IPHC staff work plan for MSAB from May 2016 to May 2018

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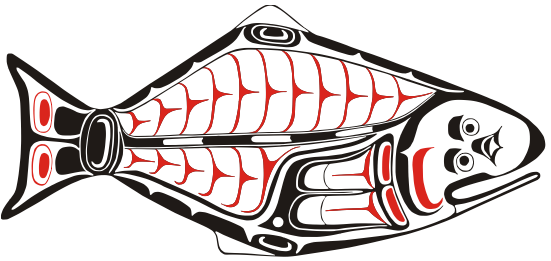
Scientific Review Board Meeting
June 21-22, 2016



INTERNATIONAL PACIFIC HALIBUT COMMISSION

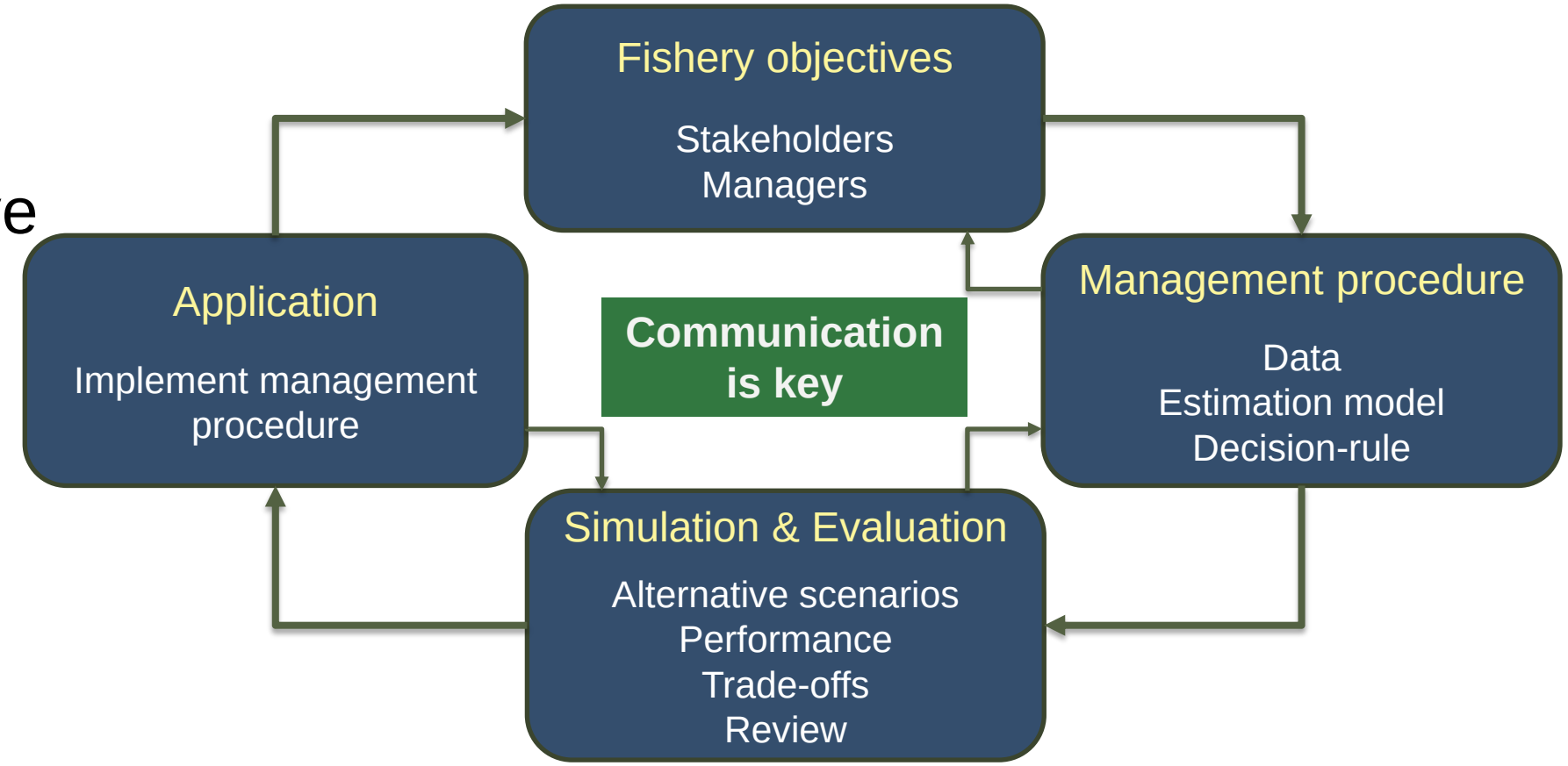
What is the work plan?

- A plan describing tasks that will be carried out for the next 2 years
- A timeline for when work on those tasks will be done and be reported

- This is flexible and likely to be changed
  - With the guidance of the MSAB and SRB
- Presented in a sort of sequential order, but is not prioritized
- Mainly directed toward me, but this is not the only work that I will do
- Please ask if there is any confusion about definitions of terms

Management Strategy Evaluation

- MSE is an adaptive learning process with consultation and repetition



Past Accomplishments of MSAB

- 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
- Members have become familiar 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 single-area (coast-wide) and multi-area (spatial) models.
- Developed an outreach plan

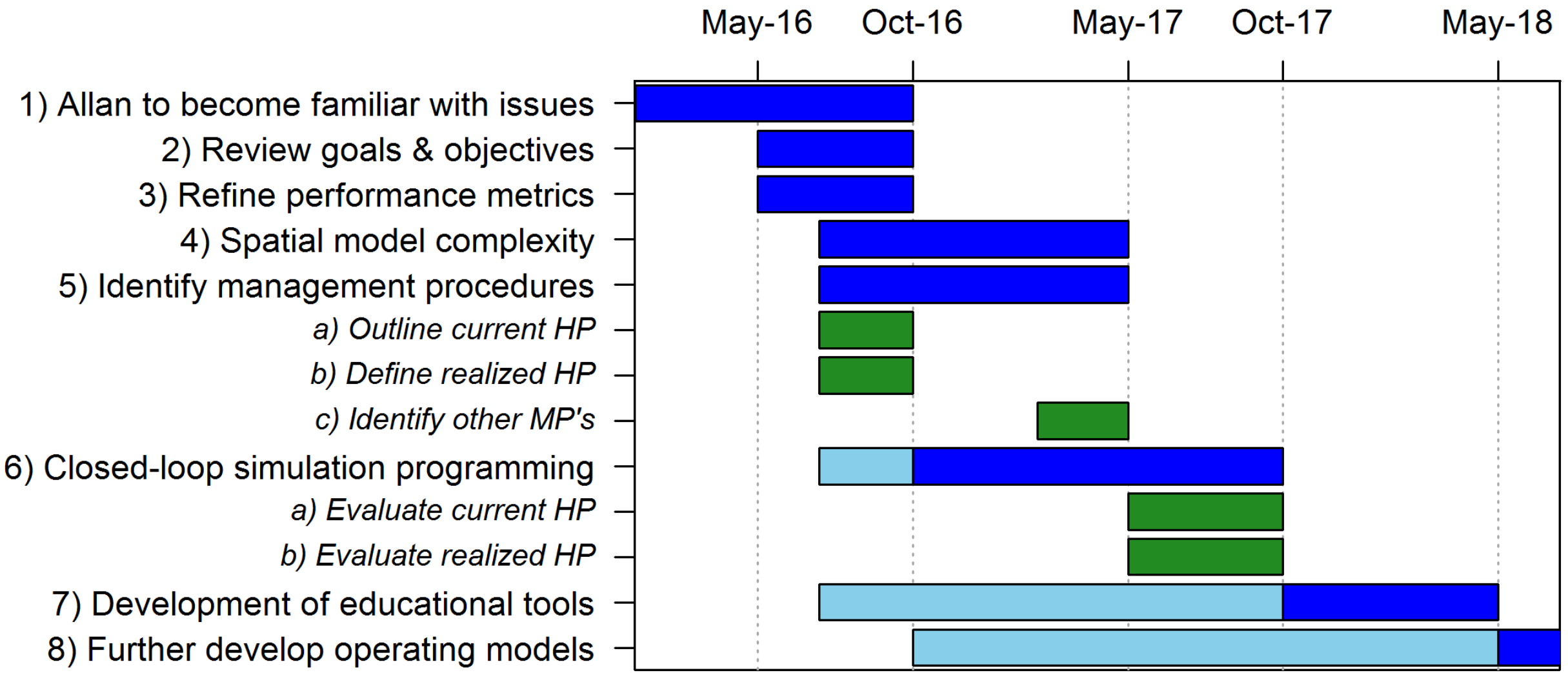
Future plan

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

Tasks

1. Become familiar with Pacific halibut biology and management
2. Review goals & objectives
3. Refine performance metrics
4. Investigate spatial model complexity
5. Identify management procedures
6. Closed-loop simulation programming
7. Development of educational tools
8. Further develop operating models

Gantt chart


May-16
Oct-16
May-17
Oct-17
May-18
1) Allan to become familiar with issues
2) Review goals & objectives
3) Refine performance metrics
4) Spatial model complexity
5) Identify management procedures
a) Outline current HP
b) Define realized HP
c) Identify other MP's
6) Closed-loop simulation programming
a) Evaluate current HP
b) Evaluate realized HP
7) Development of educational tools
8) Further develop operating models

Some working definitions

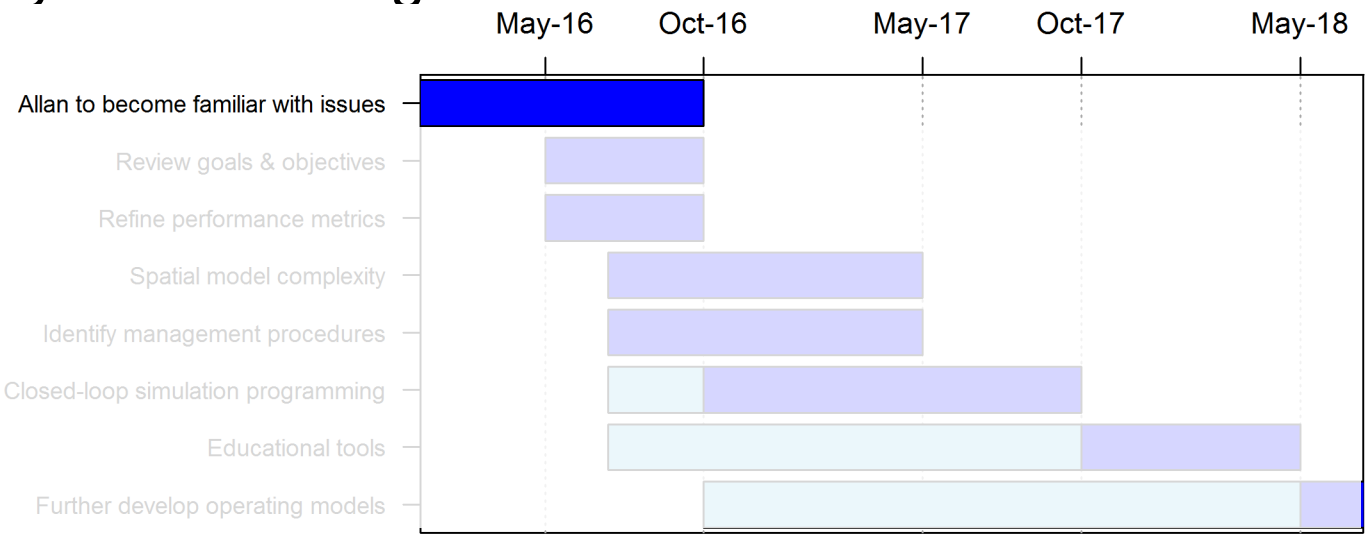
- **Harvest strategy:** The specifics of how catch is determined and adjusted. For example, harvest rates and a control rule.
- **Control rule:** Defined actions and reference points that provide an adjustment to the catch beyond the harvest rates. Often, the lower reference point is where catch is zero.
- **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 1: Become familiar with halibut and past

- Provide myself with time to learn about the research and management of Pacific halibut
- 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

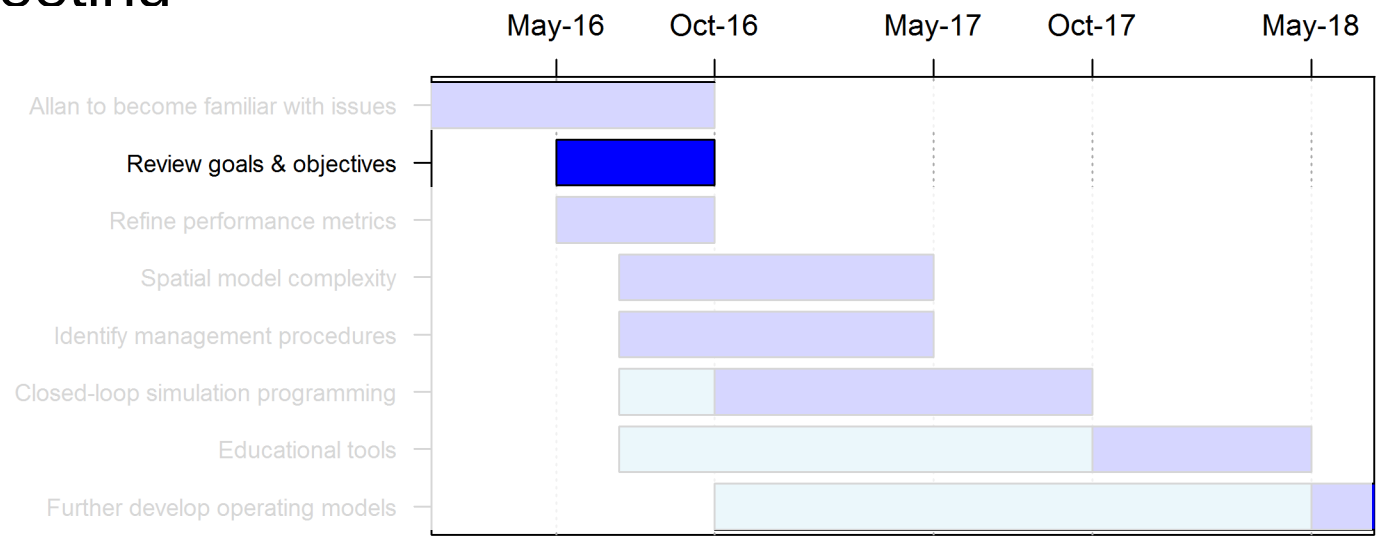
- Review the current goals and objectives
- Identify the intention of each goal and objective
- Revise if necessary
- Translate into measureable objectives
  1. An outcome (what you want)
  2. A time frame (when you want the outcome)
  3. A probability (tolerance for failure)

Task 2: 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: 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

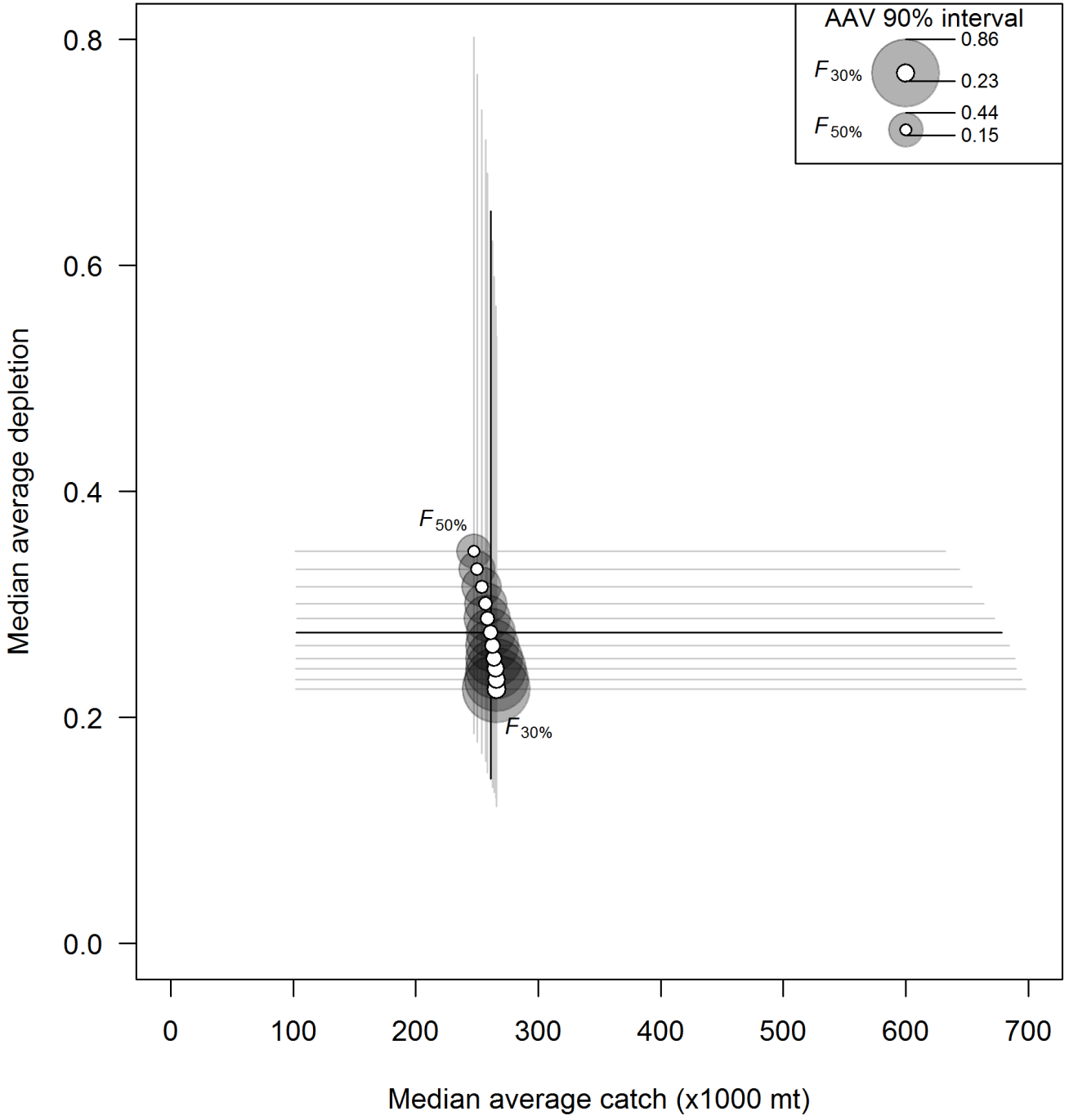
Task 3: Tables

- 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%

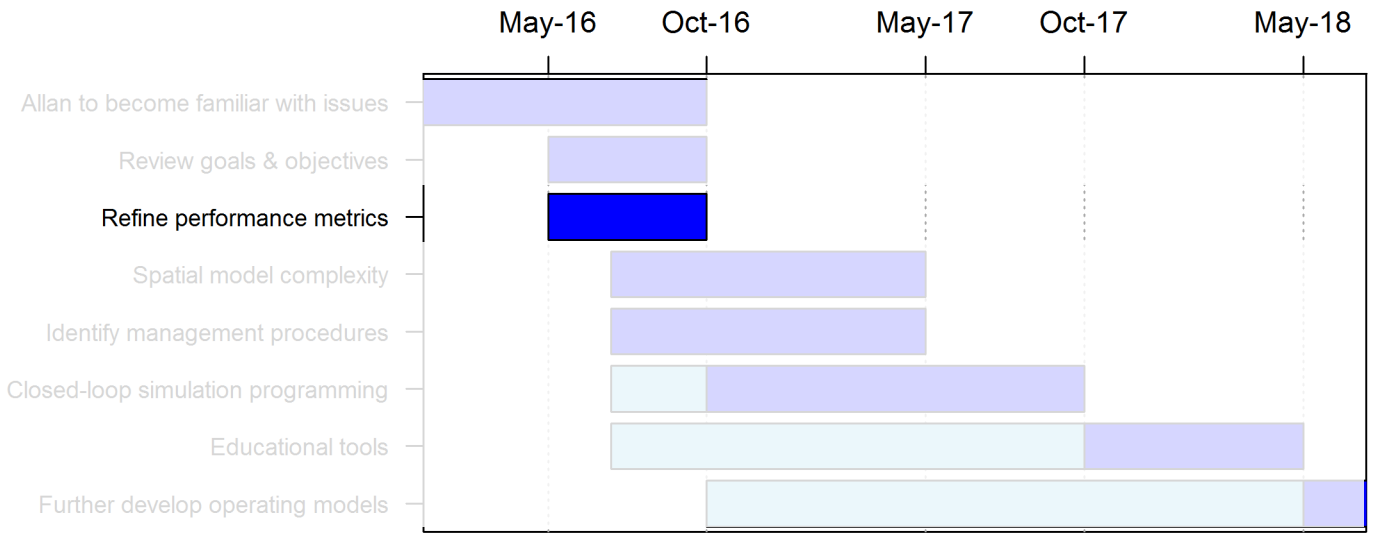
Task 3: Figures

- 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: Single-area vs multi-area models

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

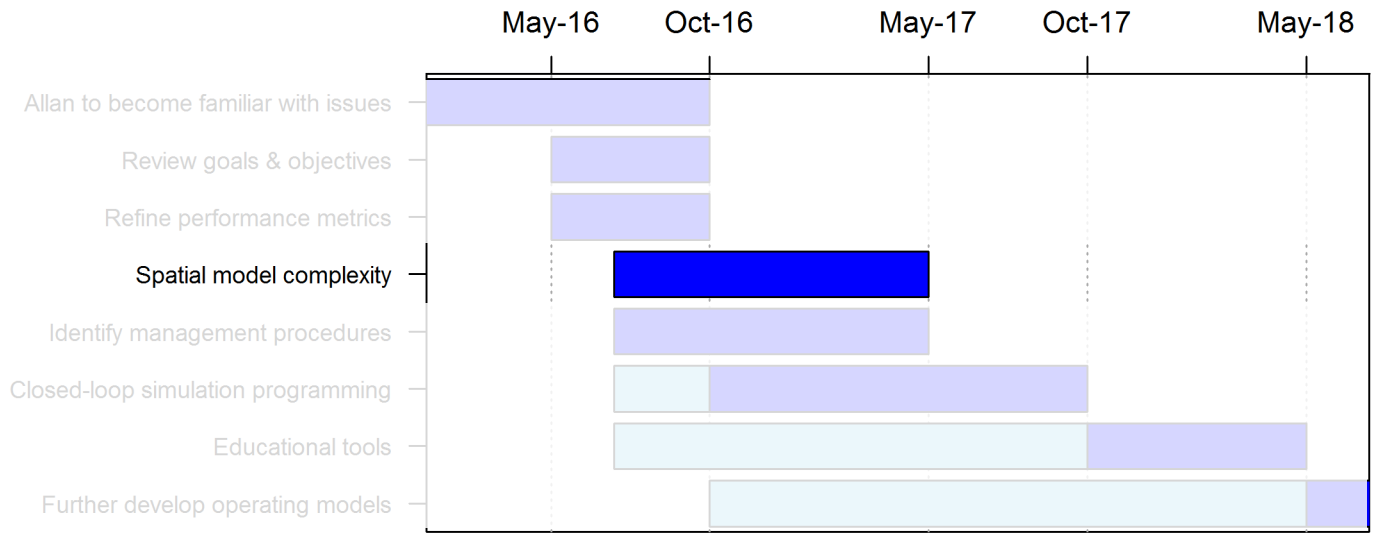
Task 4: Example of a comparison

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 single-area and multi-area 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 single-area and multi-area operating models
- Timeline
  - Initial report in October 2016 with a follow-up in May 2017

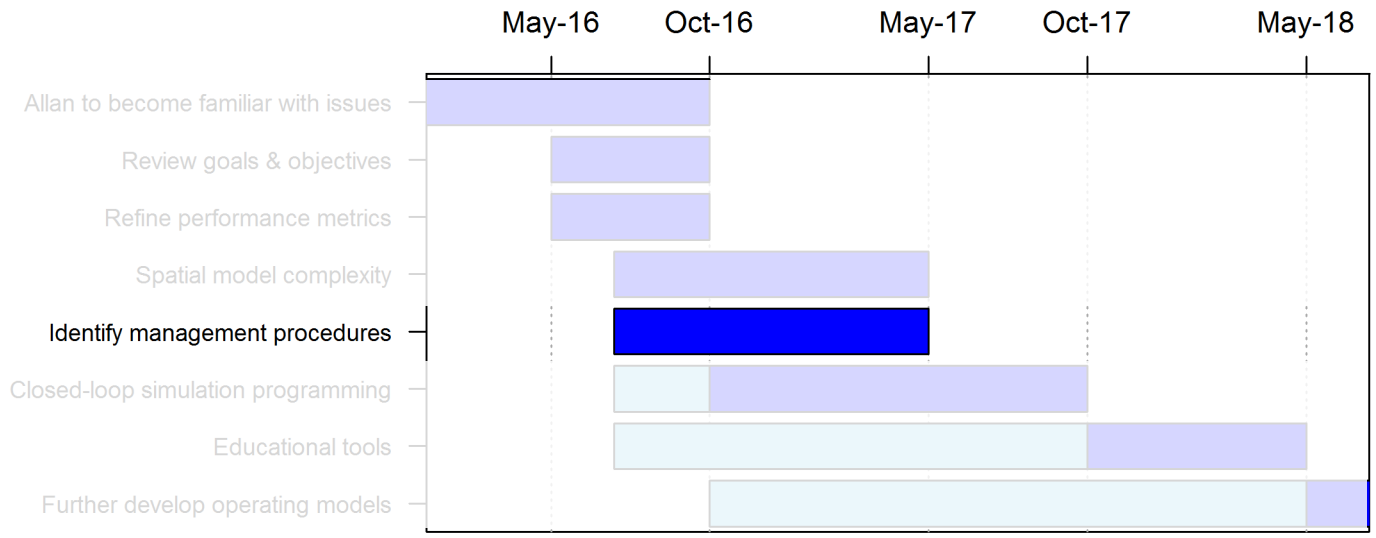


Task 5: Identify management procedures to evaluate

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

Task 5: Resources, Deliverables, Timeline

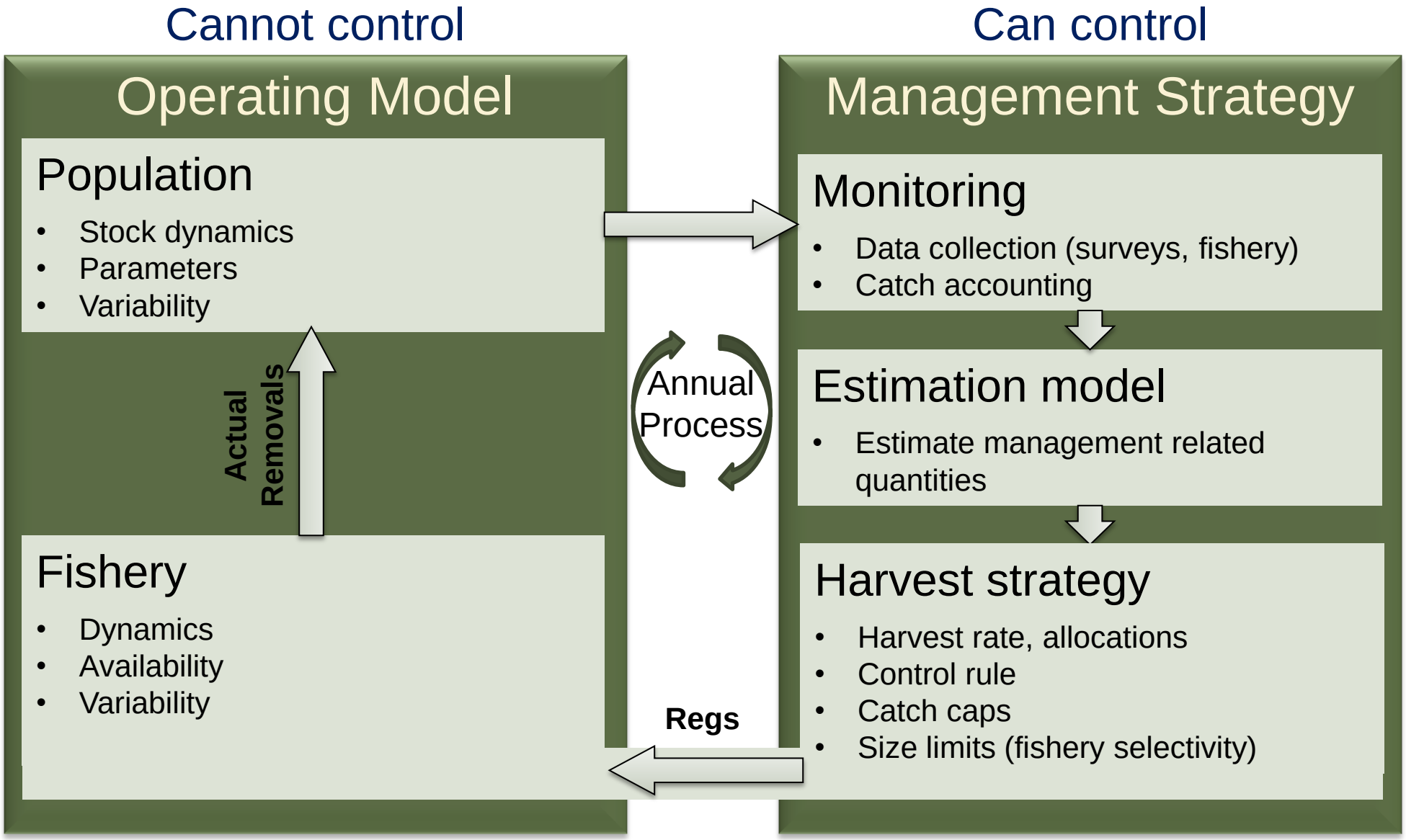
- Resources
  - IPHC staff and MSAB members
- Deliverables
  - Outline of current HP and description of realized HP
  - A set of management procedures of interest with various options
  - Combinations of those management procedures to be evaluated
    - Management strategy/harvest policies
- Timeline
  - 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.

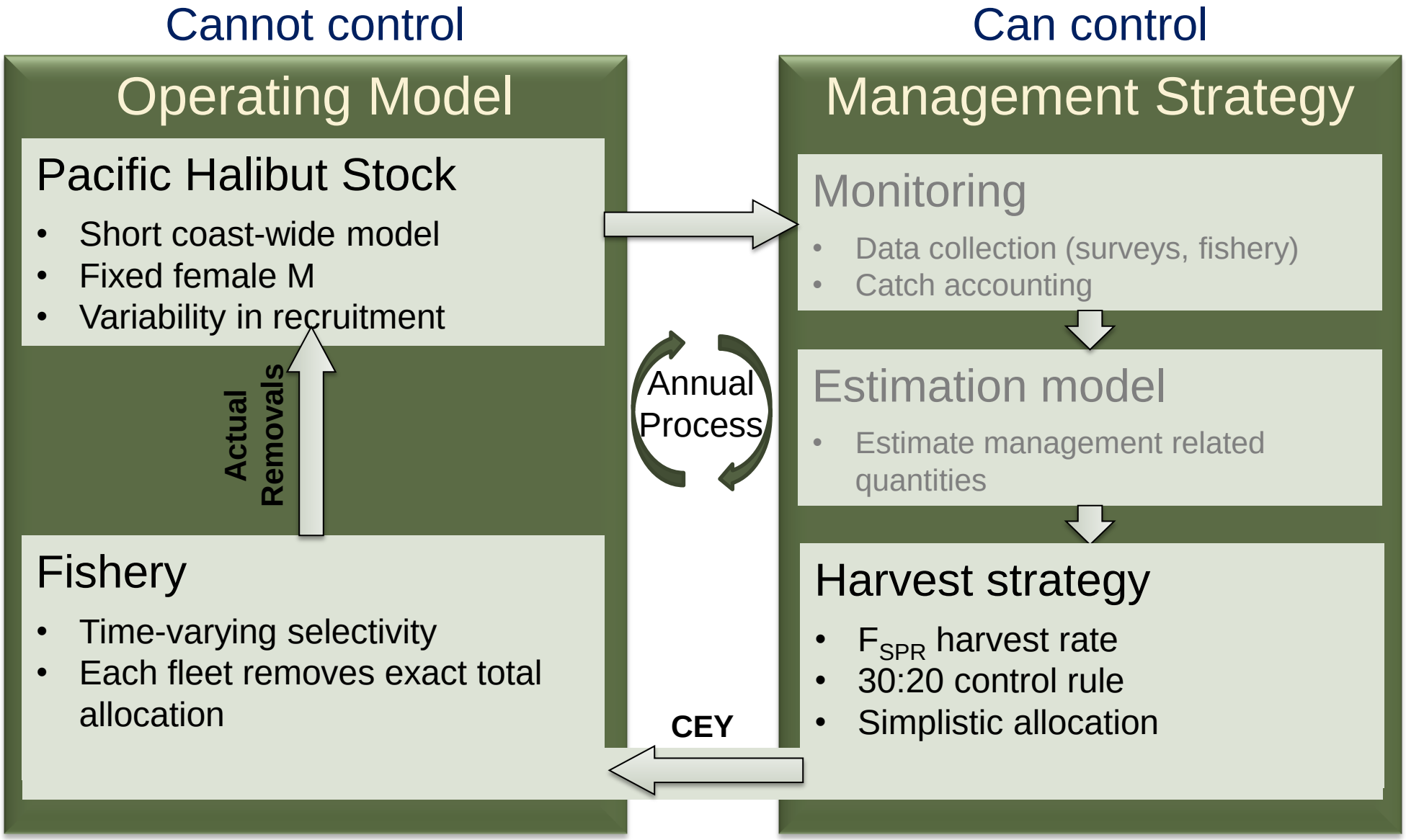
Task 6: Closed-loop simulation



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

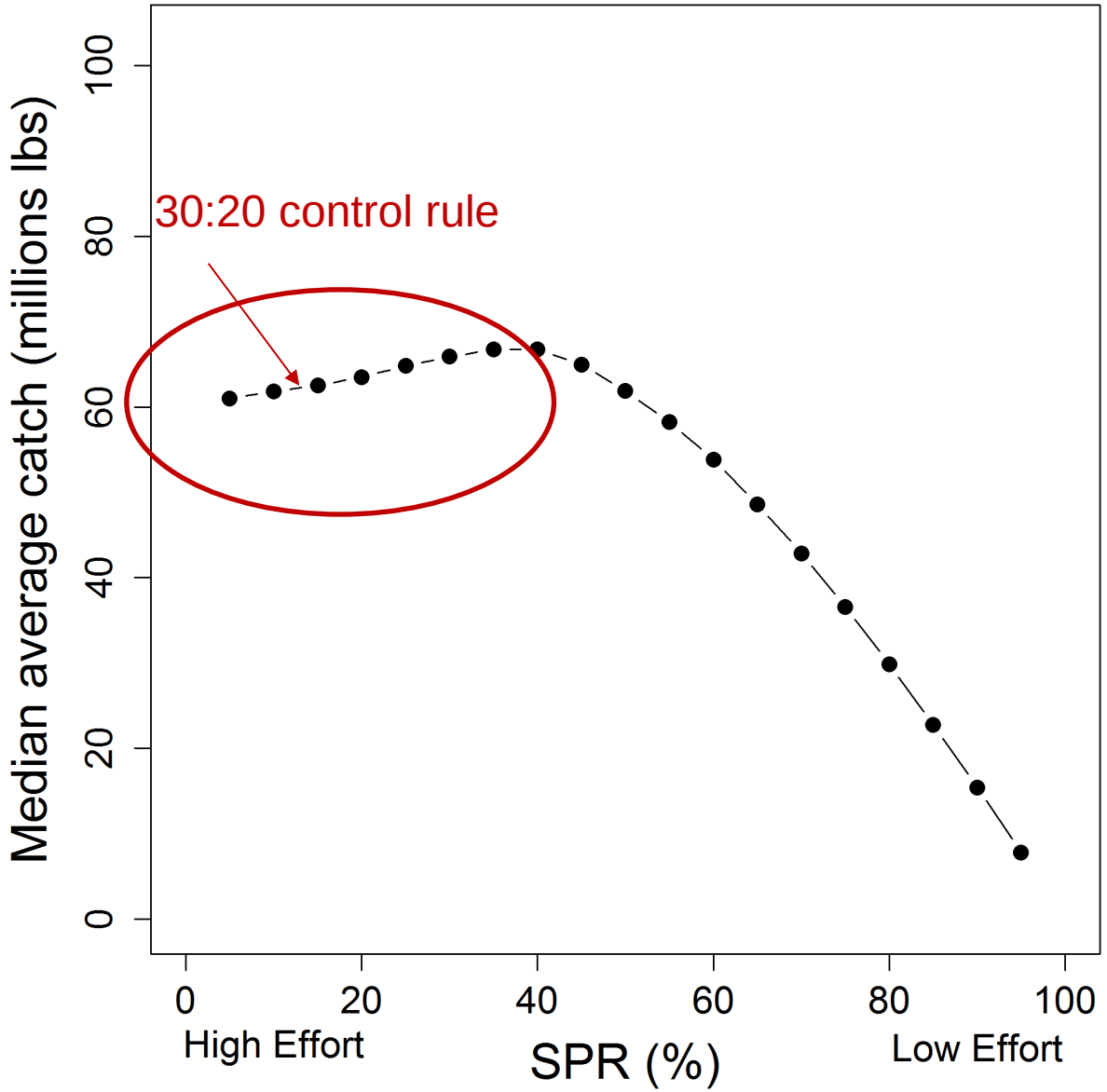


Task 6: Example of a closed-loop simulation

- Three performance metrics over a 10-year period starting 80 years in the future
  - **Yield:** Average catch
  - **Conservation:** Average relative spawning biomass
  - **Stability:** Average annual variation in catch (AAV)
- Quantiles (e.g., median) are calculated across simulations

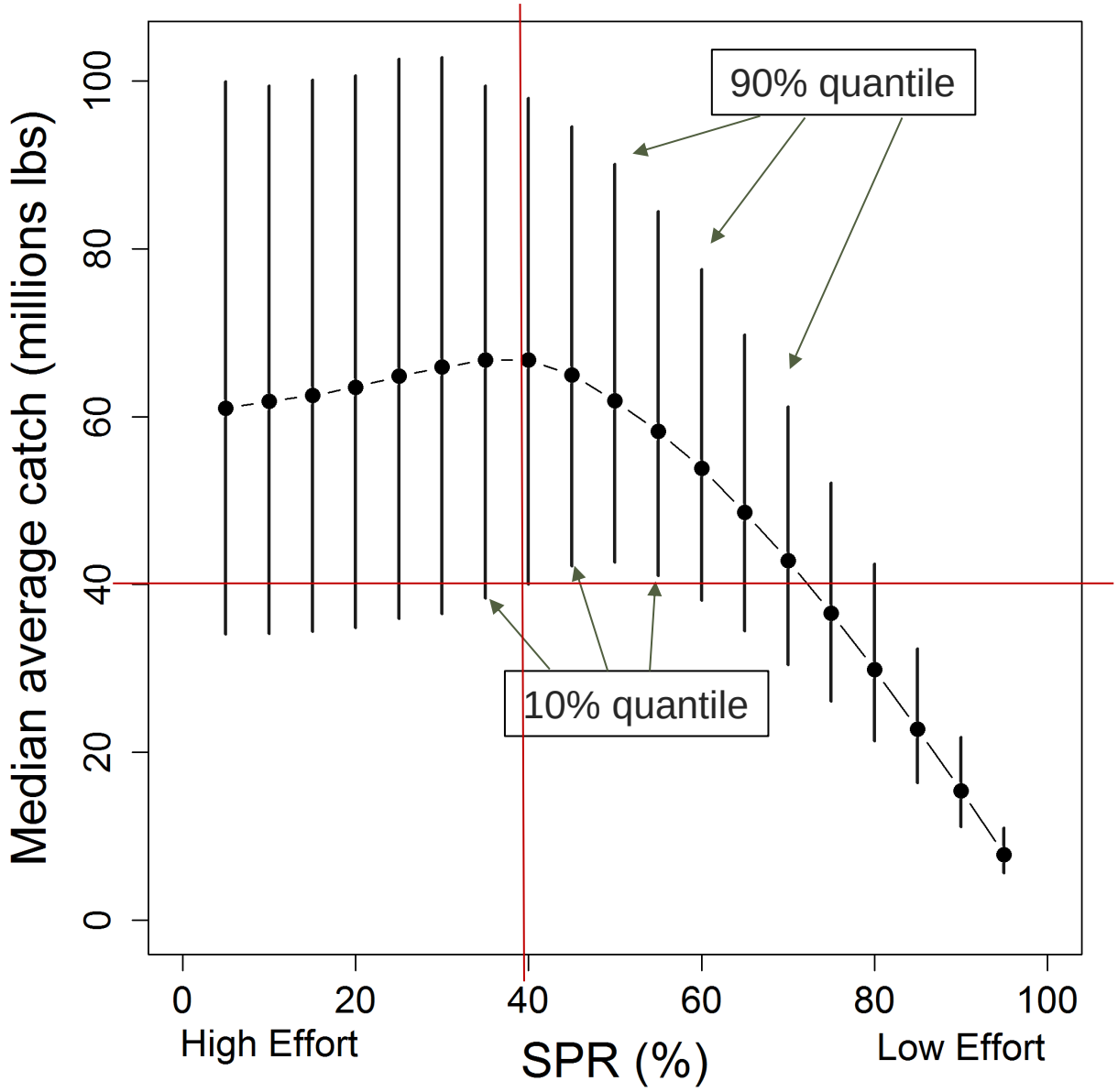
Task 6: Preliminary results (comparison to equilibrium model)

- The MSAB has seen results from an equilibrium model
  - e.g., 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 long-term results should be similar to an equilibrium model



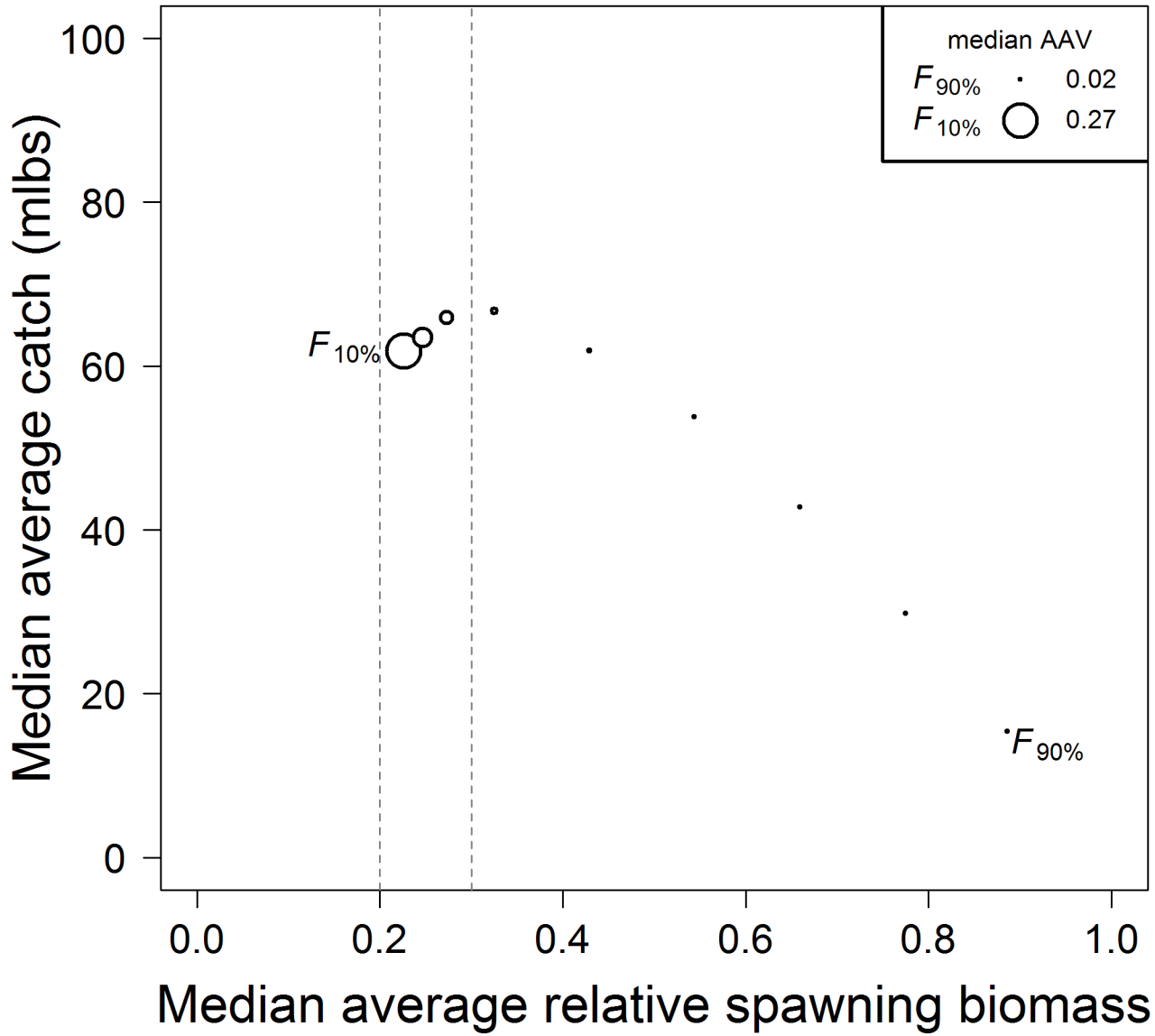
Task 6: Preliminary results (with uncertainty)

- 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 that Yield < 40mlbs with SPR=0.4 is 10%



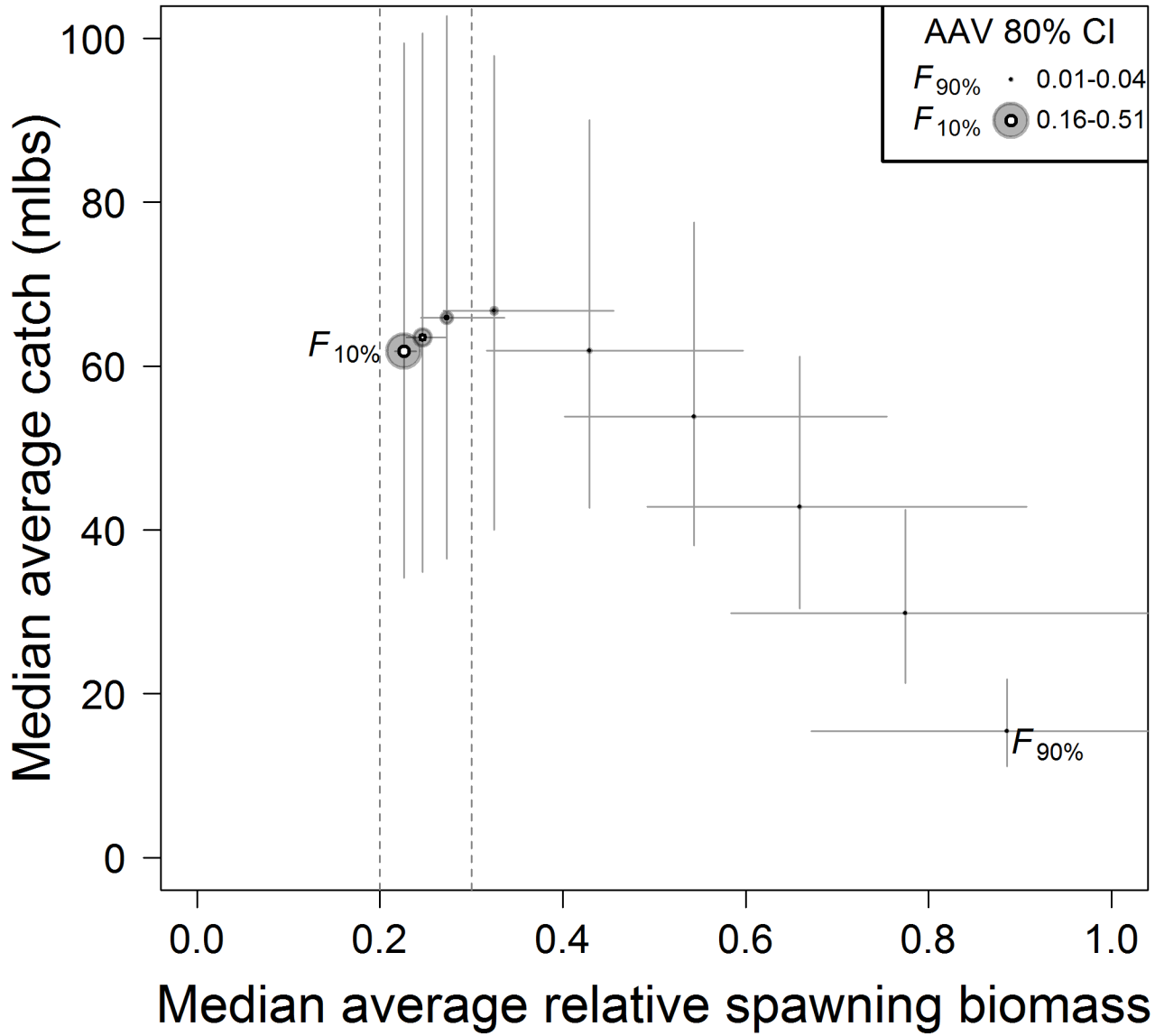
Task 6: Preliminary results (yield vs conservation vs stability)

- 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



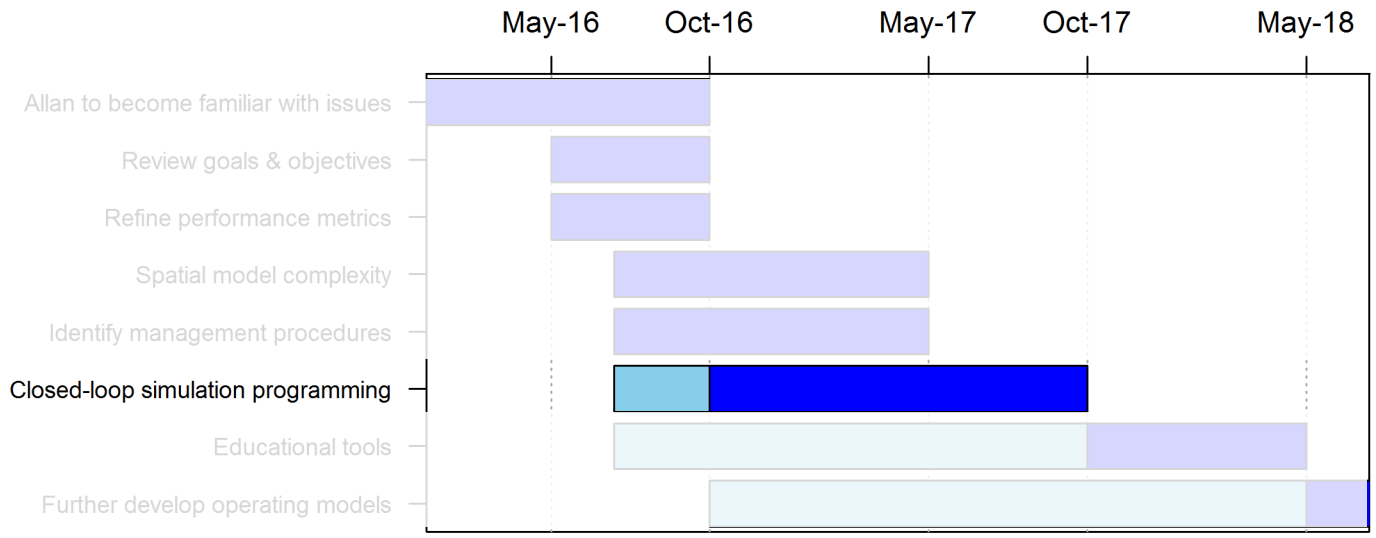
Task 6: Preliminary results (table of performance metrics)

	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: 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
  - Evaluate the current realized HP's for Oct 2017

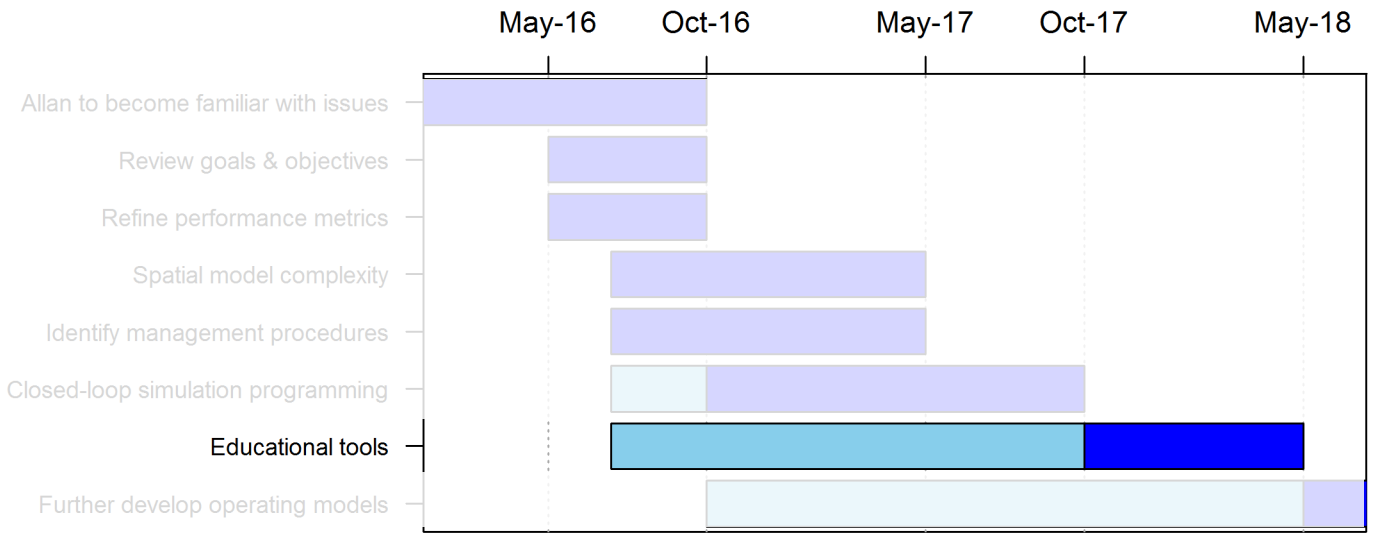


Task 7: Educational tools

- The interactive tool (Shiny app) seems to be of interest to stakeholders
  - Current tool (equilibrium model) is fast and still useful to eliminate some management procedures
  - Expand upon the equilibrium model (i.e., closed-loop simulations)
    - Outputs will change to report uncertainty
  - MSAB is more interested in results than education right now
- Materials
  - Website, descriptions, case studies, …

Task 7: Resources, Deliverables, Timeline

- Resources
  - IPHC staff, a programmer, computers, time
- Deliverables
  - An application that allows users to provide inputs and see outputs
  - Materials than can help stakeholders better understand MSE
- Timeline
  - Design app while coding Task 6
  - Release app in May 2018
  - Continually provide materials

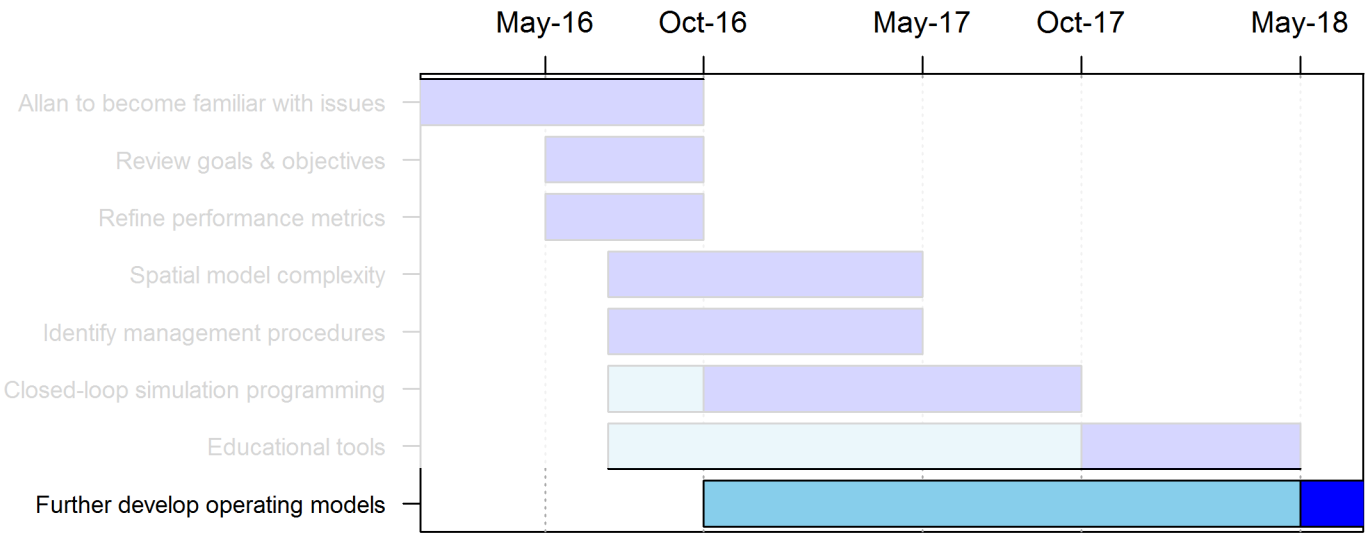


Task 8: Further the development of operating models

- Multiple scenarios are useful to understand uncertainty
- A multi-area operating model will help to answer many area-specific questions
  - Need to identify those questions so that we can develop appropriate spatial model (Task 2 and Task 4)
- 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 various operating models that satisfy the objectives
  - A design and the beginning of development
- Timeline
  - Designing in 2017
  - Programming in 2018



Potential missing topics

- Collaboration
  - with others implementing MSE
- PSC limits
  - I’m part of a working group
- Outreach
  - MSAB members are mostly doing this