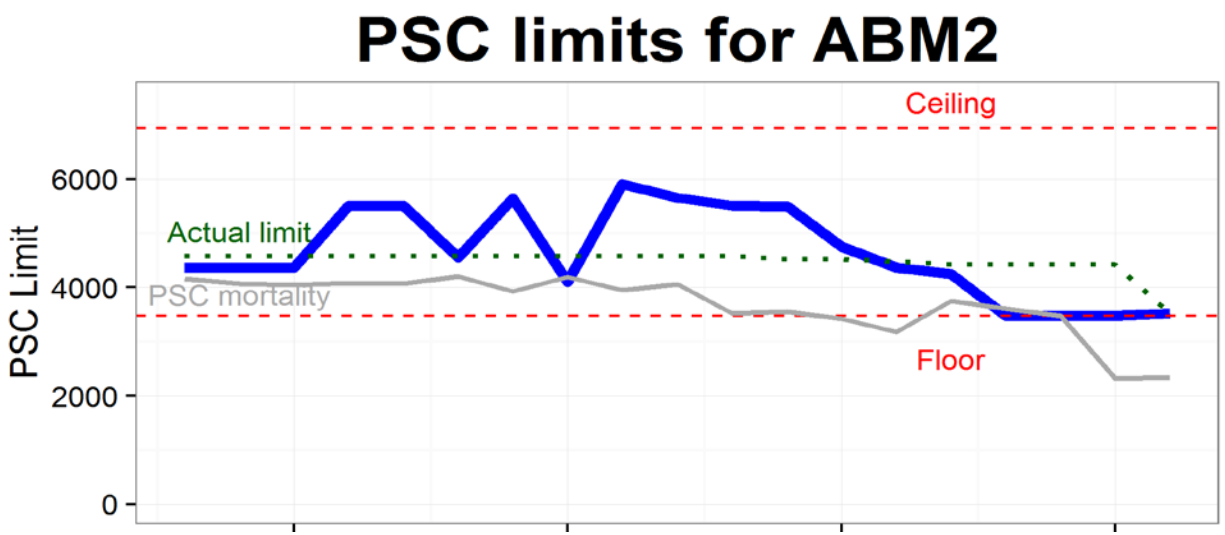
- ABM1 example tuned to 2016 yields the following PSC limits
- With Pacific halibut PSC mortality

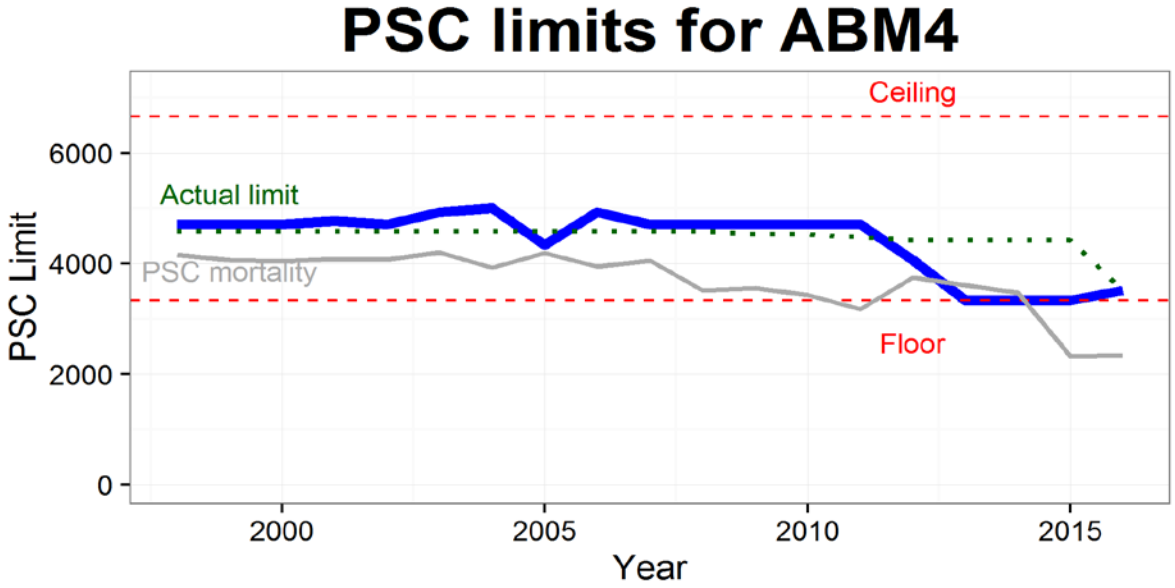


Strawman PSC cap comparisons…



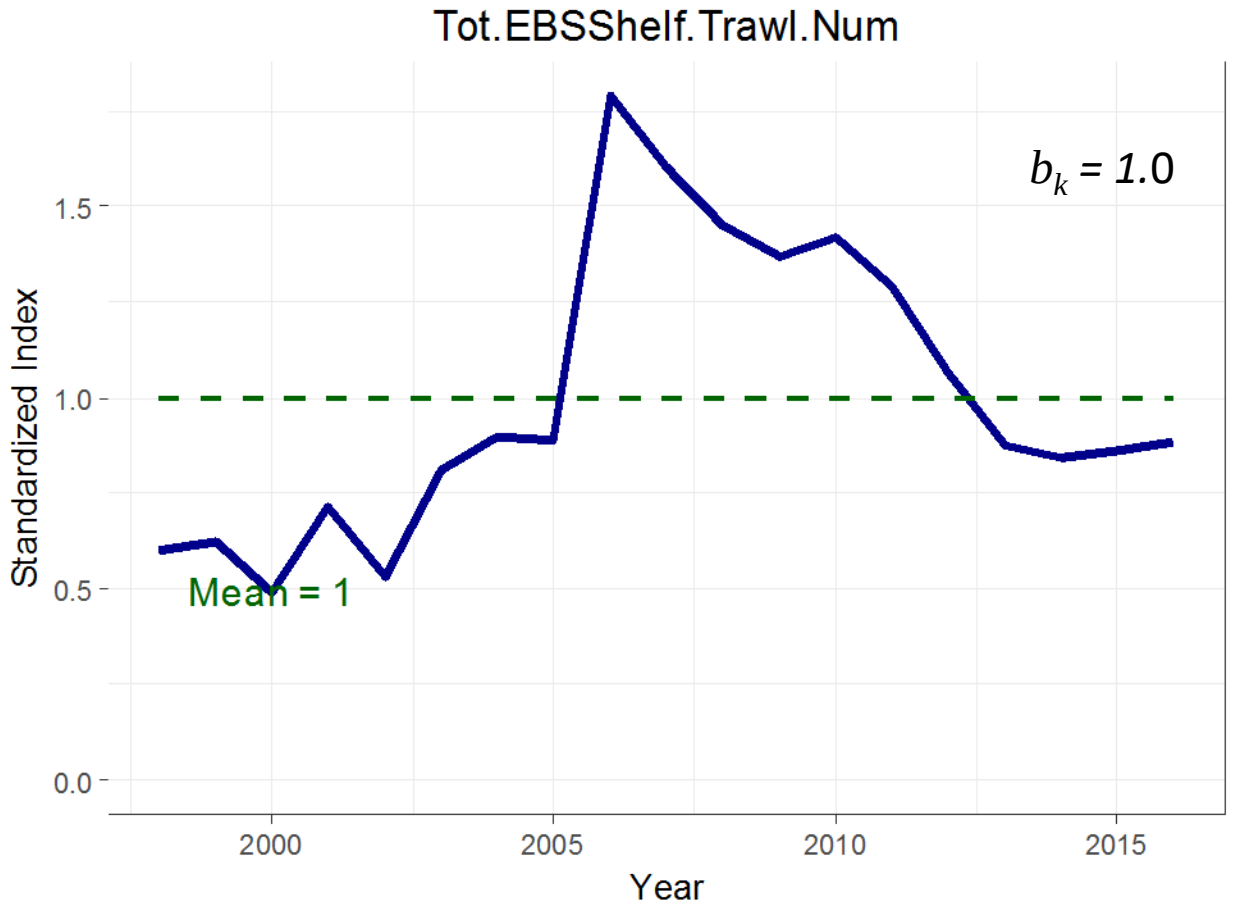






Dialing in "b_k"

If b_k=*1.0* then a 10% change in index *b x* 10% change in adjustment...

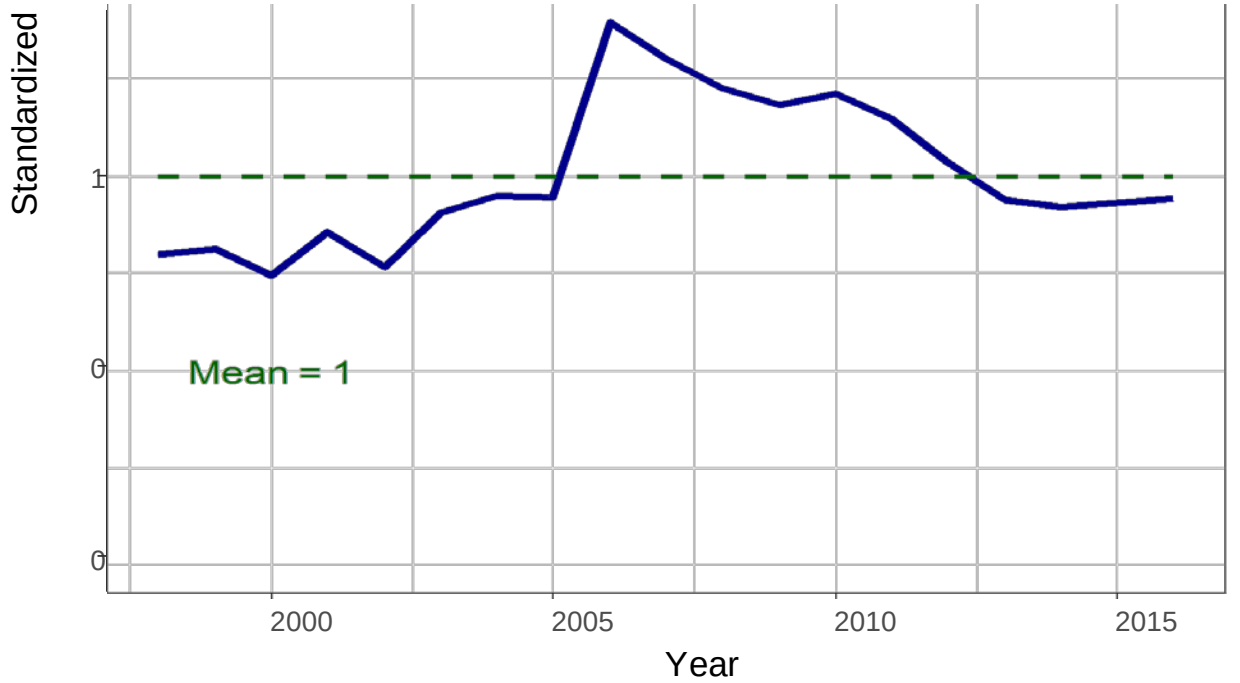


Dialing in "b_k"

If b_k = 0.5…a 10% change in index would result in a 5% change in adjustment

"b_k" basically controls responsiveness to index…

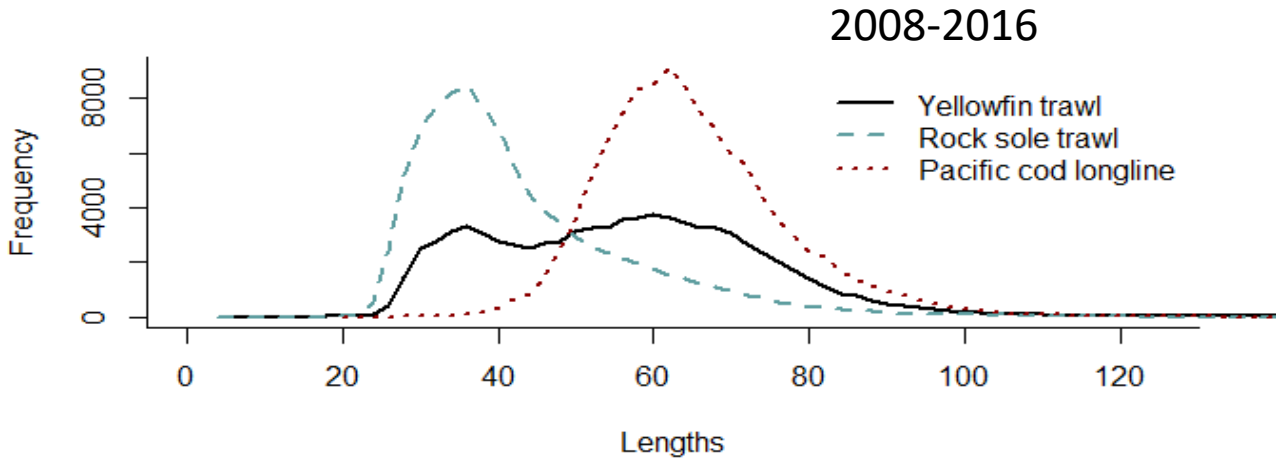
b_k = 0.5

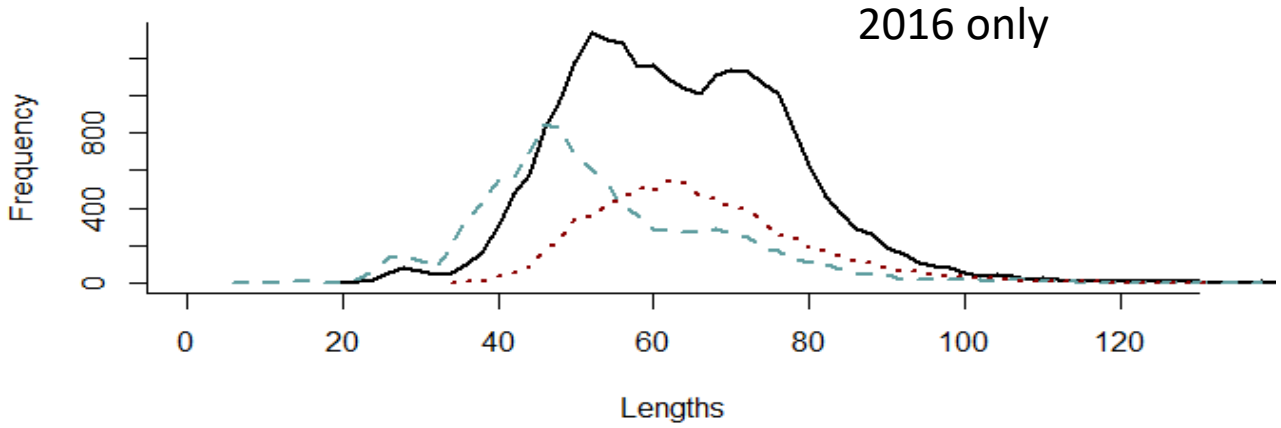


Gear considerations

- Bycatch length composition varies
  - By gear type and fishery
  - Over time
  - Affects relative impact on halibut ("footprint" or SPR rate)
- Gear-specific indices/control rules would create variable PSC allocations

Pacific halibut length frequencies by target fishery and gear type

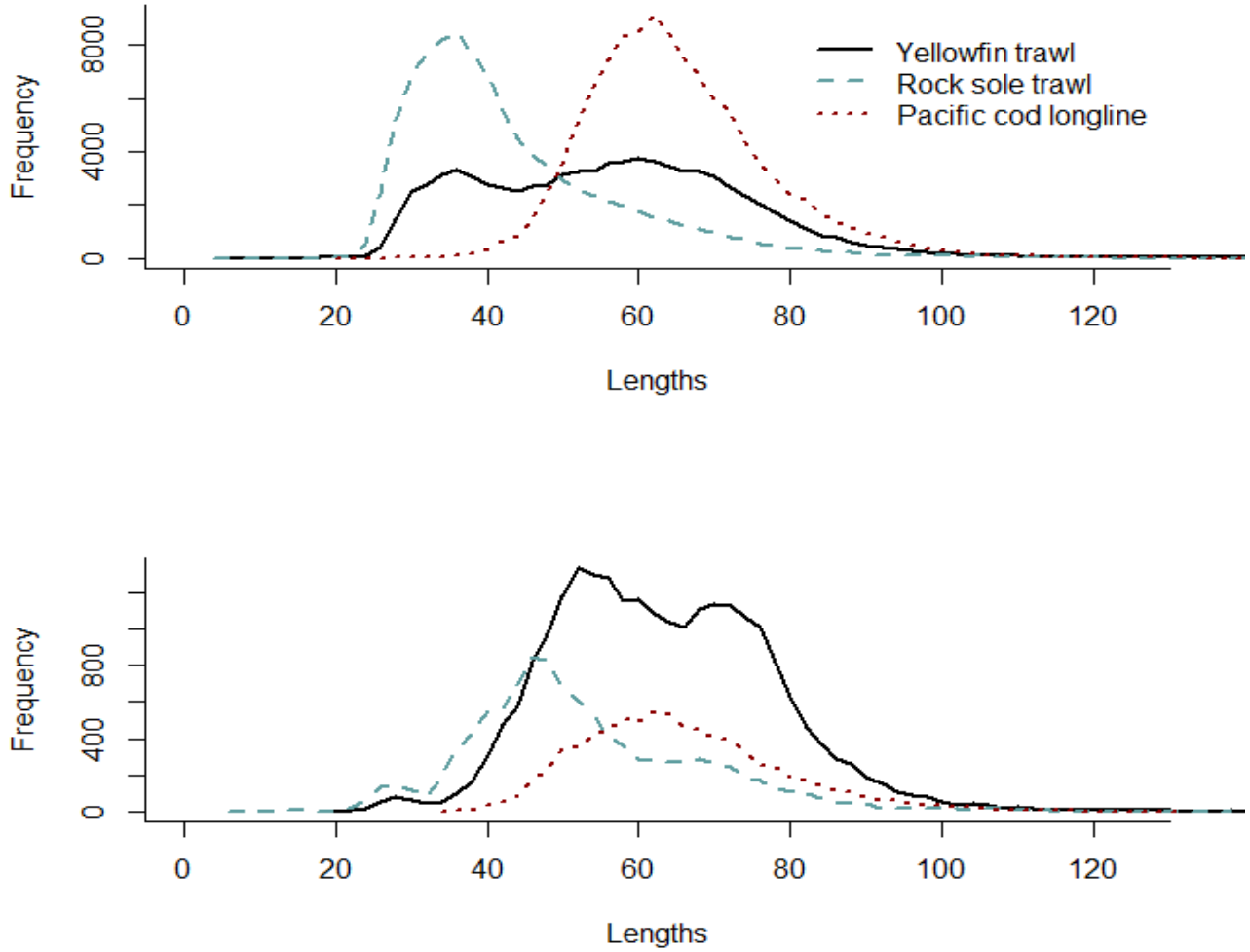




Gear considerations

- Coming up w/ gear-specific indices / control rules possible
  - But time and increased complexity prohibited development

Pacific halibut length frequencies by target fishery and gear type



Expansion to GOA

Generally

- Could be modified for the GOA by changing the “starting point” or scale of the PSC control rule
- Would require index modifications

Other considerations

- Observer coverage
- Management constraints
- Differences in fleets
- Analysis results from EBS may not apply to GOA

Feedback from February 2017 workshop

Workshop goals:

- Review the need for goals, measurable objectives and related performance metrics
- Ask questions to assist in the development of measurable objectives and related performance metrics
- Solicit feedback on modifications or additions to these objectives and performance metrics

Performance metrics

Define detailed management objectives that are measurable

- E.g., maintain halibut catch above certain level over a specified period w/ some probability of not falling below (risk)

A performance metric can then be defined to evaluate whether or not a measurable objective has been achieved

- E.g., the probability that the spawning stock abundance is above a certain level over a specific number of years

from February 2017 workshop

Performance metrics

Measurable objectives identified and will be used for

- Developing alternatives
- Developing performance metrics for alternatives analysis

Examples included

- That indices should consider size composition of PSC and directed catch
- To consider encounter rates of halibut in groundfish fishery as a metric
- Developing social and community metrics for
  - Groundfish crew jobs and
  - Halibut processor needs to viably operate (i.e., catch from directed halibut fishery)

The work group will continue to develop performance metrics throughout this process to make sure that results can be adequately evaluated against all important objectives

Incentives

Workshop participants noted the need to consider appropriate incentives when designing alternatives for analysis

Suggestions:

- Council should consider the impacts of a floating PSC limit on the incentives for groundfish vessels to avoid halibut
- ABM alternatives should include specific measures to ensure that vessels minimize PSC to the extent practicable at all levels of halibut abundance

from February 2017 workshop

Incentives

- The action currently under consideration would index BSAI halibut PSC limits to abundance
- The framing of alternatives should consider the impacts of this management change on incentives to avoid bycatch at a sector and vessel level
- Some stakeholders suggested the Council could consider developing specific incentive components as part of the ABM action (e.g., require halibut avoidance plan)
- The discussion paper highlights general considerations for developing incentive components in response to this suggestion

Next steps