

# Evaluating an ecosystem-based fishery management procedure for Georges Bank using ceilings on system removals

Amanda Hart & Gavin Fay

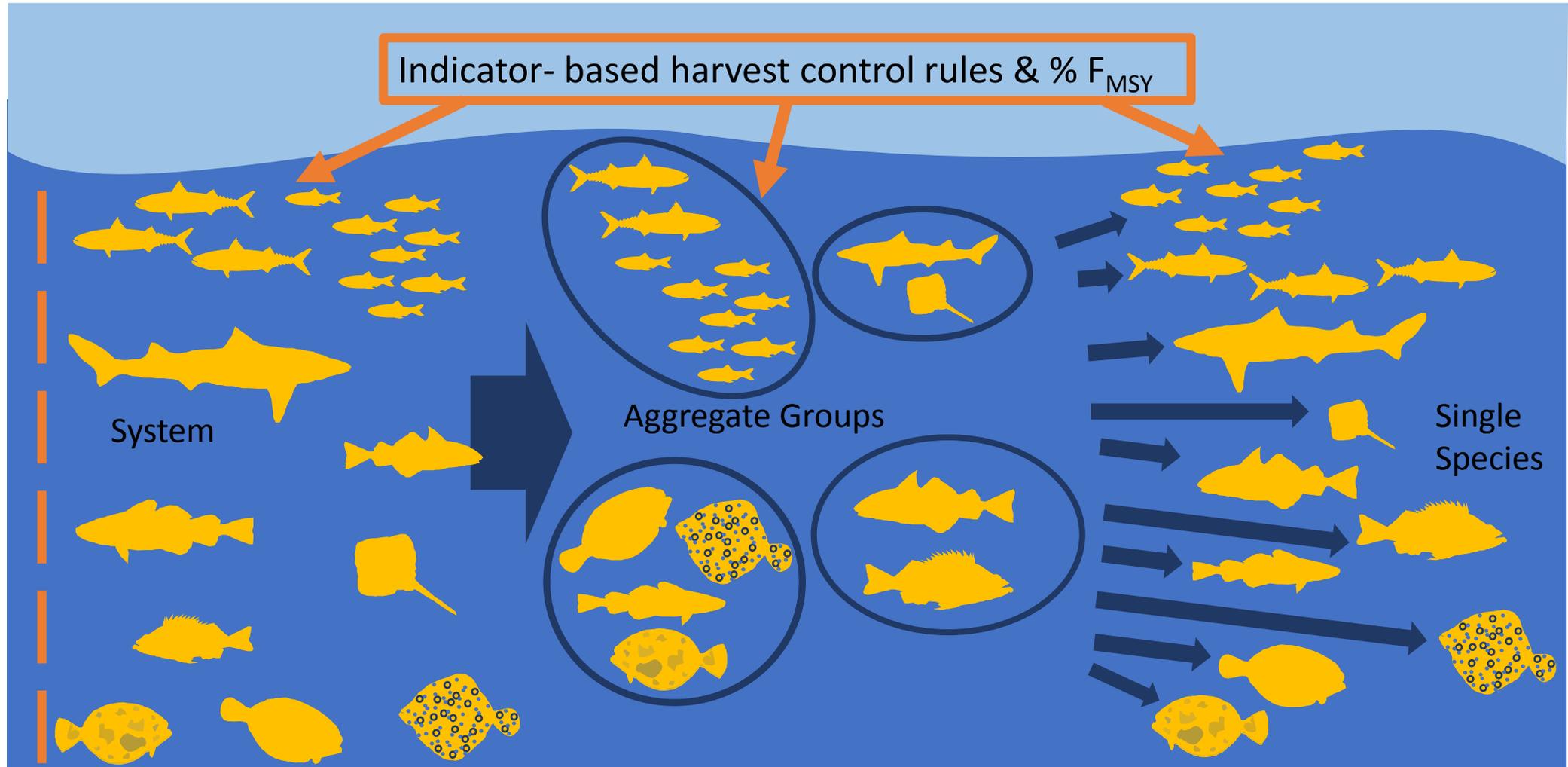
UMass Dartmouth



# Management Strategy Evaluation:

1. Model the ecosystem

2. Impose management actions



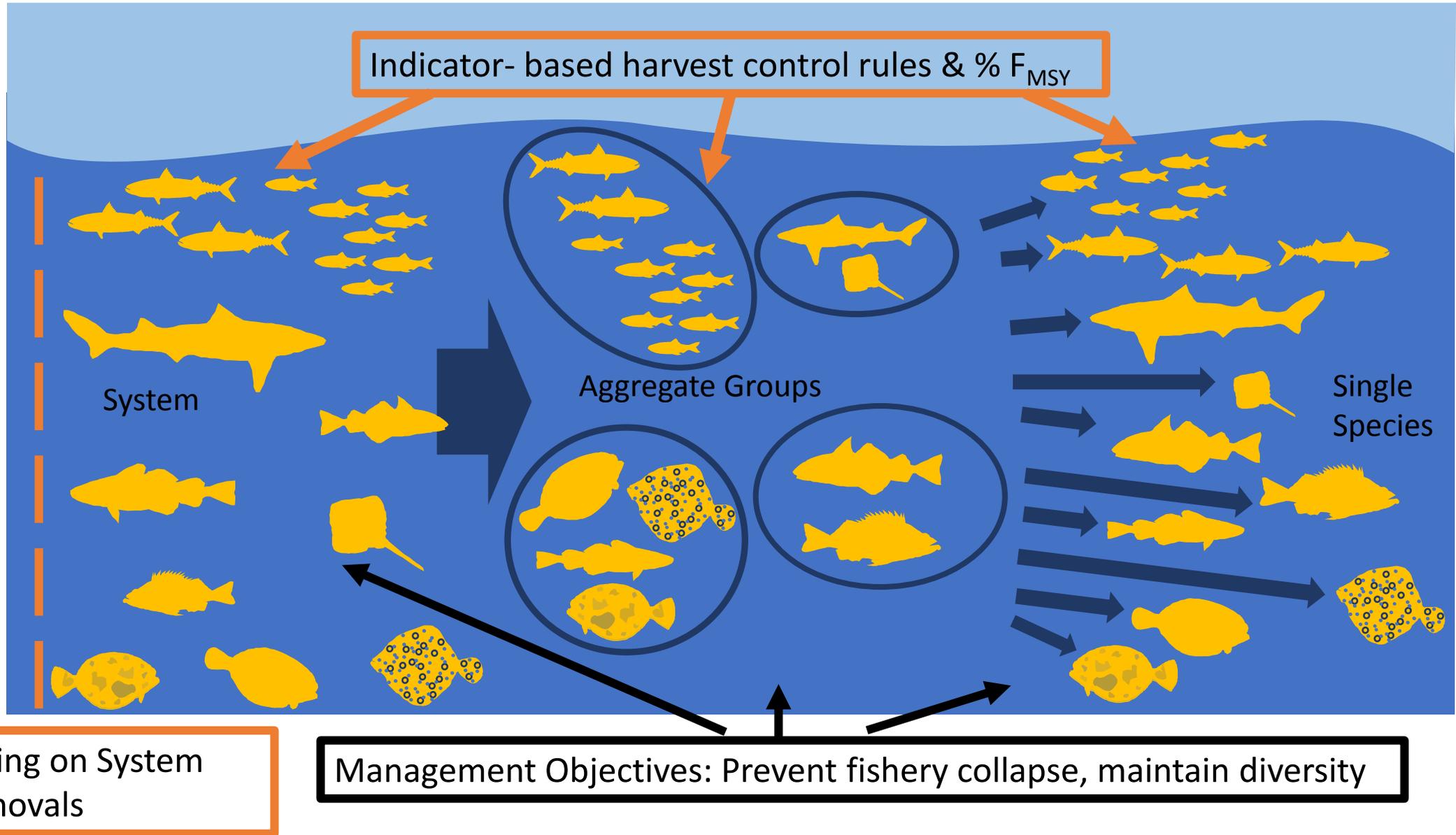
Ceilings (mt)	Indicator-Based Harvest Control Rules	Percent $F_{MSY}$
50,000	On <ul style="list-style-type: none"> <li>Trophic level survey</li> <li>Trophic level landings</li> <li>High proportion pelagic species</li> <li>Low proportion pelagic species</li> <li>High proportion predator species</li> <li>Low proportion predator species</li> <li>Proportion overfished</li> <li>Biomass variability</li> </ul>	100% $F_{MSY}$
75,000		
100,000		
125,000		
150,000		75% $F_{MSY}$
175,000		
200,000		
No ceiling		

# Management Strategy Evaluation:

1. Model the ecosystem

2. Impose management actions

3. Evaluate: Did we meet our management objectives?

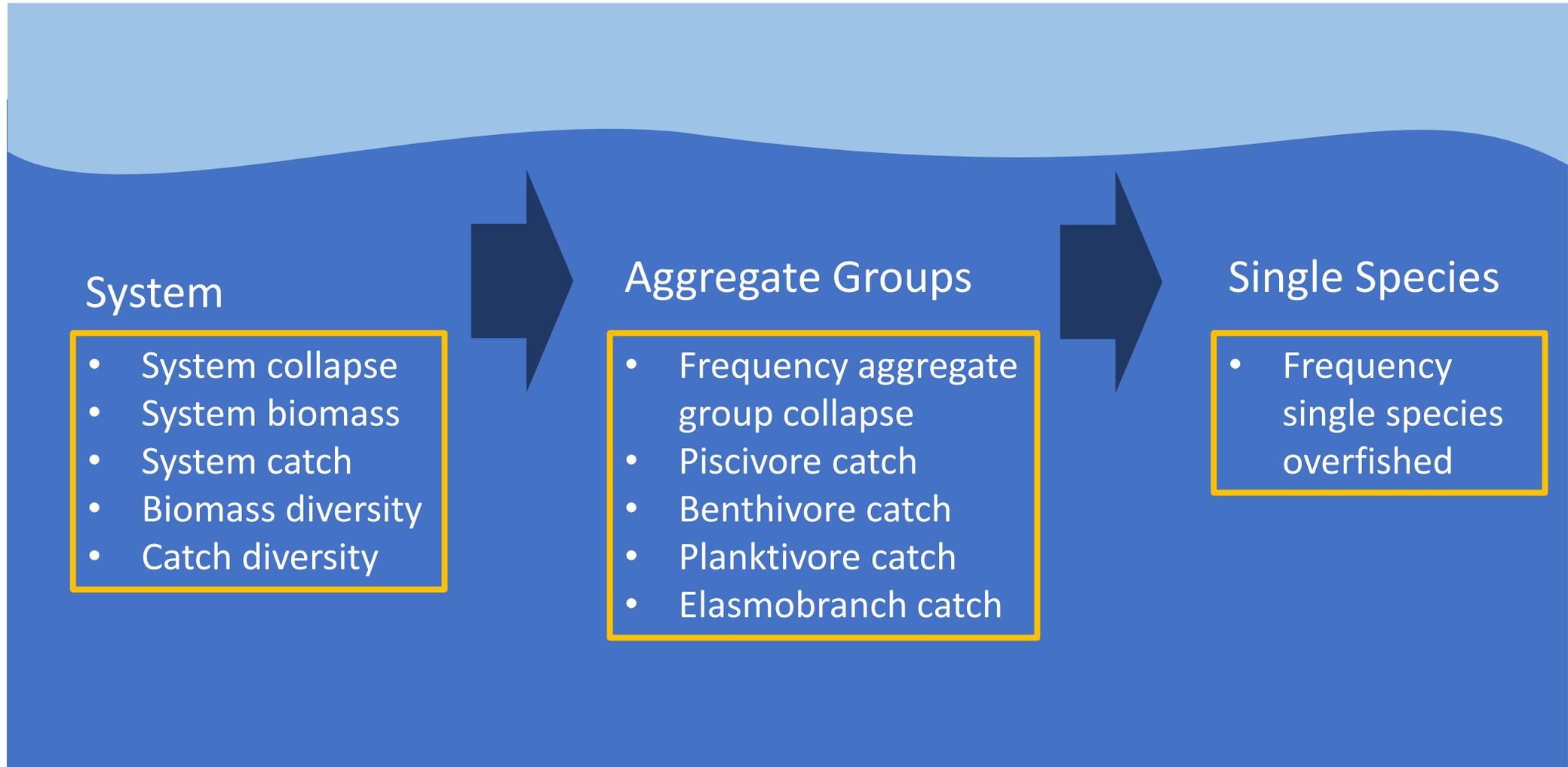


# Management Strategy Evaluation:

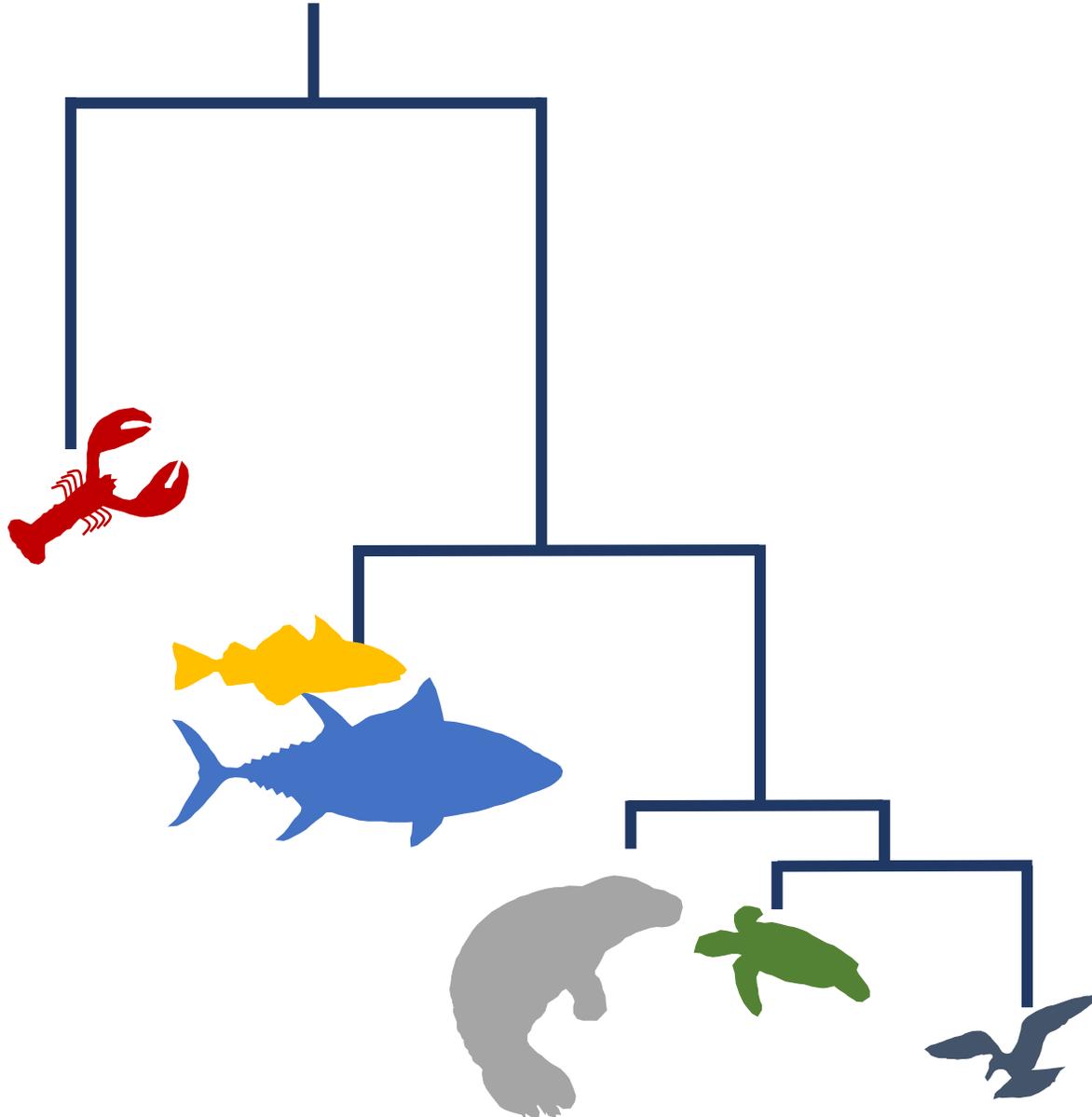
1. Model the ecosystem

2. Impose management actions

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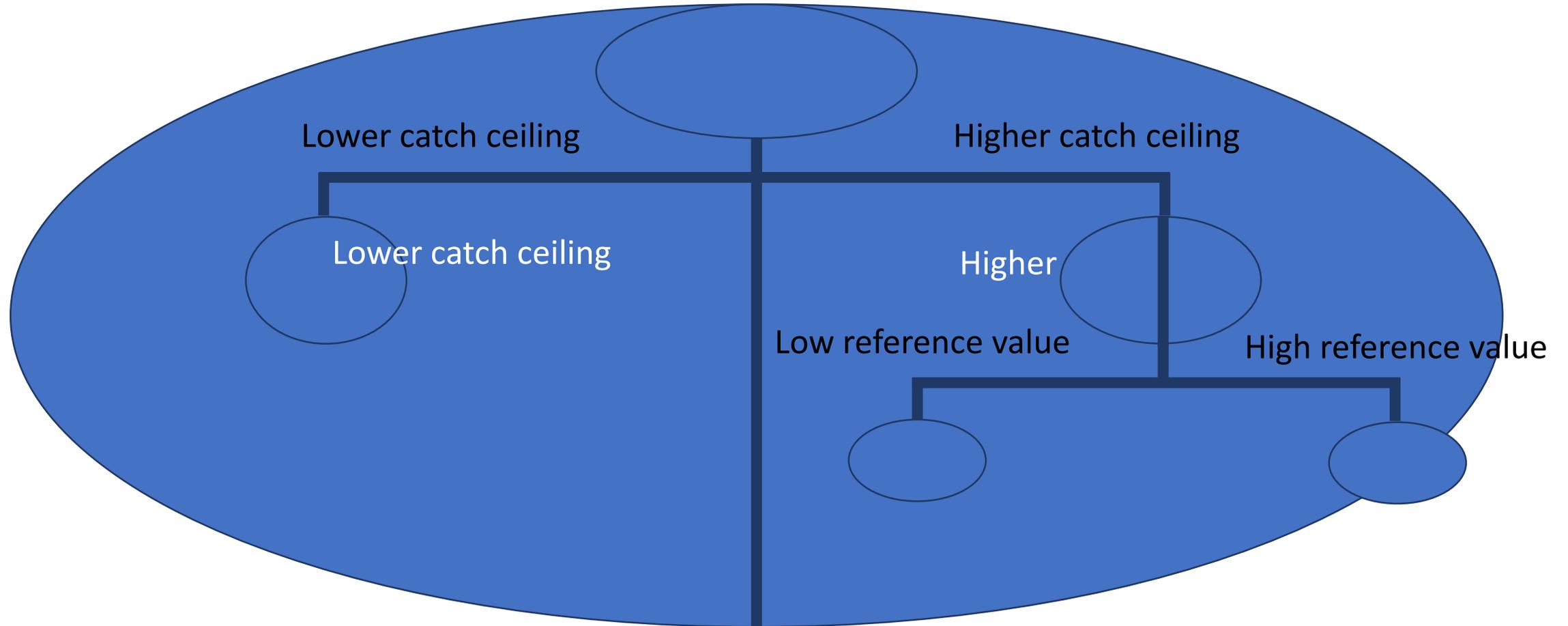


# Evaluate Management Performance: Tree Analysis (An Example)



# Evaluate Management Performance: Tree Analysis

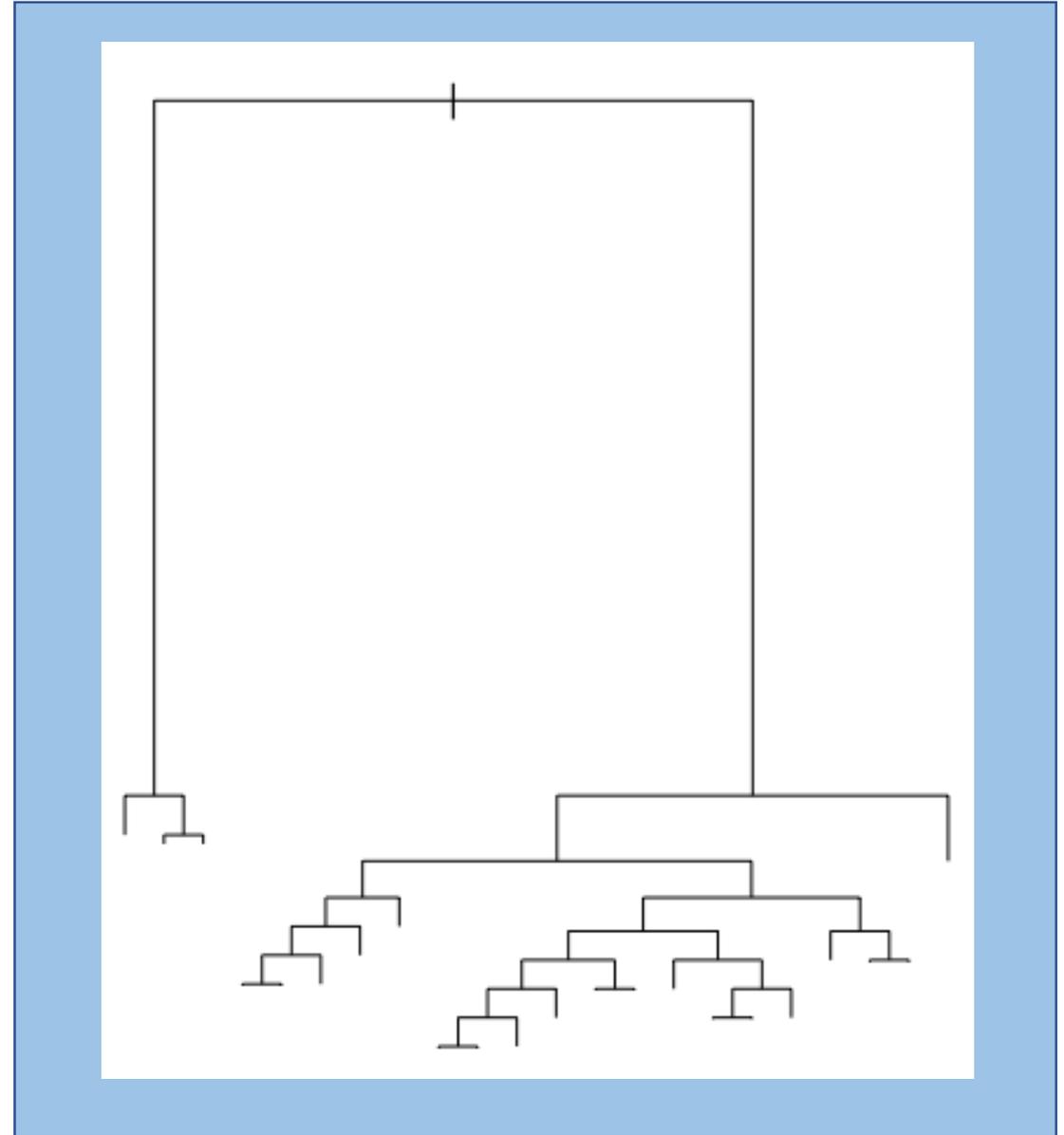
Pooled performance metric data from all simulations



# Frequency Single Species Overfished

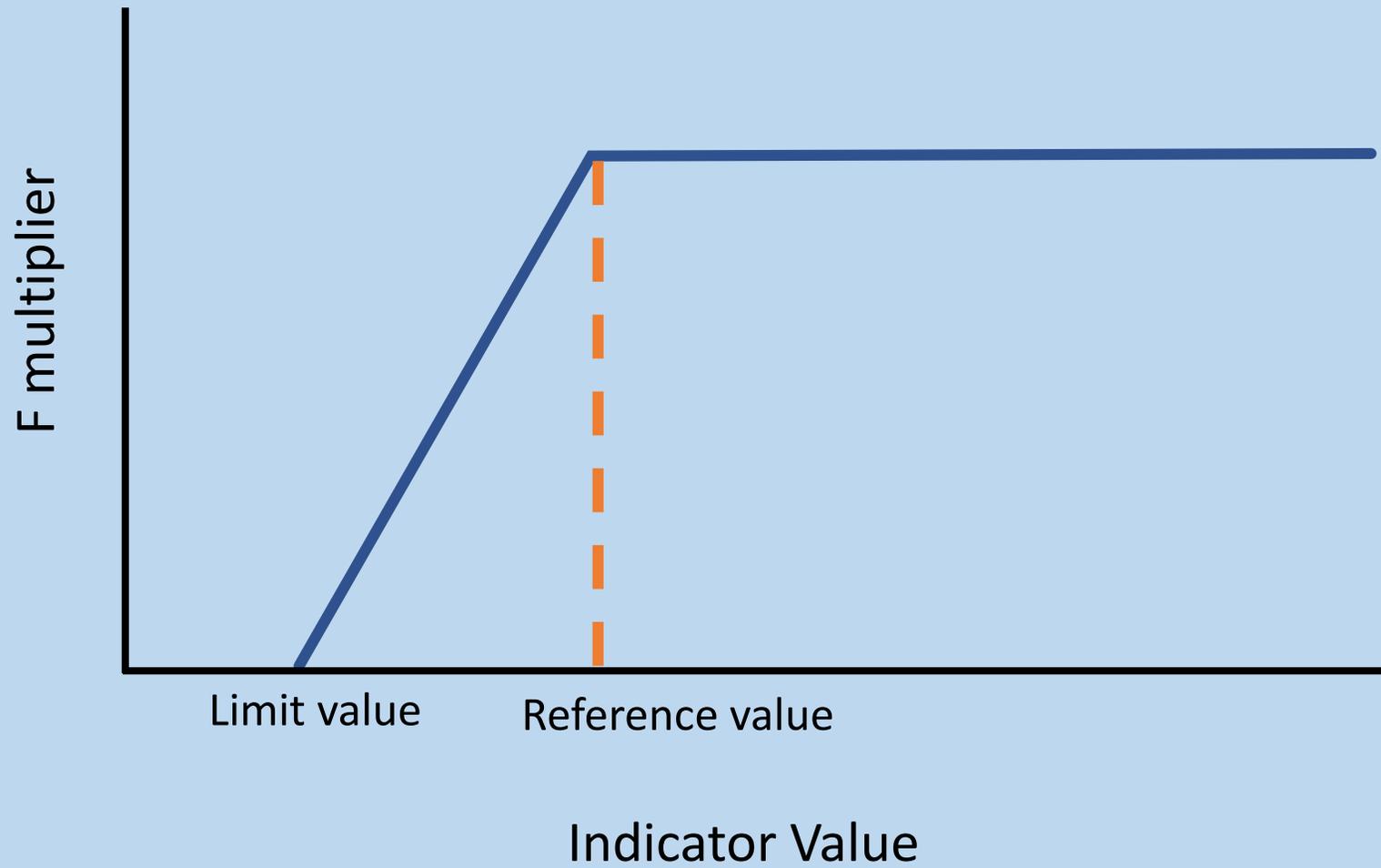
## Variables used to form splits:

- Catch ceiling value
- Indicator-based harvest control rules used
- %  $F_{MSY}$
- Survey trophic level reference value
- Landings trophic level reference value
- High proportion pelagic species reference value
- Proportion overfished reference value



Performance metrics	Catch ceiling level	Indicator-based harvest control rules used	% F <sub>MSY</sub>	Reference Values								Limit Values							
				1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Frequency Single Species Overfished	✓	✓	✓	✓	✓	✓				✓									
Frequency Aggregate Collapse	✓	✓																	
Piscivore Catch	✓	✓	✓	✓	✓		✓	✓	✓										
Benthivore Catch	✓	✓	✓	✓				✓		✓			✓	✓					
Planktivore Catch	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓		
Elasmobranch Catch	✓		✓						✓										
System Biomass	✓	✓	✓	✓					✓	✓									
System Catch	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								
Biomass Diversity	✓	✓	✓					✓	✓	✓									
Catch Diversity	✓	✓	✓			✓		✓	✓	✓			✓						

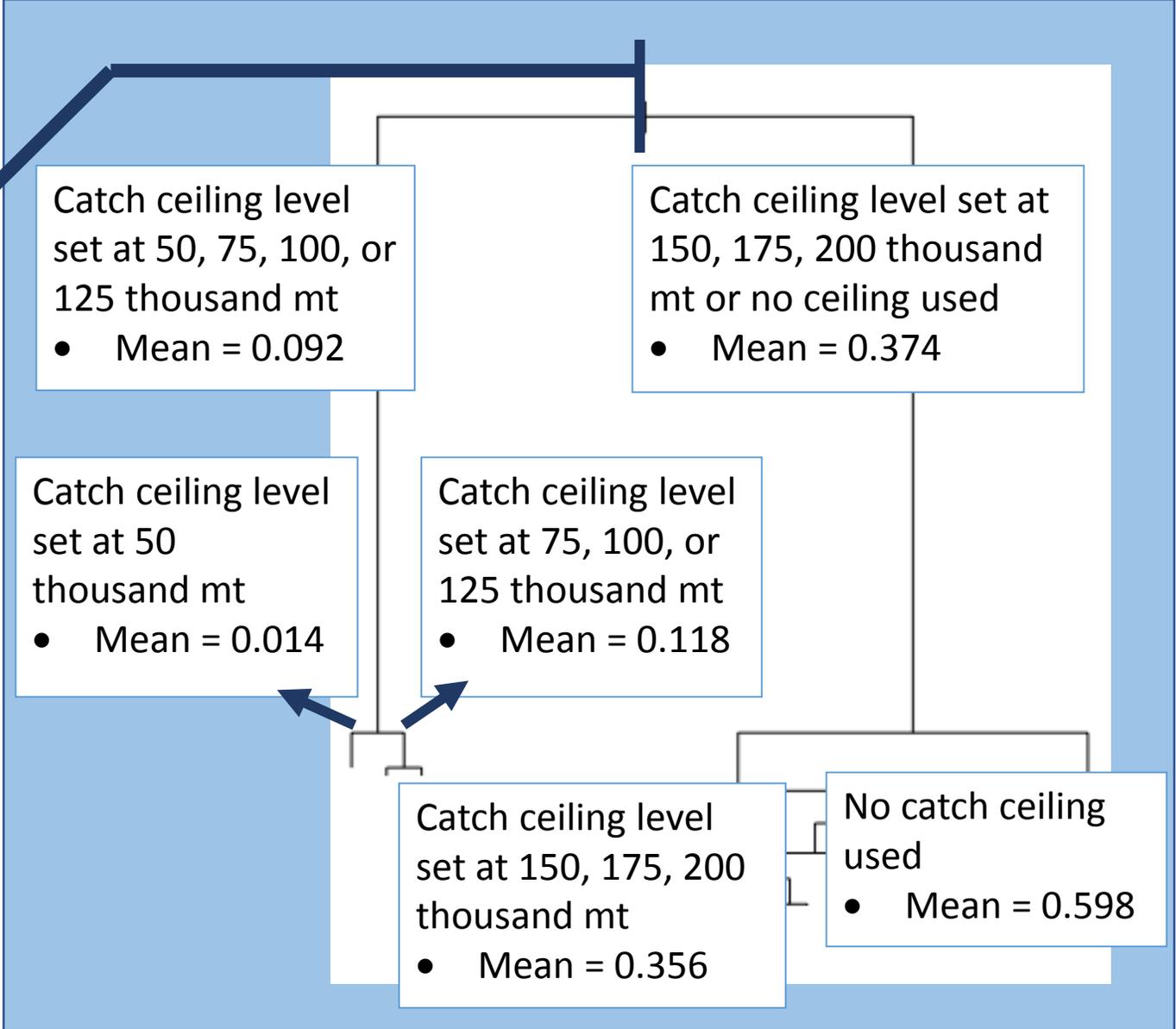
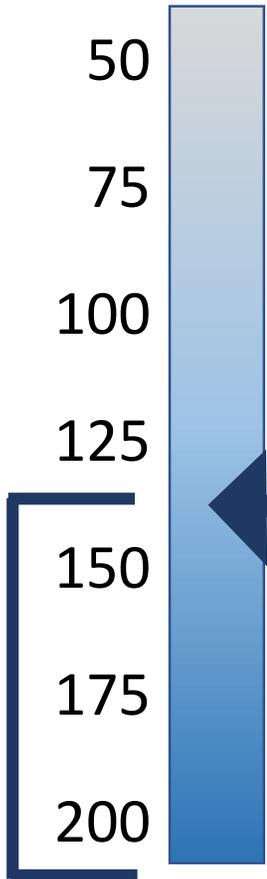
# Indicator-based Harvest Control Rule Settings: Limit Values and Reference Values



Performance metrics	Catch ceiling level	Indicator-based harvest control rules used	% F <sub>MSY</sub>	Reference Values								Limit Values							
				1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Frequency Single Species Overfished	✓	✓	✓	✓	✓	✓					✓								
Frequency Aggregate Collapse	✓	✓																	
Piscivore Catch	✓	✓	✓	✓		✓	✓	✓											
Benthivore Catch	✓	✓	✓	✓	✓			✓		✓				✓	✓				
Planktivore Catch	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓								✓	
Elasmobranch Catch	✓		✓						✓										
System Biomass	✓	✓	✓	✓	✓	✓	✓		✓	✓									
System Catch	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓							
Biomass Diversity	✓	✓	✓	✓	✓	✓		✓	✓	✓									
Catch Diversity	✓	✓	✓			✓		✓	✓	✓				✓					

# Frequency Single Species Overfished

Catch Ceiling  
(thousand mt)

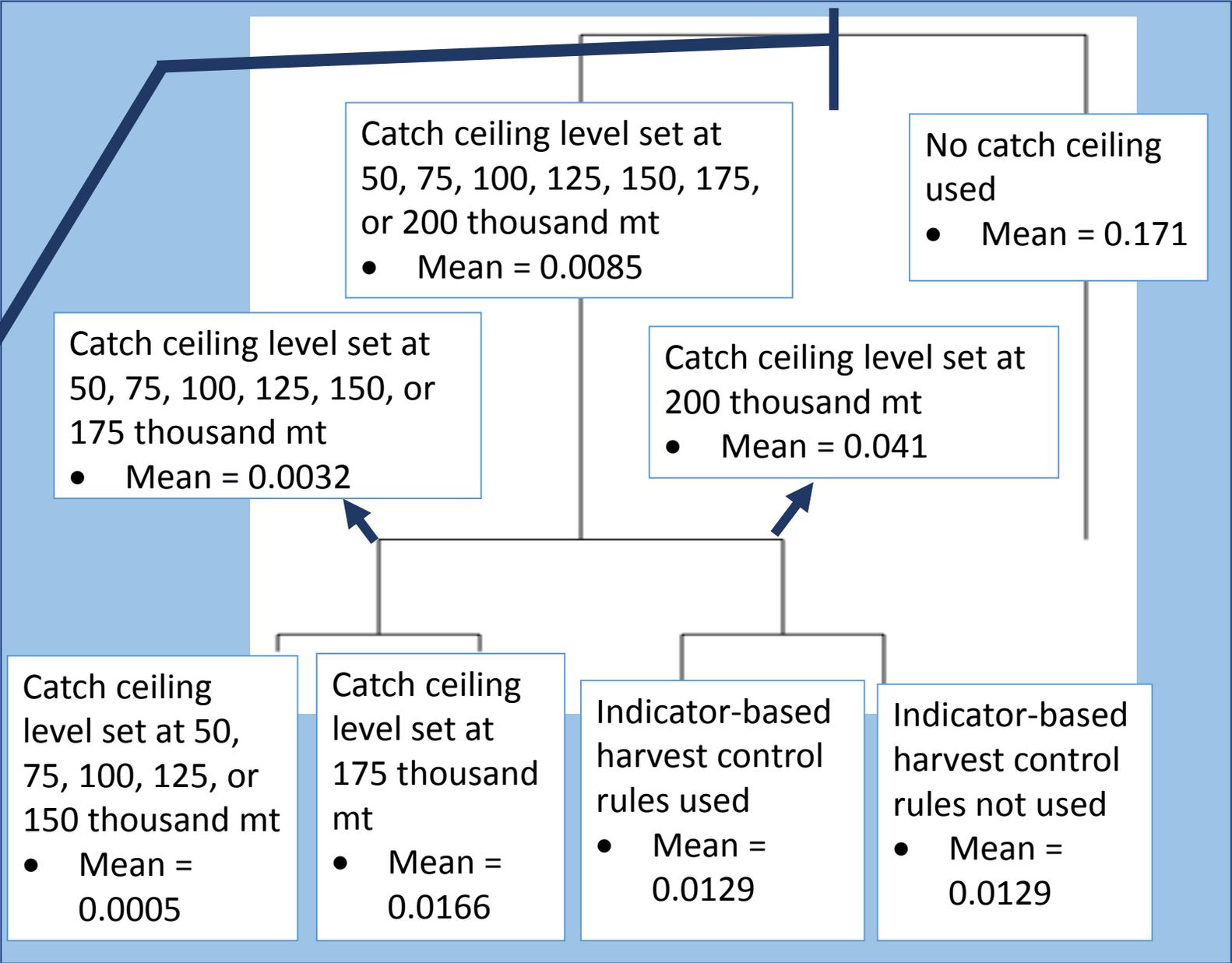


# Frequency Aggregate Group Collapse

Catch Ceiling  
(thousand mt)

50  
75  
100  
125  
150  
175  
200

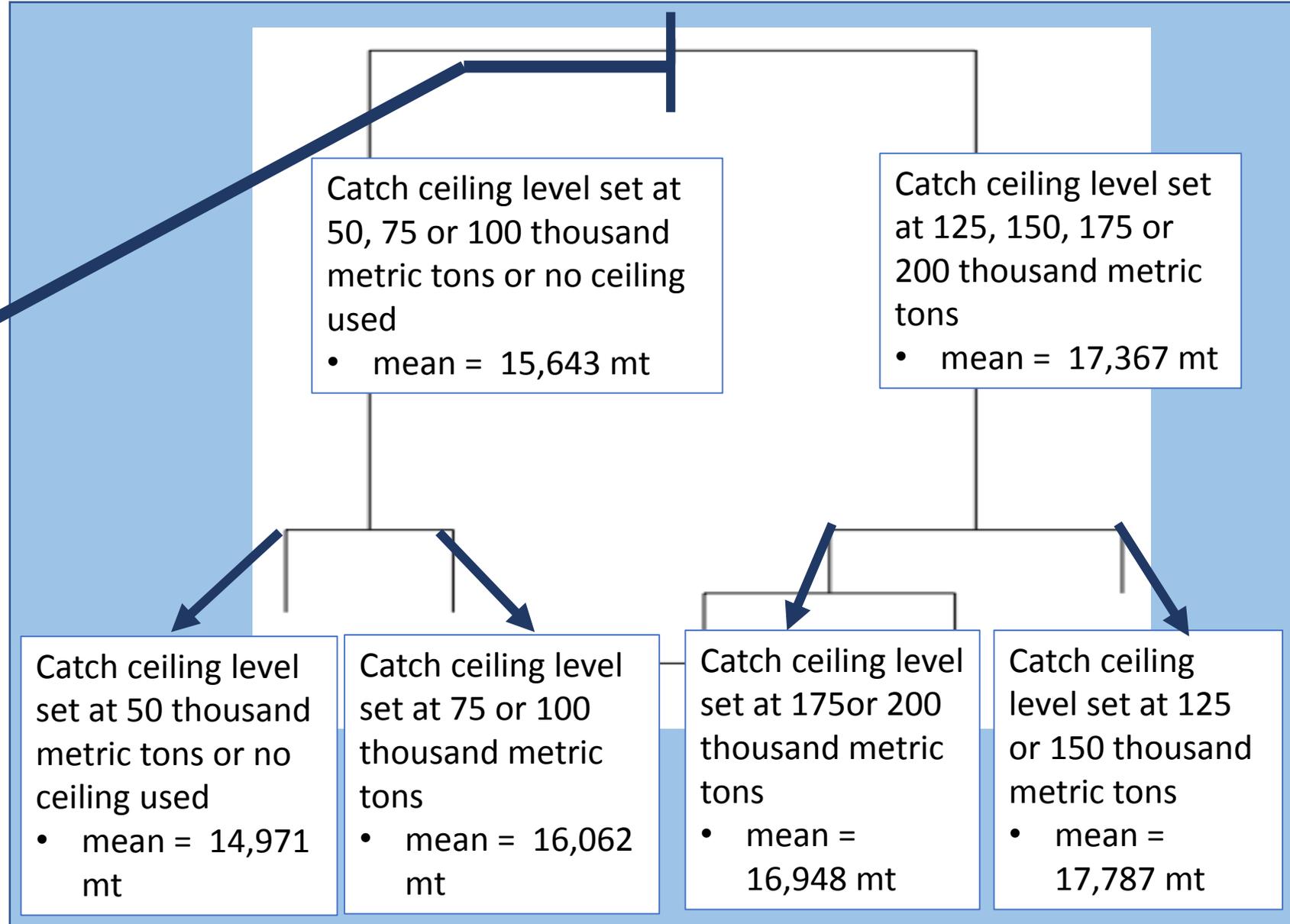
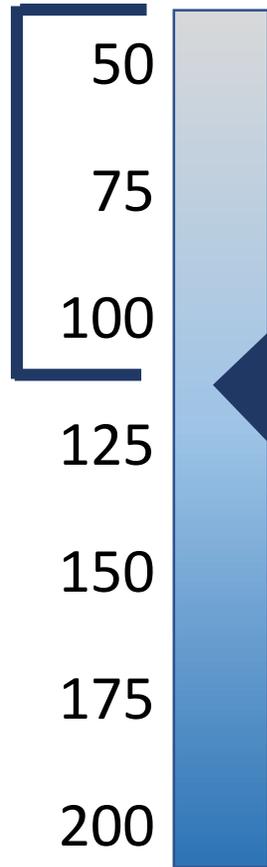
No Ceiling



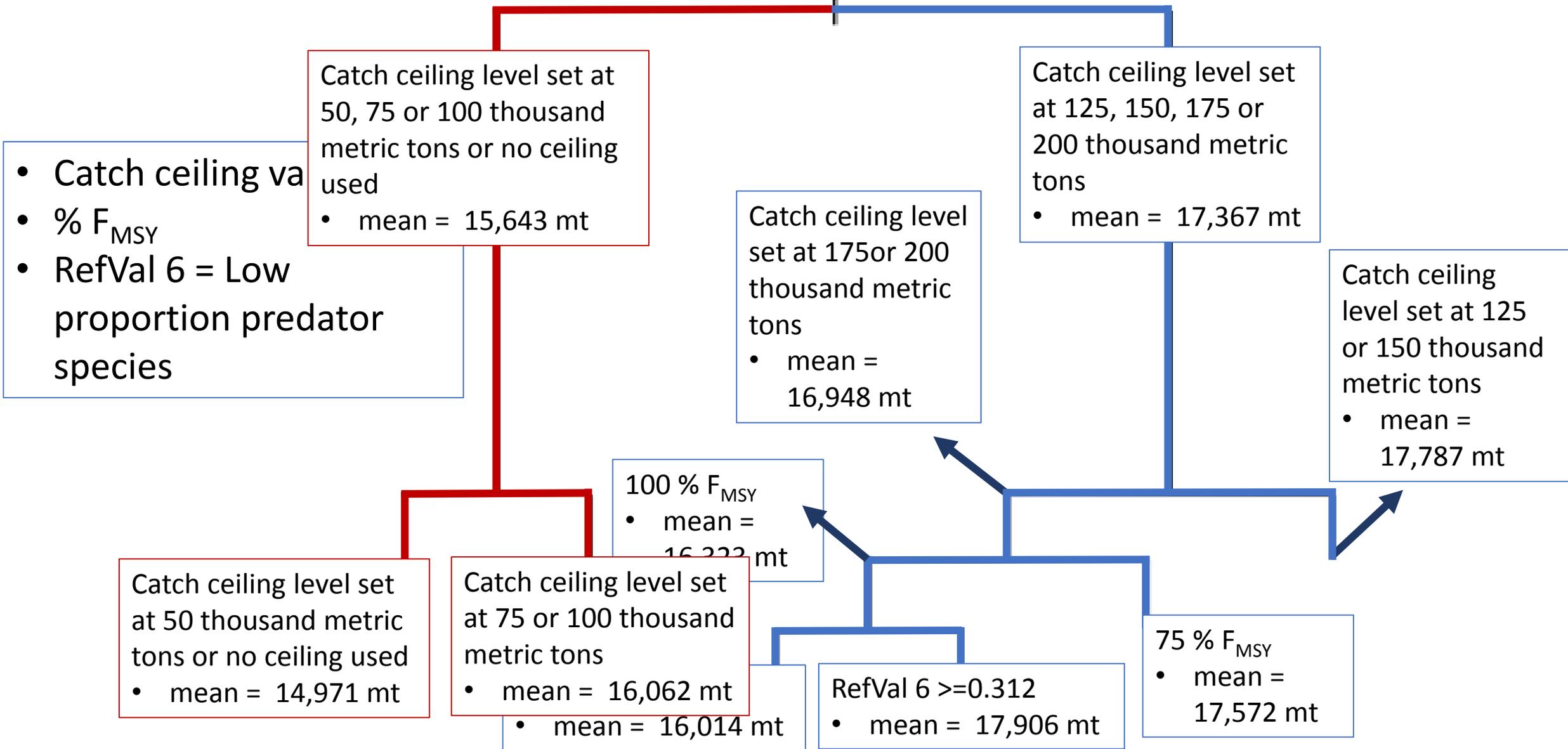
# Elasmobranch Catch

Catch Ceiling  
(thousand mt)

No  
Ceiling



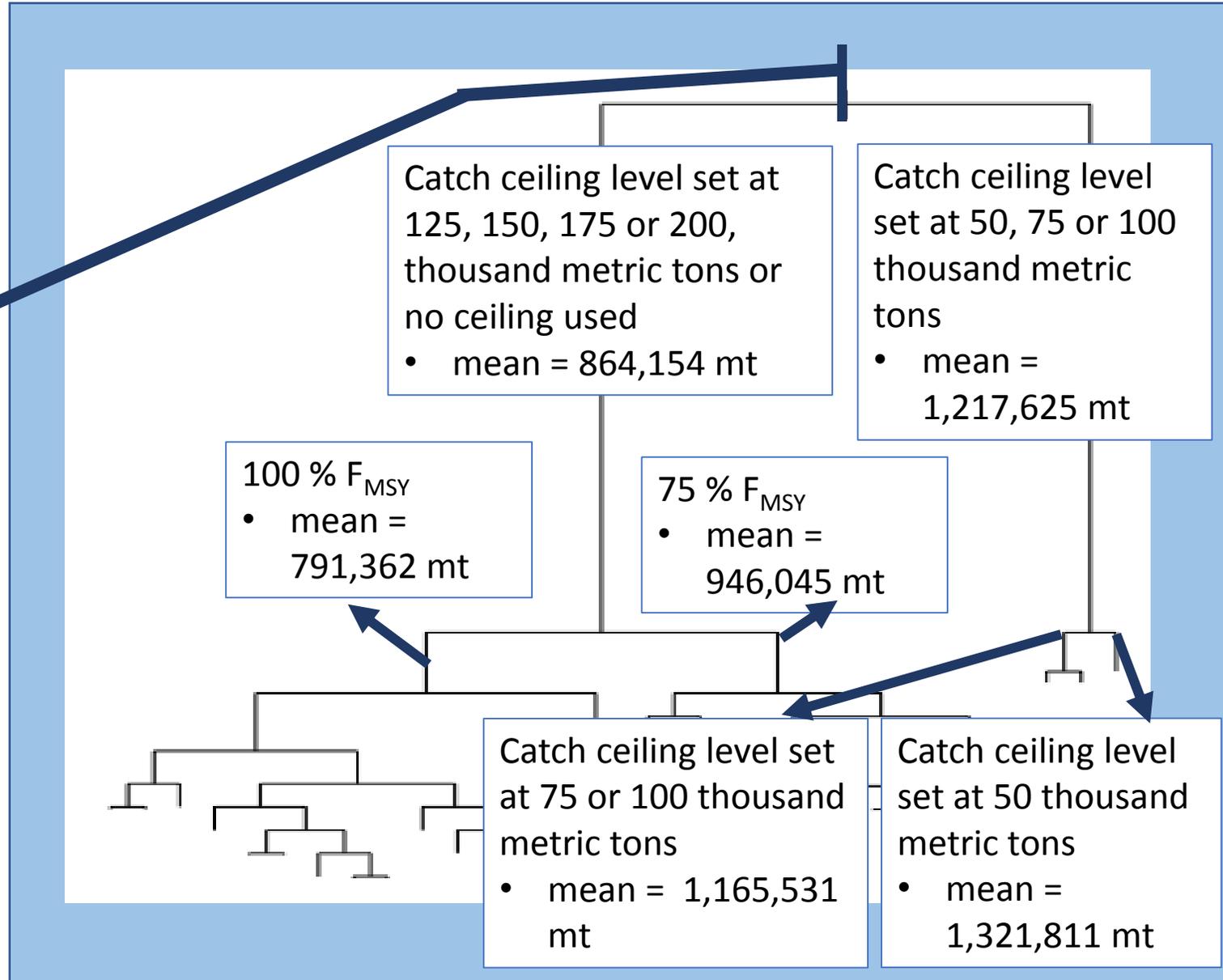
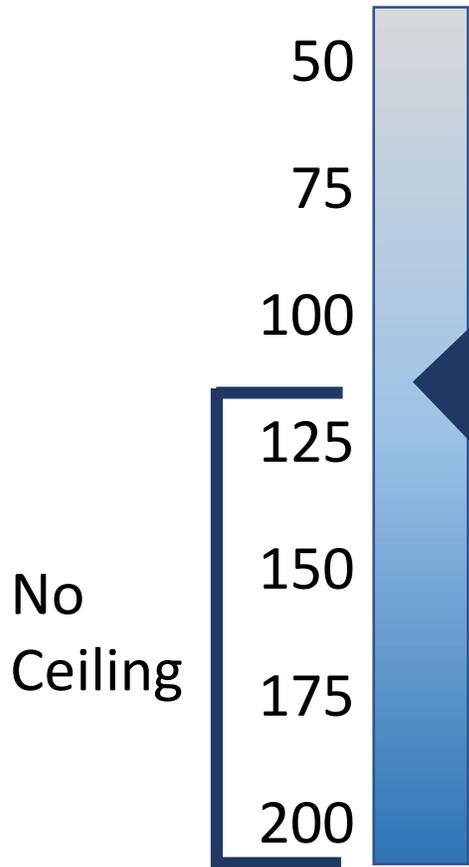
# Elasmobranch Catch



- Catch ceiling va
- %  $F_{MSY}$
- RefVal 6 = Low proportion predator species

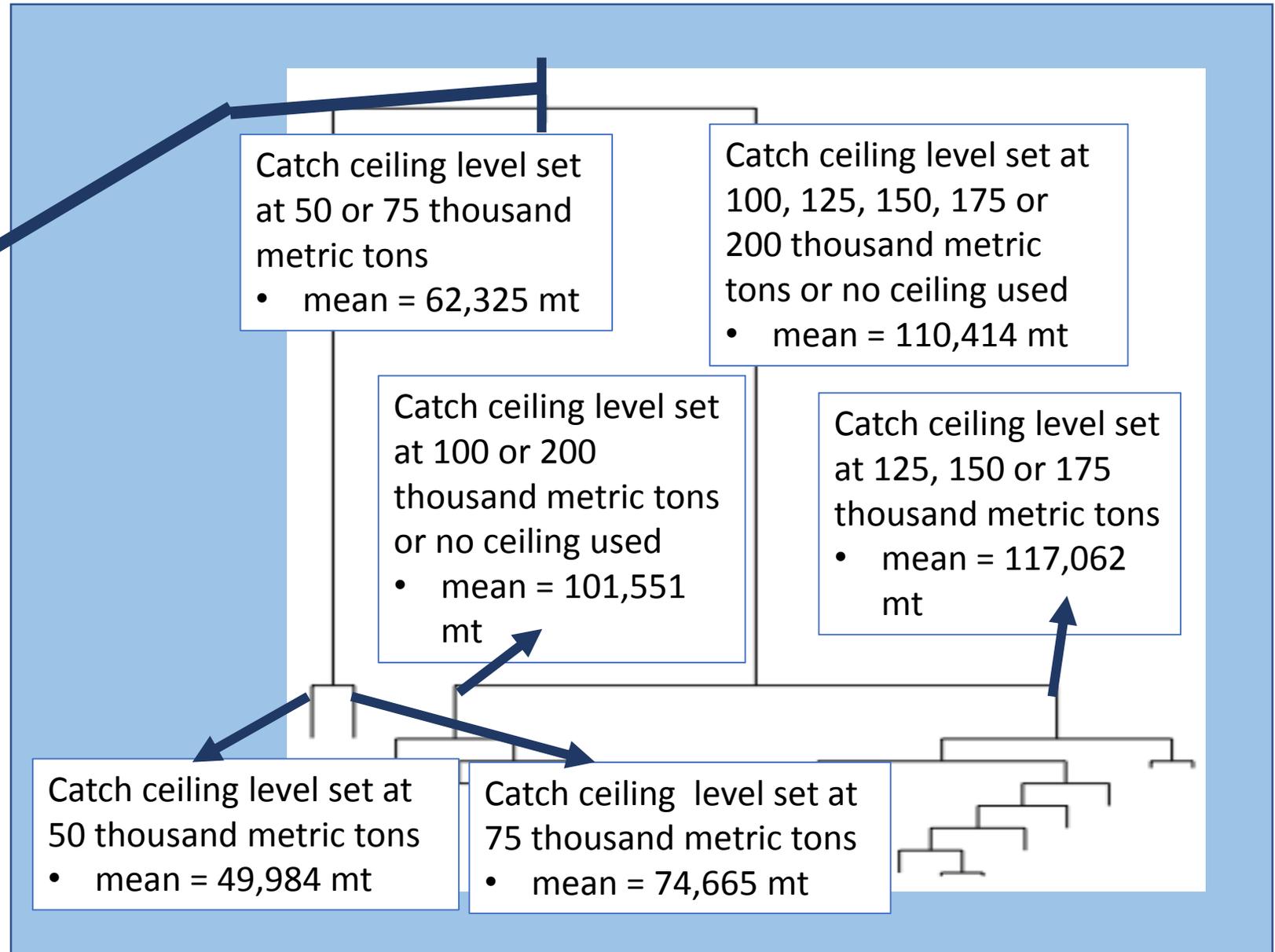
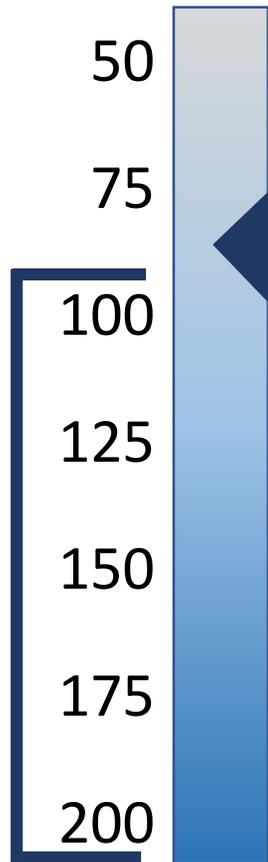
# System Biomass

Catch Ceiling  
(thousand mt)



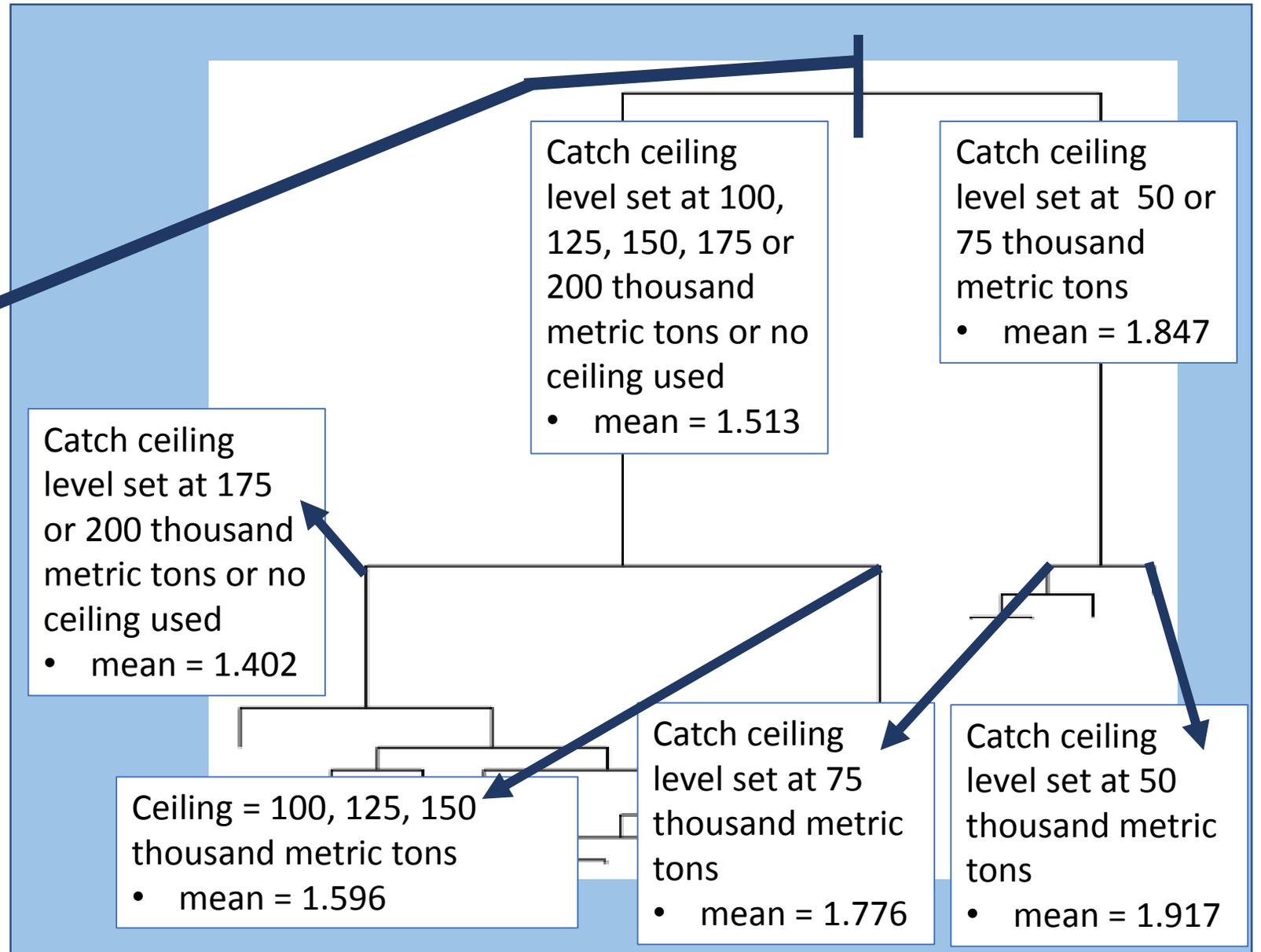
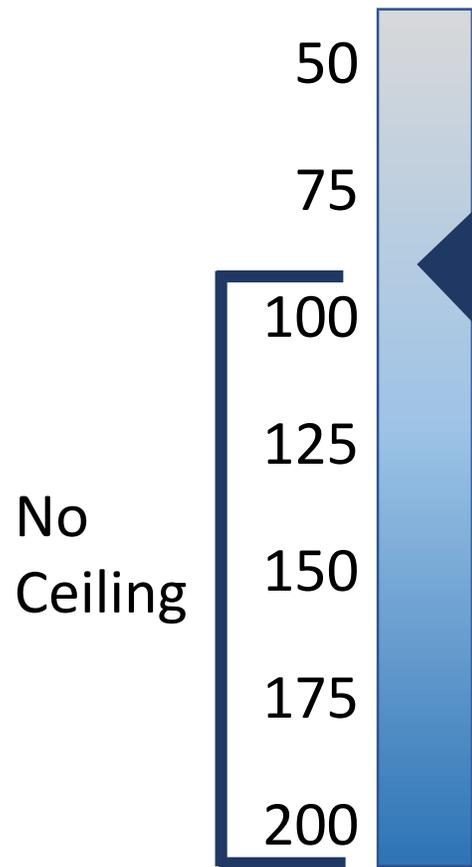
# System Catch

Catch Ceiling  
(thousand mt)



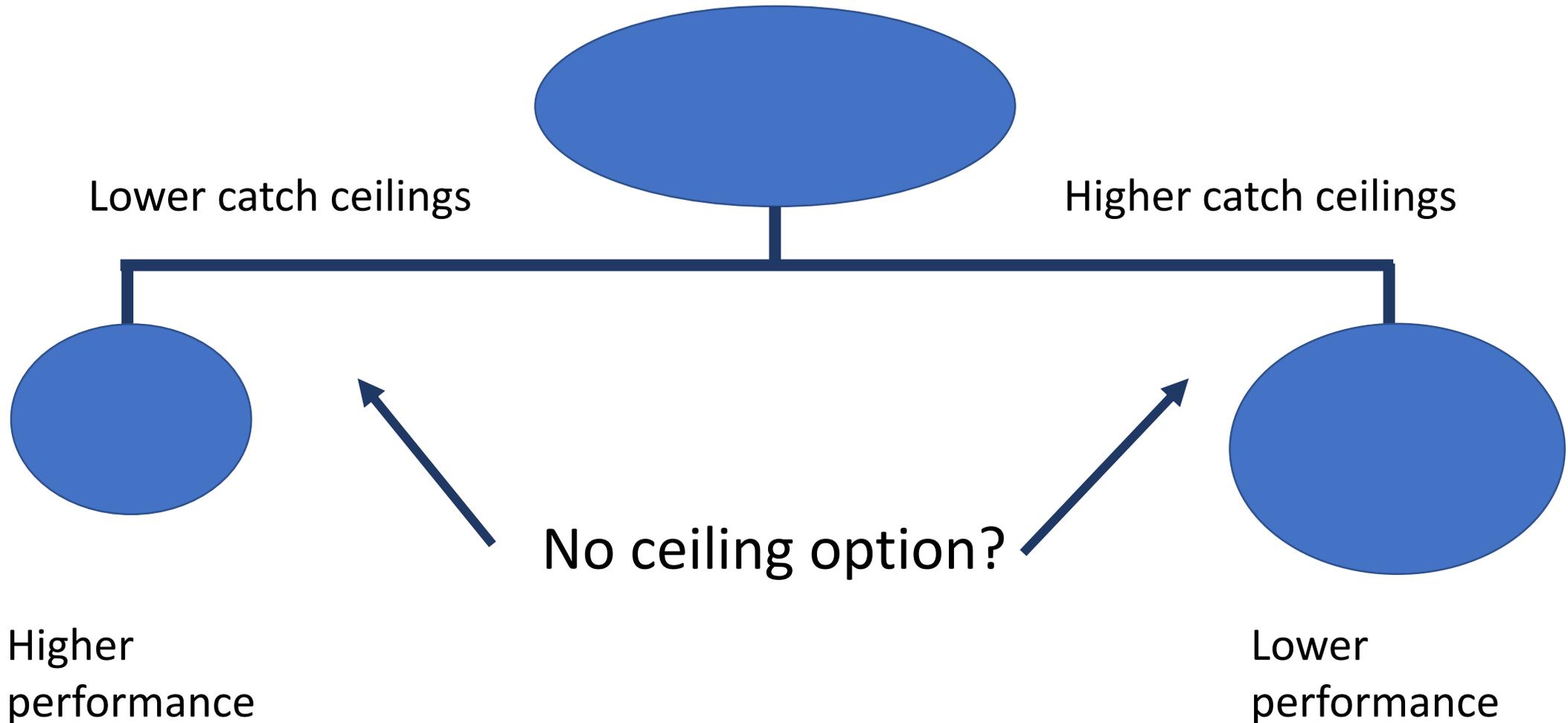
# Catch Diversity

Catch Ceiling  
(thousand mt)



# Evaluate Management Performance: Tree Analysis

Pooled performance metric data from all simulations





# Conclusions

Catch ceiling value explains most variability in performance metrics

## Higher catch ceilings



Catch



Frequency collapse



Diversity



Number of splits

## Lower catch ceilings



Catch



Frequency collapse



Diversity



Number of splits

# Next Steps:

- Evaluate catch ceilings based on ecosystem productivity
- Consider other performance metrics
- Incorporate technical interactions into operating model



# Acknowledgements:

- Gavin Fay
- Funding:



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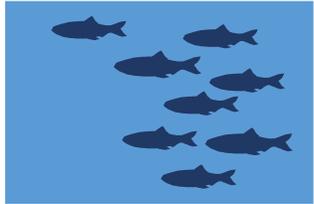
**UMass**

| Dartmouth

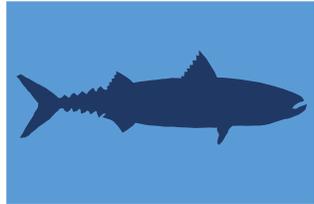


Questions?

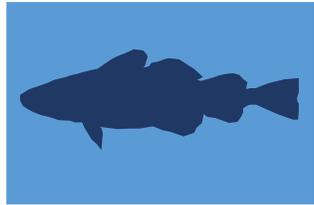




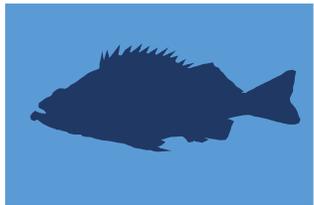
Atlantic Herring



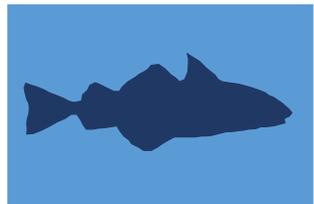
Atlantic Mackerel



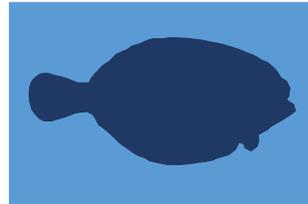
Georges Bank Cod



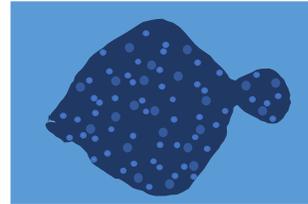
Redfish



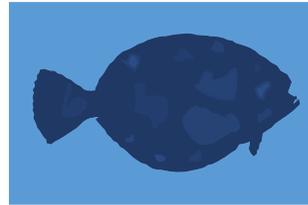
Georges Bank Haddock



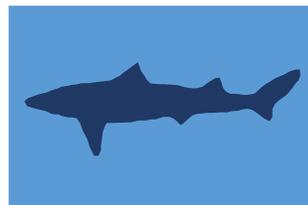
Georges Bank Yellowtail  
Flounder



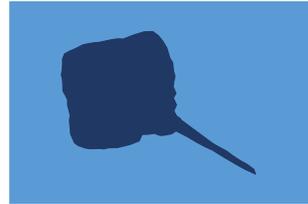
Gulf of Maine & Georges  
Bank Windowpane  
Flounder



Georges Bank Winter  
Flounder



Spiny Dogfish



Skates