IPHC staff workplan for MSAB from May 2016 to May 2018

A detailed look

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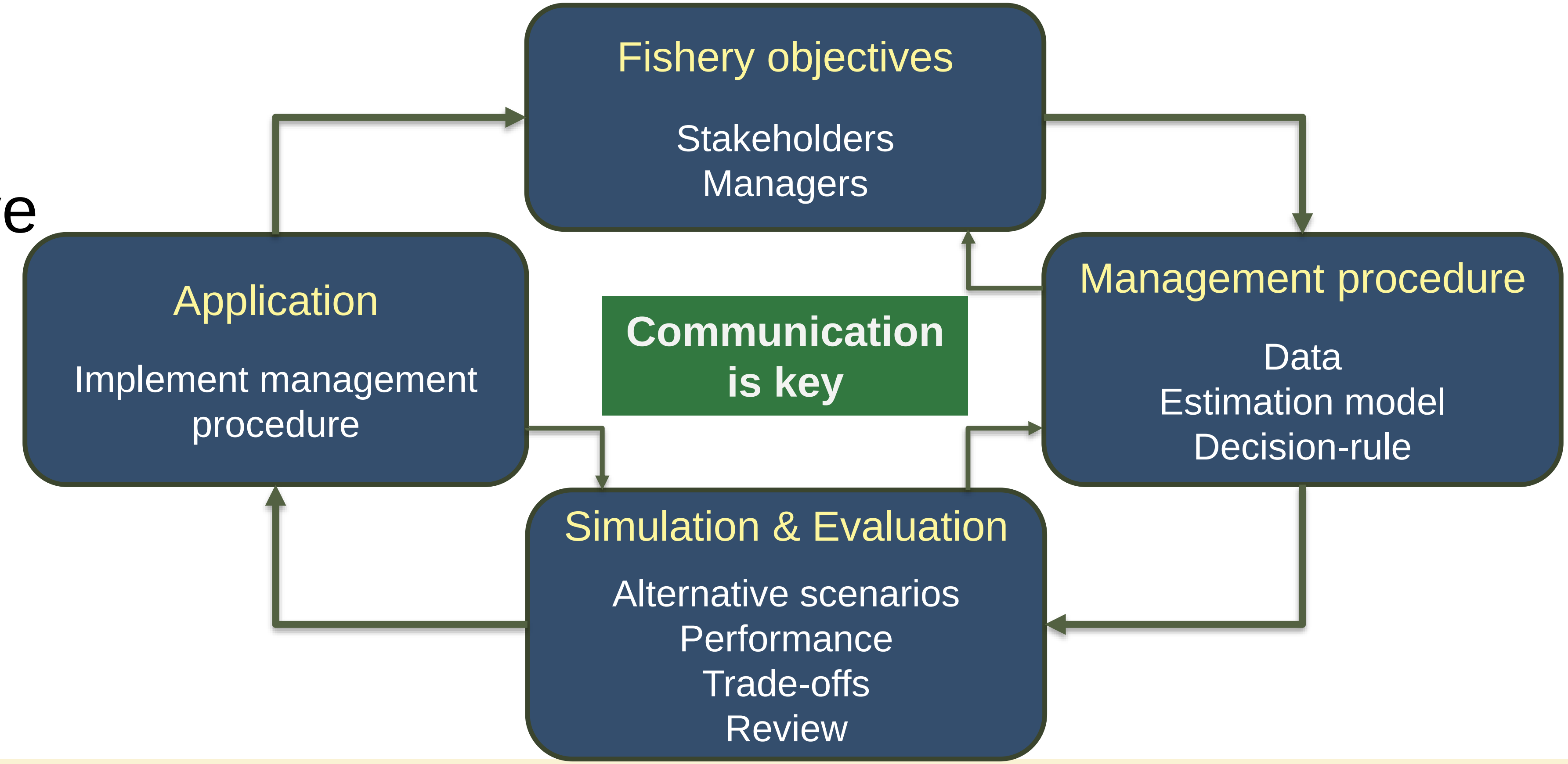
INTERNATIONAL PACIFIC HALIBUT COMMISSION

Review

- The work plan describes tasks for the next 2 years and a timeline for when work on those tasks will be done and be reported
- A plan that is flexible and may be modified as needed
- MSE is an adaptive learning process with consultation and repetition

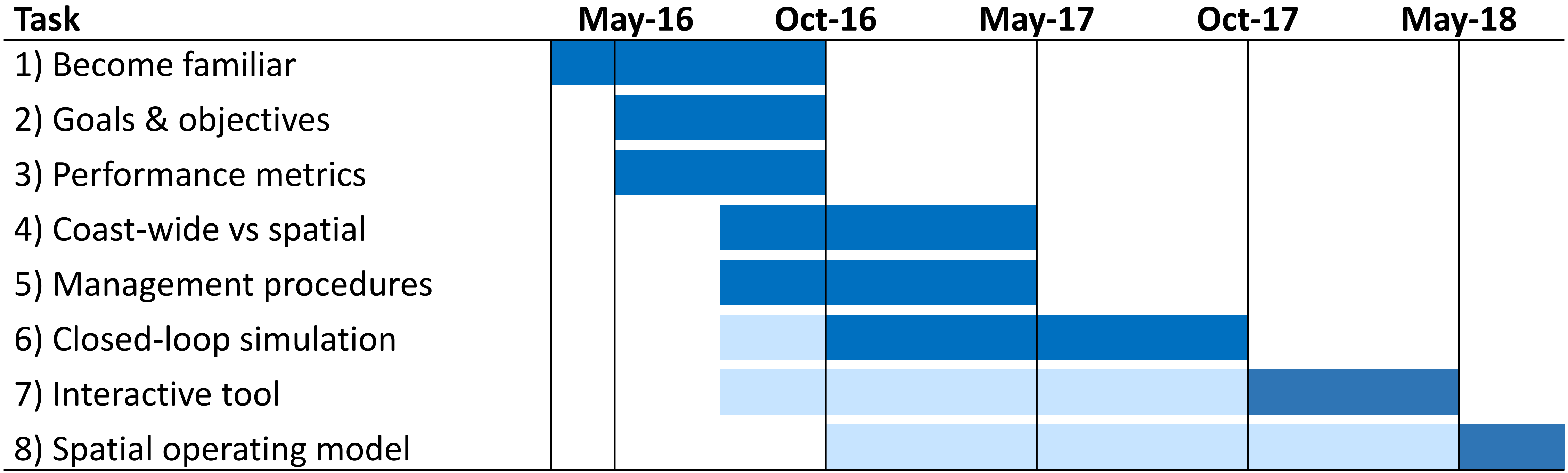


Past Accomplishments

- The Commission created the MSAB and a stakeholder driven process
- There have been six meetings in three years, led by Dr. Steve Martell
- Identified a working procedure within the MSAB
  - Terms Of Reference, co-chairs, facilitator
- Familiarization with the MSE process
- A lot of analysis work
  - Defined goals for the halibut fishery and management.
  - Development of objectives and performance metrics from those goals.
  - Identified some management procedures
  - Developed an interactive tool (the Shiny application).
  - Discussions about coast-wide and spatial models.
- Developed an outreach plan

Future plan

- Keep moving forward
- Use what has been learned to make progress on investigating management strategies
- Focus on uncertainty in the projections and achievement of objectives



Outline of this session (detailed work plan)

- Present each task in more detail
  - Provide some more background and my view of that task
  - Give examples and how the task expands on progress already made
  - Discuss the resources needed
  - List the deliverables
  - Present a timeline for the task
- Some tasks will have more detail than others

Task 1: Become familiar with halibut and past

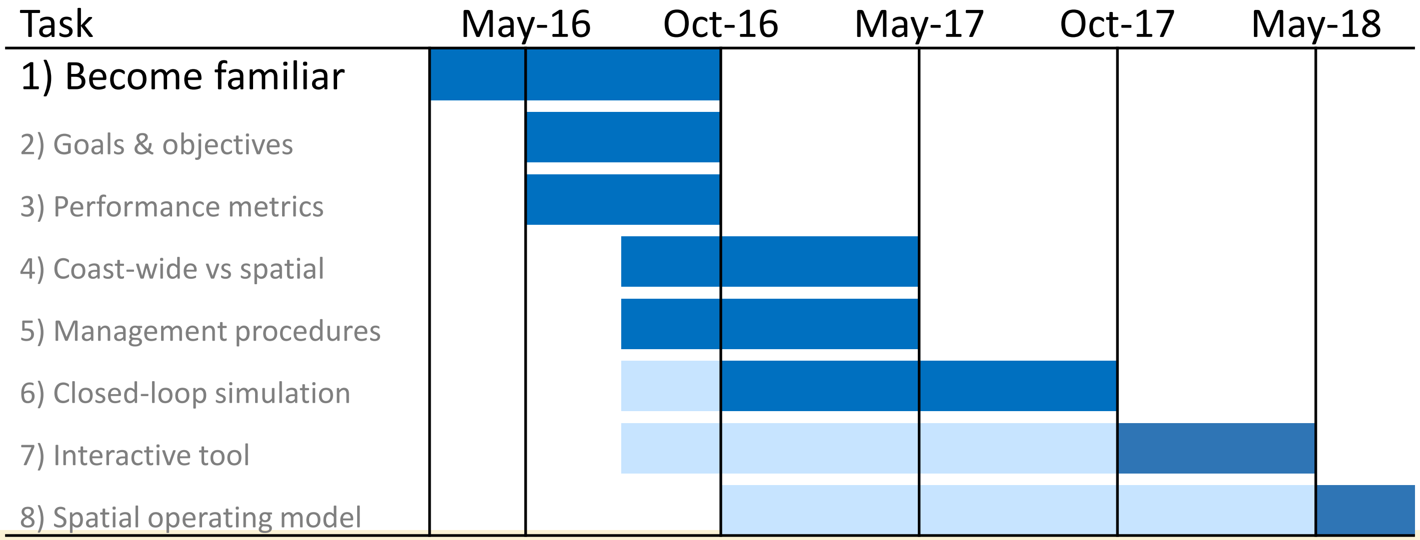
- Provide myself with time to learn about the research and management of Pacific halibut
- I am fortunate to come into a process that is already developed

Task 1: MSAB Process

- Develop a process for planning, reporting, and reviewing projects
  - Involve the SRB to review products of the MSAB
  - A possible annual process
    1. May MSAB: Logistics, plan, develop
    2. June SRB: Present plan for endorsement
    3. Sept SRB: Review results
    4. Oct MSAB: Present reviewed results, make decisions
    5. Dec Interim meeting: Present draft results and decisions to Commission
    6. Jan Annual meeting: Present reviewed results and decisions

Task 1: Resources, Deliverables, Timeline

- Resources: myself
- Deliverables
  - Hopefully I can deliver in terms of a good understanding of the issues
- Timeline
  - Need a short amount of time initially
    - A specific focus on this for next few months
  - This task is ongoing as I will always be learning about
    - Past research,
    - Current methods,
    - Management goals
    - Stakeholders objectives



Task 2: Verify goals and objectives

- Review the current goals and objectives
- Revise if necessary

Five Overarching Goals

- Biological sustainability
- Fishery (all directed fisheries) sustainability and stability
- Assurance of access – minimize probability of fishery closures
- Minimize bycatch mortality
- Serve consumer needs

Task 2: Verify goals and objectives

- Translate into measureable objectives
  1. An outcome (what you want)
  2. A time frame (when you want the outcome)
  3. A probability (tolerance for failure)

Goal: Assurance of access (minimize fishery closures)

A Measureable Objective

Outcome: *Predicted spawning biomass greater than* $0.20B_0$

Time Horizon: *Evaluate over a 10 year period far in the future*

Probability: *At least 95% of the time*

Task 2: Current goals and objectives

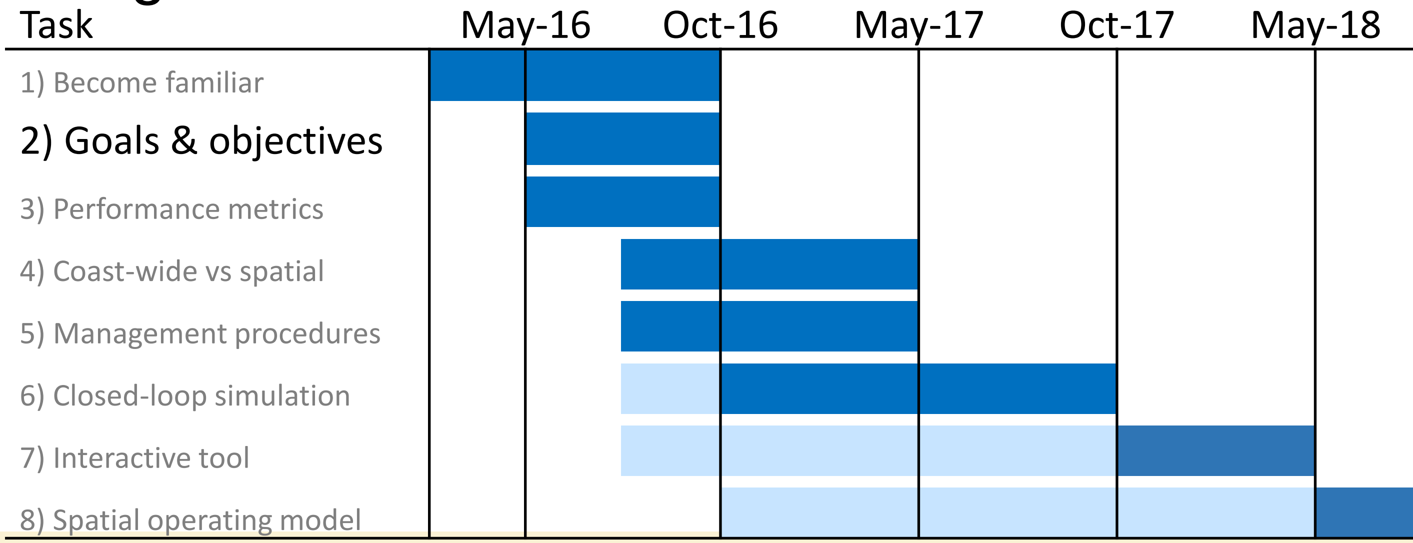
Goals	Objective	Outcome	Probability	Time frame
Biological sustainability	Keep abundance above a certain level (**Limit**)	Maintain a minimum of number of mature female halibut coast-wide (e.g., one million)	0.99	Each year
		Maintain a minimum spawning stock biomass of 20% of the unfished biomass	0.95	Each year
	Reduce harvest rate when abundance is below a certain level (**Threshold**)	Maintain a minimum spawning stock biomass of 30% of the unfished biomass	0.75	Each year
	Risk tolerance and assessment uncertainty	When the estimated biomass is between the limit and threshold, reduce the probability of further declines	0.05-0.5	10 years

Task 2: Current goals and objectives

Goals	Objective	Outcome	Probability	Time frame
Fishery sustainability and stability **Assurance of access** **Serve consumer needs**	Maintain directed fishing opportunity (fish at the target harvest rate) Maintain a median catch within ±10% of 1993-2012 average Maintain average	Maintain directed fishery (*needs a quantifiable unit*)	0.95	Each year
	Catch at >70% of historical 1993-2012 average	Maximize yield in each regulatory area (*needs a quantifiable unit*)	0.5	Each year
			??	Within 5 years
	Harvest efficiency	Wastage in the longline fishery <10% of annual catch limit	0.75	5 year period
	Limit catch variability	Annual changes in TAC (coastwide or by Regulatory Area) are less than 15%	1	Each year

Task 2: Resources, Deliverables, Timeline

- Resources
  - Myself and the MSAB members will need to review and refine
- Deliverables
  - A list of goals important to the management of the halibut fishery
  - A set of measureable objectives associated with those goals
- Timeline
  - Work on this at October 2016 meeting
  - But is always to be revisited



Task 3: Develop and refine performance metrics

- Performance metrics gauge performance relative to objectives
  - They are typically easily defined from the “outcome” of measureable objectives
  - It may be easy to define them as a probability
  - There may be more sophisticated metrics
- Determining important and useful metrics, as well as how to present them is key to
  - Communicating outcomes
  - Interpreting MSE results
  - Evaluating trade-offs
  - Making decisions on management procedures
- Many have already been defined

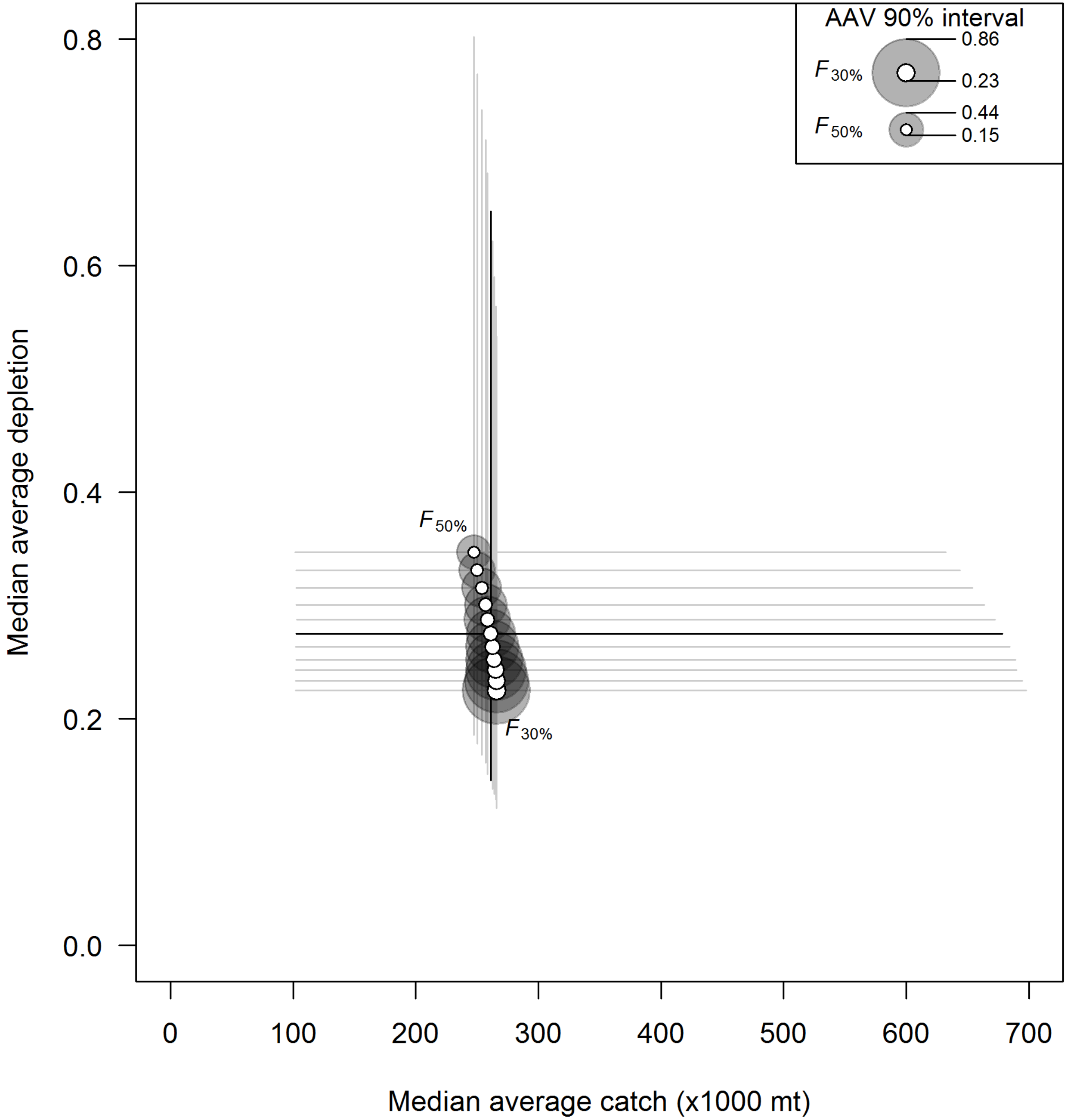
Task 3: Tables

- A table is one way to display results (from Pacific hake)

	Long-term (2033-2042)				
	Perfect	F_{40}	F_{40}:0-500	F_{40}:0-375	F_{40}:180-375
Conservation					
Median average depletion	26%	39%	42%	45%	35%
$Pr(B < B_{10\%})$	2%	6%	5%	5%	19%
$Pr(B_{10\%} \leq B \leq B_{40\%})$	77%	48%	47%	44%	41%
$Pr(B > B_{40\%})$	21%	45%	49%	51%	41%
Yield					
Median average catch	242	199	203	216	233
Median AAV	32%	52%	41%	34%	19%
Pr(catch = 0)	1%	13%	12%	10%	0%
Pr(catch < 180)	44%	52%	50%	44%	21%
Pr(180 ≤ catch ≤ 375)	31%	27%	25%	56%	79%
Pr(catch > 375)	25%	21%	26%	0%	0%

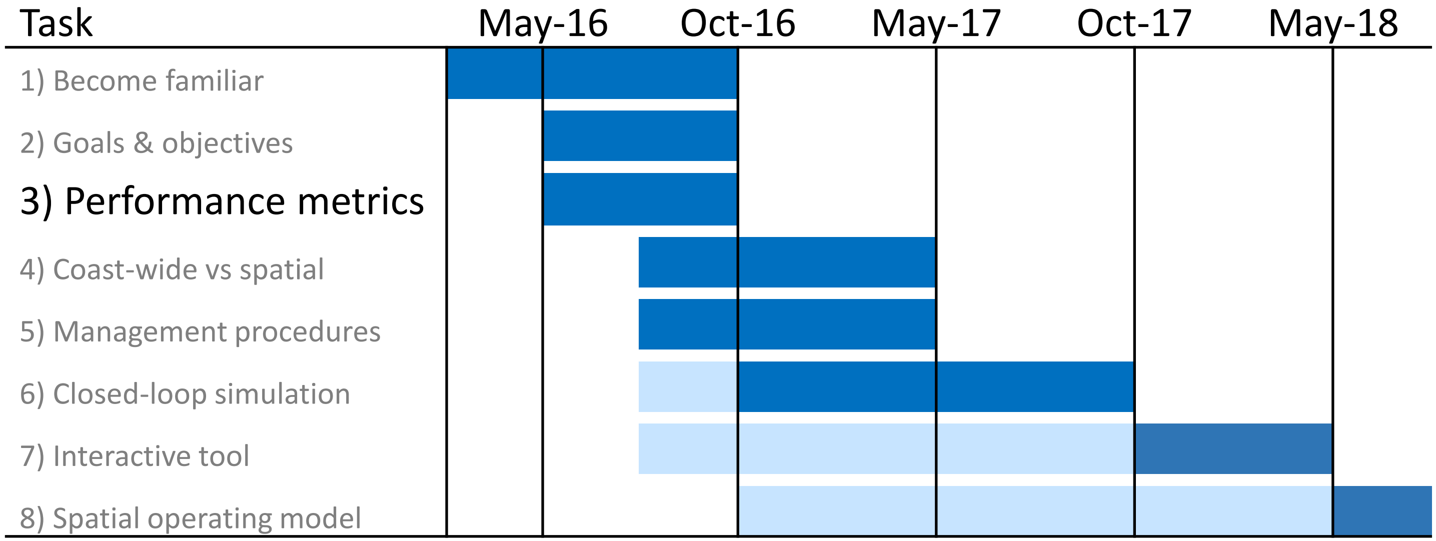
Task 3: Figures

- Or a complicated figure to show the trade-offs (from Pacific hake)
- Trade-offs are typically between conservation, yield, and stability in yield
  - Conservation: relative spawning biomass
  - Yield: catch (CEY)
  - Stability in yield: average annual variability (AAV)



Task 3: Resources, Deliverables, Timeline

- Resources:
  - Myself and the MSAB members
- Deliverables
  - Define consistent performance metrics and methods to display them so that everyone involved can easily interpret the results
  - Relate those metrics to past performance
    - For example, variability in catch can be determined from past catches
- Timeline
  - This will be done along with Task 2



Task 4: Coast-wide vs spatial models

- Model complexity in an important factor to consider
  - Determines what questions can and cannot be addressed
    - Coast-wide models can answer some important questions soon
    - Spatial models will allow the investigation of area-specific dynamics
  - Affects run time
  - Increased time to develop more complex models
- Goals and objectives will be linked to this comparison

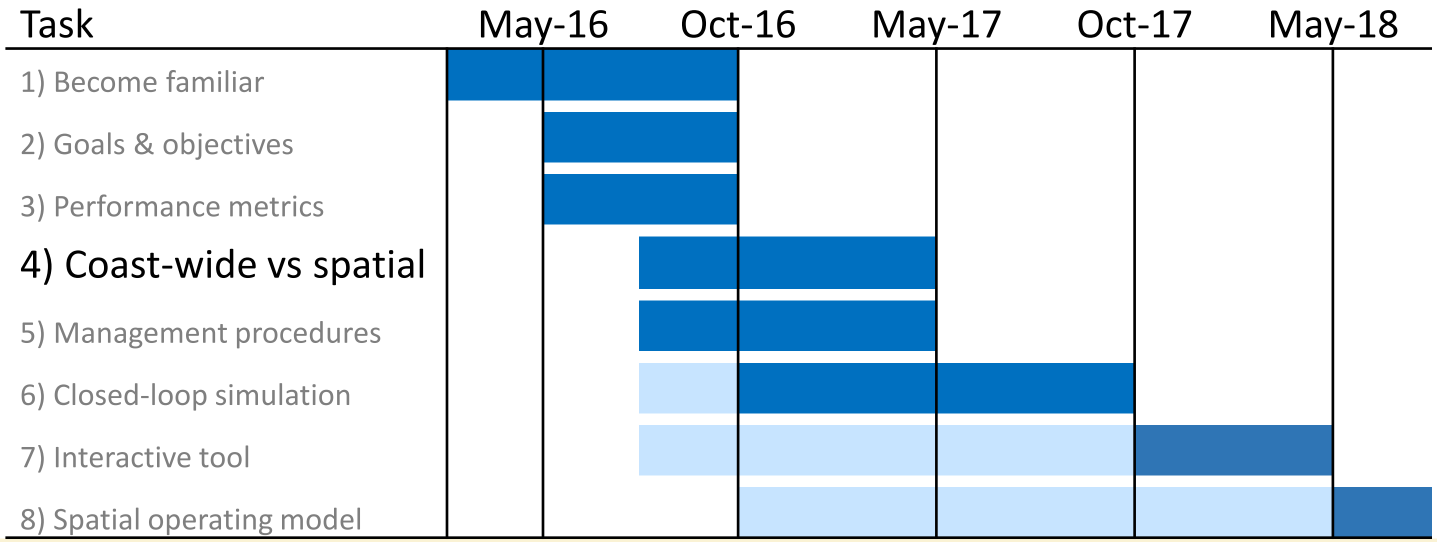
Task 4: Example of a comparison

Goal	Objective	Coast-wide	Spatial
Biological sustainability	Keep abundance above a certain level		
	Maintain abundance in a certain area above a certain level		
Fishery sustainability and stability	Catch >70% of historical 1993-2012 average		
	Catch in a specific area >70% of historical 1993-2012 average		

- This is a very simple example
- Additionally want to explore trade-offs of coding and running a spatial model

Task 4: Resources, Deliverables, Timeline

- Resources
  - Myself with review from MSAB
- Deliverables
  - Describe what is needed to develop coast-wide and spatial operating models for use in closed-loop simulations, the resources needed to do so, and how much time it may take
  - Provide a table showing what measureable objectives each model addresses
  - Present strengths and weaknesses of the coast-wide and spatial operating models
- Timeline
  - Initial report in October 2016 with a follow-up in May 2017



Task 5: Identify management procedures to evaluate

- The purpose of a MSE is to evaluate combinations of management procedures that make up harvest policies
- Need to be specific and programmable
- May introduce implementation error
- Begin with the current harvest policy and expand from there
- The larger set can be reduced in size by eliminating poor performing ones using a simple and fast model (i.e., equilibrium model)

Task 5: Some working definitions

- **Harvest strategy:** The specifics of how catch is determined and adjusted. For example, harvest rates and a control rule.
- **Control rule:** Defined actions and reference points that provide an adjustment to the catch beyond the harvest rates. Often, the lower reference point is where catch is zero.
- **Management procedure**: Something that can be modified as part of determining a harvest policy. For example, a size limit or control rule.
- **Management strategy or Harvest policy:** A set of management procedures that define how the fishery is managed.

Task 5: Management Procedures Initially Proposed

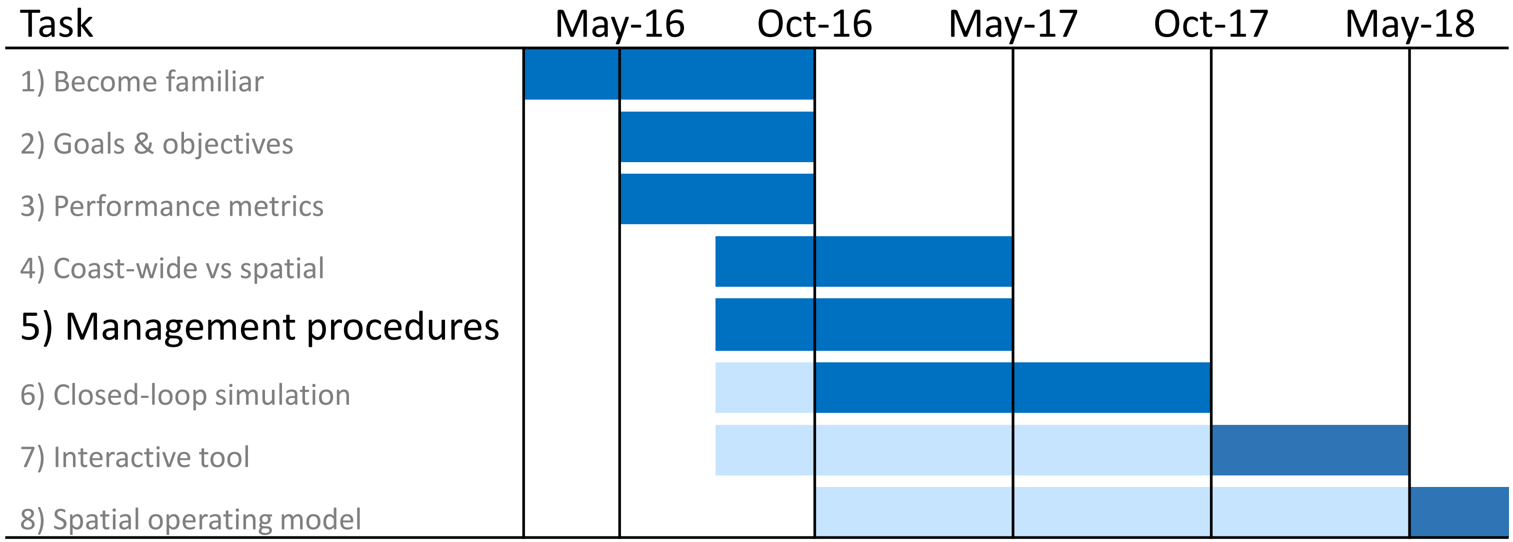
- **Total mortality**: Direct accounting by area for all sources of mortality in that area, including sublegals.
- **Size limits**: No size limit, current minimum size limit, 26 inches instead of 32, slot limits.
- **Harvest strategies**: 30:20 control rule, reference removal rate 21.5%/16.125%, coast-wide and by area.
- **National shares**: catch limits by areas would be allocated rather than based on apportionment.
- **Bycatch mitigation**: Impacts among areas for bycatch in a particular area.

Task 5: Example of a management strategy

- Coast-wide F_{SPR} with a 30:20 control rule on coast-wide catch
- Allocation to areas based on proportion of survey biomass
- Size limit of 32 inches
- Bycatch accounting and impact procedures
- Allocation to sectors
- Annual survey
- Annual assessment

Task 5: Resources, Deliverables, Timeline

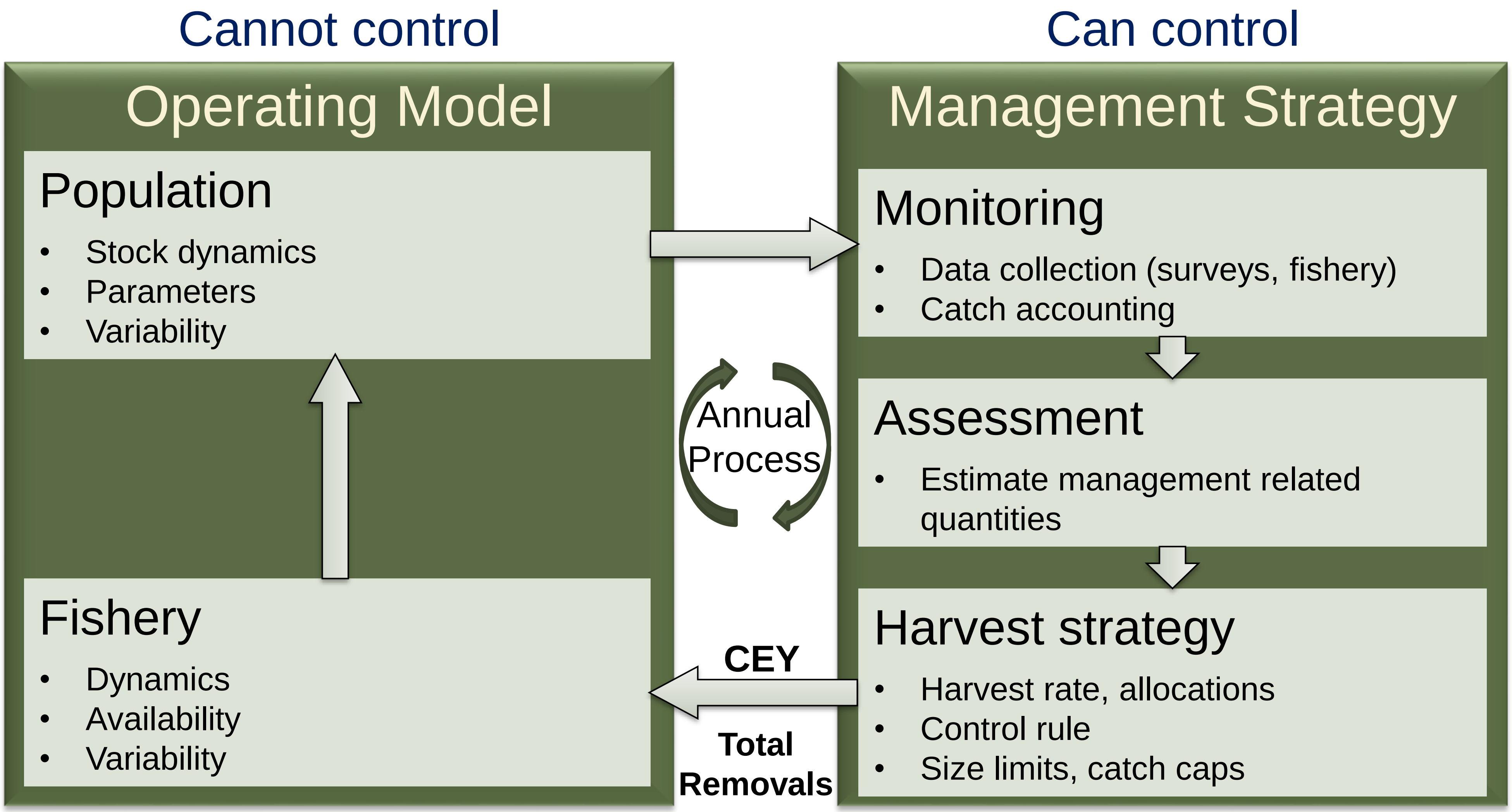
- Resources
  - IPHC staff will help the MSAB members in making these decisions
- Deliverables
  - A set of management procedures with various options
  - A set of combinations of those management procedures to be evaluated (management strategy/harvest policies)
- Timeline
  - Current harvest policy first
  - Then add others
  - Begin by defining them before implementing them



Task 6: Develop a closed-loop simulation framework

- This is the engine of the MSE
- The process of
  - Simulating the dynamics (we **cannot** control)
    - Population fluctuations
    - Harvest dynamics
  - And the management process (we **can** control)
    - Data gathering
    - Assessment
    - Policy
      - Harvest dynamics, rates, etc.

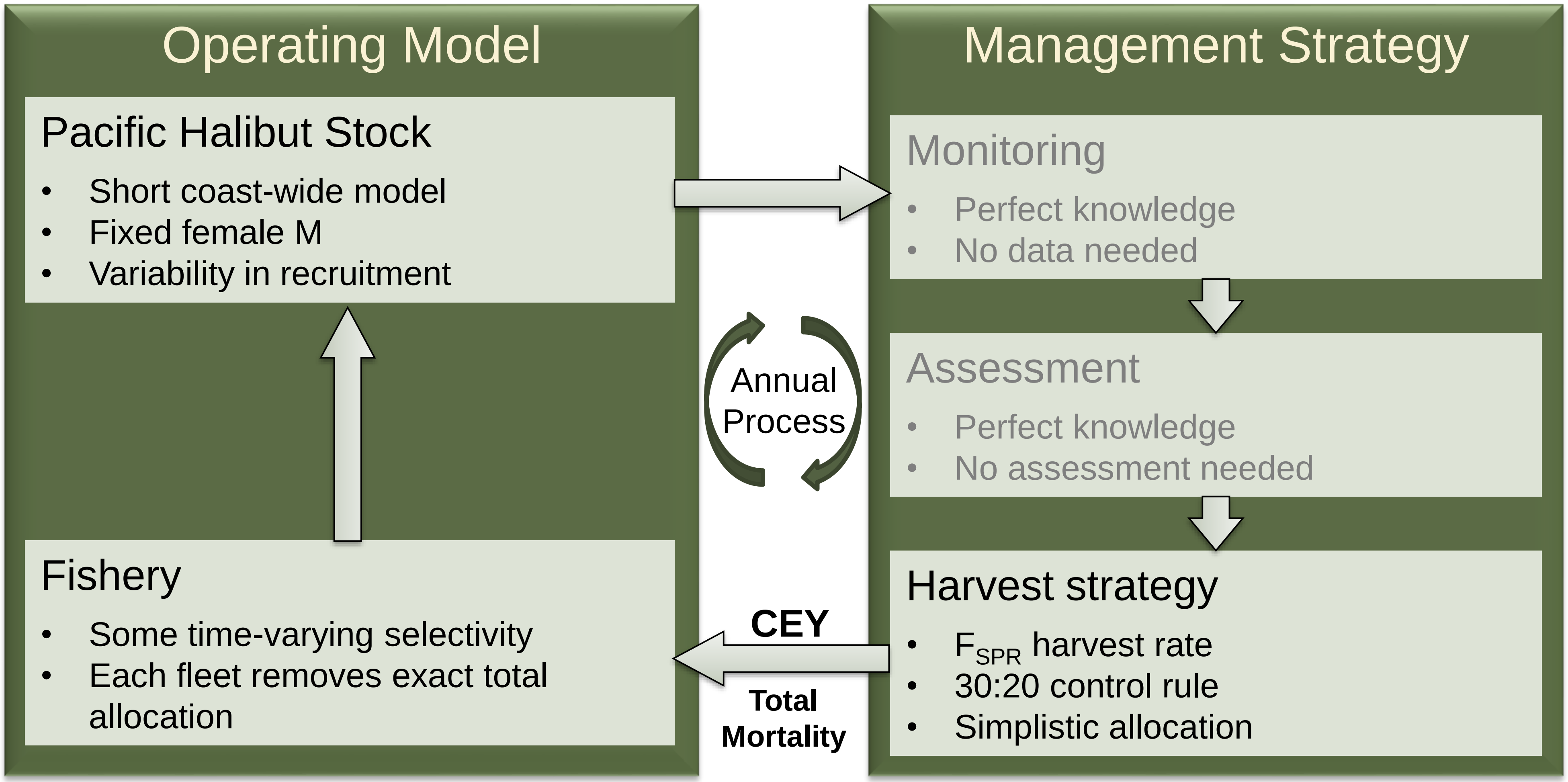
Task 6: Closed-loop simulation



Task 6: Example of a closed-loop simulation

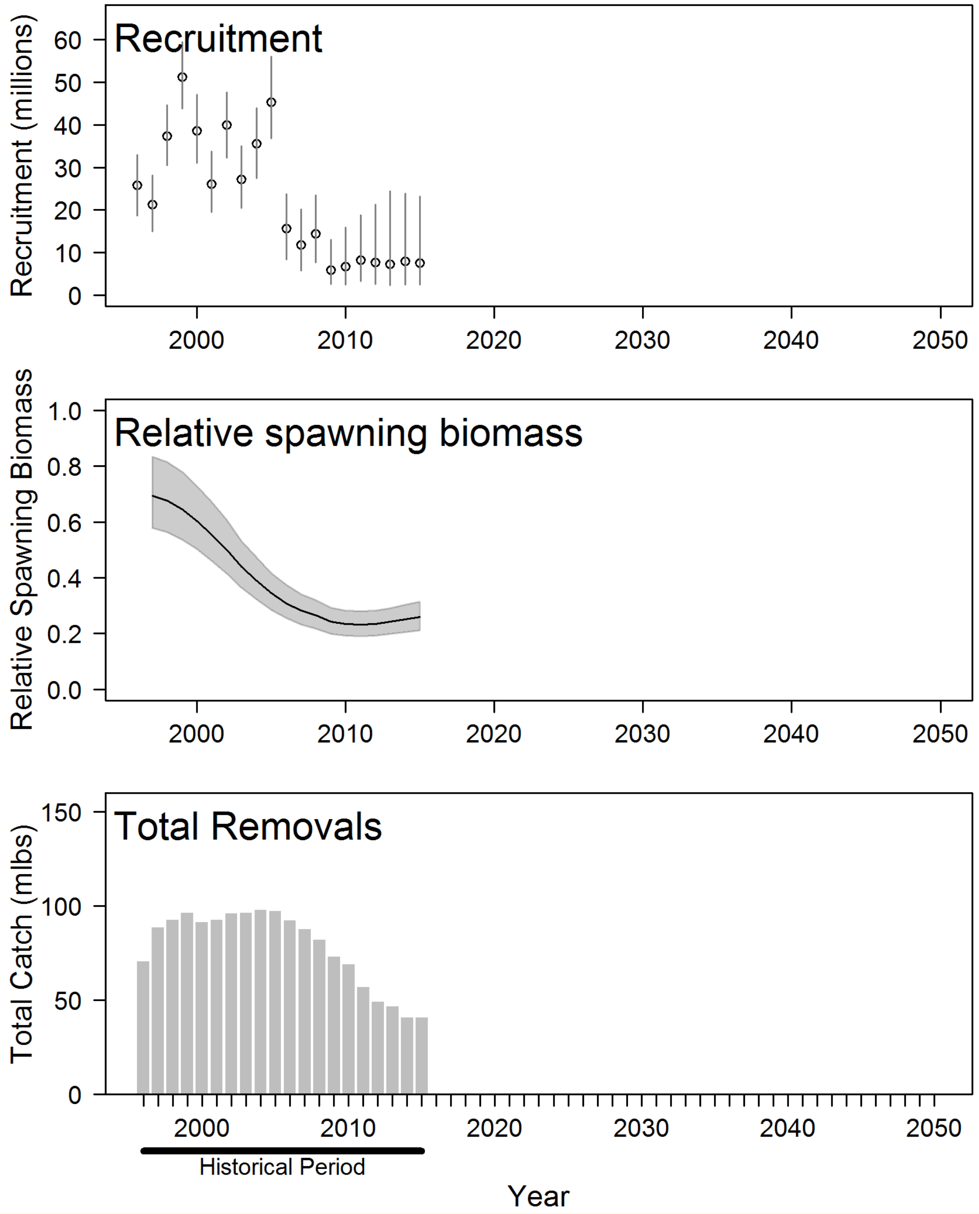
- Use one of the ensemble models as an operating model
- Project forward 90 years with stochastic recruitment
- Determine catch every year using **perfect knowledge** of the stock
  - No data or assessment needed
  - F_{SPR} coast-wide harvest rate, 30:20 control rule
  - Assumed a very simple allocation based on recent years

Task 6: Example of a closed-loop simulation



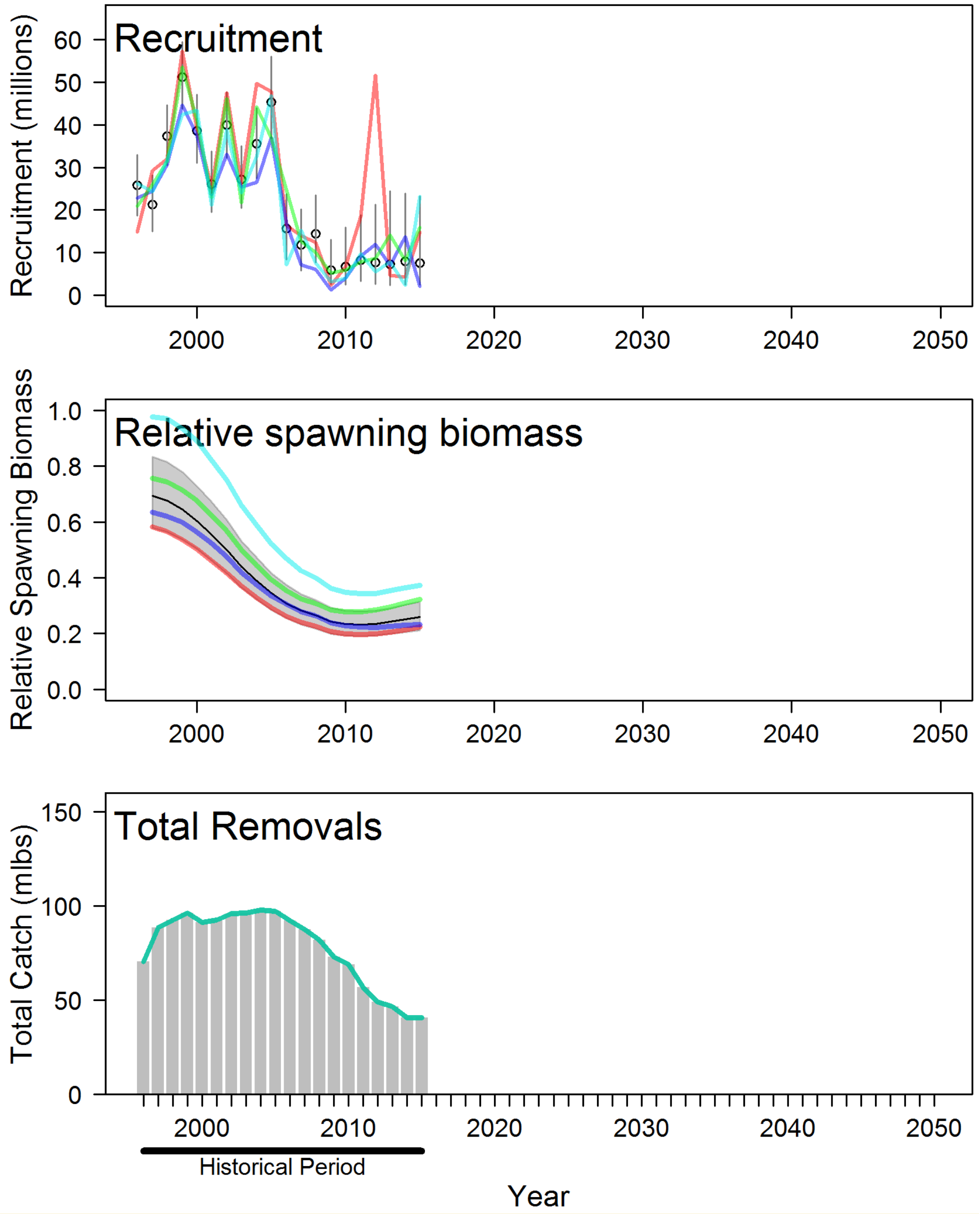
Task 6: Illustration of MSE calculations (1)

- Start with an operating model



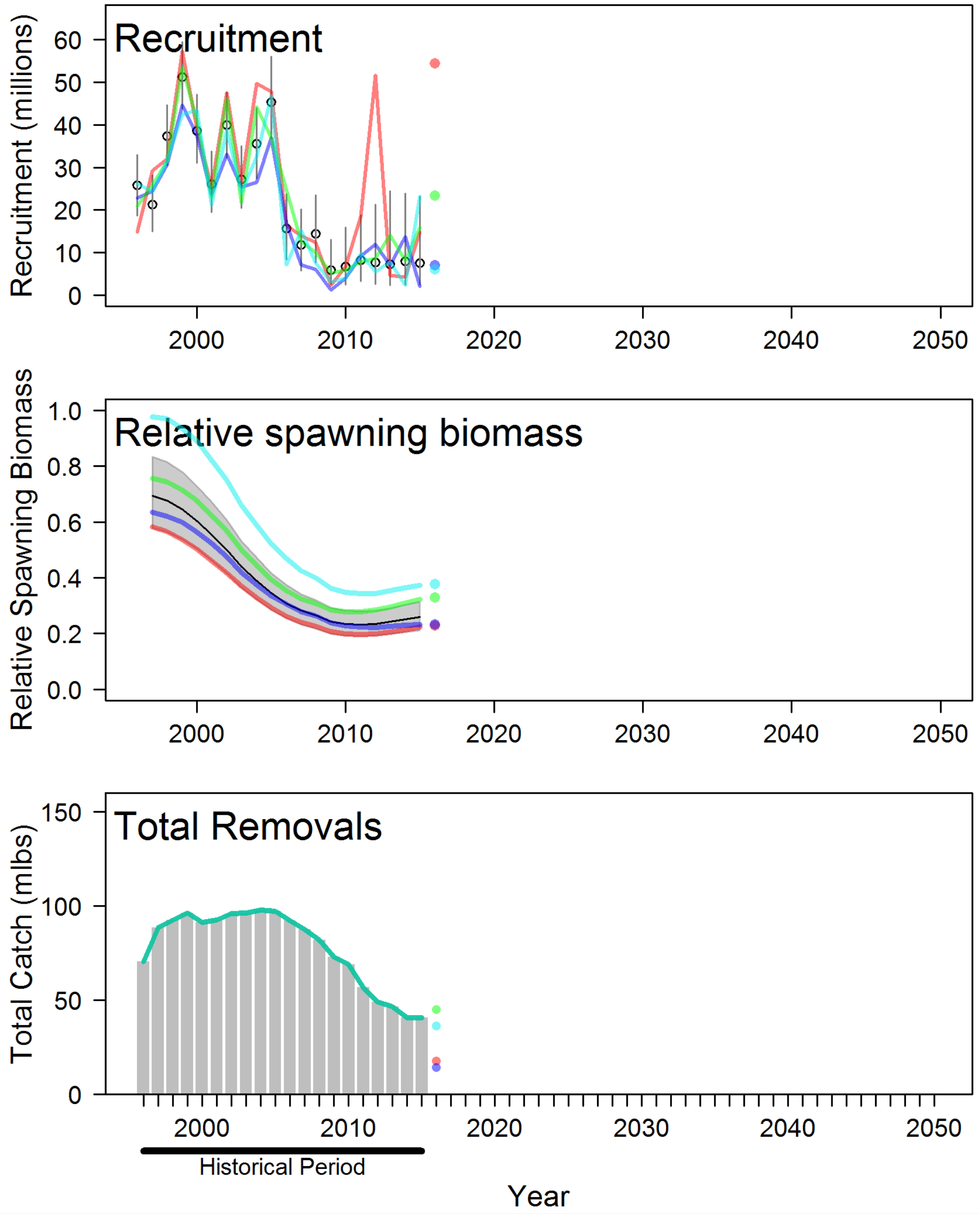
Task 6: Illustration of MSE calculations (2)

- Start with an operating model
- Introduce variability in the operating model
  - Catch history is assumed known



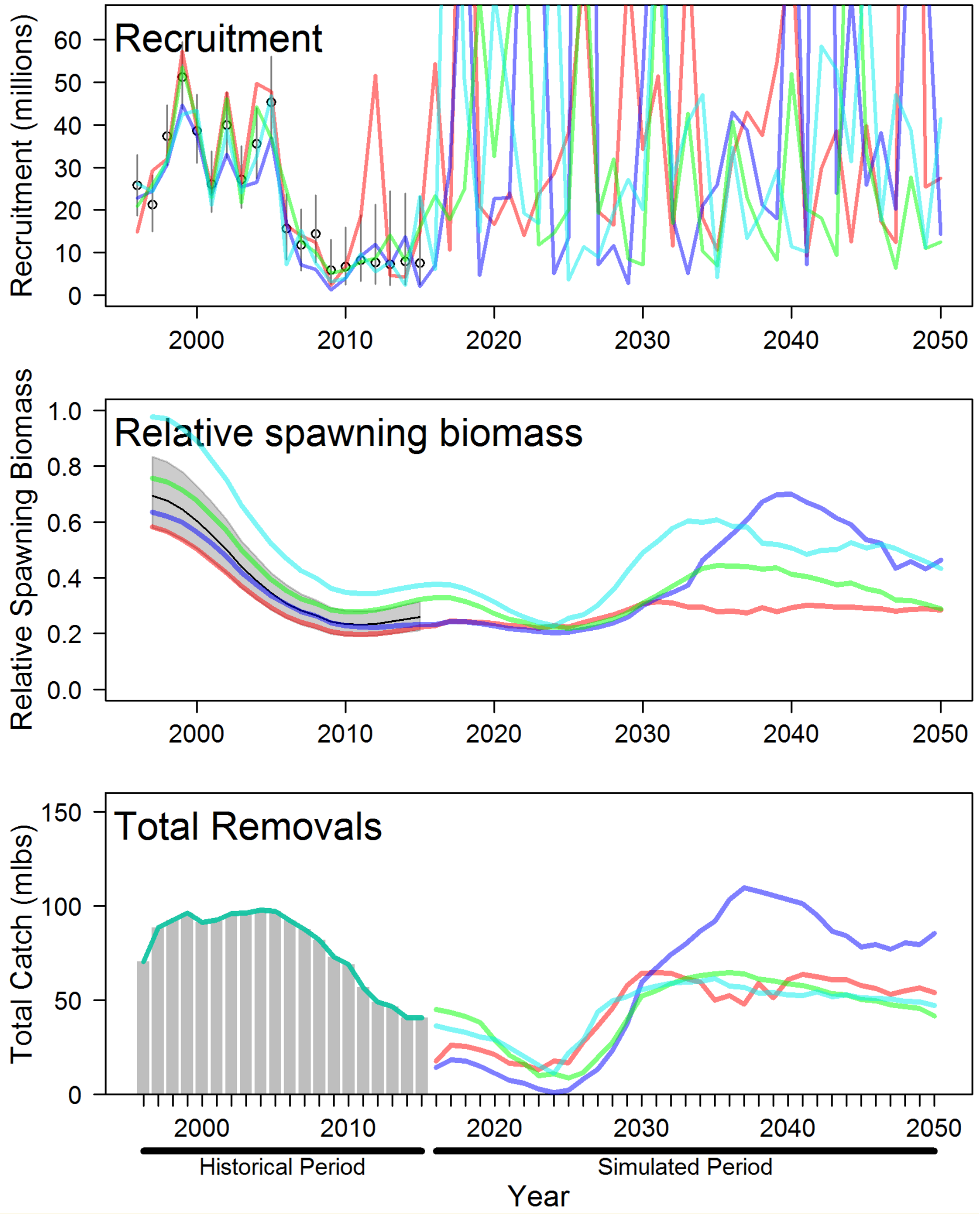
Task 6: Illustration of MSE calculations (3)

- Start with an operating model
- Introduce variability in the operating model
  - Catch history is assumed known
- Project one year and determine total removals



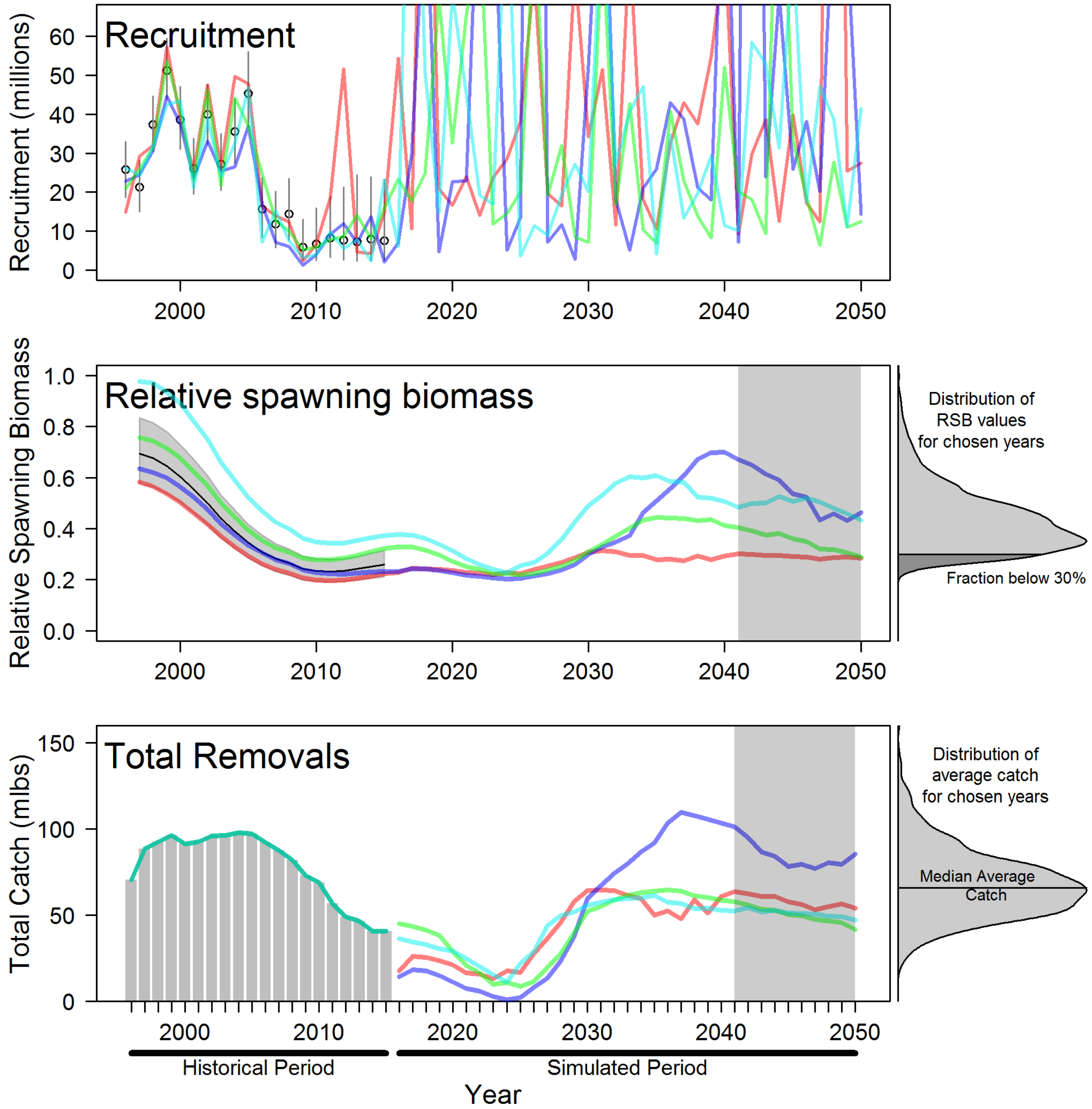
Task 6: Illustration of MSE calculations (4)

- Start with an operating model
- Introduce variability in the operating model
  - Catch history is assumed known
- Project one year and determine total removals
- Repeat this for many years
  - The future is uncertain



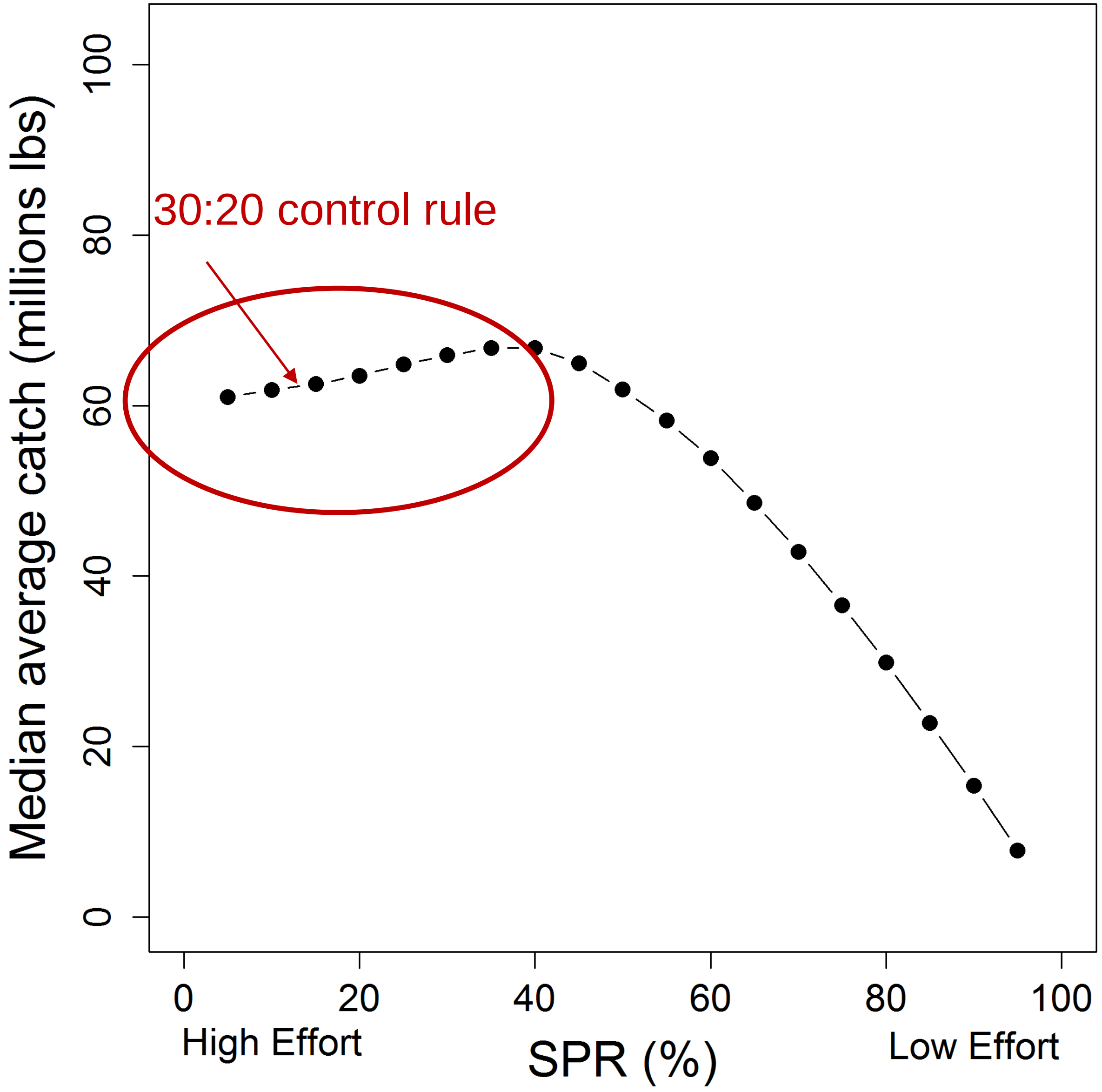
Task 6: Illustration of MSE calculations (5)

- Start with an operating model
- Introduce variability in the operating model
  - Catch history is assumed known
- Project one year and determine total removals
- Repeat this for many years
  - The future is uncertain
- Do this for many random trajectories
- Summarize performance metrics over a specified period



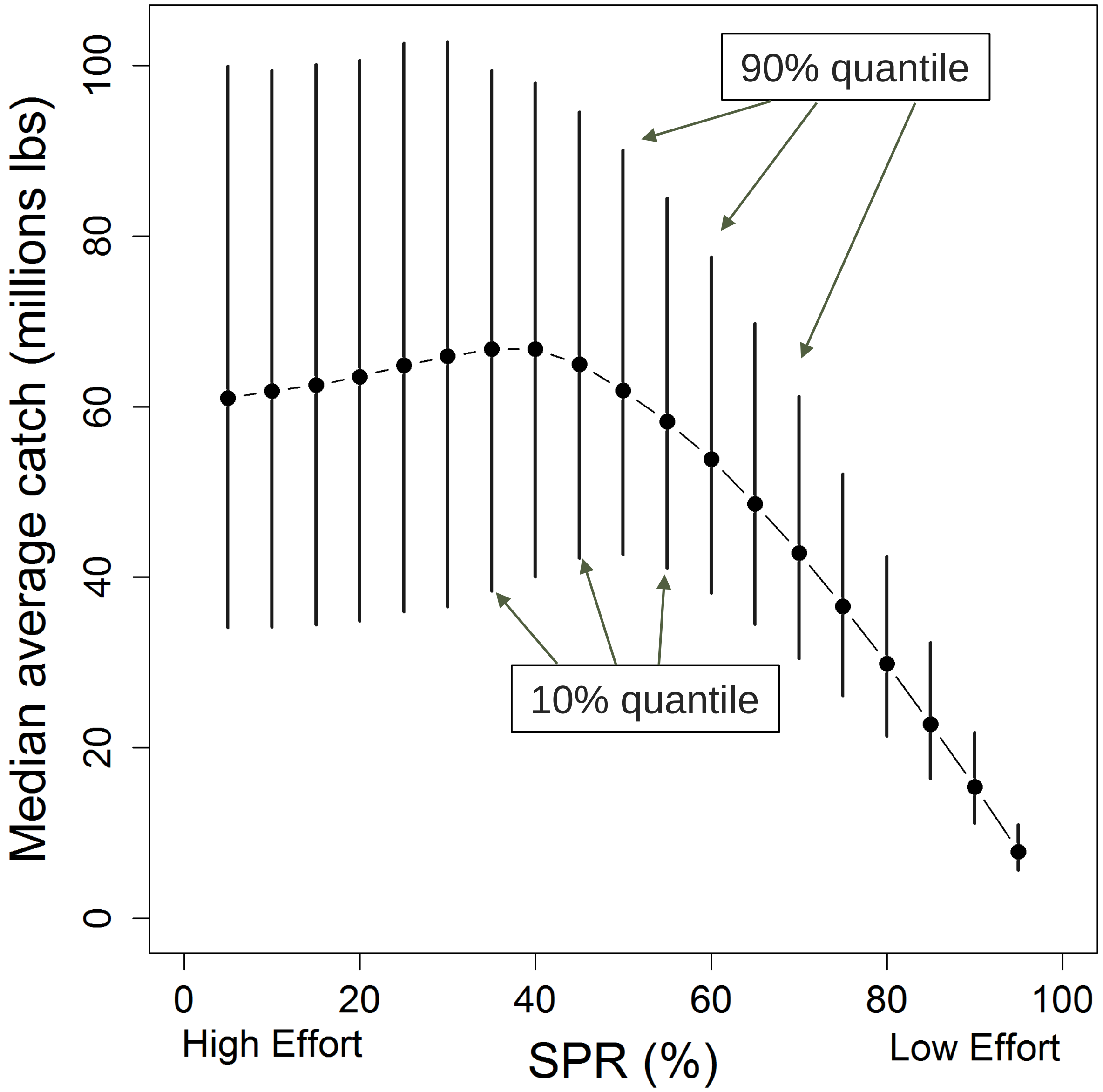
Task 6: Preliminary results (comparison to equilibrium model)

- In the equilibrium model, we have seen plots of yield as a function of fishing effort
- Here is an example of a closed-loop simulation looking at different F_{SPR} rates
  - High SPR = Low effort
  - Low SPR = High effort
- Average (or median) long-term results should be similar to an equilibrium model



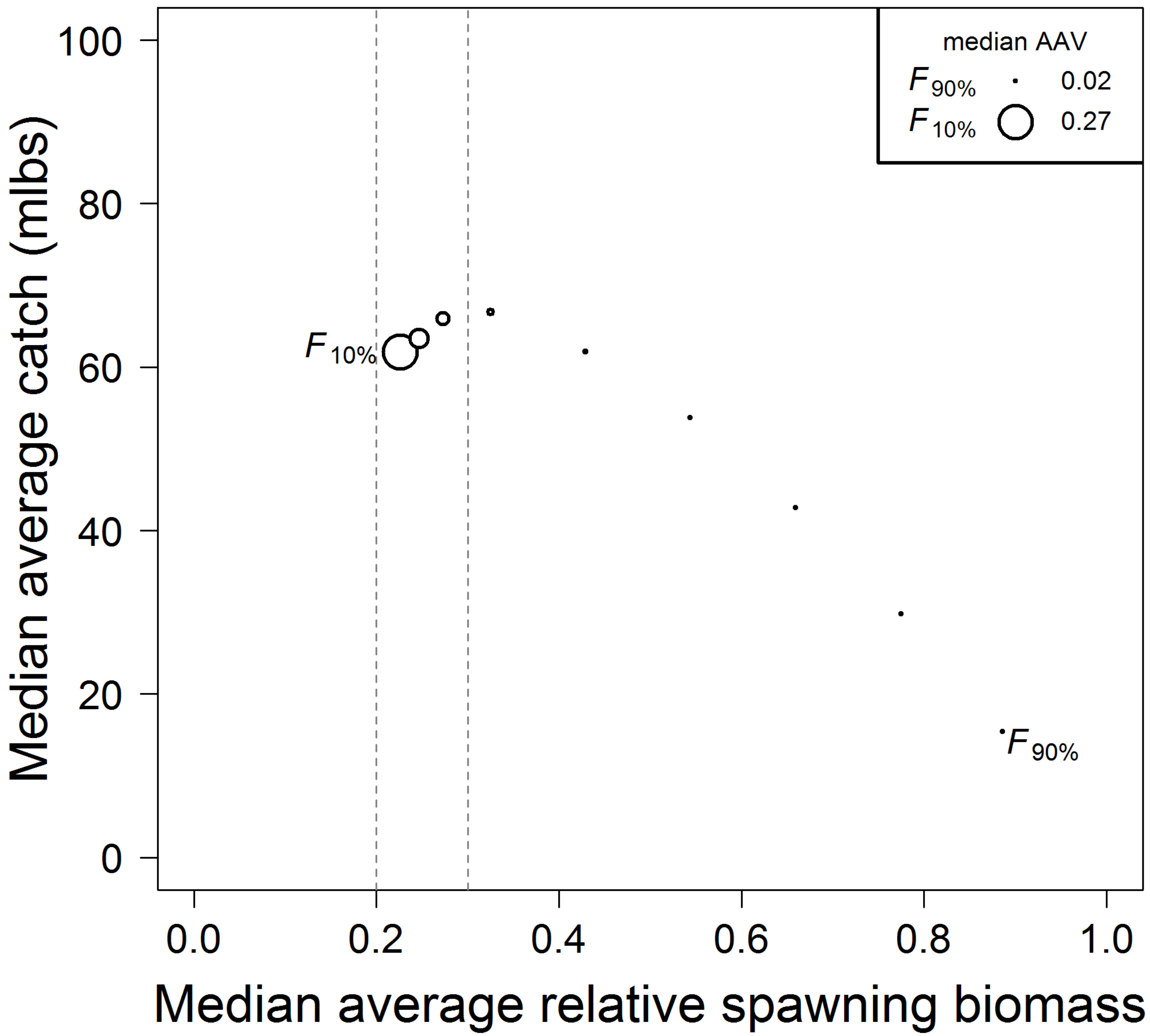
Task 6: Preliminary results (with uncertainty)

- Closed-loop simulations include many simulated trajectories with uncertainty
- This translates to uncertainty in the outputs (i.e., catch)
- We can begin to summarize outputs using probabilities
  – Probability Yield < 40mlbs with SPR=0.4 is 10%



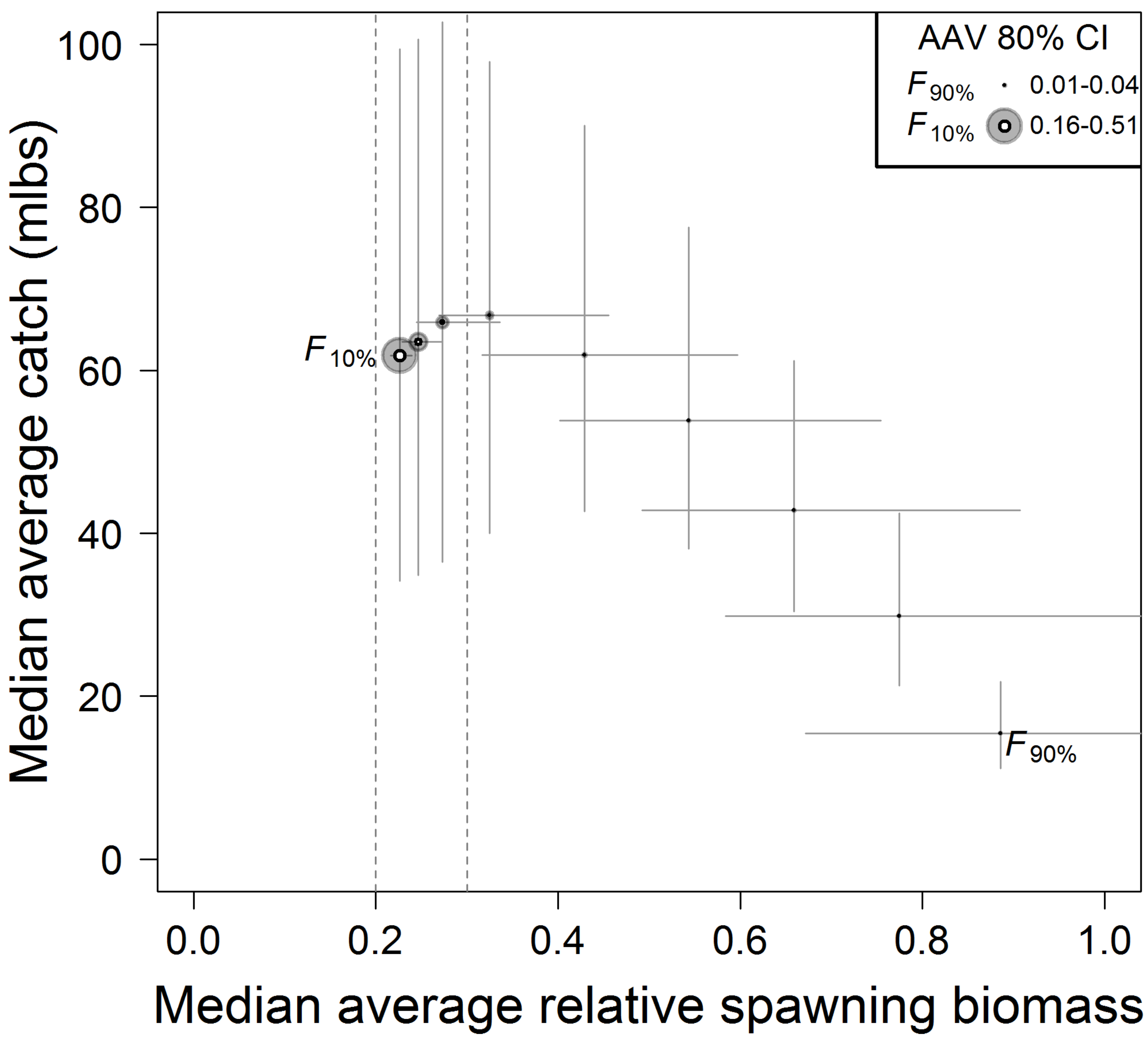
Task 6: Preliminary results (yield vs conservation vs stability)

- There are trade-offs to consider and these are typically between conservation, yield, and stability in yield
  - Conservation: relative spawning biomass
  - Yield: catch (CEY)
  - Stability in yield: average annual variability (AAV)



Task 6: Preliminary results (yield vs conservation vs stability)

- Uncertainty also plays an important role in understanding trade-offs



Task 6: Preliminary results (table of performance metrics)

	Long-term (2095-2105)					
	High Effort					*Low Effort*
Perfect Information	**SPR=10%**	**SPR=20%**	**SPR=30%**	**SPR=40%**	**SPR=50%**	**SPR=60%**
Conservation						
Median average RSB	22.6%	24.7%	27.3%	32.5%	42.9%	54.3%
Pr($B < B_{20\%}$)	1%	0%	0%	0%	0%	0%
Pr($B < B_{30\%}$)	100%	96%	76%	37%	8%	1%
Yield (Total Removals)						
Median average TR	61.8	63.5	65.9	66.7	61.9	53.9
Median AAV	27.4%	15.2%	9.8%	4.9%	2.8%	2.5%
Pr(TR < 60)	52%	50%	45%	38%	46%	65%
Pr(60 ≤ TR ≤ 80)	21%	22%	22%	33%	35%	26%
Pr(TR < 80)	72%	71%	67%	72%	81%	91%

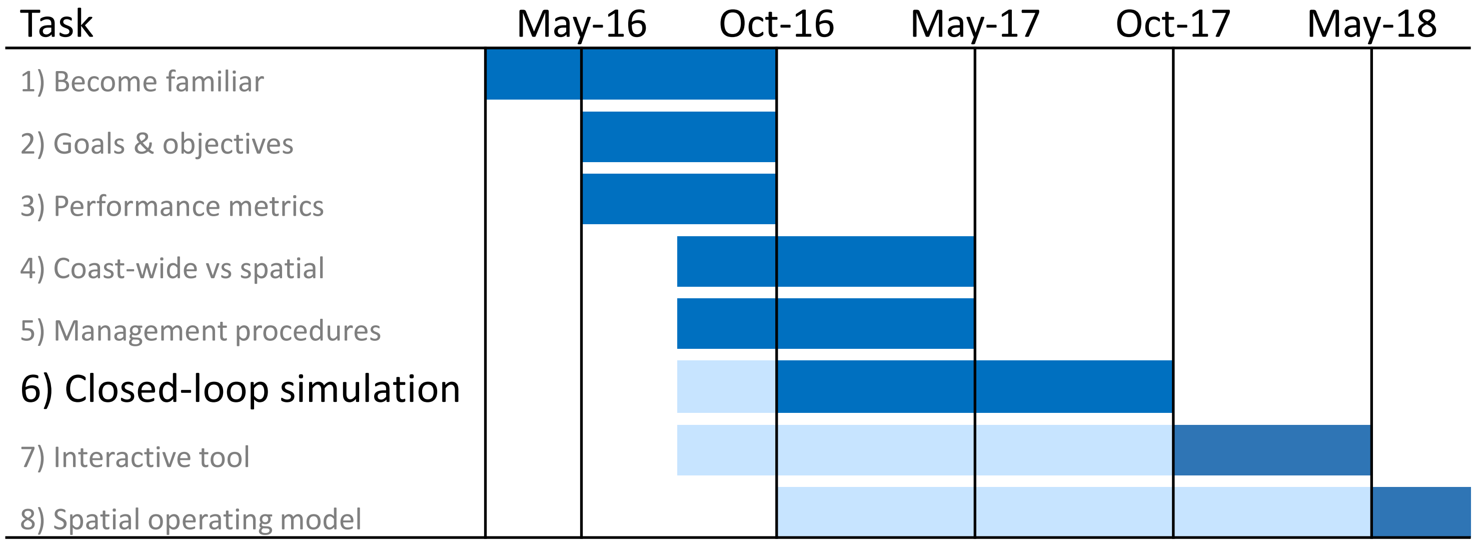
Historical 1993-2012 average total removals is 83 million lbs. AAV from 1993-2012 is 6.7%

Task 6: Other thoughts

- Most objectives cannot be met with a 100% probability with any harvest strategy
  - It may be impossible to always keep catch above a certain level (even zero)
  - This is why we need to think in probabilities, which I typically frame as a risk
  - For example, you cannot always have the catch greater than 60 mlbs. But, you can minimize the risk that catch is less than 60 mlbs while also accounting for other trade-offs.

Task 6: Resources, Deliverables, Timeline

- Resources
  - Myself & IPHC staff, a programmer, computers, time
- Deliverables
  - A design of a framework for closed-loop simulations that can meet future needs
  - Code implementing this framework
- Timeline
  - Before October 2016, start designing the framework
  - Report progress in May 2017
  - Have a framework and code in October 2017

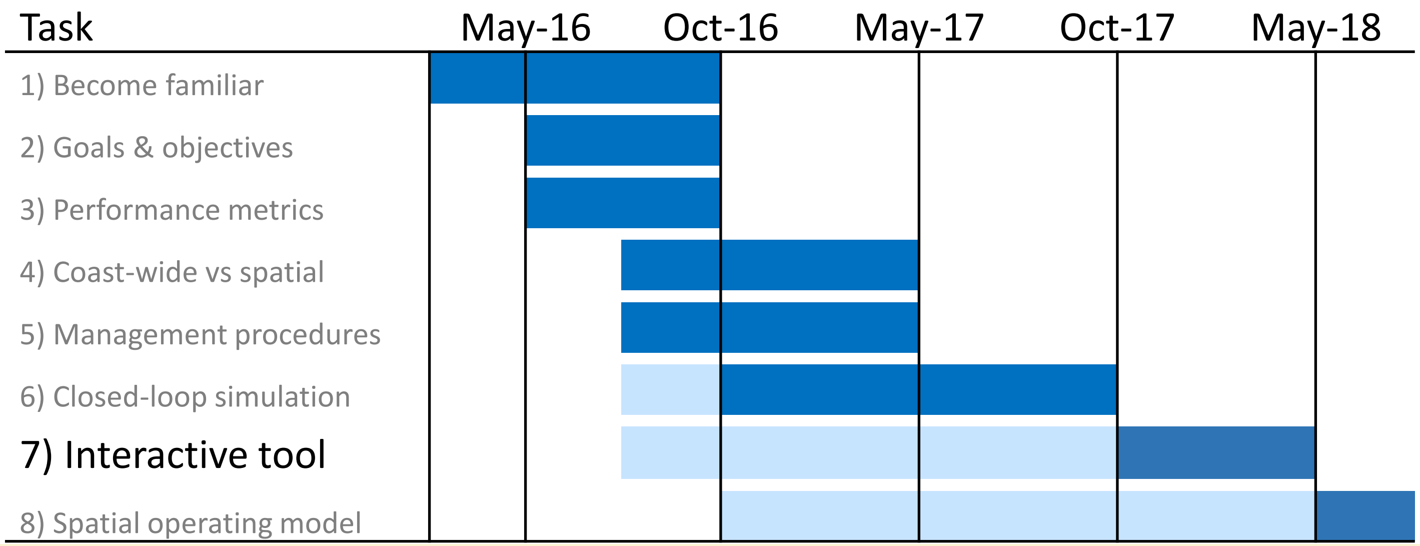


Task 7: Further development of the interactive tool

- The interactive tool (Shiny app) seems to be of interest to stakeholders
- Expand upon the equilibrium model (i.e., closed-loop simulations)
  – Current tool is fast and still useful to eliminate some management procedures
- Outputs will change to report uncertainty
- Is it useful to maintain the current equilibrium Shiny app?

Task 7: Resources, Deliverables, Timeline

- Resources
  - IPHC staff, a programmer, computers, time
- Deliverables
  - An application that allows users to provide inputs and see outputs
  - May be web-based or stand-alone
- Timeline
  - Before October 2016, start designing the framework
  - Design while coding Task 6
  - Have an application in May 2018



Task 8: Spatial operating model

- A spatial operating model will help to answer many area-specific questions
  - Need to identify those questions so that we can develop appropriate spatial model
- This is a complex task and will take time
  - It will be better to define scope and develop a design before starting programming

Task 8: Resources, Deliverables, Timeline

- Resources
  - A considerable amount of resources will be helpful
  - IPHC staff, a programmer, testers, computers, time, research
- Deliverables
  - Specifications of a spatial operating model that satisfy the objectives
  - A design and the beginning of development
- Timeline
  - Designing in 2017
  - Programming in 2018