INTERNATIONAL PACIFIC HALIBUT COMMISSION

Management Strategy Evaluation: update

Agenda Item 8.1

(IPHC-2018-IM094-12)

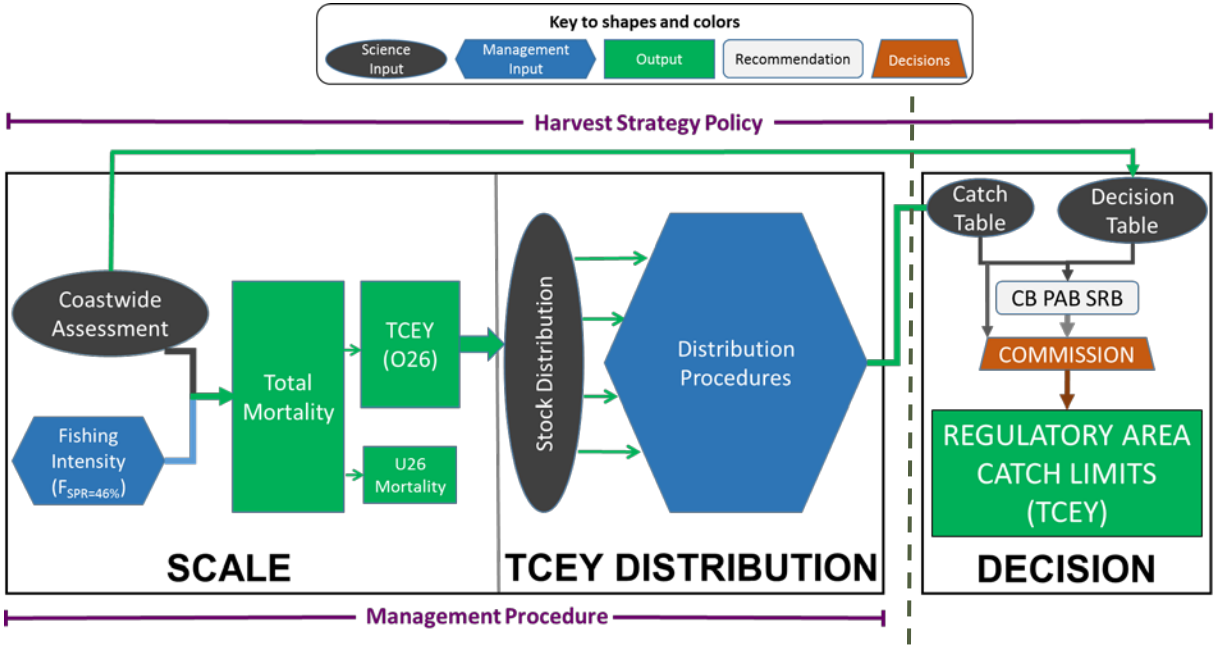
D. Griffay

Program of Work

AM095 (2019): Results on Scale

AM096 (2020): Update on Distribution and Scale

AM097 (2021): Results on Distribution and Scale

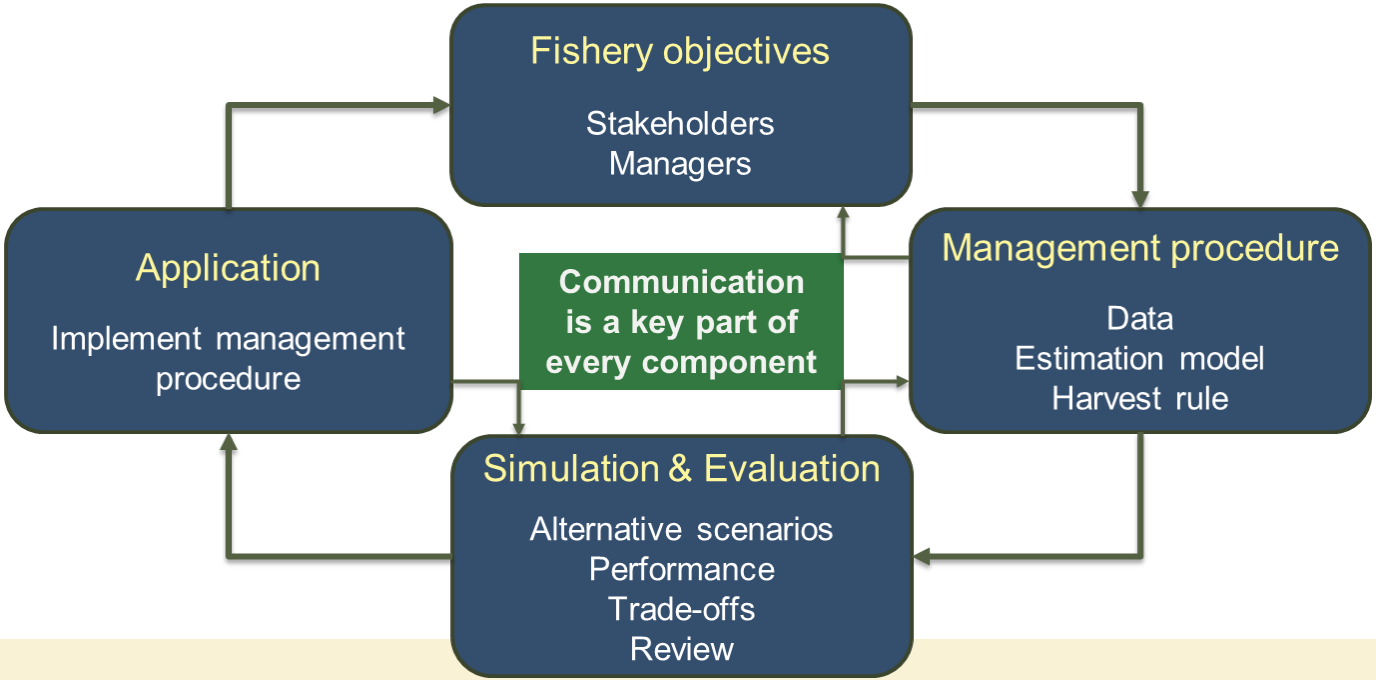


Outline

- Biological and fishery objectives related to Scale
- Results on Scale
- Update on Distribution

Management Strategy Evaluation (MSE)

a process to evaluate harvest strategies and
develop a management procedure that is robust to uncertainty and
meets defined objectives



Primary Biological objectives

1.1. The primary objective is to avoid a critical biomass below which the stock may not recover

- No more than a 10% risk of being below
- 20% of the dynamic unfished equilibrium biomass
- Long-term (and short-term is of interest)

Short-term: 4-13 years	Medium-term: 14-23 years	Long-term: Equilibrium

Primary Fishery objectives

2.1. Limit annual changes in the TCEY

- No more than a 25% risk of being above
- 15% Average Annual Variability (AAV)
- Short-term (and long-term is of interest)

2.2. Maintain a minimum TCEY

- Not sure what that minimum is or a tolerance

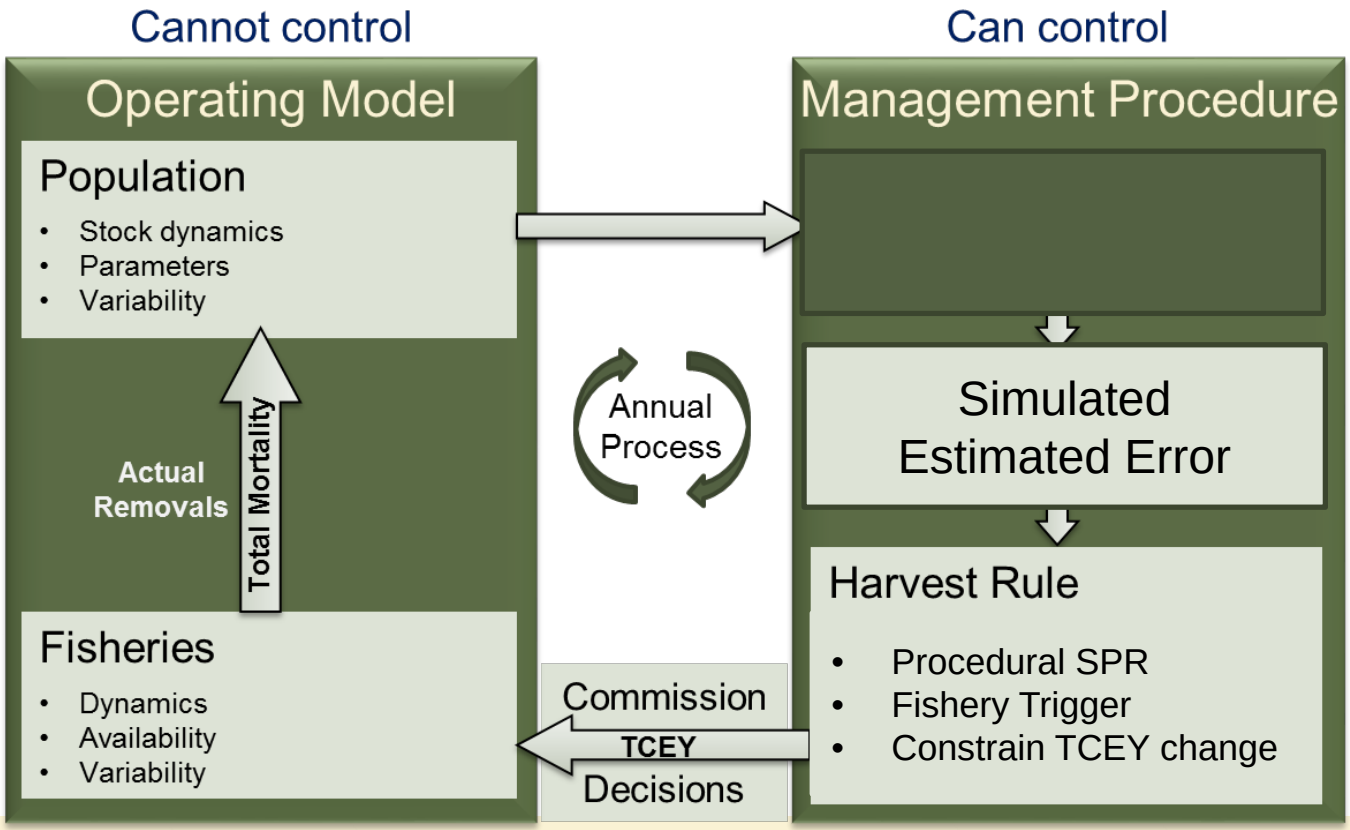
2.3. Maximize TCEY subject to above

Prioritized objectives

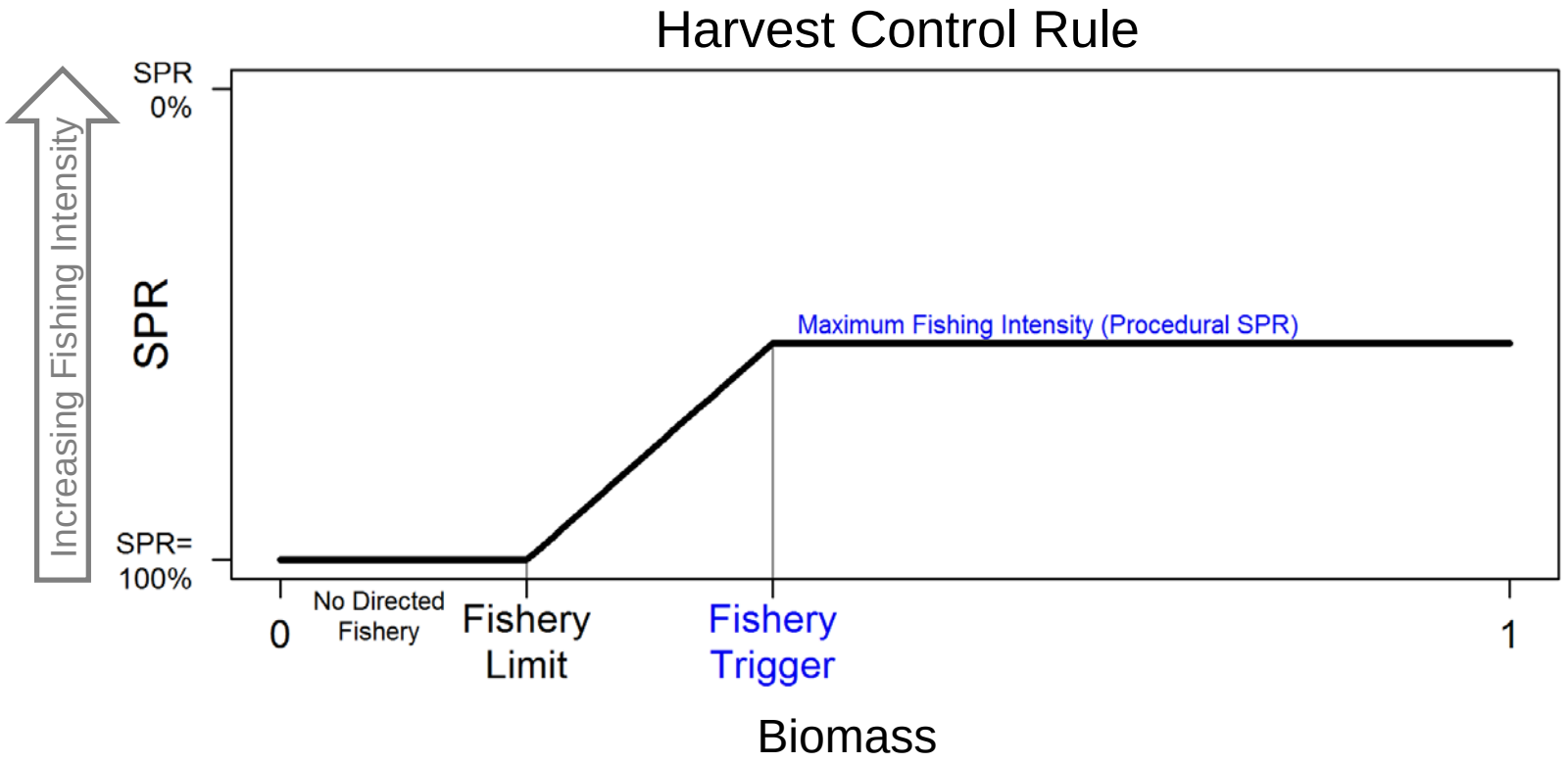
- Must meet long-term Biological Sustainability (1.1)
- Then meet short-term catch limit stability (2.1) and maintain a minimum catch limit (2.2)
- Then maximize short-term fishery yield subject to above

- Statistics of interest can be informative and benefit the evaluation
  - For example. P(SB<30%), median AAV, or quantiles

Closed-loop simulation framework



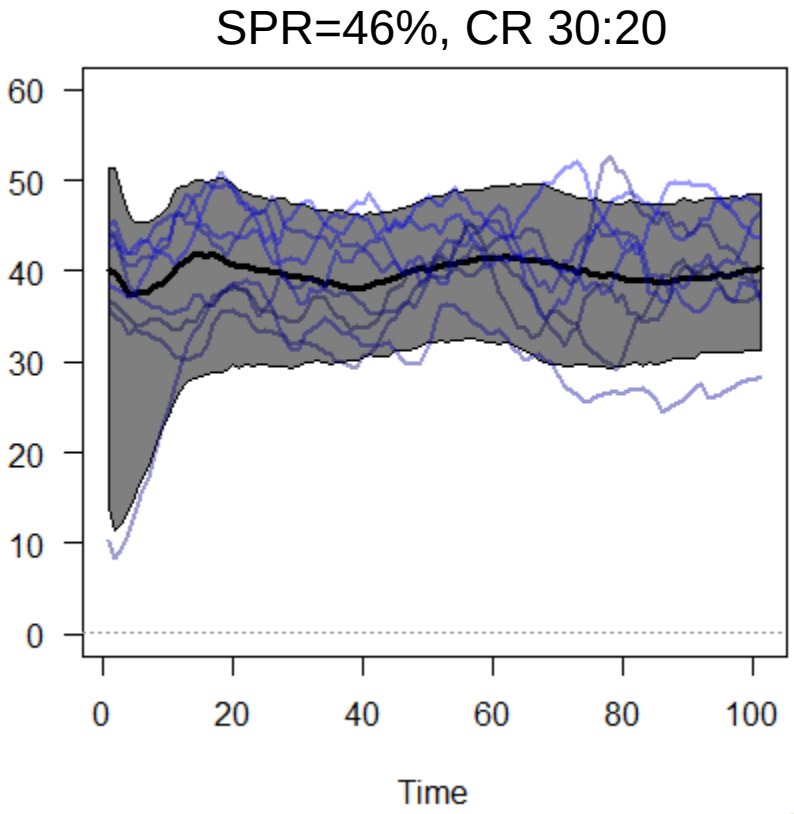
Scale Management Procedure



Simulated trajectories (spawning biomass)

Reminder

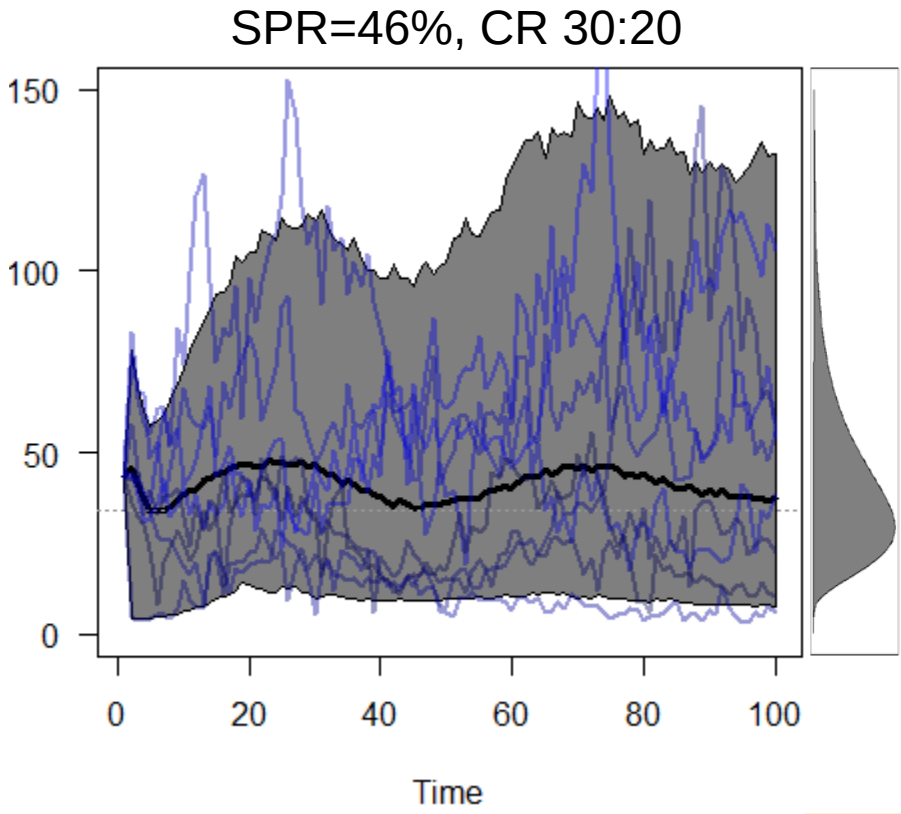
- Goal of MSE is to evaluate MPs for robustness given possible scenarios (strategic)
- Goal of assessment is to predict past, now, and immediate future (tactical)



Simulated trajectories (total mortality)

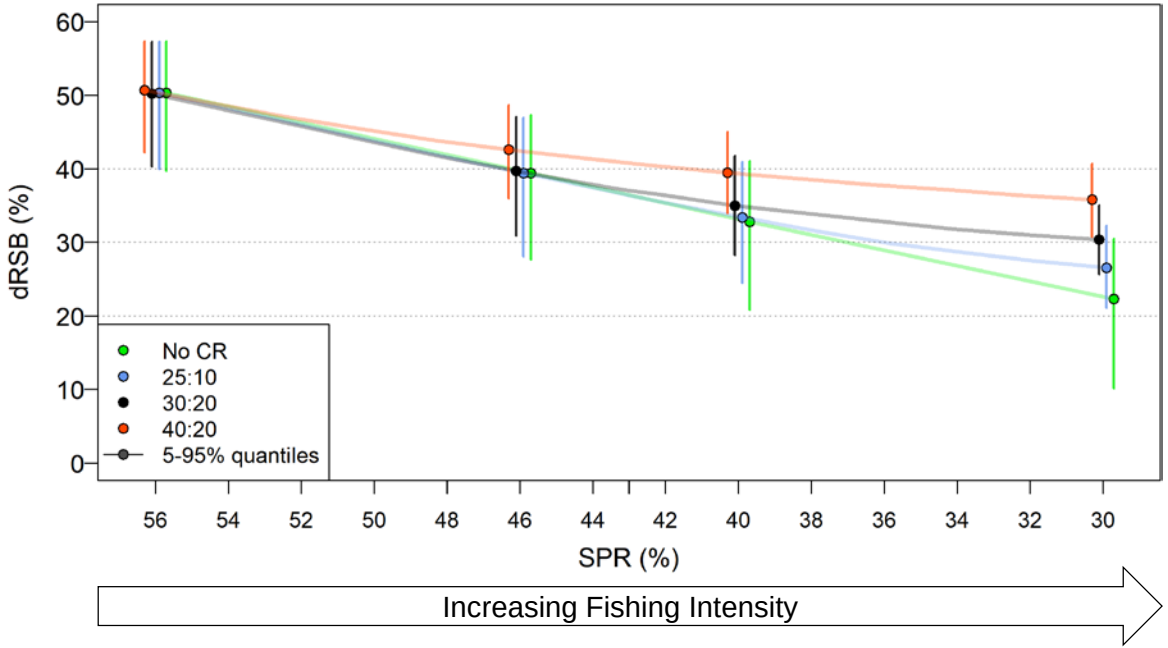
Variability

- The population is inherently variable
- Estimation error contributes to majority of the variability
- SPR-based rule adjusts TM according to this variability

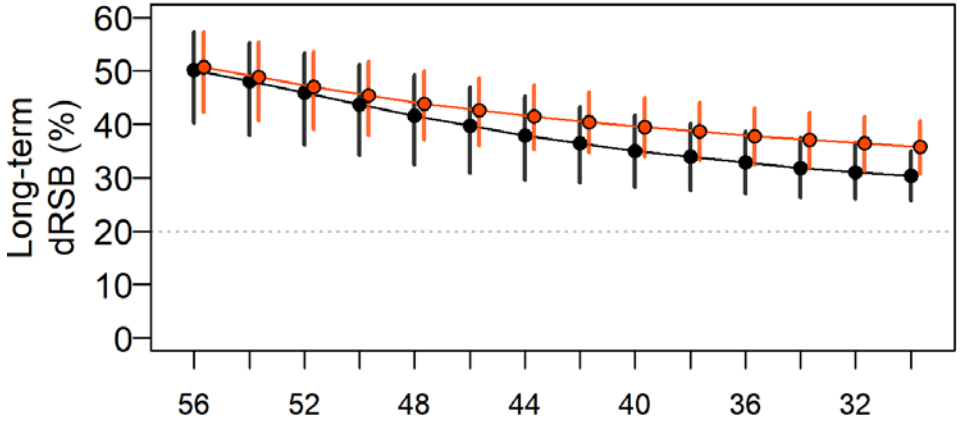


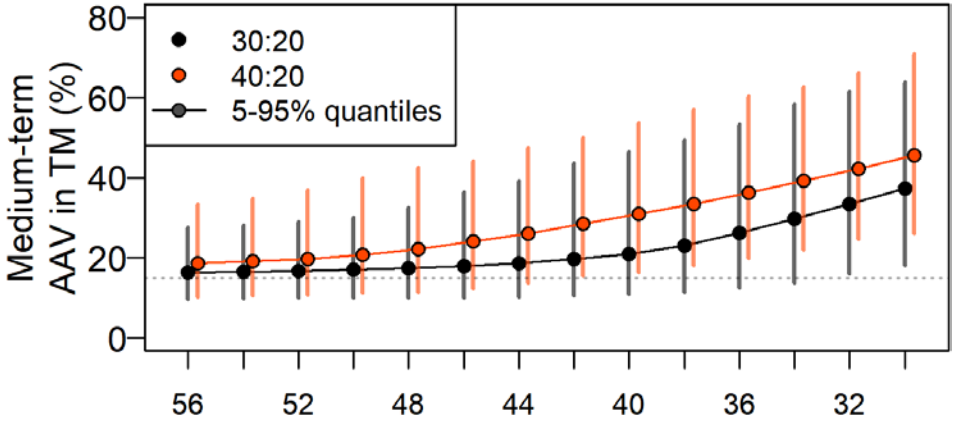
Effect of the control rule (CR)

- Similar biomass at low fishing intensity (FI)
- Higher biomass at high FI with CR
- The combination of SPR and CR determines average biomass level
- Lower risk of low biomass with CR

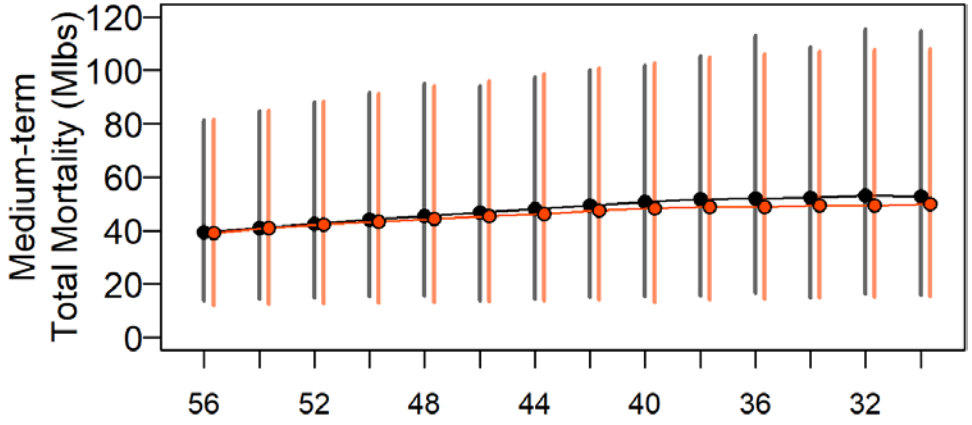


Performance metrics (40:20 & 30:20)

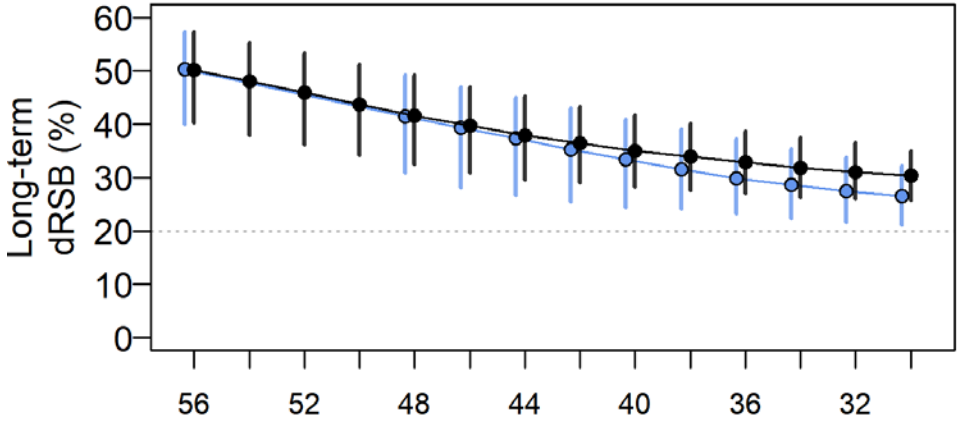


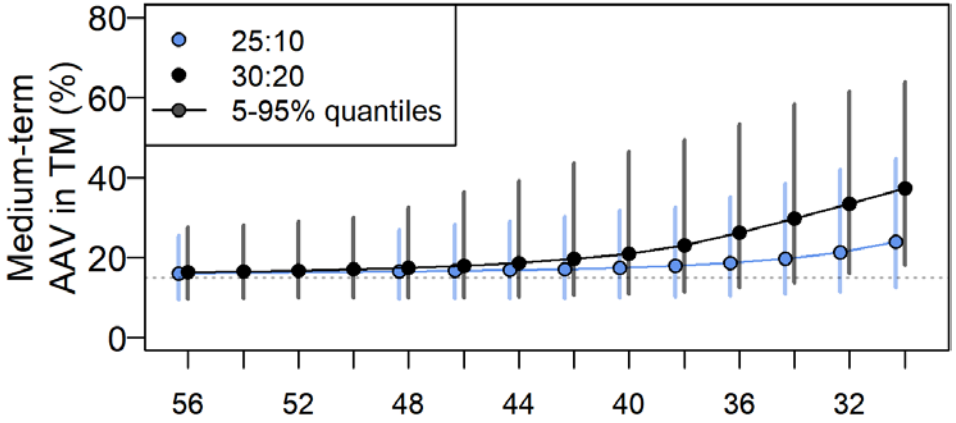


- Bio objective satisfied for all procedures
- AAV objective not satisfied for all procedures
- Median TM increases slightly and range increases with FI

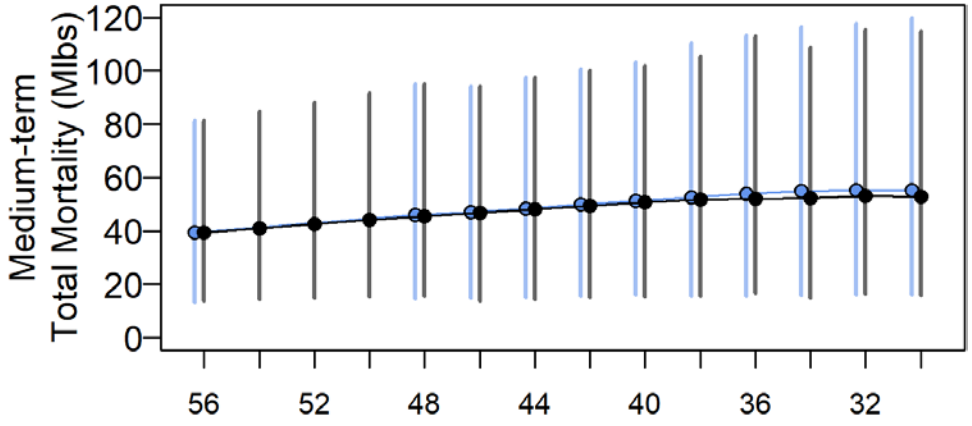


Performance metrics (25:10 & 30:20)





- Bio objective satisfied for all procedures
- AAV objective not satisfied for all procedures (but lower)
- Median TM slightly higher for 25:10 CR



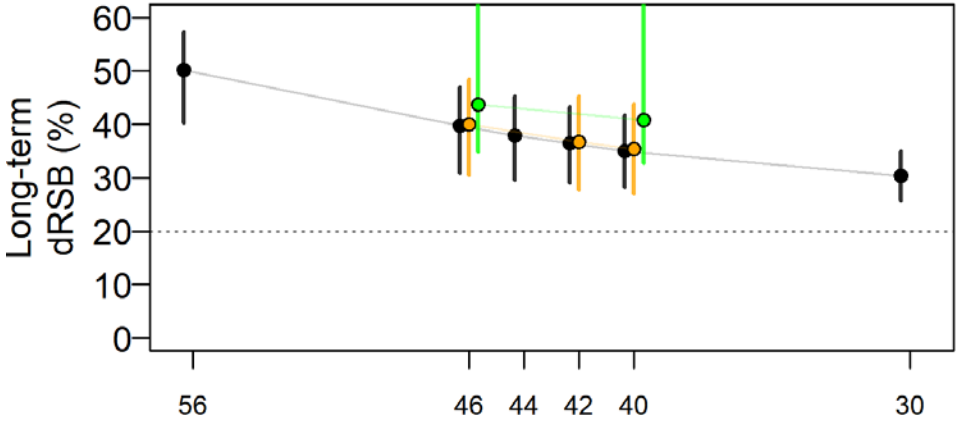
SPR (%)

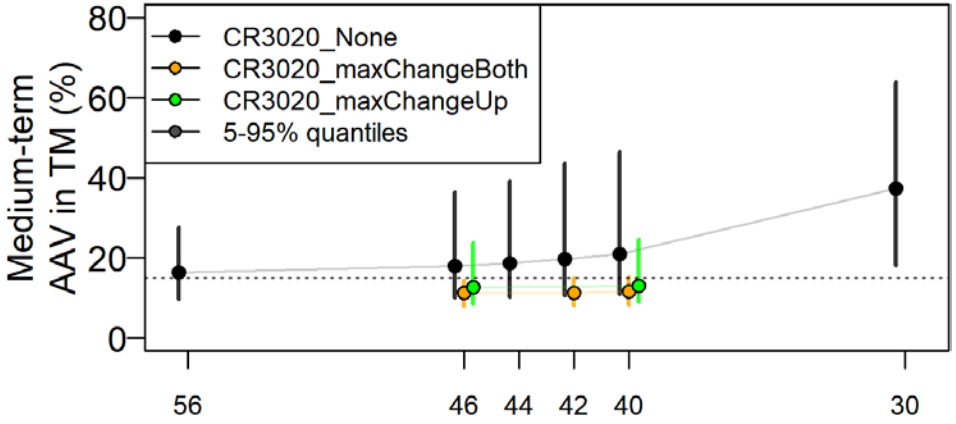
Constrained Management Procedures

All use a 30:20 control rule

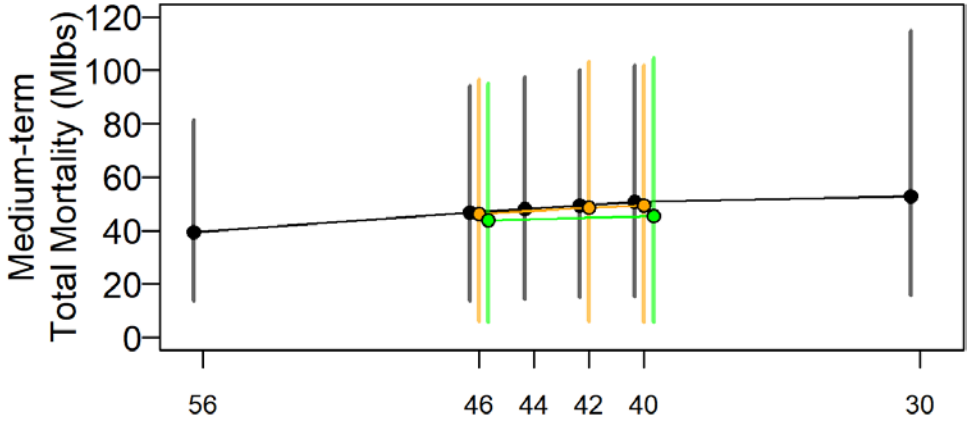
- MaxChangeBoth
  - TM constrained to change no more than 15% up or down
- MaxChangeUp
  - TM constrained to change no more than 15% up, but full down
- SlowUpFastDown
  - TM constrained to increase 1/3rd of amount to procedure TM
  - TM constrained to decrease 1/2 of amount to procedure
- SlowUpFullDown
  - TM constrained to increase 1/3rd of amount to procedure TM
- Cap
  - TM cannot exceed the maximum (60 Mlbs or 80Mlbs)

Performance metrics: Max Change





- Bio objective satisfied by all
- AAV reduced and maxChangeBoth meets objective
- maxChangeUp results in lost yield



Constrained MPs

- Max Change
  - Has potential, but should examine conservation risk and potential for lost yield and fishery closures
- Slow-up, fast or full down
  - Has potential, but should examine conservation risk and potential for fishery closures
- Caps
  - Reduced AAV when stock at high levels, similar AAV when at low levels
  - Possibly increase median yield, but do not take advantage of very high yield opportunities

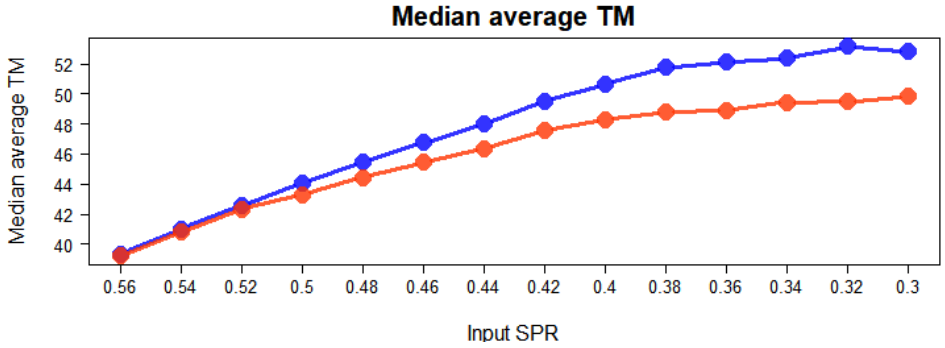
Summary of scale evaluations

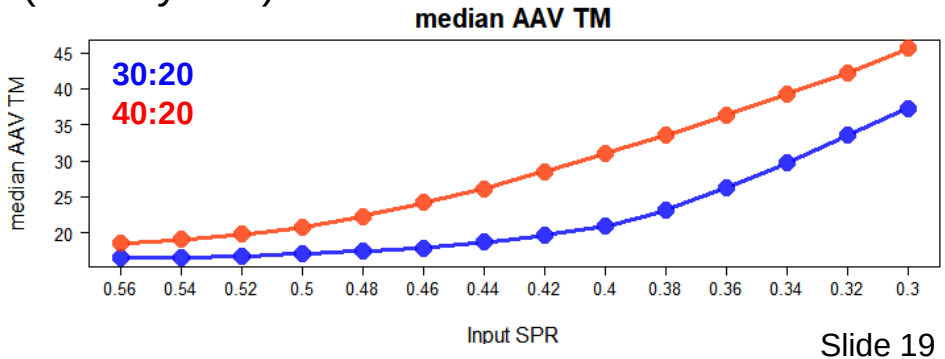
- All MPs with SPR greater than 40% met the long-term biological sustainability objective
  - Short-term biological risks were greater and many MPs showed a greater risk than tolerable (>10%)
- Only some constrained MPs met the variability objective
  - Only maxChangeBoth met this for the short-term
- Median TM differed slightly between MPs, and showed a wide range

Scale outcomes

- Some investigation of control rules may be useful
- A constraint may increase conservation risk, but would reduce mortality limit variability
- At SPR values lower than 40%
  - median mortality limit showed minimal increase
  - the variability in the mortality limit increased more quickly

Medium-term (14-23 years)





Objectives

- Some discussion in the MSAB was about being comfortable keeping the stock around a specific biomass
  - An unstated biological objective

MSE Explorer

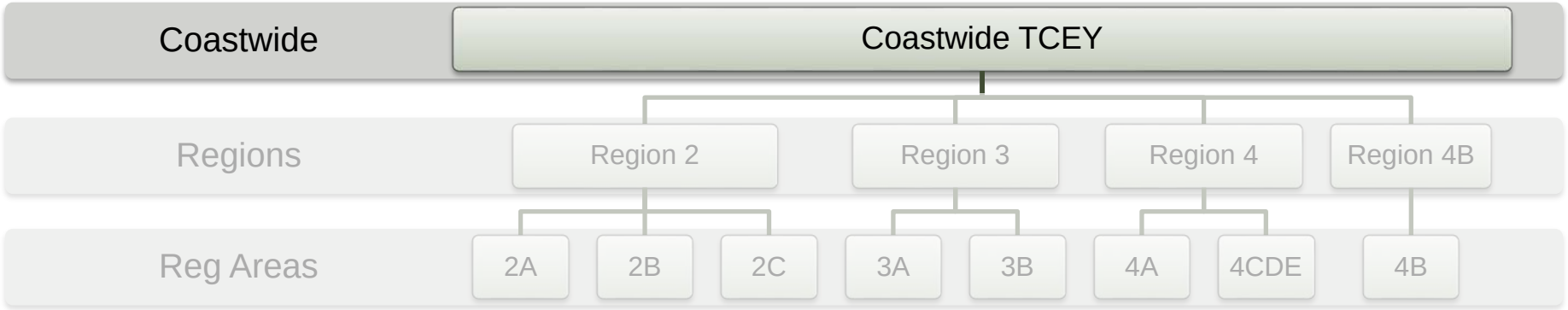
- View the results and make comparisons
- Create tables that can be downloaded
- Create plots that can be saved

http://bit.ly/iphc-msab012

A procedure for distributing the TCEY (1)

Coastwide Target Fishing Intensity

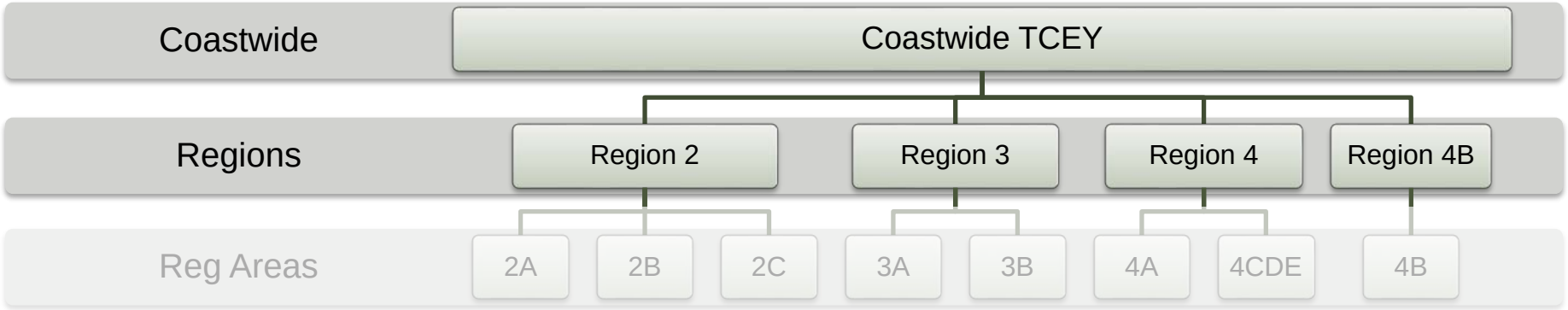
- Determine coastwide Total Mortality from Scale MP
- Separate TM into O26 (TCEY) and U26 components



A procedure for distributing the TCEY (2)

Regional Stock Distribution

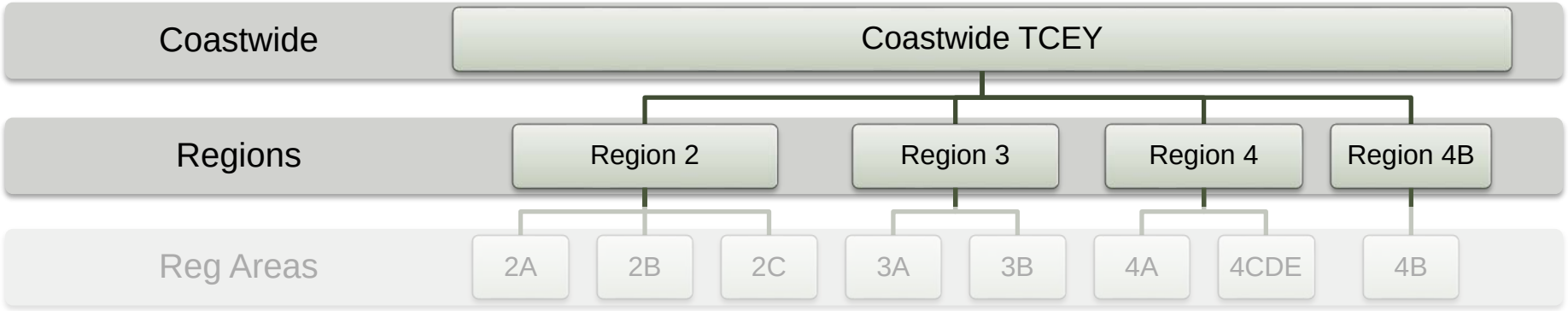
- Distribute the coastwide TCEY to biologically-based Regions
  - Use proportion of the stock estimated in each Region for “all sizes” WPUE index from IPHC fishery-independent setline survey
- Biological Sustainability objectives



A procedure for distributing the TCEY (3)

Regional Allocation Adjustment

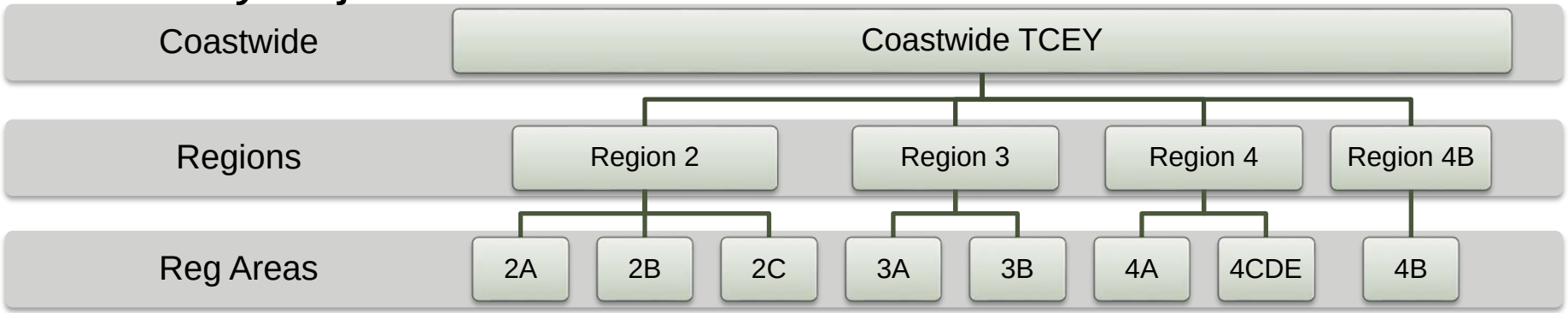
- Adjust the distribution of the TCEY among Regions
  - For example, use relative target harvest rates by Region
- Biological Sustainability and Fishery objectives



A procedure for distributing the TCEY (4)

Regulatory Area Allocation

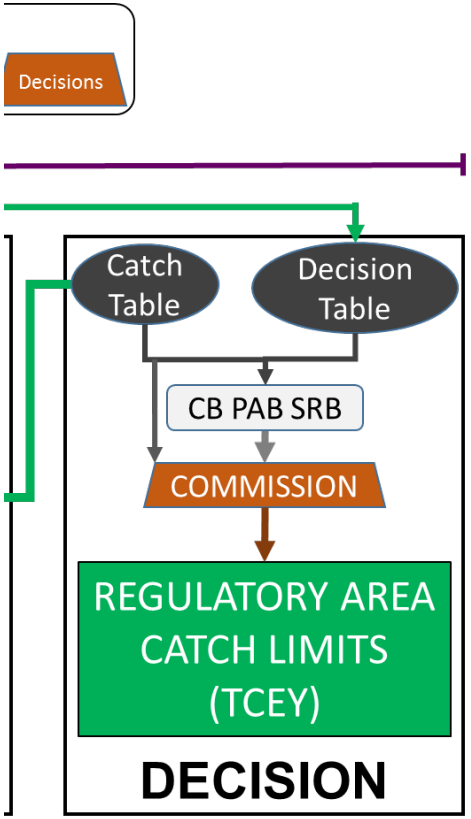
- Apply allocation percentages for each Regulatory Area within a Region
- Based on policy, data, observations, or agreement
- Fishery objectives



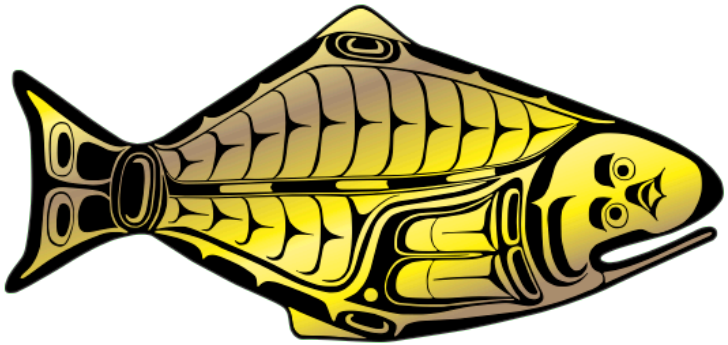
Decision-Making

Annual Regulatory Area Adjustment

- Adjust Regulatory Area TCEY's to account for other factors as needed
- This step may deviate from the management procedure
  - Will have unpredictable consequences
  - The policy part of the harvest strategy policy



INTERNATIONAL PACIFIC



HALIBUT COMMISSION

http://bit.ly/iphc-msab012

Primary Biological and Fishery objectives

General Objective	Measurable Objective	Measurable Outcome	Time-frame	Tolerance	Performance Metric
1.1. Keep biomass above a limit to avoid critical stock sizes **Biomass Limit**	Maintain a minimum female spawning stock biomass above a biomass limit reference point at least 90% of the time	SB < Spawning Biomass Limit (SB_{Lim}) SB_{Lim}=20% spawning biomass	Long-term	0.10	$P(SB < SB_{Lim})$
2.1 Limit Catch Variability	Limit annual changes in the coastwide TCEY	Average Annual Variability (*AAV*) > 15%	Long-term Short-term	0.25	$P(AAV > 15\%)$
2.2 Maximize Directed Fishing Yield	Maintain TCEY above a minimum level coastwide	Coastwide TCEY < $TCEY_{min}$	Long-term Short-term	?? ??	$P(TCEY < TCEY_{min})$

Primary Biological and Fishery objectives

General Objective	Measurable Objective	Measurable Outcome	Time-frame	Tolerance	Performance Metric
1.1. Keep biomass above a limit to avoid critical stock sizes **Biomass Limit**	Maintain a minimum female spawning stock biomass above a biomass limit reference point at least 90% of the time	SB < Spawning Biomass Limit (SB_{Lim}) SB_{Lim}=20% spawning biomass	Long-term	0.10	$P(SB < SB_{Lim})$
2.1 Limit Catch Variability	Limit annual changes in the coastwide TCEY	Average Annual Variability (*AAV*) > 15%	Long-term Short-term	0.25	$P(AAV > 15\%)$
2.2 Maximize Directed Fishing Yield	Maximize TCEY subject to other objectives	Median TCEY	Long-term Short-term		$Median(TCEY)$

Biological objective

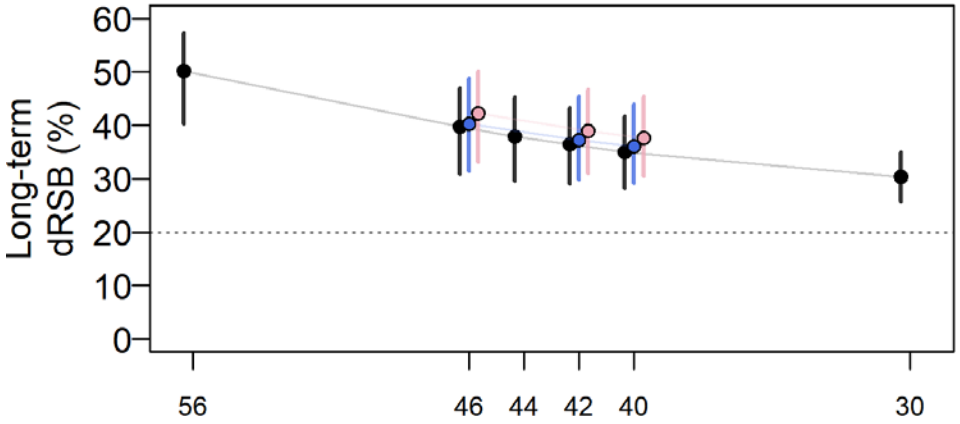
- Why is there only one biological objective?
  - Two spawning biomass objectives makes one moot
  - The target SPR results in an equilibrium biomass

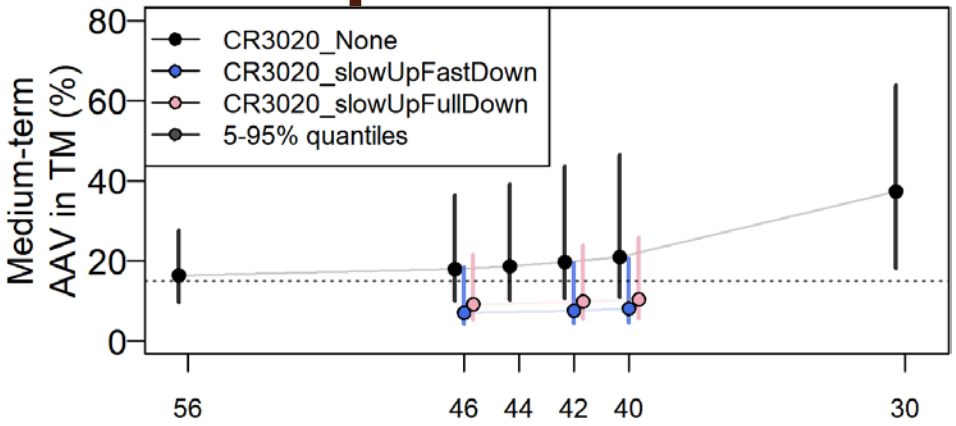
Increasing Fishing Intensity

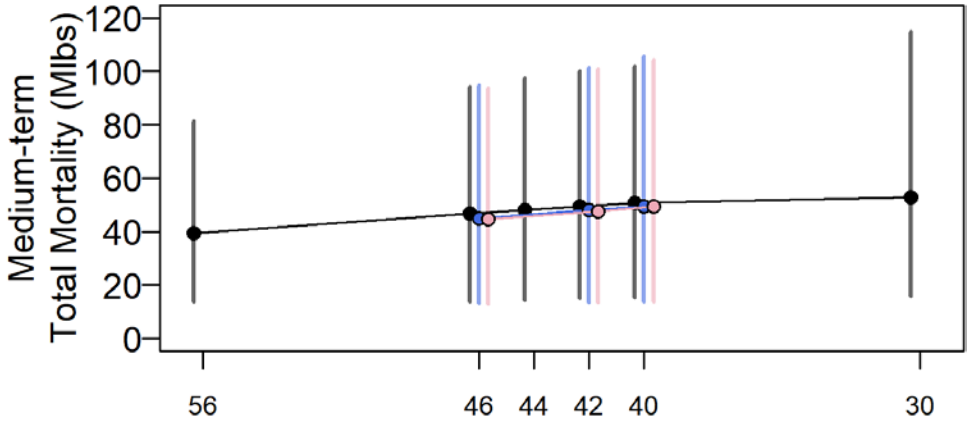
SPR	56%	46%	40%	36%	30%
Theoretical stock status	52%	41%	35%	30%	24%
Simulated stock status	49%	41%	36%	32%	27%

  - The main objective is to avoid critical states where the stock may not recover (i.e., 20% of unfished)

Performance metrics: Slow-Up

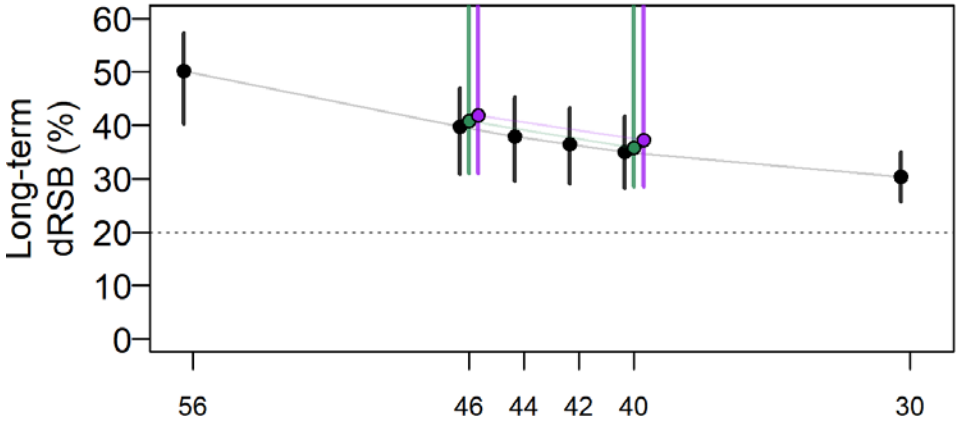


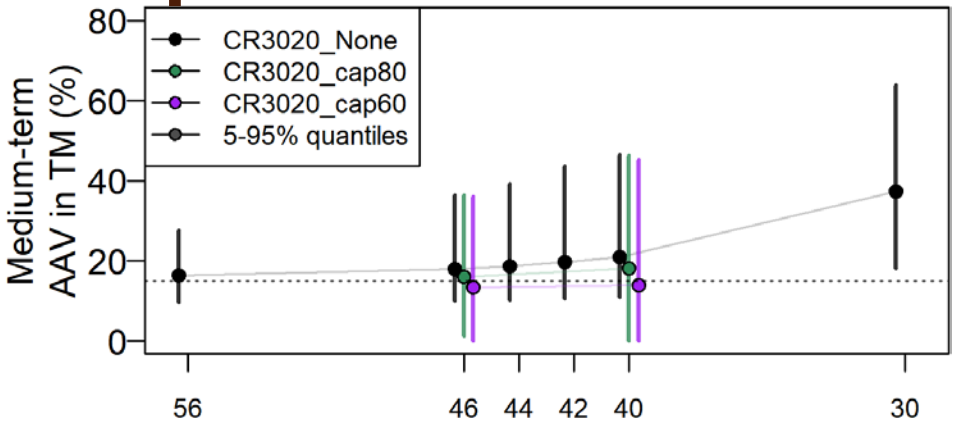




- Bio objective satisfied by all
- AAV reduced and some SPRs meet objective for medium- and long-term
- Slightly reduced yield
- Values other than those specified not simulated

Performance metrics: Cap





- Bio objective satisfied by all
- AAV reduced but does not meet objective
- Does not take advantage of high catch potential, but slight increase in median TM
- Drivers other than fishing are a large part of variability