EBFM: Tangible Worked Example tools

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Council meeting
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New England
Fishery Management Council

Tangible worked example development

Objective
- Comparison of steps to develop catch advice under EBFM approach vs a single species approach, not the outcome
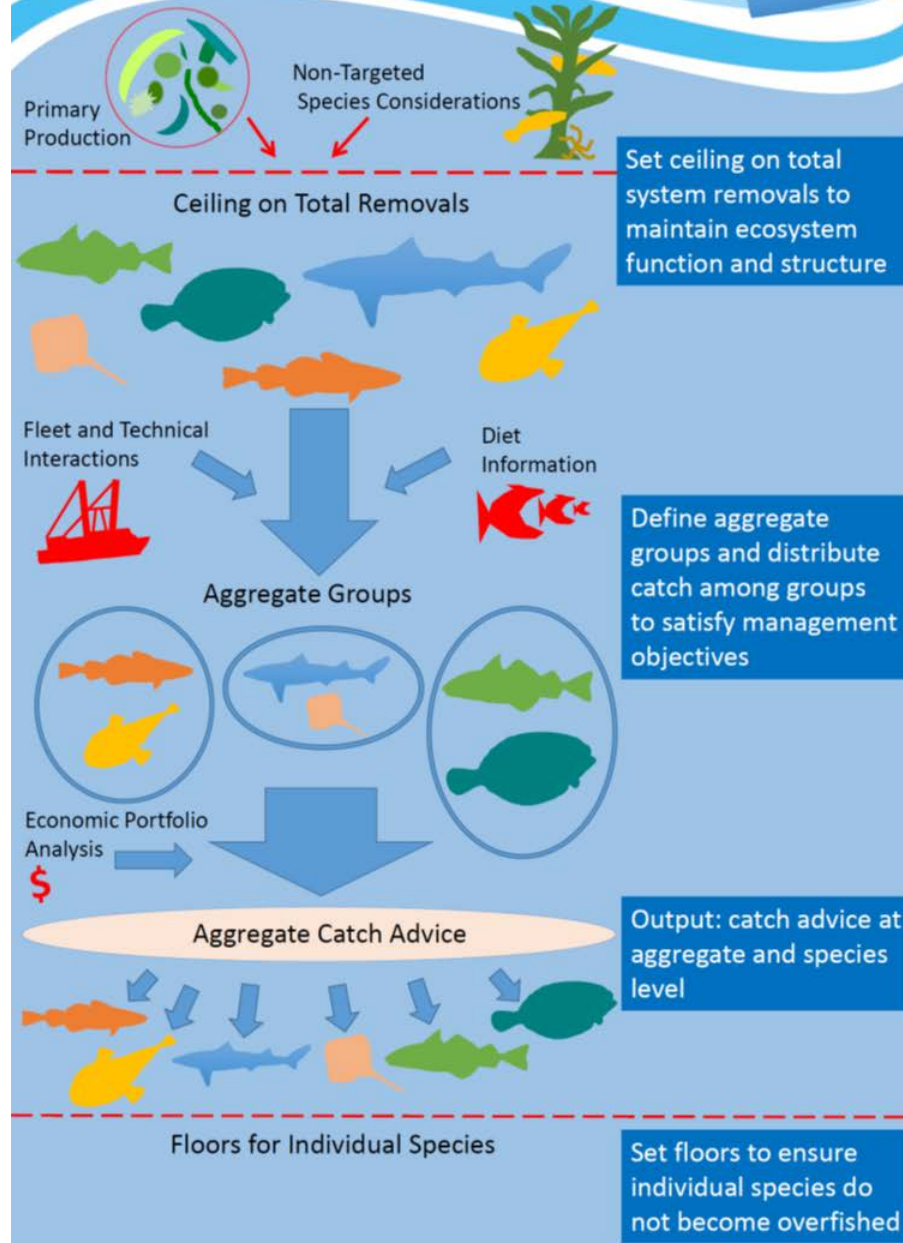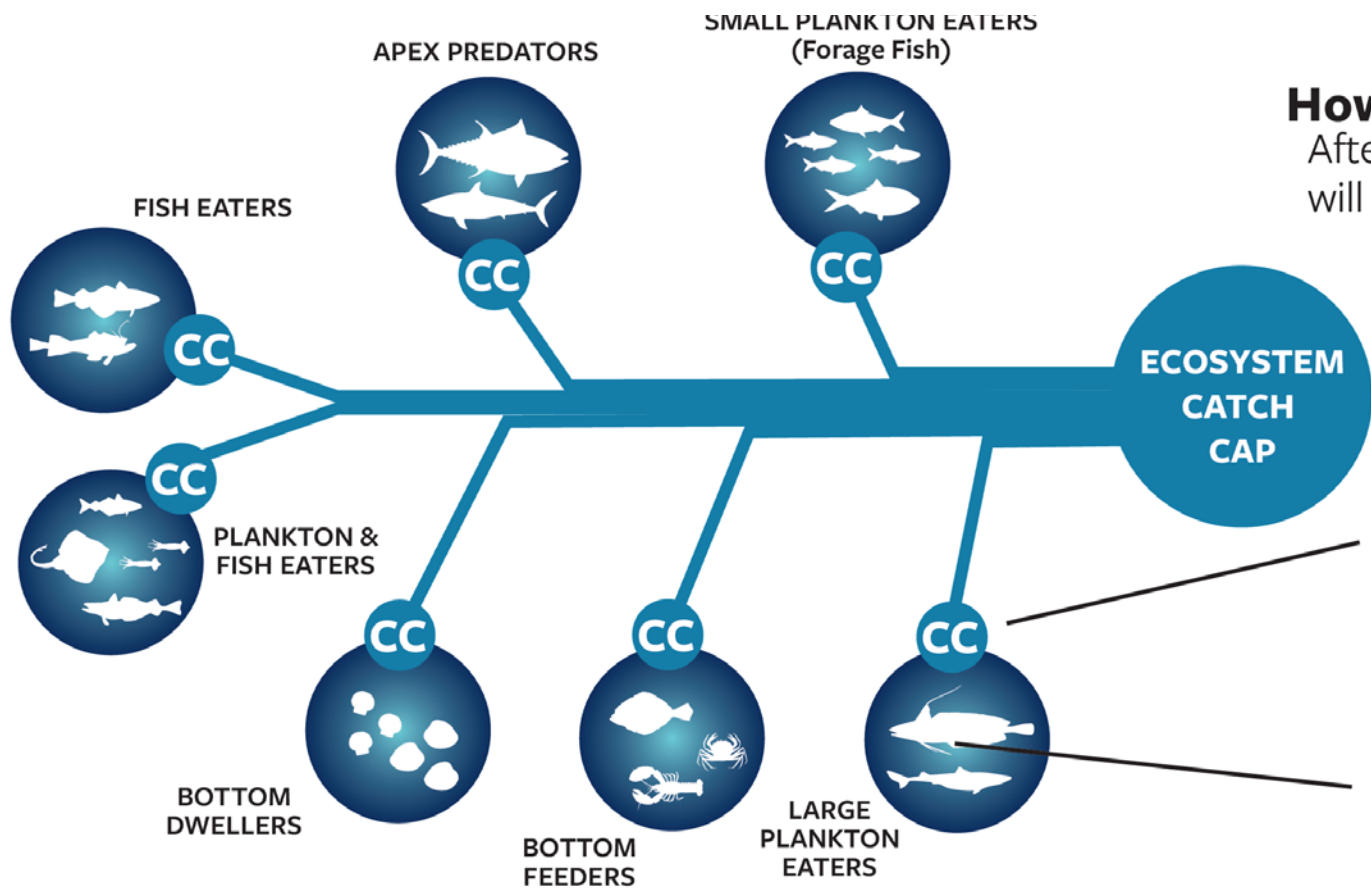- Demonstration of concept

Approach
- Start simple, add more complexity as needed to demonstrate the concept

MSE (later)
- Comparison of performance of different output controls to achieve desirable objectives.

Ecosystem Based Fishery Management Strategy Framework

Primary Production

Non-Targeted Species Considerations

Ceiling on Total Removals

Set ceiling on total system removals to maintain ecosystem function and structure

Fleet and Technical Interactions

Diet Information

Aggregate Groups

Define aggregate groups and distribute catch among groups to satisfy management objectives

Economic Portfolio Analysis

Aggregate Catch Advice

Output: catch advice at aggregate and species level

Floors for Individual Species

Set floors to ensure individual species do not become overfished

FISH EATERS

APEX PREDATORS

SMALL PLANKTON EATERS
(Forage Fish)

PLANKTON & FISH EATERS

BOTTOM DWELLERS

BOTTOM FEEDERS

LARGE PLANKTON EATERS

CC

ECOSYSTEM CATCH CAP

How are EBFM Catch Ceilings Determined?
After assessing factors of ecosystem health, managers will set three different types of catch ceilings:

1. *The total ecosystem catch (including unmanaged species) cannot exceed a Cap related to annual ecosystem productivity.*

2. *Fish species are grouped into complexes based on similar ecosystem roles. Species complex catch ceilings are determined based on ecosystem health and cannot total more than the ecosystem cap.*

3. *Each fish species population cannot be fished below levels determined to be critical for survival, the species biomass floors.*

Tangible Worked Example tools

Demonstration of ecosystem catch advice	Kraken Visualization Tool	Hydra Model

• 2 stock complexes of four hypothetical stocks
• No biological interactions, but this capability is being developed
• Interactive - Catch advice based on fraction of Fmsy
• Applies example harvest control rule
  • Floors for stocks and stock complexes
  • Ceilings for ecosystem and stock complex cap.
	• Stock complexes
	• Biological interactions among 10 stocks
	• Interactive effort control
	  • No harvest control rule, but may run different scenarios and starting conditions
	  • Executable program
		• Stock complexes, Multifleet
		• Biological interactions among 10 stocks
		• Harvest control rule, effort based
		• Not interactive, multiple iterations

Demonstration of ecosystem catch advice

- Interactive model and short text overview
- Demonstration of how ceilings (ecosystem cap and stock complex mortality) and floors (stock complex biomass) affect single species and stock complex catch advice.
- Hypothetical four stock simulation, two stock complexes
- Time series and Kobe plots
- Tabular results
- Overview tab
- Video demo
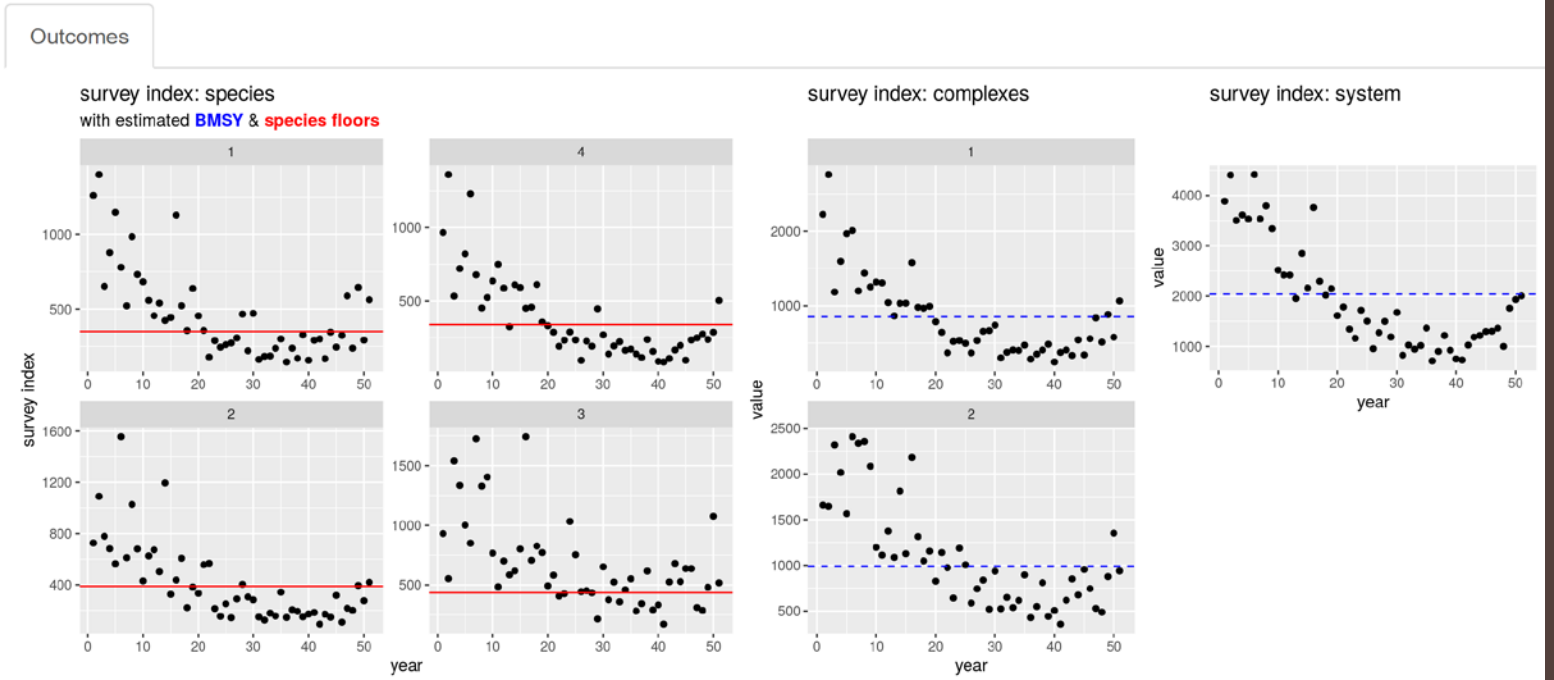
Kraken Visualization Tool

- 4-page plain language manual
  - What is does and doesn't do (give catch estimates)
  - How to install and use
  - Types and interpretation of output
  - Two example scenarios: 1) predation only, 2) predation and competition
- Examine cause and effect of biological and technical interactions
  - User adjusts relative fishing effort on stock complexes
- 10 stocks, 4 stock complexes

Kraken visualization tool

- Outputs

  - Time series 'dynamic arc' plots

  - Uncertainty plots

 - 4 plane biomass plots by stock complex
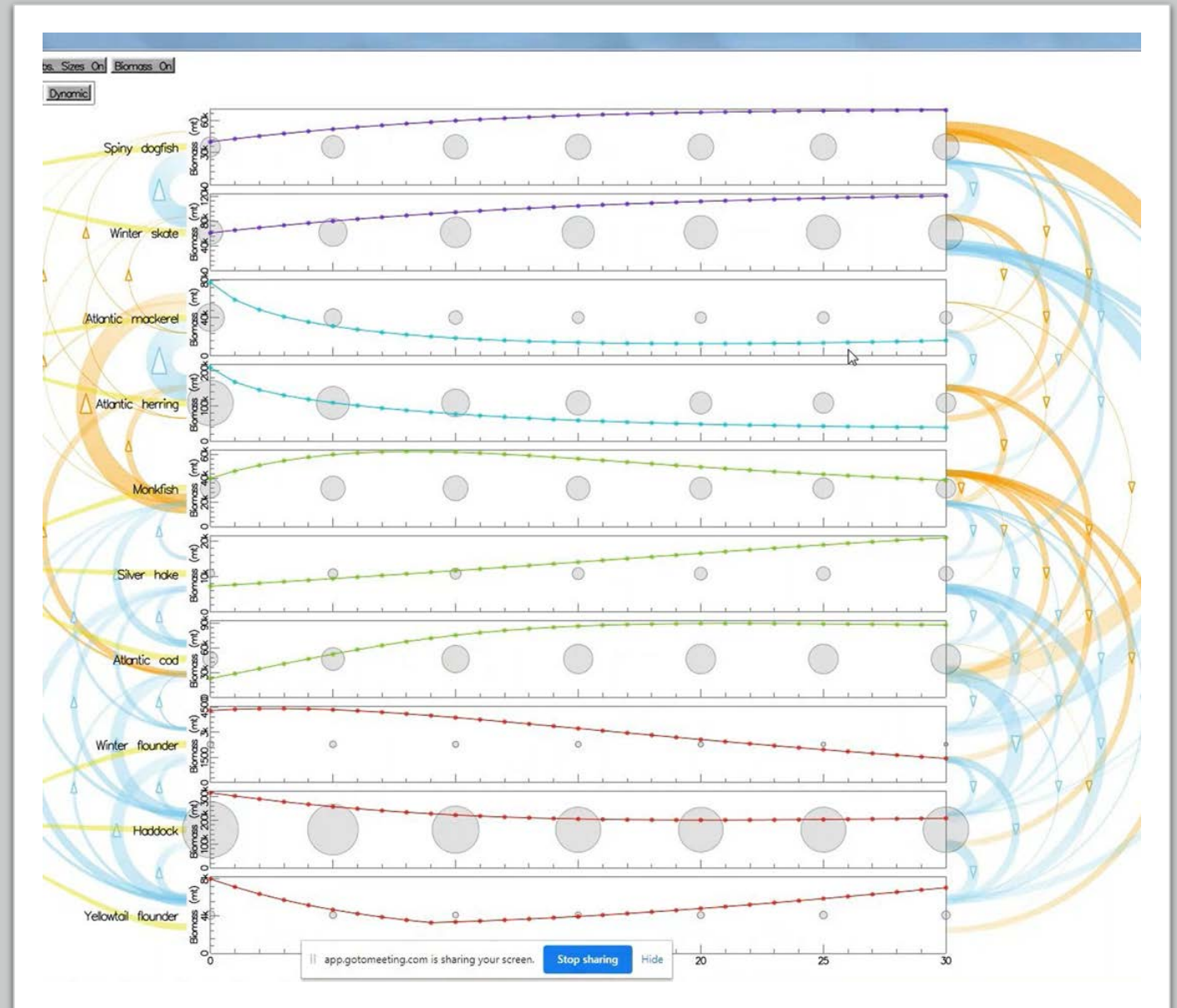
Hydra operating model

- Shorter plain language description of model and example scenarios

- Not interactive

- Three fleets:
  - Demersal trawl, Fixed gear, Pelagic trawl

- Three stock complexes of 10 Georges Bank stocks:
  - Fish eaters, bottom feeders, plankton feeders

		Demersal Trawl	Fixed Gear	Pelagic Trawl
Fish-eaters	Dogfish	●	●	●
	Winter Skate	●	●	
	Goosefish	●	●	
	Silver Hake	●		●
	Cod	●	●	
Bottom-feeders	Haddock	●	●	●
	Yellowtail Flounder	●		
	Winter Flounder	●		
Plankton-feeders	Herring	●		●
	Mackerel	●		●

Hydra operating model

- Simulated populations with biological interactions using estimated life-history parameters

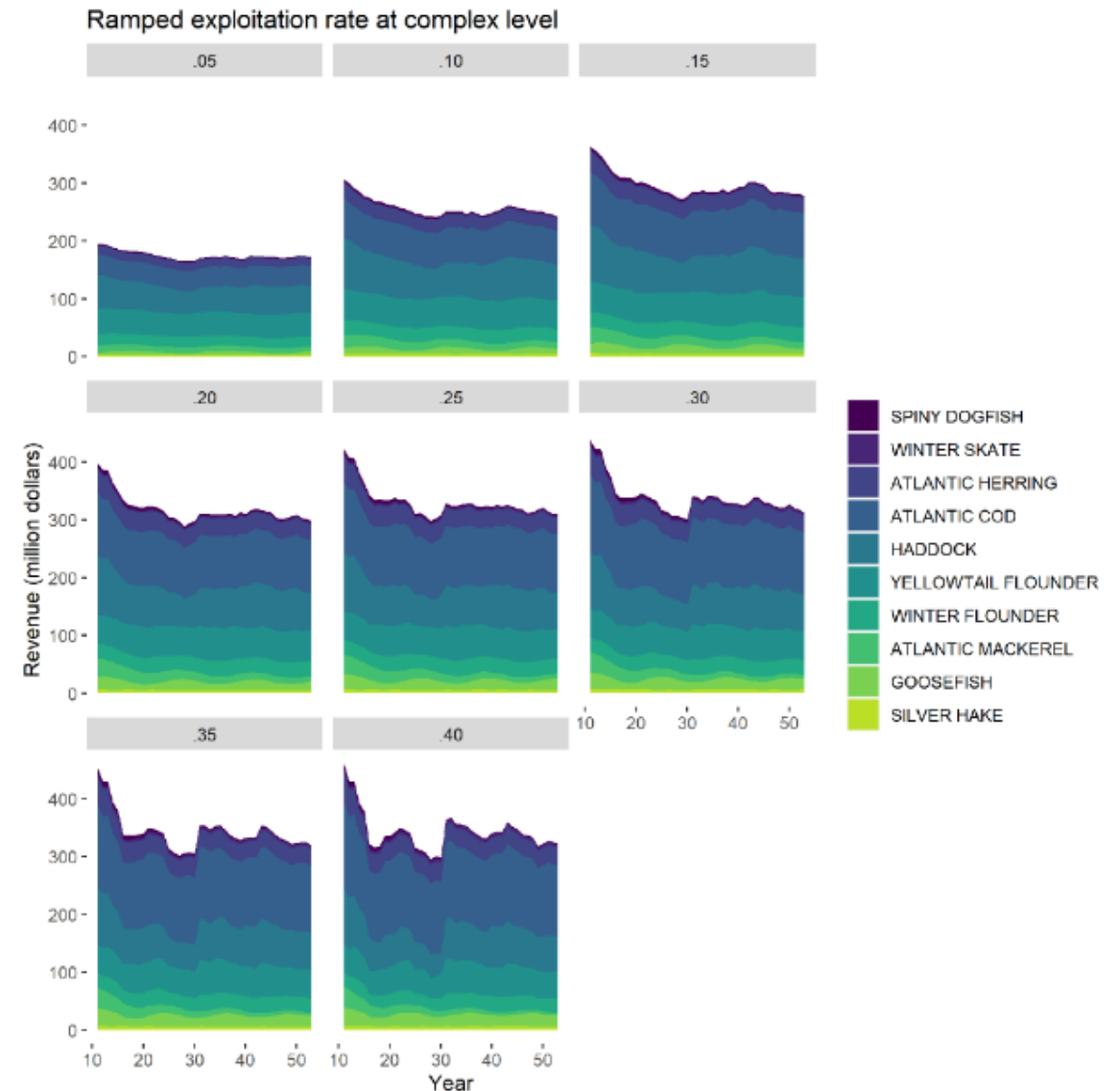- Biomass based general harvest control rule applied
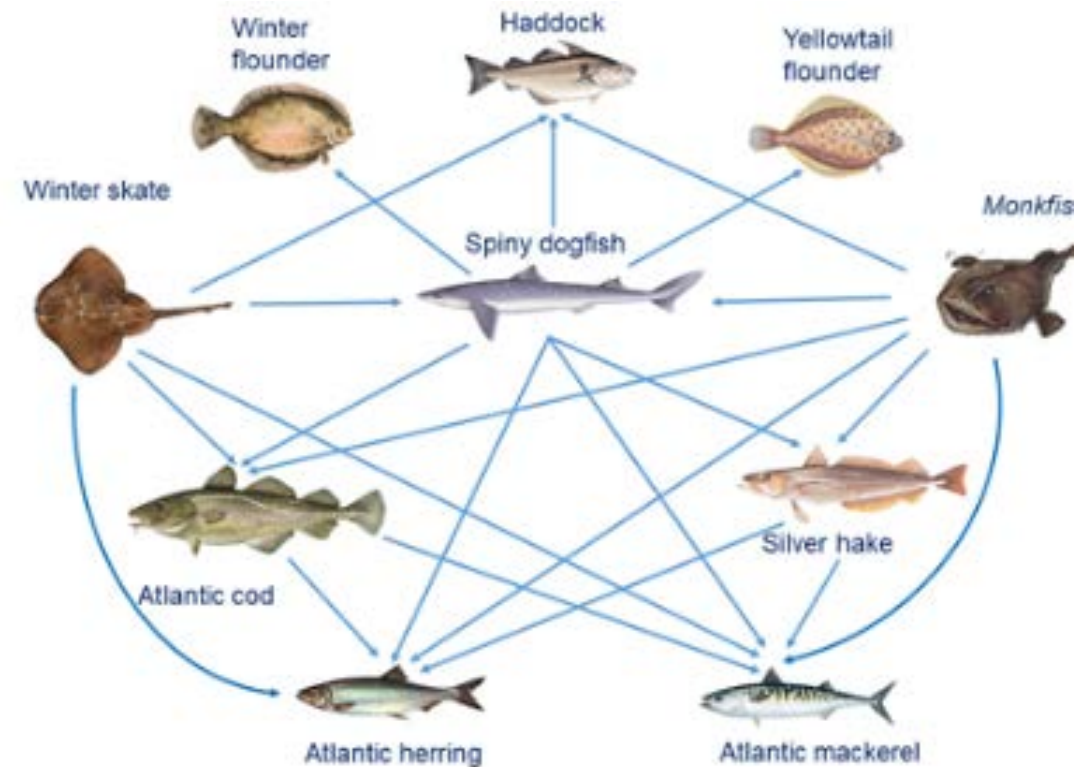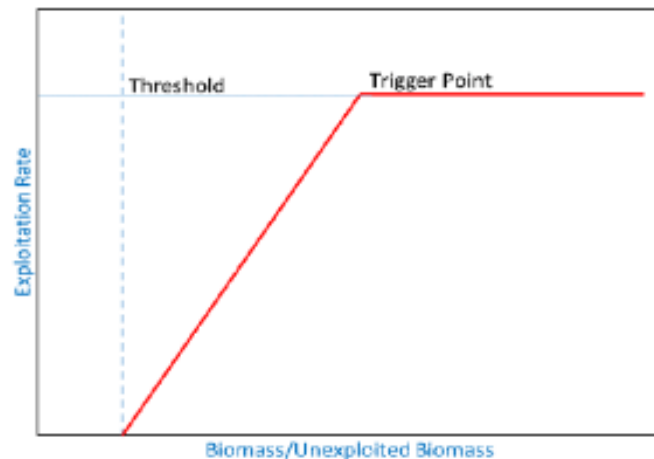
Hydra operating model

- Four scenarios
  1. Fixed exploitation rates between 0.05 and 0.40, increments of 0.05
  2. System-wide harvest control rule with stock biomass floors (20% of unfished biomass)
  3. Individual fleet harvest control rule (variable exploitation rate) with stock complex biomass floors (40% by stock complex)
  4. Individual fleet harvest control rule (variable exploitation rate) with stock complex biomass floors (40% by stock complex) and stock biomass floors (50% for spiny dogfish and winter skate; otherwise 40%)
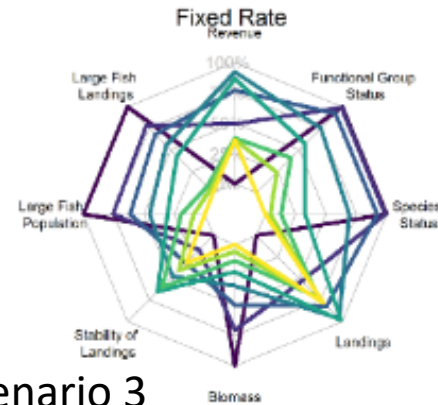
Hydra operating model
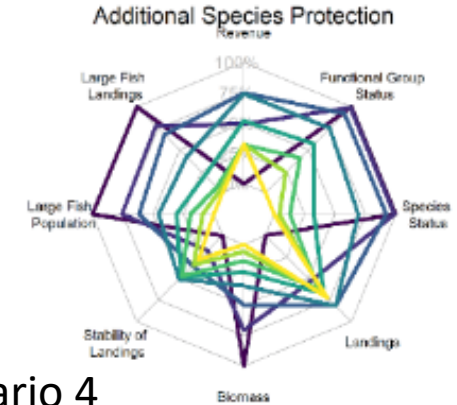
- Outputs
  - Time series charts

Hydra operating model

- Outputs
  - Radar plots
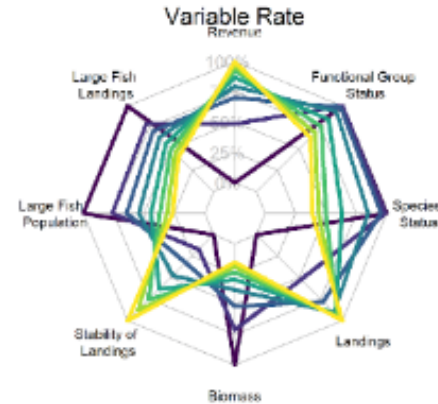 - Evaluate performance tradeoffs

Scenario 1 — Fixed Rate

Scenario 2 — Additional Species Protection

Scenario 3 — Variable Rate

Scenario 4 — Additional Species Protection