

# Example Fishery Ecosystem Plan Purpose and Overview (eFEP)

**Andrew Applegate**  
**EBFM Plan Coordinator**  
**September 24, 2019**



**NOAA  
FISHERIES**

NEFSC

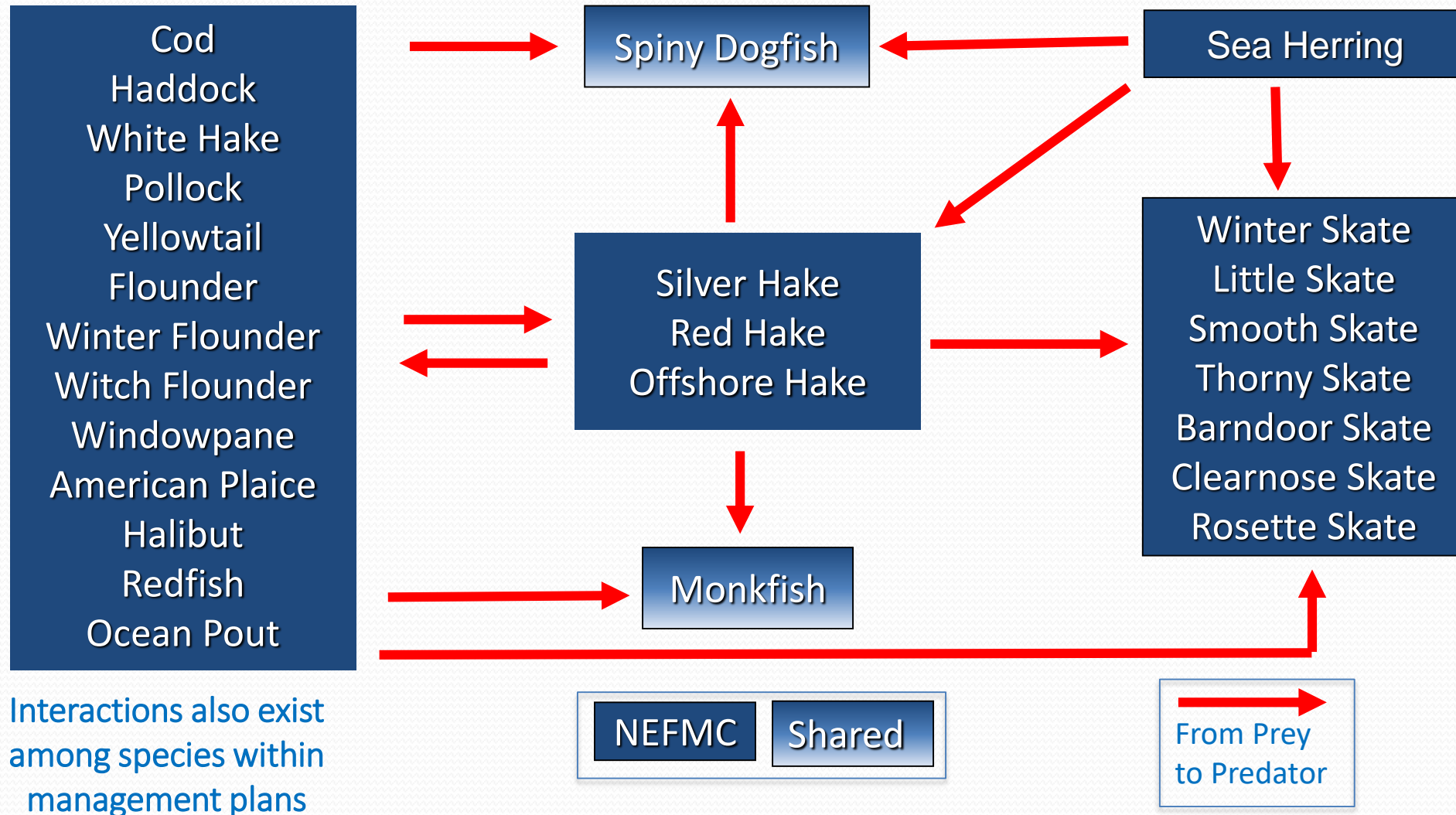
# Background and Brief Overview

Georges Bank eFEP  
Joint EBFM Committee-PDT  
Meeting August 21, 2019

# EBFM PDT members and eFEP contributors

- **Andrew Applegate, New England Fishery Management Council, chair**
- **Dr. Peter Auster, University of Connecticut and Mystic Aquarium**
- **Dr. Rich Bell, The Nature Conservancy**
- **Timothy Cardiasmenos, Greater Atlantic Regional Fisheries Office, NEPA Policy Division**
- **Dr. Kiersten Curti, Northeast Fisheries Science Center, Population Dynamics Branch (2015-2018)**
- **Dr. Geret DePiper, Northeast Fisheries Science Center, Social Sciences Branch**
- **Dr. Gavin Fay, University of Massachusetts Dartmouth**
- **Dr. Michael Fogarty, Northeast Fisheries Science Center, Ecosystem Assessment Program**
- **Ashton Harp, Atlantic States Marine Fisheries Commission (2015-2016)**
- **Ms. Emily Keiley**
- **Dr. Sean Lucey, Northeast Fisheries Science Center, Ecosystem Assessment Program**
- **Dr. Wendy Morrison, Fisheries Ecologist, Domestic Fisheries Division, National Marine Fisheries Service (2019-present)**
- **Brandon Muffley, Mid-Atlantic Fishery Management Council (2017-present)**
- **Dr. Danielle Palmer, Greater Atlantic Regional Fisheries Office, Protected Resources Division**
- **Richard Seagraves, Mid-Atlantic Fishery Management Council (2015-2017)**
- **Dr. David Stevenson, Greater Atlantic Regional Fisheries Office, Habitat Conservation Division**
- **Megan Ware, Fishery Management Plan Coordinator, Atlantic States Marine Fisheries Commission (2015-2017)**

# Interacting Species are now Covered by Separate Management Plans



# Interacting Species are now Covered by Separate Management Plans

Atlantic Mackerel  
Butterfish  
Longfin Squid  
Shortfin Squid  
Alewife  
Atlantic Menhaden  
American Shad  
Blueback Herring  
Summer Flounder  
Bluefish  
Golden Tilefish  
American Lobster  
Scup  
Smooth Dogfish  
Striped Bass  
Tautog  
Weakfish  
Black Sea Bass  
Surfclam & Quohog

Cod  
Haddock  
White Hake  
Pollock  
Yellowtail  
Flounder  
Winter Flounder  
Witch Flounder  
Windowpane  
American Plaice  
Halibut  
Redfish  
Ocean Pout

Spiny Dogfish

Silver Hake  
Red Hake  
Offshore Hake

Monkfish

Sea Herring

Winter Skate  
Little Skate  
Smooth Skate  
Thorny Skate  
Barndoor Skate  
Clearnose Skate  
Rosette Skate

Marine Mammals  
Sharks  
Tunas  
Swordfish

Blackbelly Rosefish  
Chain Dogfish  
Cunner  
Cusk  
Fourspot Flounder  
John Dory  
Lumpfish  
Northern Searobin  
Octopus  
Striped Searobin

Interactions also exist  
among species within  
management plans

NEFMC

Shared

MAFMC  
ASMFC

MMPA  
HMS

Unmanaged





Menu

#### RESOURCES

## Ecosystem-Based Fisheries Management Policy

February 05, 2018

NOAA Fisheries Policy 01-120

PDF



Document | National



Northeast Regional

Implementation Plan of the NOAA Fisheries  
Ecosystem-Based Fishery Management Roadmap

- EBFM Policy
  - <https://www.fisheries.noaa.gov/resource/document/ecosystem-based-fisheries-management-policy>
- NE EBFM Implementation Plan
  - <https://www.fisheries.noaa.gov/webdam/download/90850749>

# SSC report

## Approaches to EBFM

1. Incremental or “evolutionary” → EAM
  - Works within existing FMP structure
  - Adds linkages among FMPs and effects of environmental components on each
  - In progress.
2. Holistic or “revolutionary” → true EBFM
  - Fully integrated FEPs for EPU
  - Adopts integrated analytical framework based on new tools, etc. Integrated ecosystem assessments
3. Blended:
  - Planning approach of #1, but uses analytical tools of #2 to set ecosystem-level goals and constraints



# Benefits to Council of Adopting EBFM

- Simplification of management structures
- Coordination of management actions for stocks, protected species, biodiversity & habitat
- Comprehensive consideration of fishery & biological interactions
- Accounts for ecosystem constraints on rebuilding
- Consideration of climate change
- Coordination with State EBM efforts & Northeast Regional Ocean Council



# NEFMC Approach

- To prepare:
  1. A policy describing goals and objectives, and approaches, for taking account of ecosystem processes in fishery management, and
  2. An example of a fishery ecosystem plan that is based on fundamental properties of ecosystem (e.g., energy flow and predator/prey interactions) as well as being realistic enough and with enough specification such that it could be implemented. The example should not be unduly constrained by current perceptions about legal restrictions or policies.



# NEFMC Process

3. With respect to number 2, it is understood that the example might not be implemented, but it should make clear what a fishery ecosystem plan would actually entail and it should focus debate.



# NEFMC Approach

- The Council is pursuing a fundamentally different EBFM approach relative to other Fishery Management Councils and management authorities.
- Unlike other EBFM approaches, the NEFMC is focused on place-based management and trophic guilds (i.e., energy production units) as management units rather than managing fish stocks using independent harvest control rules.
- The new approach addresses the implications of both biological interactions (i.e., predator/prey) and fishery interactions (bycatch and mix species fisheries).



# NEFMC Process

**Don't design solution without understanding the problem**

- Phase I – decide on application
- Phase II – develop example Fishery Ecosystem Plan (eFEP)
- Phase III – test management strategies
- Phase IV – develop alternatives for final FEP
- Phase V – implement and make adjustments





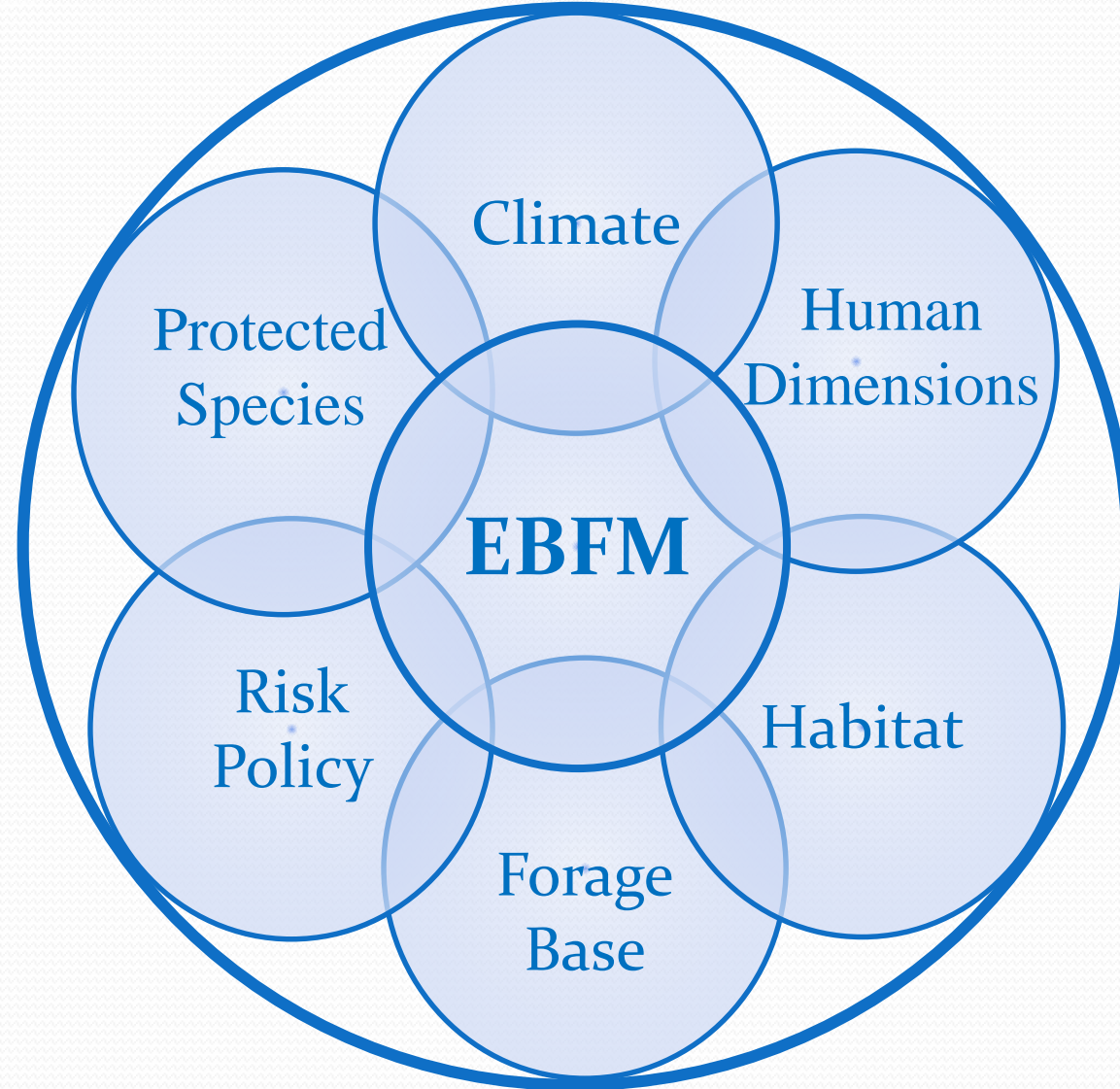
# eFEP

- **Concept of developing an eFEP was approved by the Council in April 2015**
- **Peer review of a Worked Example was requested by the Council in September 2016**
  - **Results presented to the Council in September 2018**
- **Recommitted to completing the eFEP and initiating MSE development using a Steering Committee in January 2019.**

# EBFM Defined

*“[EBFM is]...a systematic approach to fisheries management in a geographically specified area that contributes to the resilience and sustainability of the ecosystem; recognizes the physical, biological, economic, and social interactions among the affected fishery-related components of the ecosystem, including humans; and seeks to optimize benefits among a diverse set of societal goals”.*

# EBFM Integrates a Broad Spectrum of Scientific and Management Issues



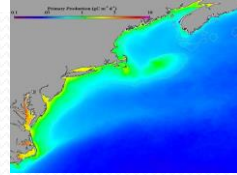
# Core Elements of the Approach

Define Spatial Units



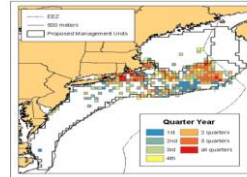
Delineate Ecological Production Units on the Northeast U.S. Shelf

Estimate Fishery Production Potential



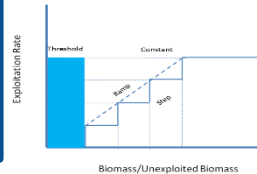
Develop Bottom-up Estimates of Food Web Production

Define Fishery Species Complexes



Integrate Information on Technical and Biological Interactions to Define Species Complexes Functional Groups

Specify Management Procedures



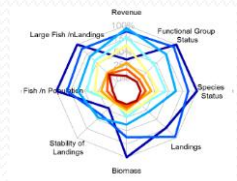
Identify Simple Decision Rules incorporating Protections at System and Species Levels

Develop Operating Models



Develop Length-Structured Multispecies-Multifleet Operating Model and Simpler Multispecies Productions Model

Test Management Procedures



Conduct Simulation Studies of Performance of Management Procedure



# Stock Complexes under MSFMCA

**A stock complex is defined as** “a group of stocks that are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar”

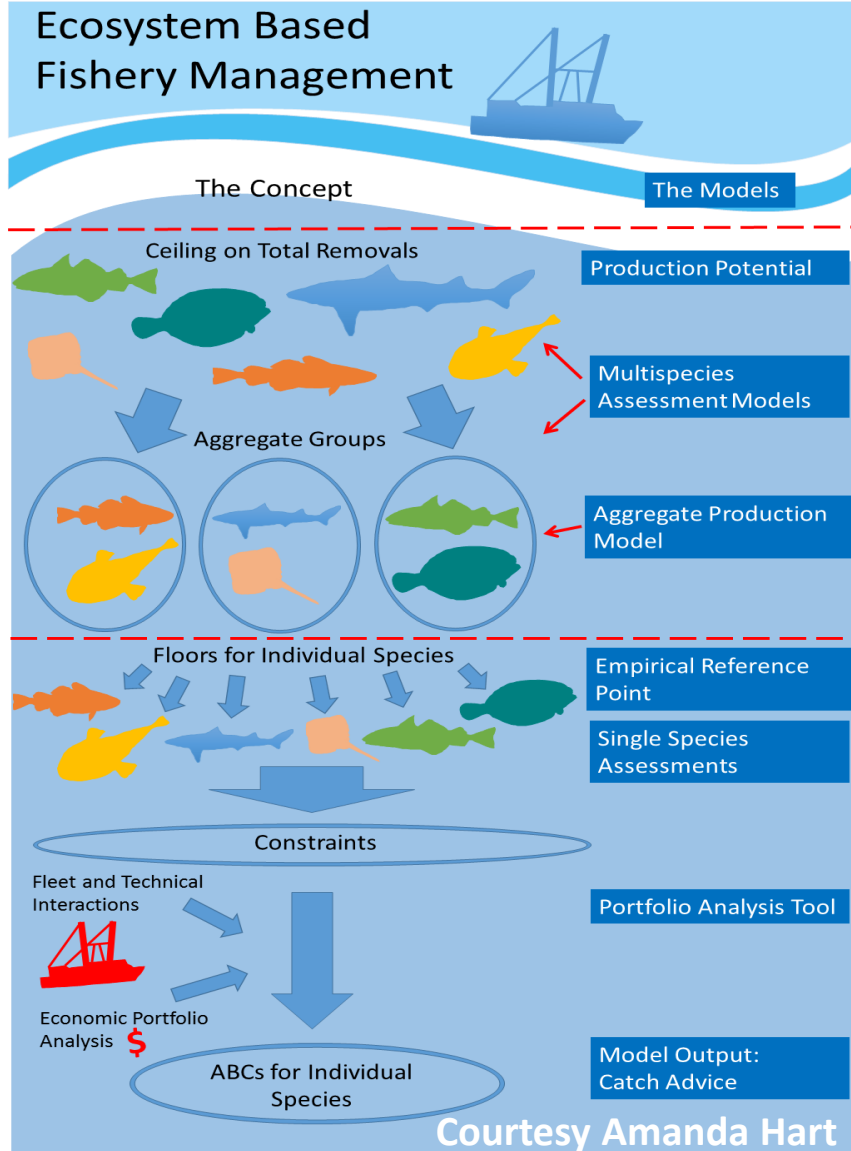
**Stocks may be grouped into complexes if:**

(1) they cannot be targeted independently of one another in a multispecies fishery, (2) there are insufficient data to determine their status relative to established criteria, or (3) it is infeasible for fishermen to distinguish between individual stocks .

# Defining Species Complexes for the eFEP

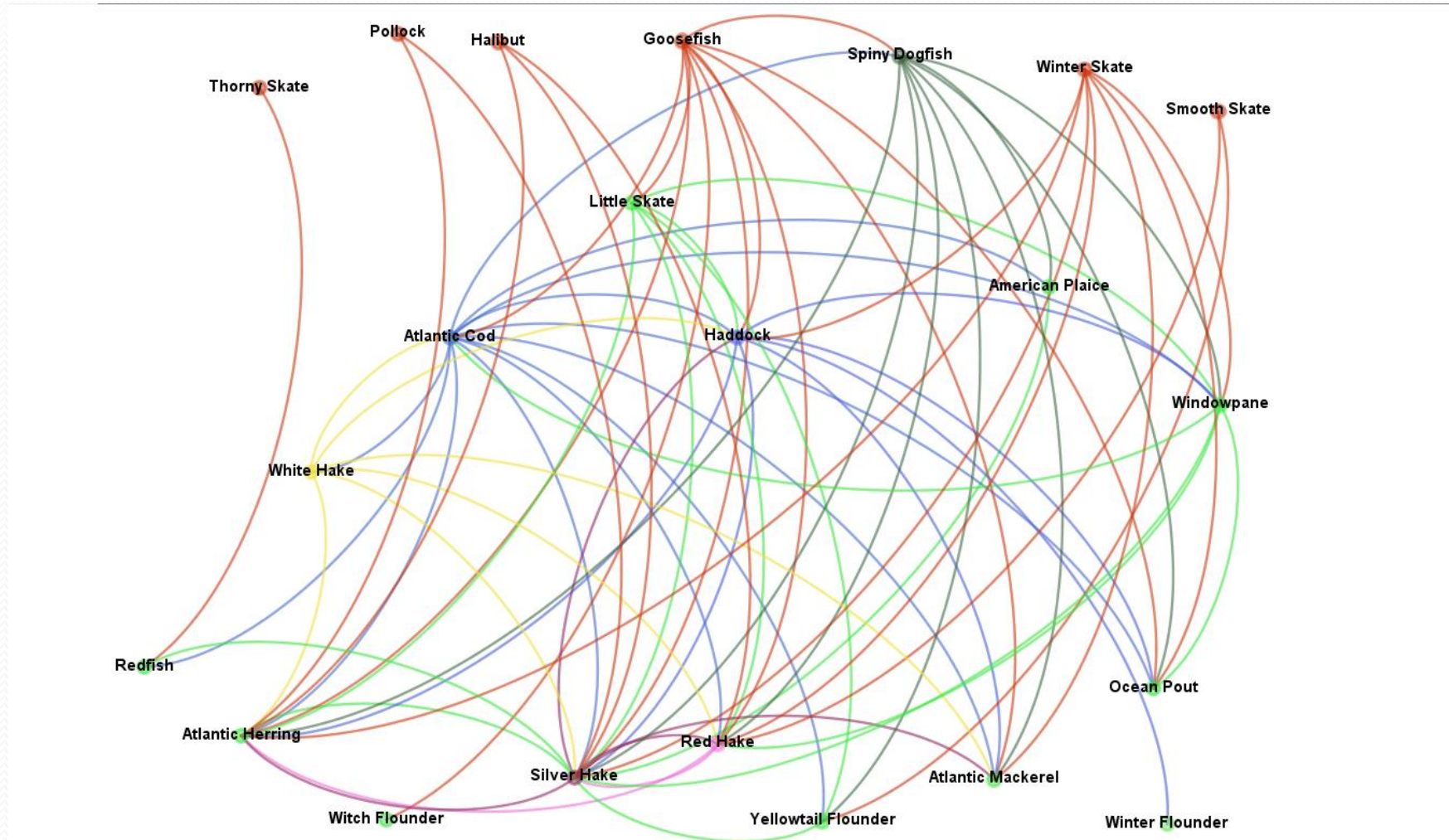
In the NEFMC eFEP, Species Complexes are groups of species that have similar life history characteristics, and play similar roles in the transfer of energy in the system

# Elements of the Management Procedure



- Set overall ceiling (cap) on catches on the basis of target exploitation rate and estimated biomass levels
- Define minimum biomass levels (floors) below which a species is considered depleted
- If biomass drops below a trigger or threshold level, implement reductions in exploitation on the species complex as a whole before floor is reached
- Simulate MP performance

# Georges Bank Trophic Linkages





# New Operating Model: Network Model (Rpath)

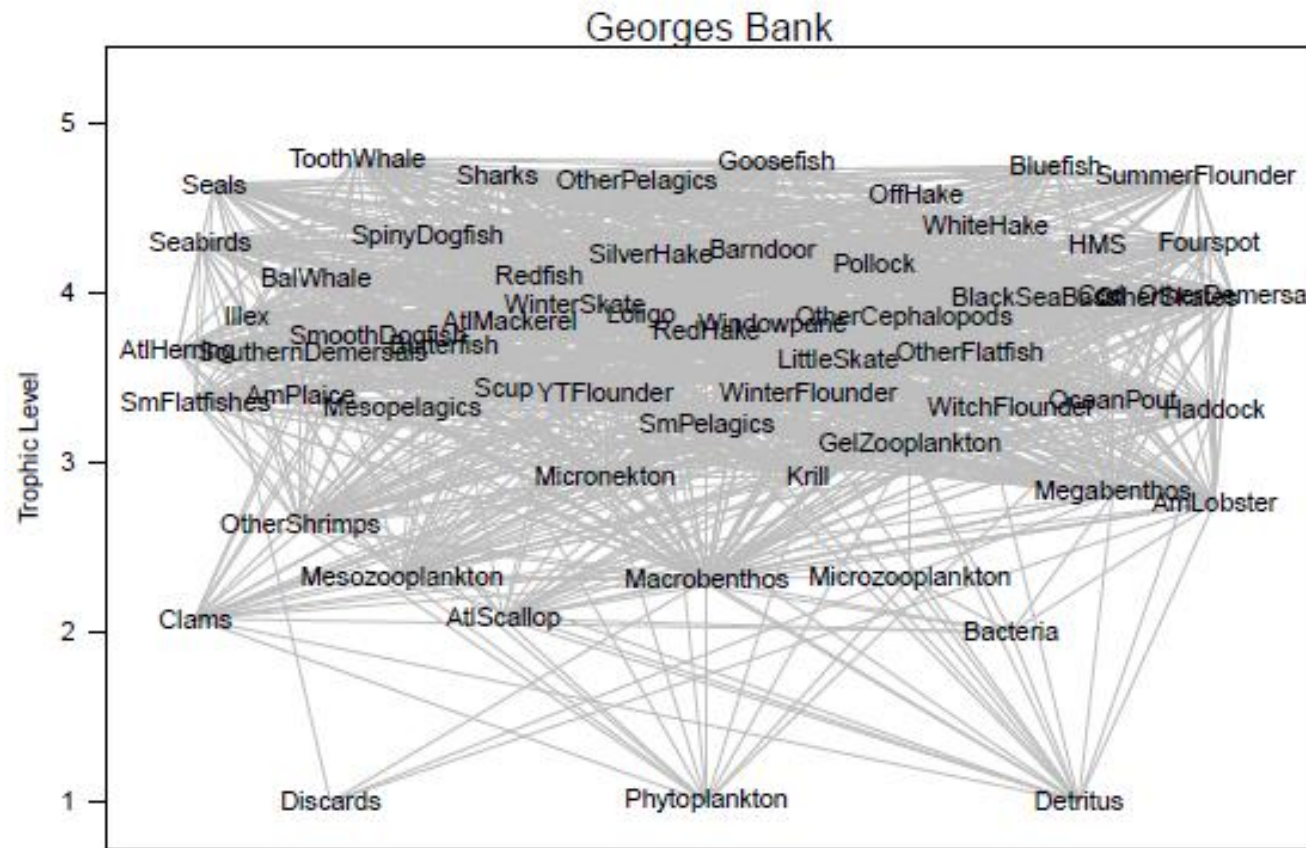
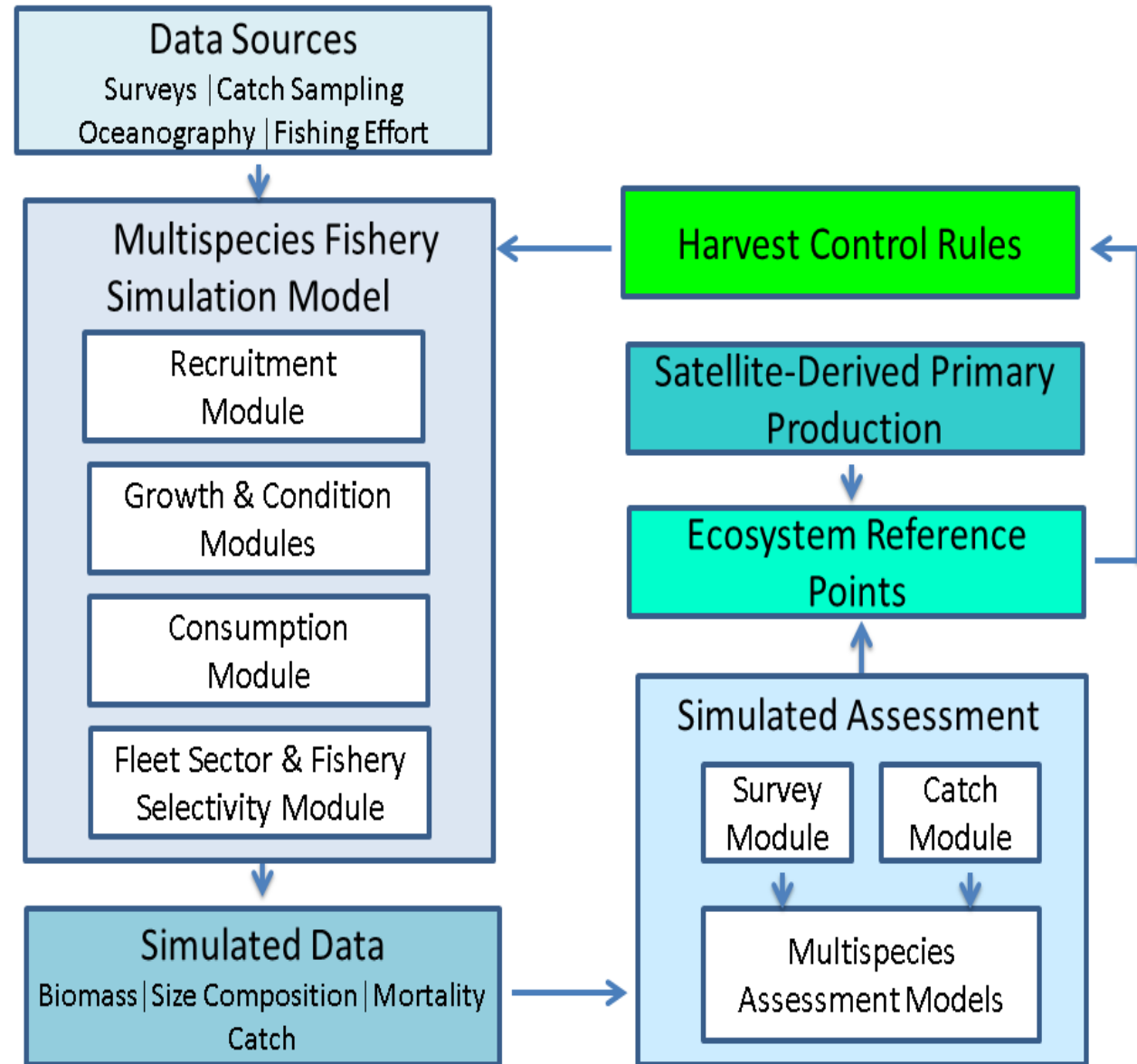
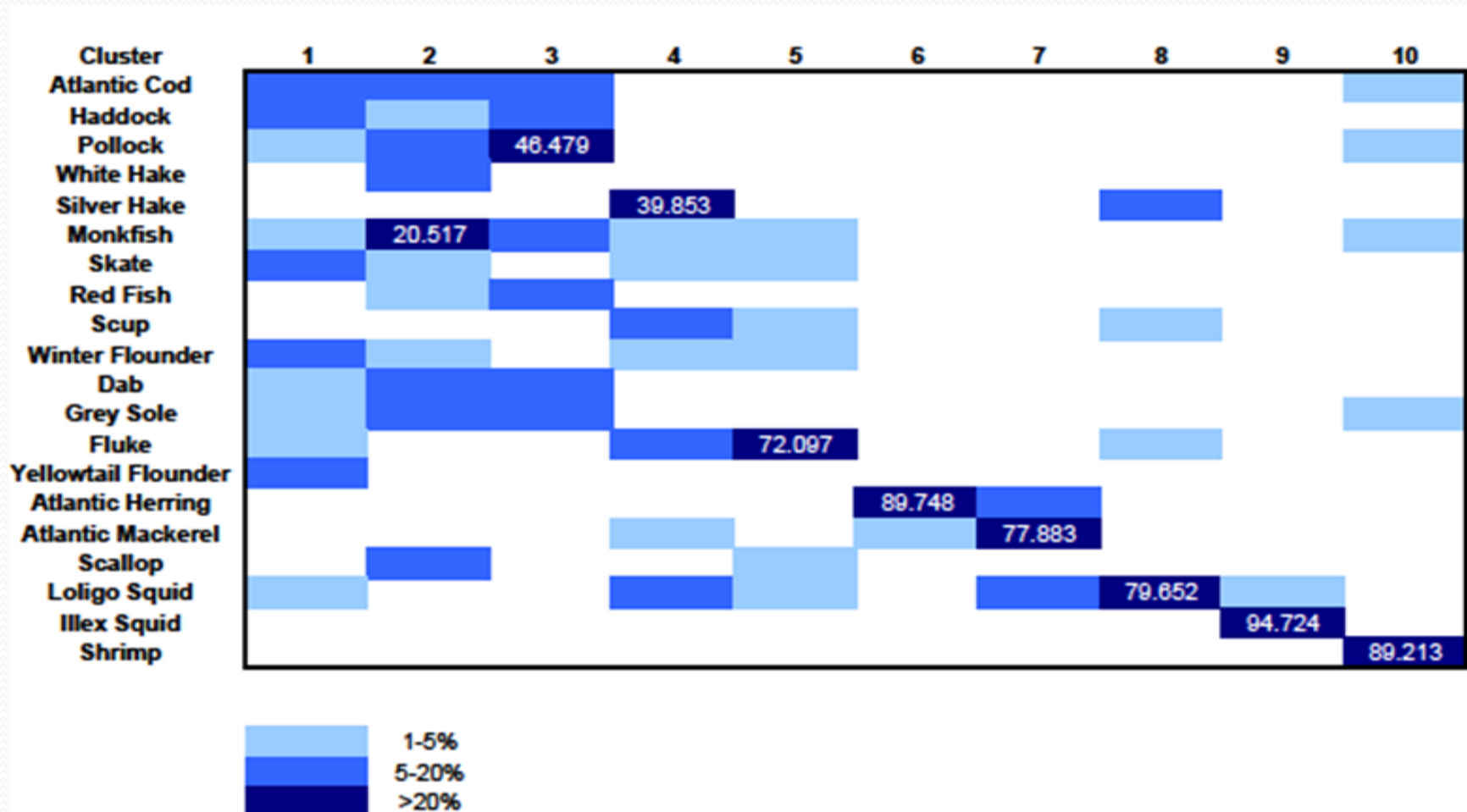


Figure 4.2: Food web of the Georges Bank Rpath model.

# HydraStructure



# Defining Operational Fisheries on Georges Bank



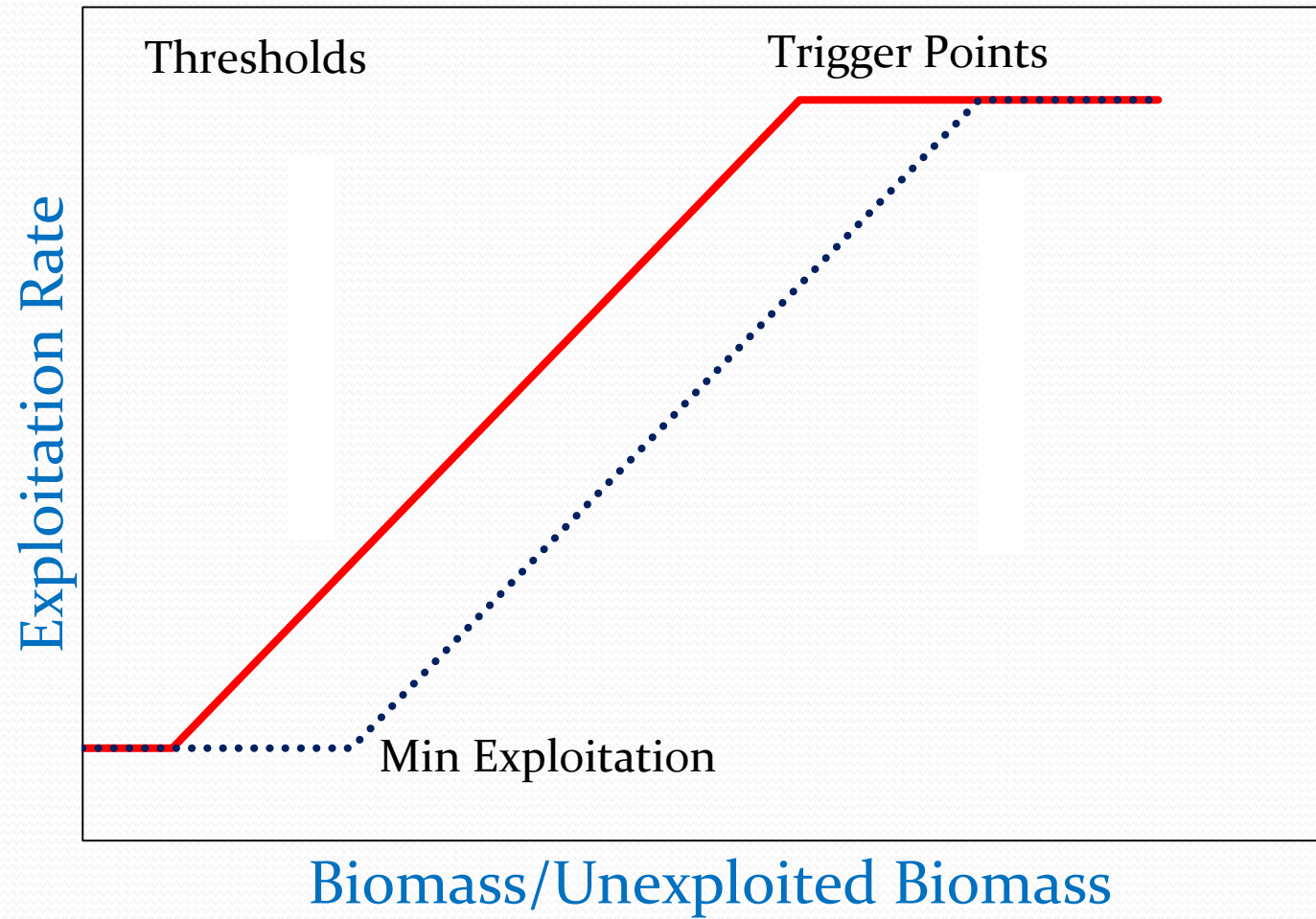
Lucey and Fogarty (2010)

# Hydra 'Fishery Functional Groups'

Species	Fishery Functional Group: Species Complex				
Common Name	Demersal Trawl-Piscivore	Demersal Trawl- Benthivore	Fixed Gear Piscivore	Fixed Gear Benthivore	Pelagic Trawl Planktivore
Atlantic cod					
Silver hake					
Monkfish					
Spiny dogfish					
Winter skate					
Winter flounder					
Yellowtail flounder					
Haddock					
Atlantic herring					
Atlantic mackerel					



# Harvest Control Rule

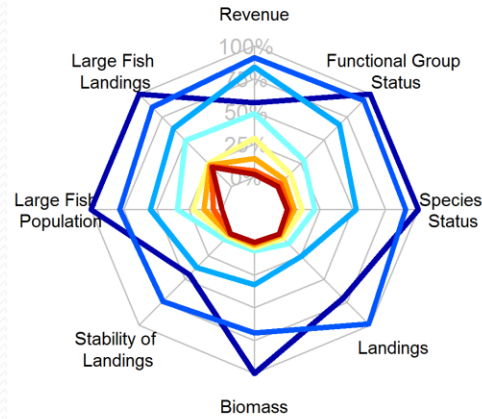


# Performance Metrics

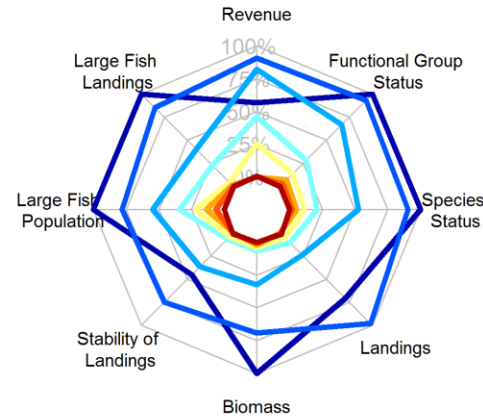
- Biomass (by species and functional group)
- Revenue (by species and functional group)
- Species diversity
- Species depletion index
- Functional group depletion index
- Big fish index (in population and catch)
- Stability of landings
- Functional group ratios (system structure)

# Harvest Control Rules Shepherd Model Years 41-50

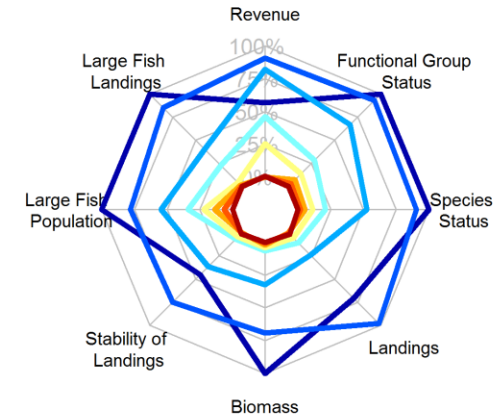
Fixed Rate: Functional Group



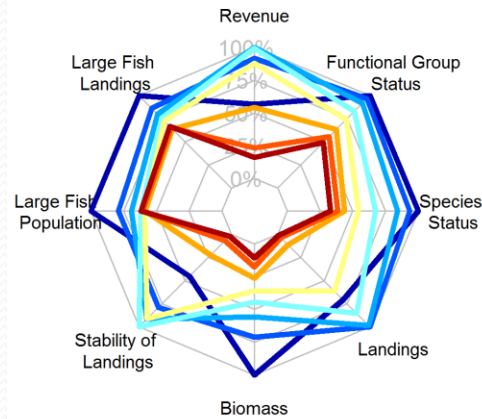
Species



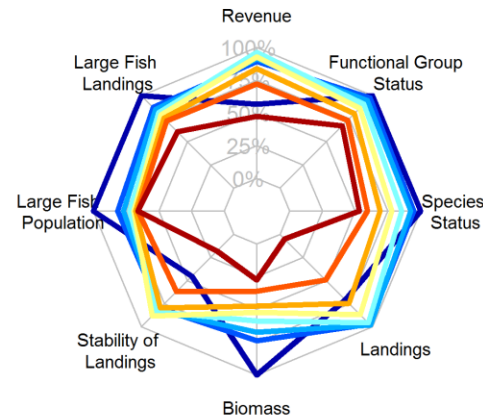
Species (Increased Threshold)



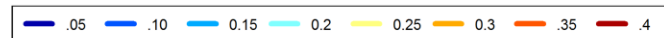
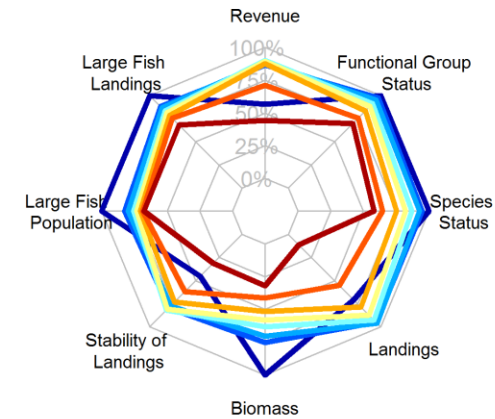
Ramped Rate: Functional Group



Species

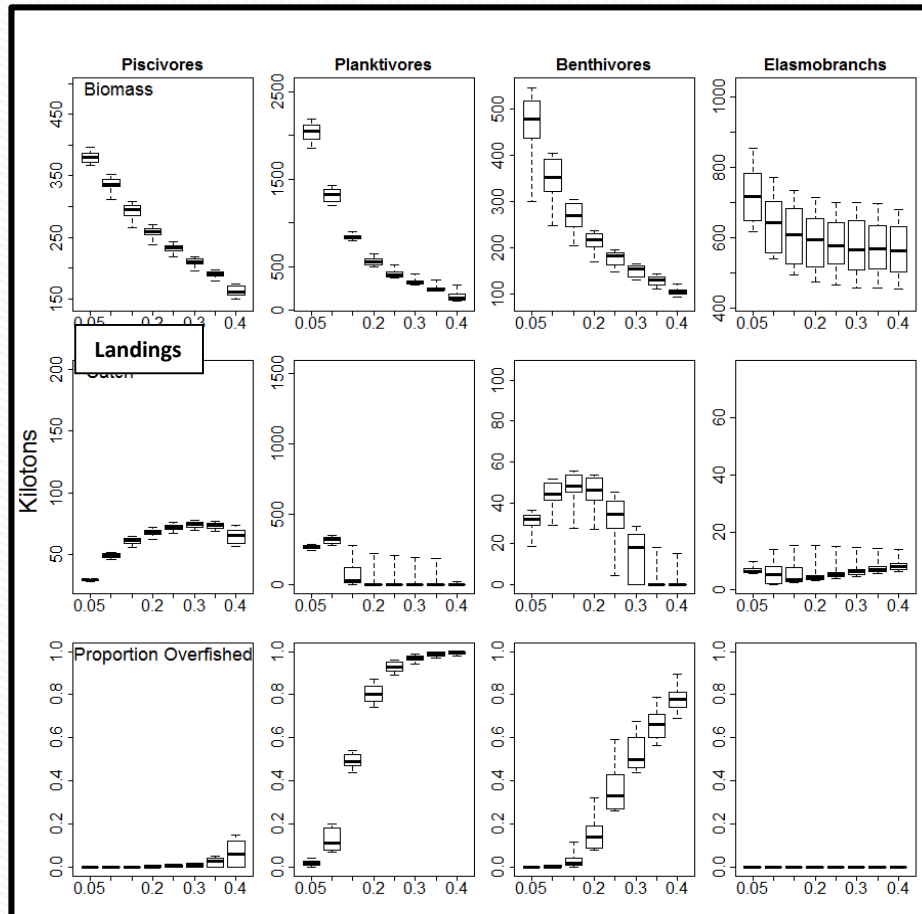


Species (Increased Threshold)

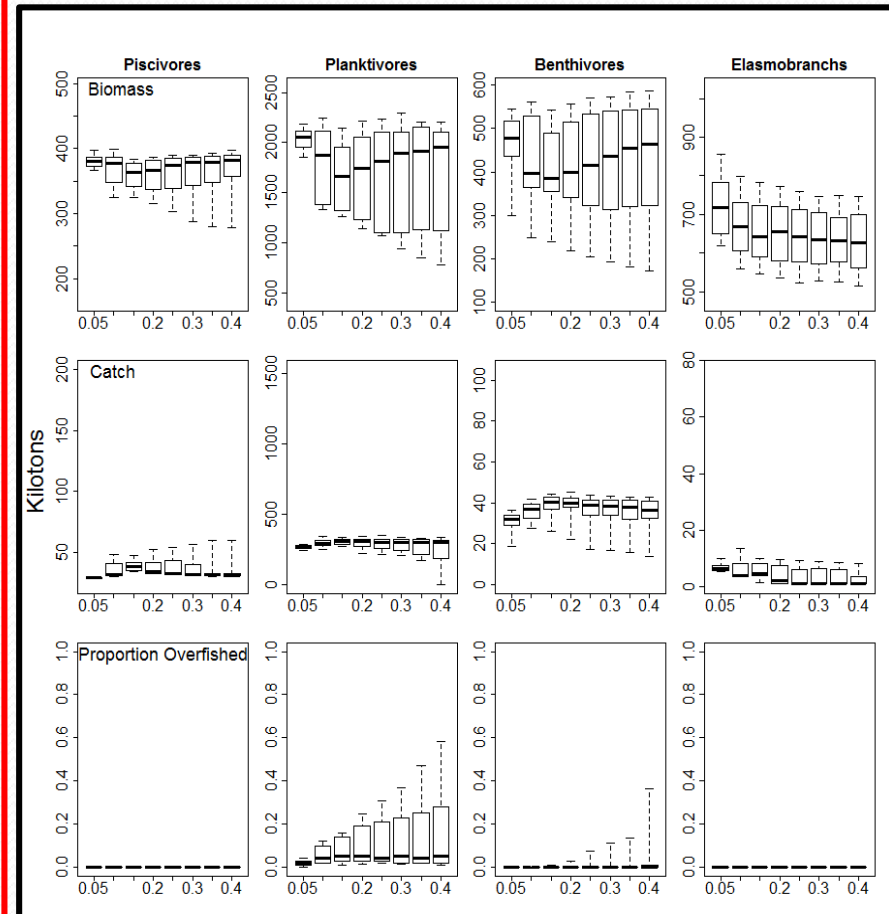


# Biomass, Landings, Status by Functional Group

## Threshold



## Trigger





# eFEP

- **January 2019**
  - **Council re-committed to developing the eFEP**
  - **Followed by a Management Strategy Evaluation**
  - **Formation of a Steering Committee**
- **February to July 2019**
  - **Joint development of eFEP component discussion documents, options, strengths and weaknesses**
- **Draft discussion documents and Committee guidance incorporated into eFEP sections**

# Document Organization

## 2.0 Table of Contents

1.0	Executive Summary and Overview .....	3
2.0	Table of Contents .....	7
2.1	List of Figures .....	8
2.2	List of Tables .....	10
2.3	List of Maps .....	11
2.4	Acronyms used in this document .....	11
3.0	Introduction .....	13
4.0	Goals and objectives .....	17
4.1	Goals – measurable or desirable outcomes .....	17
5.0	Overview of FEP framework .....	19
6.0	Scope .....	19
6.1	Ecological Production Units .....	20
6.2	Fishing Patterns in Relation to the Georges Bank Ecological Production Unit .....	21
6.3	Management Unit (or subunits) (MU) .....	27
6.4	Species Complexes .....	28
7.0	Operational Framework .....	31
7.1	General FEP framework .....	33
7.2	Ecosystem Reference Points .....	34
7.3	Catch Limits .....	36
7.4	Overfished stocks .....	37
8.0	Management Strategy Evaluation .....	39
8.1	Candidate Operating Models – strengths and weaknesses .....	41
9.0	Prototype Ecosystem-Based Management Strategy for Georges Bank .....	43
9.1	Ecosystem reference points, control rules, and catch limits .....	43
9.2	Incentive-based measures .....	58
9.3	Special priority management .....	68
9.4	Jurisdictional authority, cooperation and coordination .....	74
9.5	Limited Access and Authorization to Fish .....	81
9.6	Fishing impacts on ecosystem and spatial management .....	88
9.7	Environmental Impact Statement (EIS) .....	91
9.8	Catch Monitoring, Ecosystem Data Collection and Research to Support EBFM in New England	91
10.0	Description of the Georges Bank Ecosystem .....	95
10.1	Benthic Habitats .....	96
10.2	Oceanographic Setting .....	97



# Executive Summary

- **Describes a high-level framework that we believe is a possible way forward – flexible, adaptive, responsive to ecosystem changes**
- **End result may be somewhat different than the one described**
- **Framework to manage fisheries in a way that is**
  - **More adaptive to changes in the ecosystem production,**
  - **More flexible for fishermen to make better choices about where and how to fish, and**
  - **Sets limits on catch that are more consistent with achieving a broad range of objectives and improved ecosystem services.**
- **Georges Bank was chosen because ecological science and modelling has focused here**



*“When everybody thinks alike nobody thinks at all”*

Professor E. H. Krehbiel of Stanford University

“War and the Social Conscience”

March 10, 1919



# Purpose of Document

- **Explain how a different type of management system could work**
- **Structure and focus discussion on the possibilities**
- **Starting point for further evaluation**
- **Purpose of MSE is to identify viable management approaches to achieve a broad range goals and objectives that will become an approved Fishery Ecosystem Plan**

# What is different about a Fishery Ecosystem Plan (FEP)

- **Considers a broader range of goals, objectives, and improvements of ecosystem services.**
- **Sets a limit on total ecosystem catches based on system-wide primary productivity.**
- **Harvest control rules take into account interactions amongst predators and prey, given their stock size. Harvest control rules may be more stable and robust**



# What is different about a Fishery Ecosystem Plan (FEP)

- **More adaptive and flexible, allowing vessels to catch and land a suite of species in a stock complex.**
- **The productivity of an individual stock is understood to vary with changes in relative abundance of both predators and prey.**

# Introduction

- **Foundation for developing EBFM; background**
- **Scientific and Statistical Committee guidance**
  - **Simplification of management structures and cost savings**
  - **More realistic consideration of effects of biological and fishery interactions**
  - **Direct consideration of environmental changes**
  - **Consideration of ecosystem constraints and more compatible recovery plans**
  - **More effective coordination among management actions**



# Draft

## Fishery Ecosystem Plan Goals

*To protect the ecological integrity of US marine resources as a sustainable source of wealth and well-being for current and future generations*

### ● Strategic Goals

(Derived from Magnuson definition of OY as in Risk Policy Document):

- Optimize Food Provision through targeted fishing and fishing for species for bait
- Optimize Employment
- Optimize Recreational Opportunity
- Optimize Intrinsic (Existence) values
- Optimize Profitability
- Promote stability in both the biological and social systems



# Draft

## Fishery Ecosystem Plan Objectives

- Maintain/restore functional production levels (ecosystem, community scale emphasis)
- Maintain/restore functional biomass levels (community/species scale emphasis)
- Maintain/restore functional trophic structure
- Maintain/restore functional habitat

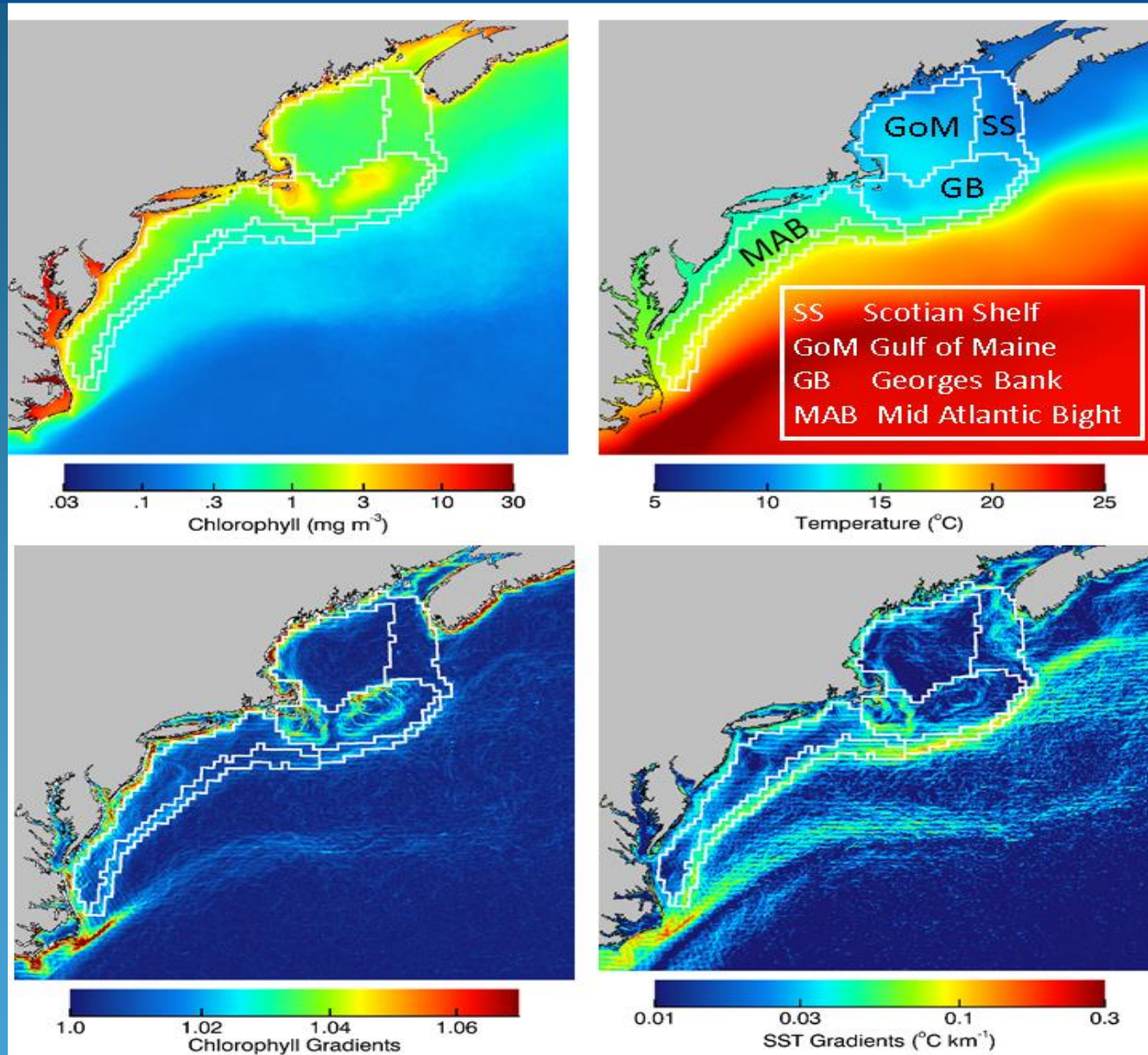


# Document Organization

## 2.0 Table of Contents

1.0	Executive Summary and Overview .....	3
2.0	Table of Contents.....	7
2.1	List of Figures.....	8
2.2	List of Tables .....	10
2.3	List of Maps.....	11
2.4	Acronyms used in this document.....	11
3.0	Introduction.....	13
4.0	Goals and objectives .....	17
4.1	Goals – measurable or desirable outcomes.....	17
5.0	Overview of FEP framework.....	19
6.0	Scope.....	19
6.1	Ecological Production Units .....	20
6.2	Fishing Patterns in Relation to the Georges Bank Ecological Production Unit .....	21
6.3	Management Unit (or subunits) (MU).....	27
6.4	Species Complexes .....	28
7.0	Operational Framework .....	31
7.1	General FEP framework .....	33
7.2	Ecosystem Reference Points .....	34
7.3	Catch Limits .....	36
7.4	Overfished stocks.....	37
8.0	Management Strategy Evaluation.....	39
8.1	Candidate Operating Models – strengths and weaknesses .....	41
9.0	Prototype Ecosystem-Based Management Strategy for Georges Bank.....	43
9.1	Ecosystem reference points, control rules, and catch limits .....	43
9.2	Incentive-based measures .....	58
9.3	Special priority management .....	68
9.4	Jurisdictional authority, cooperation and coordination .....	74
9.5	Limited Access and Authorization to Fish .....	81
9.6	Fishing impacts on ecosystem and spatial management.....	88
9.7	Environmental Impact Statement (EIS).....	91
9.8	Catch Monitoring, Ecosystem Data Collection and Research to Support EBFM in New England	91
10.0	Description of the Georges Bank Ecosystem .....	95
10.1	Benthic Habitats.....	96
10.2	Oceanographic Setting.....	97

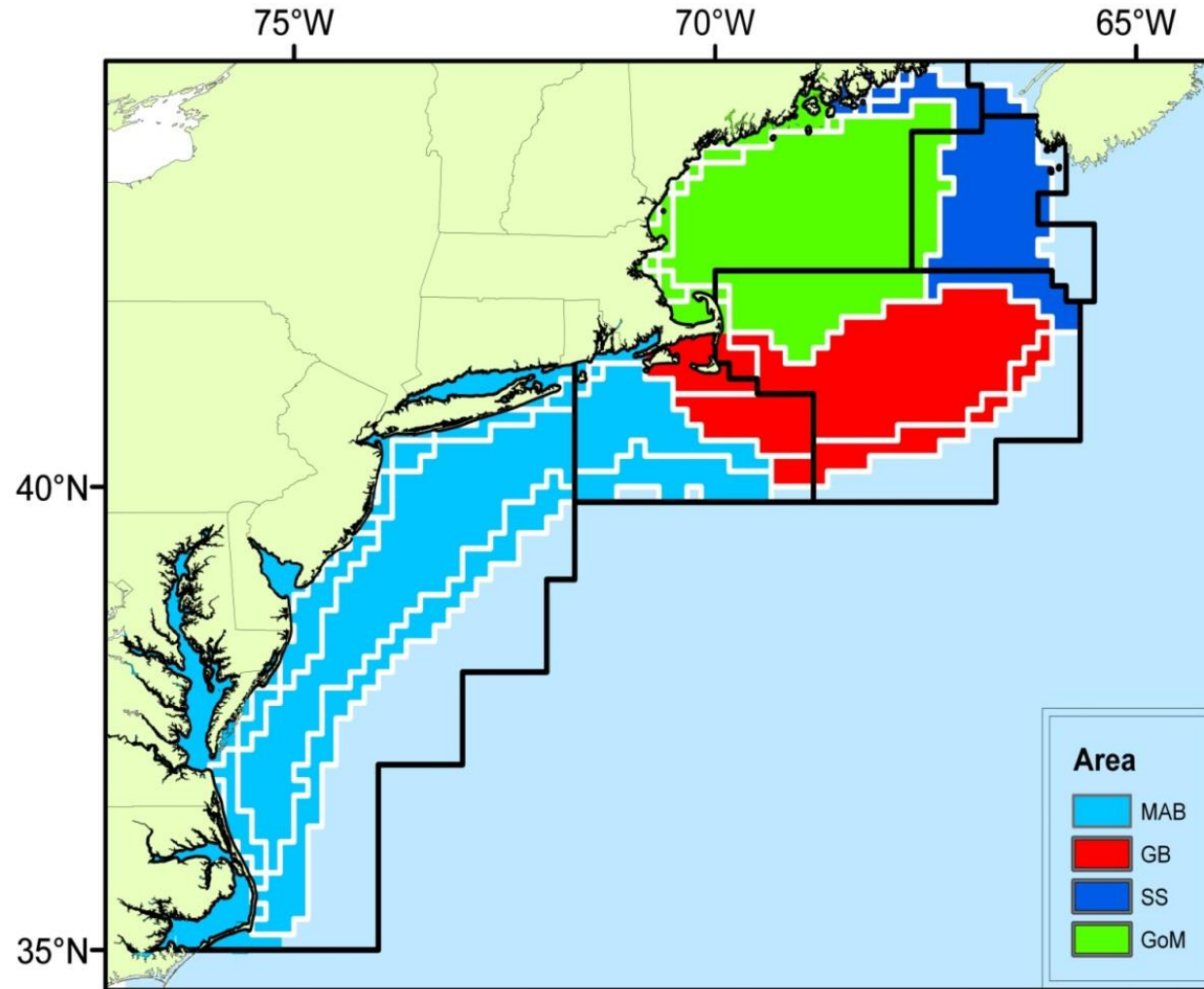
# Oceanography and Ecology Define Spatial Management Units



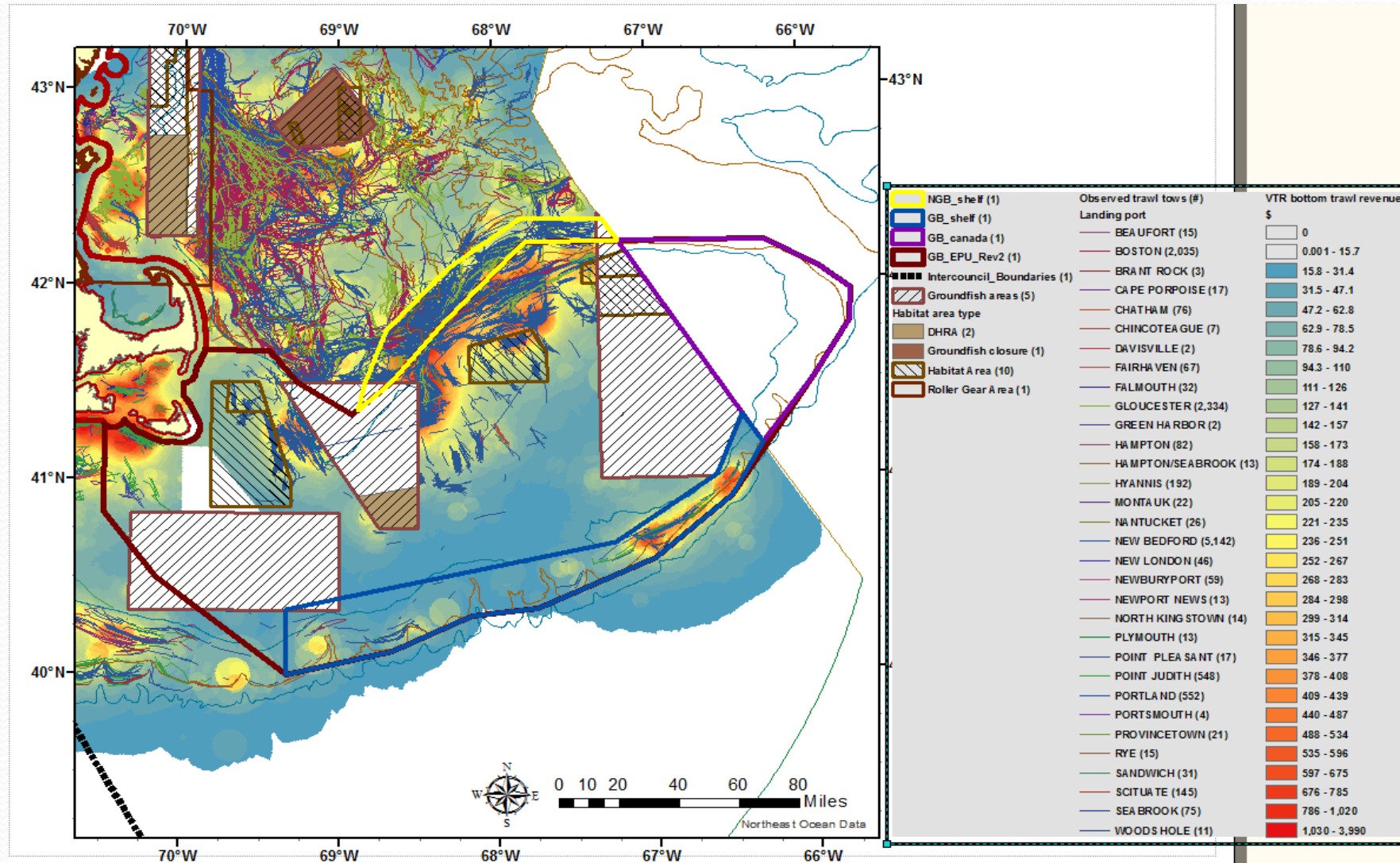
Satellite-based observations permit inferences on nearshore units



# Ecological Production Units



# Trawl fishing activity



# Document Organization

## 2.0 Table of Contents

1.0	Executive Summary and Overview .....	3
2.0	Table of Contents .....	7
2.1	List of Figures .....	8
2.2	List of Tables .....	10
2.3	List of Maps .....	11
2.4	Acronyms used in this document .....	11
3.0	Introduction .....	13
4.0	Goals and objectives .....	17
4.1	Goals – measurable or desirable outcomes .....	17
5.0	Overview of FEP framework .....	19
6.0	Scope .....	19
6.1	Ecological Production Units .....	20
6.2	Fishing Patterns in Relation to the Georges Bank Ecological Production Unit .....	21
6.3	Management Unit (or subunits) (MU) .....	27
6.4	Species Complexes .....	28
7.0	Operational Framework .....	31
7.1	General FEP framework .....	33
7.2	Ecosystem Reference Points .....	34
7.3	Catch Limits .....	36
7.4	Overfished stocks .....	37
8.0	Management Strategy Evaluation .....	39
8.1	Candidate Operating Models – strengths and weaknesses .....	41
9.0	Prototype Ecosystem-Based Management Strategy for Georges Bank .....	43
9.1	Ecosystem reference points, control rules, and catch limits .....	43
9.2	Incentive-based measures .....	58
9.3	Special priority management .....	68
9.4	Jurisdictional authority, cooperation and coordination .....	74
9.5	Limited Access and Authorization to Fish .....	81
9.6	Fishing impacts on ecosystem and spatial management .....	88
9.7	Environmental Impact Statement (EIS) .....	91
9.8	Catch Monitoring, Ecosystem Data Collection and Research to Support EBFM in New England	91
10.0	Description of the Georges Bank Ecosystem .....	95
10.1	Benthic Habitats .....	96
10.2	Oceanographic Setting .....	97



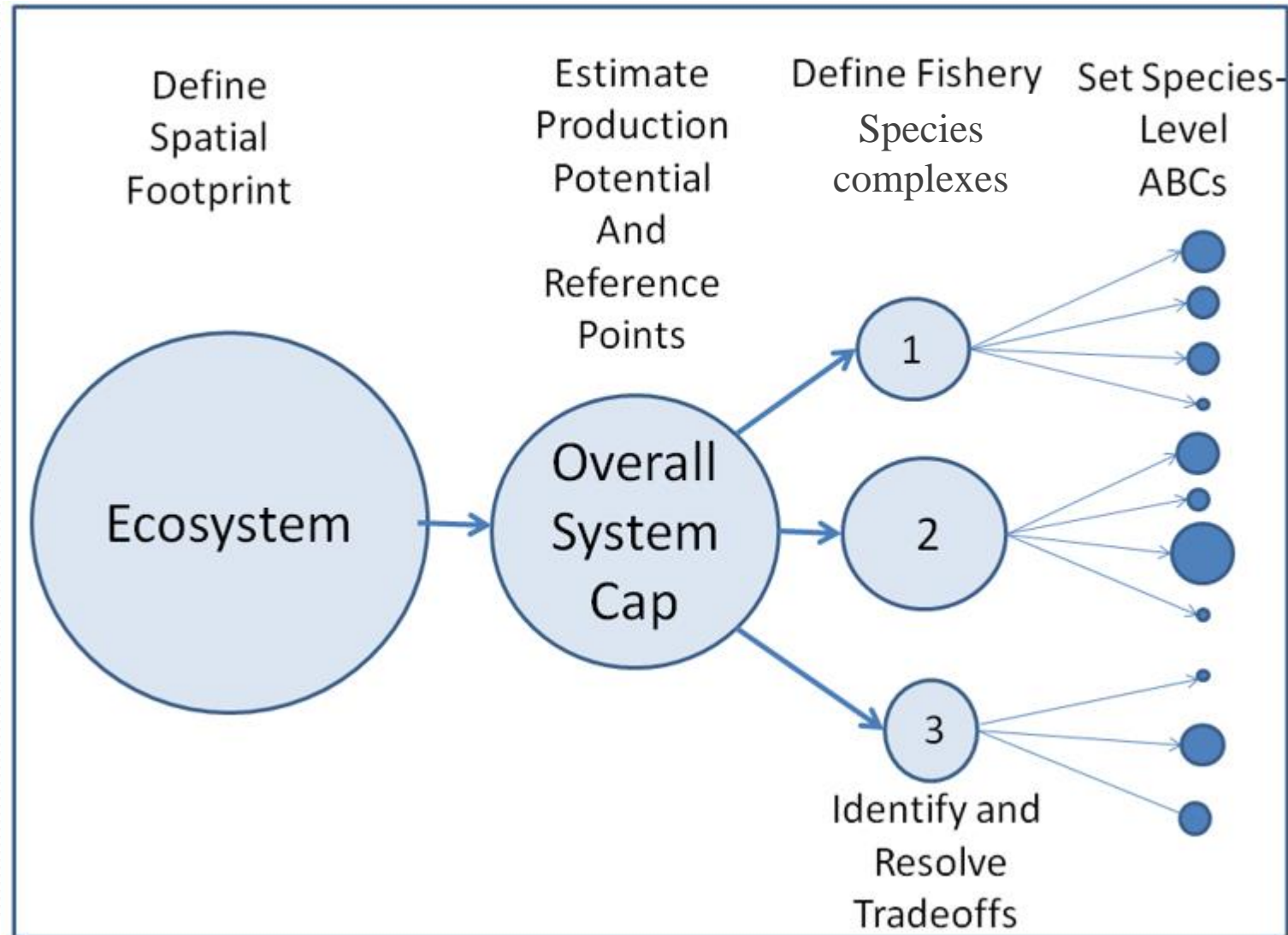
Bank EPU.

- Examples

[illegible]

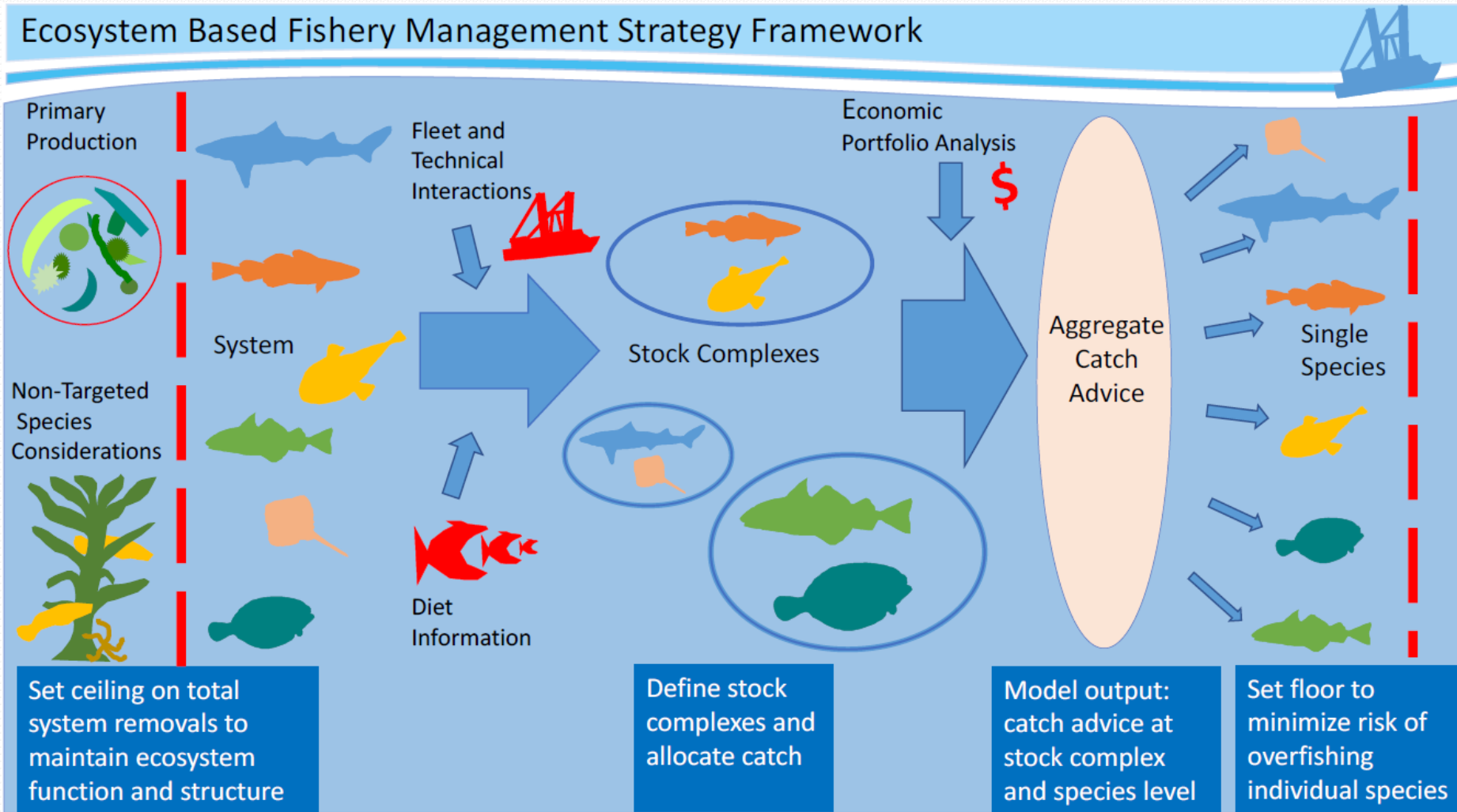
# Draft Operational Framework

## Conceptual design





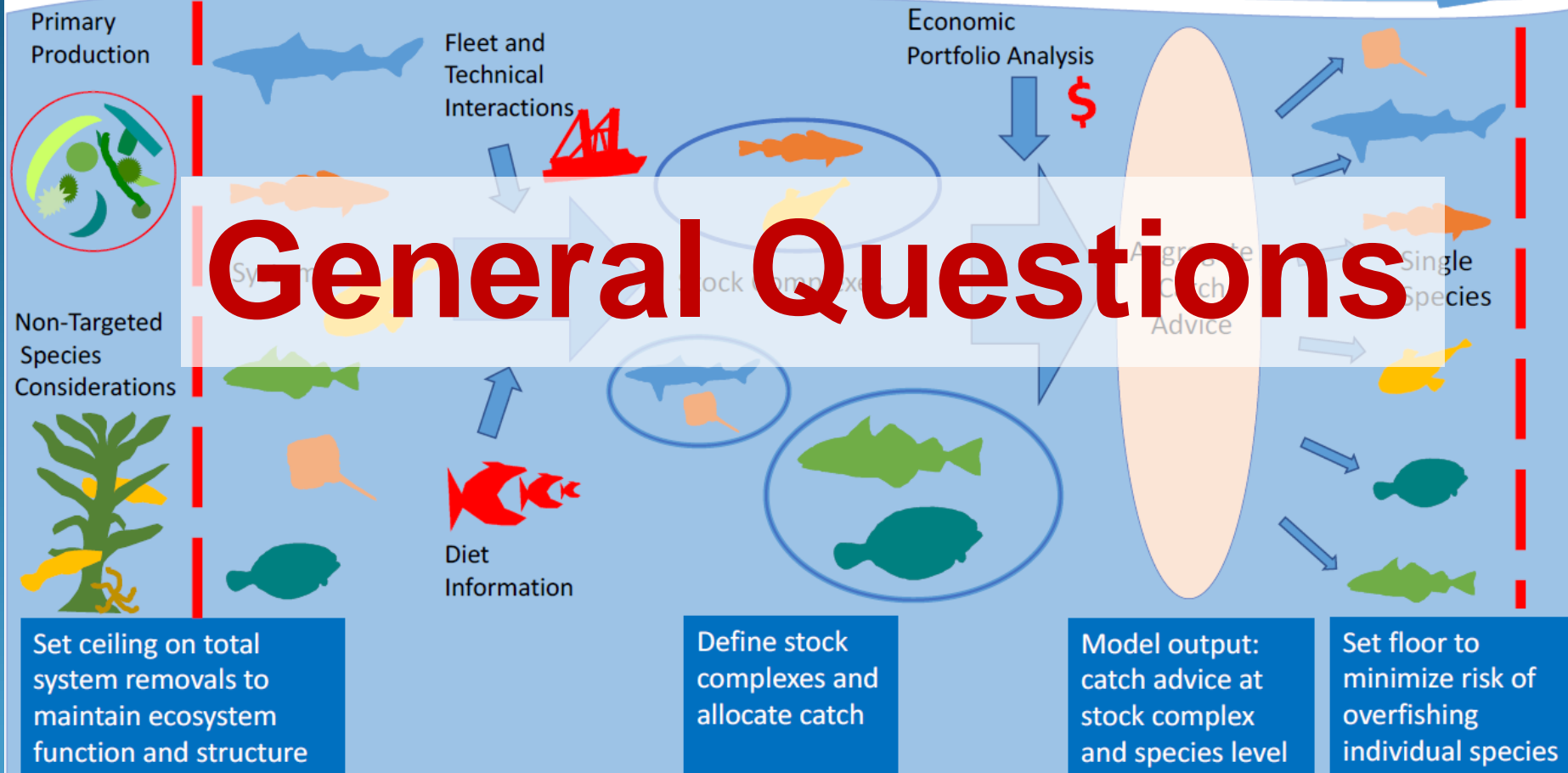
# EBFM Framework



Amanda R. Hart UMass Dartmouth



## Ecosystem Based Fishery Management Strategy Framework



Amanda R. Hart UMass Dartmouth

