

# **EBFM Development by the New England Fishery Management Council**

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**EBFM PDT Chair**

**EBFM Operating Model Review  
April 30, 2018**



New England  
Fishery Management Council

# SSC White Paper

## 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

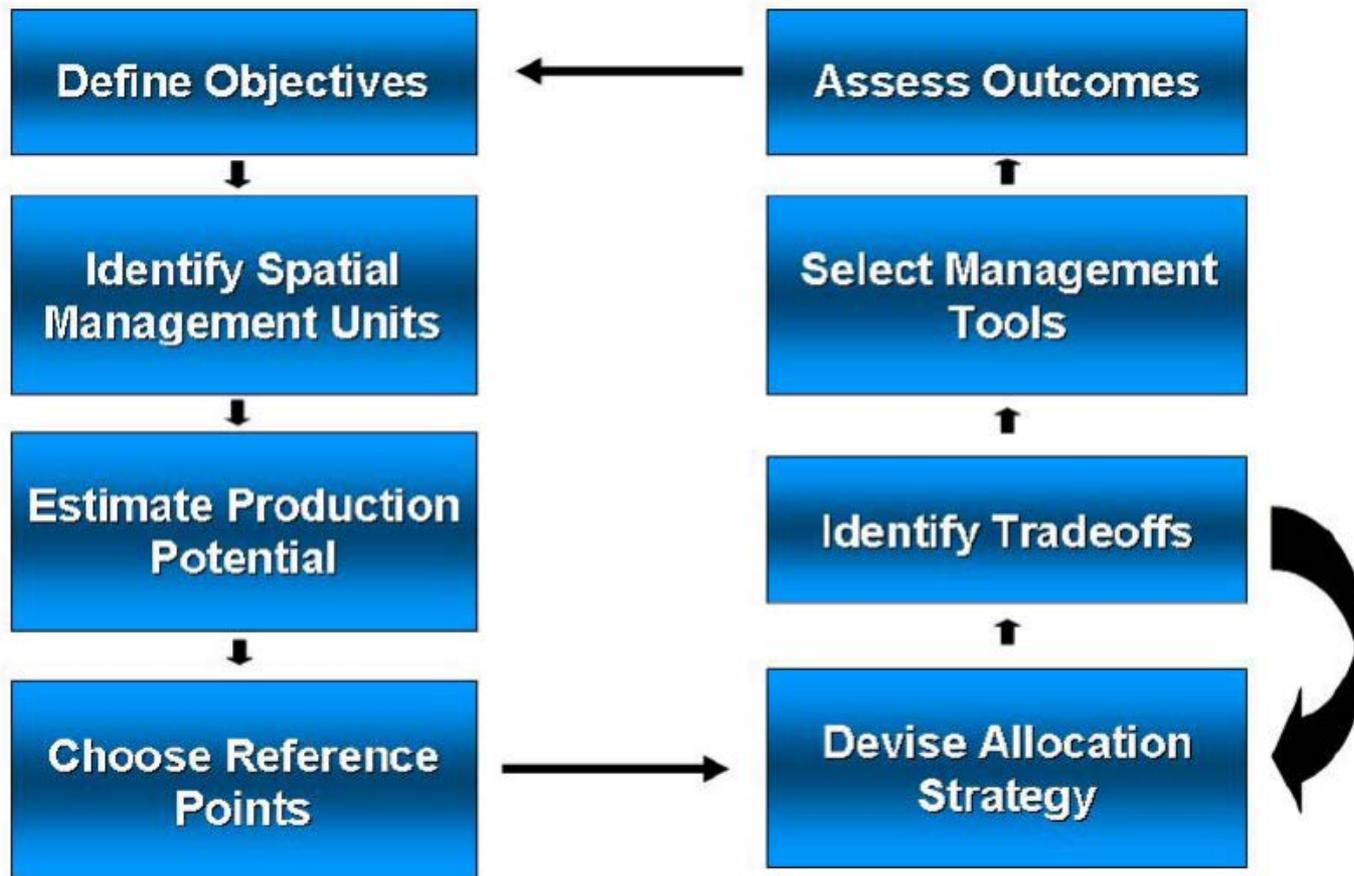


# SSC: Focus during transition period

- Defining Ecosystem Production Units (EPU) which will serve as the basis of EBFM management units
- Identifying issues associated with the ecosystem components of each EPU that require attention under EBFM,
- Defining the EBFM objectives to be achieved for each EPU and the risks of not achieving these
- Designing management strategies to achieve the EBFM objectives and the processes to facilitate consensus
- Developing assessment tools required to monitor progress towards EBFM objectives

# SSC White Paper

## EBFM Process



# Process choices here and elsewhere

- **Decide on approach**

April 2015: <http://s3.amazonaws.com/nefmc.org/2.-EBFM-procedure-discussion.pdf>

- Ecosystem Approach (EAFM) policy documents
  - Example Fishery Ecosystem Plan (eFEP)
  - Implemented Fishery Ecosystem Plan (iFEP)
  - Blended Fishery Ecosystem Plan (bFEP or Omnibus Amendment)
- EBFM/EAFM initiatives for other Councils and Countries
    - Summary: <http://www.nefmc.org/calendar/may-22-2014-ecosystems-based-fisheries-management-meeting>



# MAFMC Ecosystem Approach (EAFM) policy documents <http://www.mafmc.org/eafm/>

- Topical workshops
- EAFM Guidance document
- Species Interactions white paper
- Climate change and variability white paper
- MAFMC forage fish white paper

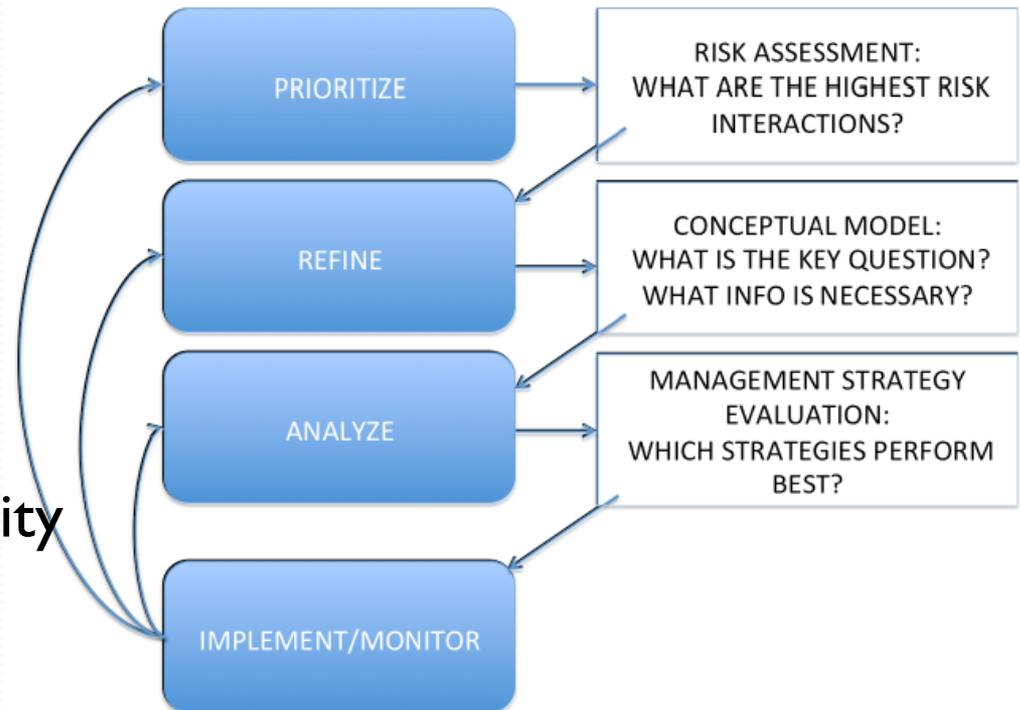


Figure 15. A potential framework for integrating interactions into management



# 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 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

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. To the extent practicable, these documents should be completed in about one year. In consideration of these documents, the Council will adopt a plan for implementation.



# 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 – testing, verification, engage public (scoping)
- Phase IV – develop alternatives for final FEP
- Phase V – implement and make adjustments



# Example Fishery Ecosystem Plan Characteristics

- Account for trophic interactions
  - Multispecies ecosystem models (under development)
  - Focus on Georges Bank ecosystem
  - Integrated ecosystem assessment (advisory?)
- ‘Functional group’ or ‘Stock complex’-based catch limits (ACL)
  - Defines overfishing at ecosystem and stock complex level
- Overfished/depleted – Biomass floor
  - Actions to reduce risk to single species and promote rebuilding when necessary
- Place-based spatial management
  - Leveraging common values and experience to build buy-in and ‘ownership’

# 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



## 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



# Committee guidance to focus eFEP development on a worked example:

1. Describe a trophic web area based operating model that specifies:
  - ❖ an ecosystem area
  - ❖ species present in the area that will be dynamically model
  - ❖ species present in the area that will be treated as externalities (they participate in the food web, but their numbers and biomass is determined outside the model- e.g., mammals, birds, most benthic invertebrates)
  - ❖ feeding models that account for preference, suitability and availability
  - ❖ matrix of production attributable to ecosystem area (incorporating seasonality)
  - ❖ stochastic nature of these relationships- could use Bayesian approach

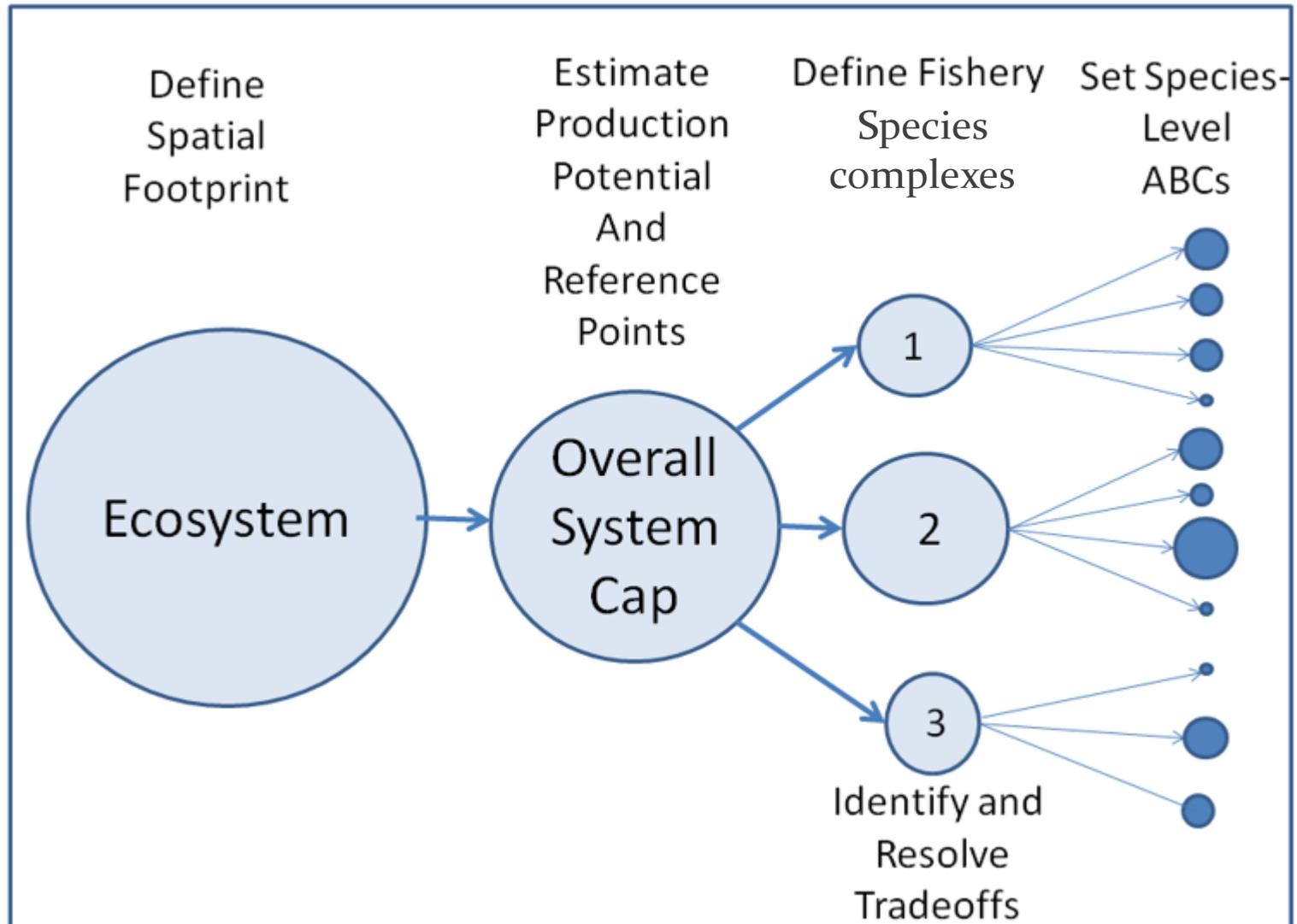
# Committee guidance to focus eFEP development on a worked example:

2. Test alternative approaches to management including:
  - ❖ current single species approach
  - ❖ guild (trophic level) approach
  - ❖ Total ecosystem productivity approach
  
3. For each approach, specify:
  - ❖ criteria for overfishing
  - ❖ rebuilding strategy
  - ❖ mechanism to protect most targeted or vulnerable stocks (min, biomass, but not necessarily linked to BMSY)



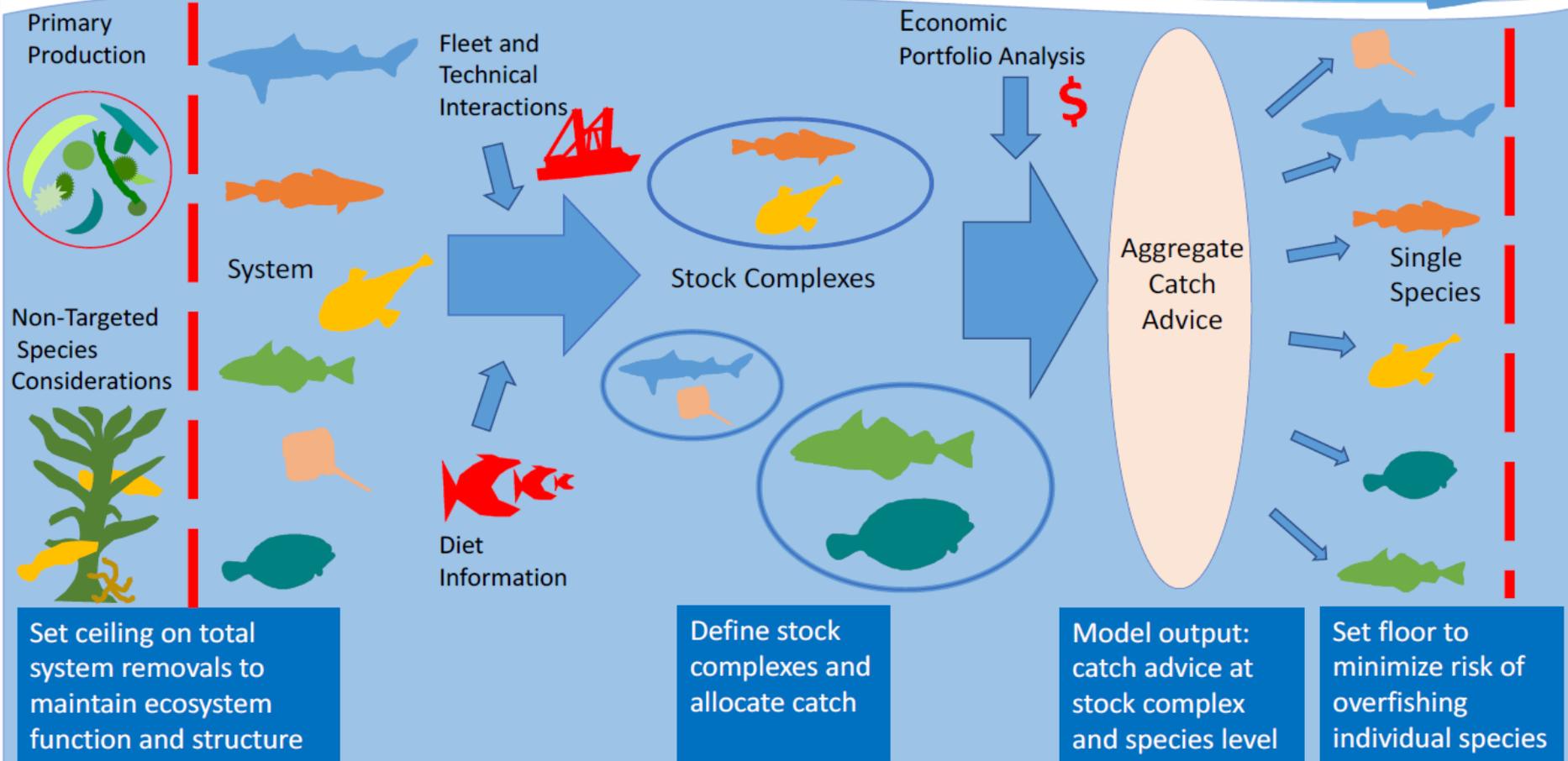
# Draft Operational Framework

## Conceptual design



# EBFM Framework

## Ecosystem Based Fishery Management Strategy Framework



Amanda R. Hart UMass Dartmouth

# Scope – species/stocks

## Georges Bank EPU

Common Name	Scientific Name	Management authority	FMP	Pop/BYield etc	Feeding guild	Functional Group	Trophic level	Adult size	Primary Offshore Habitat	Preferred Depth Range (m)	On Georges Bank?	ECS	Otter Trawl?	Gillnet	Longline	Pot	Seiner	Dredge	
American Plaice	<i>Hippoglossoides platessoides</i>	NEFMC	NE Multispecies	1	Benthivore	Benthivore	3.7	83	Mud and sand	40-300	X		X						
Haddock	<i>Melanogrammus aeglefinus</i>	NEFMC	NE Multispecies	1	Benthivore	Benthivore	4.1	112	Sand, shells, gravel, along margins of rocky reefs	40-160	X		X	X					X
Winter Flounder	<i>Pseudopleuronectes americanus</i>	NEFMC	NE Multispecies	1	Benthivore	Benthivore	2.8	64	Mud, sand, and hard bottom	10 to 70	X		X						X
Yellowtail Flounder	<i>Limanda ferruginea</i>	NEFMC	NE Multispecies	1	Benthivore	Benthivore	3.2	64	Sand with and w/o shells, gravel, and rocks	30-90	X		X						X
Atlantic Wolffish	<i>Anarhichas lupus</i>	NEFMC	NE Multispecies	1	Benthivore	Benthivore	3.2	150	Sand and gravel, spawn in rocky habitats	70-184	?								
Little Skate	<i>Leucoraja erinacea</i>	NEFMC	NE Skate Complex	1	Benthivore	Benthivore	3.6	54	Sand and gravel	10-100	X		X	X					X
Red Hake	<i>Urophycis chuss</i>	NEFMC	NE Small-mesh Multispecies	1	Benthivore	Benthivore	3.6	66	Soft sediments and shells	50-300	X		X						X
Soupin	<i>Alycocephalus cecodecemspinus</i>	NEFMC	NE Multispecies	1	Benthivore	Benthivore	3.7	46				X							
American Lobster	<i>Homarus americanus</i>	ASMFC	Lobster	1	Benthivore	Benthivore													X
Atlantic Sea Scallop	<i>Placopectin magellanicus</i>	NEFMC	Sea Scallop	1	Suspension Feeder	Benthos	1.94		Sand and gravel	18-110	X								X
Atlantic Cod	<i>Gadus morhua</i>	NEFMC	NE Multispecies	1	Demersal Piscivore	Demersal Piscivore	4.4	200	Complex hard bottom habitats, sand and gravel	30-160	X		X	X	X				X
Atlantic Halibut	<i>Hippoglossus hippoglossus</i>	NEFMC	NE Multispecies	1	Demersal Piscivore	Demersal Piscivore	4.5	470	Sand, gravel, or clay	60-140, also on slope	X				X				
Barndoor Skate	<i>Dipturus laevis</i>	NEFMC	NE Skate Complex	1	Benthivore-Piscivore	Demersal Piscivore		152	Mud, sand, and gravel	40-400	X	X	X						
Fourspot Flounder	<i>Hippoglossina oblonga</i>	Unmanaged	NA	1	Demersal Piscivore	Demersal Piscivore		41				X							
Monkfish	<i>Lophius americanus</i>	NEFMC/MAFMC	Monkfish	1	Demersal Piscivore	Demersal Piscivore	4.45	120	Variety of habitats, prefer soft sediments	50-400	X		X	X					X
Offshore Hake	<i>Amerluccius albidus</i>	NEFMC	NE Small-mesh Multispecies	1	Demersal Piscivore	Demersal Piscivore	4.3	41	?	160-500	X		X						
Silver Hake	<i>Amerluccius bilinearis</i>	NEFMC	NE Small-mesh Multispecies	1	Demersal Piscivore	Demersal Piscivore	4.3	76	Sand	40-400	X		X		X				X
Spiny Dogfish	<i>Squalus acanthias</i>	MAFMC/NEFMC	NE Skate Complex	1	Demersal Piscivore	Demersal Piscivore	4.3	160		20-300	X			X	X				
Summer Flounder	<i>Paralichthys dentatus</i>	MAFMC/ASMFC	Summer Flounder, Soup, and Black Sea Bass	1	Demersal Piscivore	Demersal Piscivore	4.5	94			X		X	X	X				
Bluefin Tuna	<i>Thunnus thynnus</i>	NMFS-SFD	HMS	1	Large Pelagic Piscivore	Piscivore Delagic			Pelagic						X				
Swordfish	<i>Xiphias gladius</i>	NMFS-SFD	HMS	1	Large Pelagic Piscivore	Piscivore Delagic			Pelagic							X			
Shortfin squid	<i>Illex illecebrosus</i>	MAFMC	Mackerel, Squid, and Butterfish	1	Piscivore Pelagic	Piscivore Pelagic	3.33		Pelagic	70-400	X								
Pollock	<i>Pollachius virens</i>	NEFMC	NE Multispecies	1	Planktivore-Piscivore	Planktivore	4.4	130	Over rocky substrates	80-300	X		X	X					
Atlantic Herring	<i>Clupea harengus</i>	NEFMC/ASMFC	Herring	1	Planktivore	Planktivore	3.2	45	Pelagic	60-140	X		X						X
Atlantic Mackerel	<i>Scomber scombrus</i>	MAFMC	Mackerel, Squid, and Butterfish	1	Planktivore	Planktivore	3.7	60	Pelagic				X						X
Acadian Redfish Blackbelly	<i>Sebastes fasciatus</i>	NEFMC	NE Multispecies	1	Planktivore-Piscivore	Planktivore	4	30	Soft sediments, gravel, and rocky habitats	100-300	X		X	X					



# Functional groups

Table 2. Catchability-adjusted average biomass for the Georges Bank EPU derived from spring and fall trawl surveys, categorized by feeding guild (columns) and functional group (rows representing technical interactions).

⊕

Functional group	Value Total biomass, '000 mt # of Species	Feeding guild										
		Apex Predator	Benthivore	Benthos	Macroplanktivore	Macrozooplanktivore	Mesoplanktivore	Piscivore	Planktivore	Planktivore-Piscivore	Small Shark	Total
Bottom trawl	Biomass				34.3				569.1		0.0	
	Species		10		4	7		10		1		32
Mid-water Trawl	Biomass								62.2			
	Species						5		2			7
Sink gillnets	Biomass				0.3	68.3			553.1		0.0	
	Species		2		2	2		6		1		13
Drift gillnets	Biomass											
	Species	1										1
Bottom longline	Biomass				0.3				411.0			
	Species		1		2	2		5				10
Drift longline	Biomass											
	Species	3										3
Pot	Biomass											
	Species		11									11
Seine	Biomass		949.3		5.3	83.0		26.6	50.8			
	Species		3		1	3	4	3	1			15
Dredge	Biomass								1.2			
	Species		2	4					1			7
Demersal recreational	Biomass				10.8				569.1		0.0	
	Species		12		4	6		10		1		33
Pelagic recreational	Biomass							5.6	50.8			
	Species	4						1	1			6
P. species consumption	Biomass				30.3							
	Species				2		4					6

Functional group	Value Total biomass, '000 mt # of Species	Feeding guild										
		Apex Predator	Benthivore	Benthos	Macroplanktivore	Macrozooplanktivore	Mesoplanktivore	Piscivore	Planktivore	Planktivore-Piscivore	Small Shark	Total
Ecosystem component	Biomass								34.5			
	Species	1	9	1	3	3		4	1			22

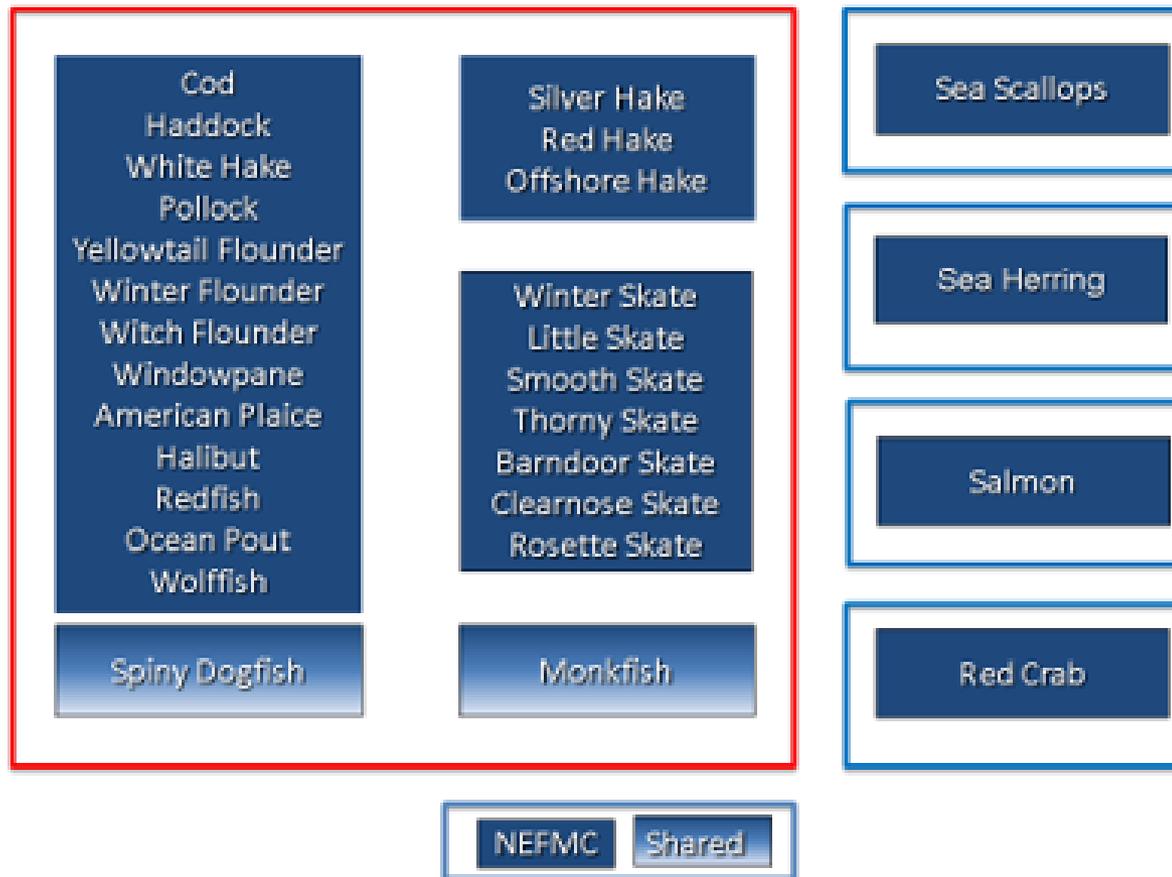
# NEFMC Managed Species

		Landings (mt)	GEAR_G		Standup		Lobster	Hand or		Mid-water		
Management	Plan	COMMON_NAME	FEEDING_GUILD	Trawls	Dredges	Gill nets	Traps	Longlines	Hook	trawls	Fish Traps	Total
MAFMC	Surf Clam & Ocean Quahog	Clam, Surf	Benthos		8586.1							8586.1
MAFMC/NEFMC	Spiny Dogfish	Dogfish, Spiny	Piscivore	14.0	0.0	2420.7		2677.1	246.2	0.5		5358.5
NEFMC	Sea Scallop	Scallop, Sea	Benthos	2.6	3932.2							3934.8
NEFMC	Skate	Skate, Winter	Piscivore	697.6	0.1	3102.1		3.3	0.6			3803.7
NEFMC	Small-Mesh Multispecies	Hake, Silver (Whiting)	Piscivore	3712.9	0.2	3.8		0.0		0.1		3717.0
NEFMC	NE Multispecies	Haddock	Benthivore	3657.4	0.0	6.8		1.0	0.3	7.9		3673.4
ASMFC		Crab, Jonah	Shrimp_crabs	0.3			2142.9		0.0		341.3	2484.5
NEFMC	Monkfish	Goosefish	Piscivore	2080.5	245.7	151.9		0.0	0.0			2478.1
ASMFC	American Lobster	Lobster, American	Shrimp_crabs	208.1	0.0	10.8	2083.5	7.4	8.0		159.7	2477.5
MAFMC	Squid, Mackerel, Butterfish	Mackerel, Atlantic	Planktivore	48.1		14.9		1.6	516.4	854.6	10.5	1446.1
NEFMC	NE Multispecies	Ocean Perch, (Redfish)	Planktivore-Piscivore	1068.4		8.2		0.0	0.0	0.2		1076.8
NEFMC	NE Multispecies	Cod, Atlantic	Piscivore	793.6	0.2	92.2	0.0	0.6	17.0		0.1	903.7
NEFMC	NE Multispecies	Pollock, Atlantic	Macrozoo-piscivore	664.9		56.9		0.0	2.0			723.8
NEFMC	NE Multispecies	Flounder, Winter	Benthivore	711.0	0.6	1.2			0.2			713.0
		Mussel, Blue	Benthos	12.1	590.2							602.3
MAFMC	Squid, Mackerel, Butterfish	Squid, Long Finned (Loligo)	Macroplanktivore	442.0	3.4	0.1			0.0		0.1	445.6
MAFMC	Squid, Mackerel, Butterfish	Butterfish	Planktivore	350.7		0.0					0.2	350.9
MAFMC	Surf Clam & Ocean Quahog	Clam, Ocean Quahog	Benthos		296.3							296.3
NEFMC	NE Multispecies	Hake, Atlantic, White	Piscivore	268.2		18.8		0.0	0.2			287.2
NEFMC	NE Multispecies	Flounder, Plaice, American (Dab)	Macroplanktivore	286.0	0.5	0.3						286.8
NEFMC	Red Crab	Crab, Red Deepsea	Shrimp_crabs				0.9				172.8	173.7
NEFMC	NE Multispecies	Flounder, Witch (Gray Sole)	Benthivore	123.6	0.7	0.1						124.4
		Whelk, Knobbed	Benthos	97.8	5.4						3.5	106.7
MAFMC	Summer Flounder, Black Sea	Flounder, Summer (Fluke)	Piscivore	92.4	0.1	0.0			0.8			93.3
HMS	Atlantic Tunas	Tuna, Bluefin	Apex Predator					5.5	81.2			86.7
MAFMC	Summer Flounder, Black Sea	Scup	Benthivore	60.8	3.4	0.0	0.0	0.0	2.0		1.1	67.3
NEFMC	NE Multispecies	Flounder, Yellowtail	Benthivore	50.4	0.5	0.3						51.2
NEFMC	Small-Mesh Multispecies	Hake, Atlantic, Red	Macrozoo-piscivore	47.9		0.1		0.2				48.2
		Total		15555.1	13706.4	5911.9	4238.7	2752.0	912.7	863.3	734.8	44674.9



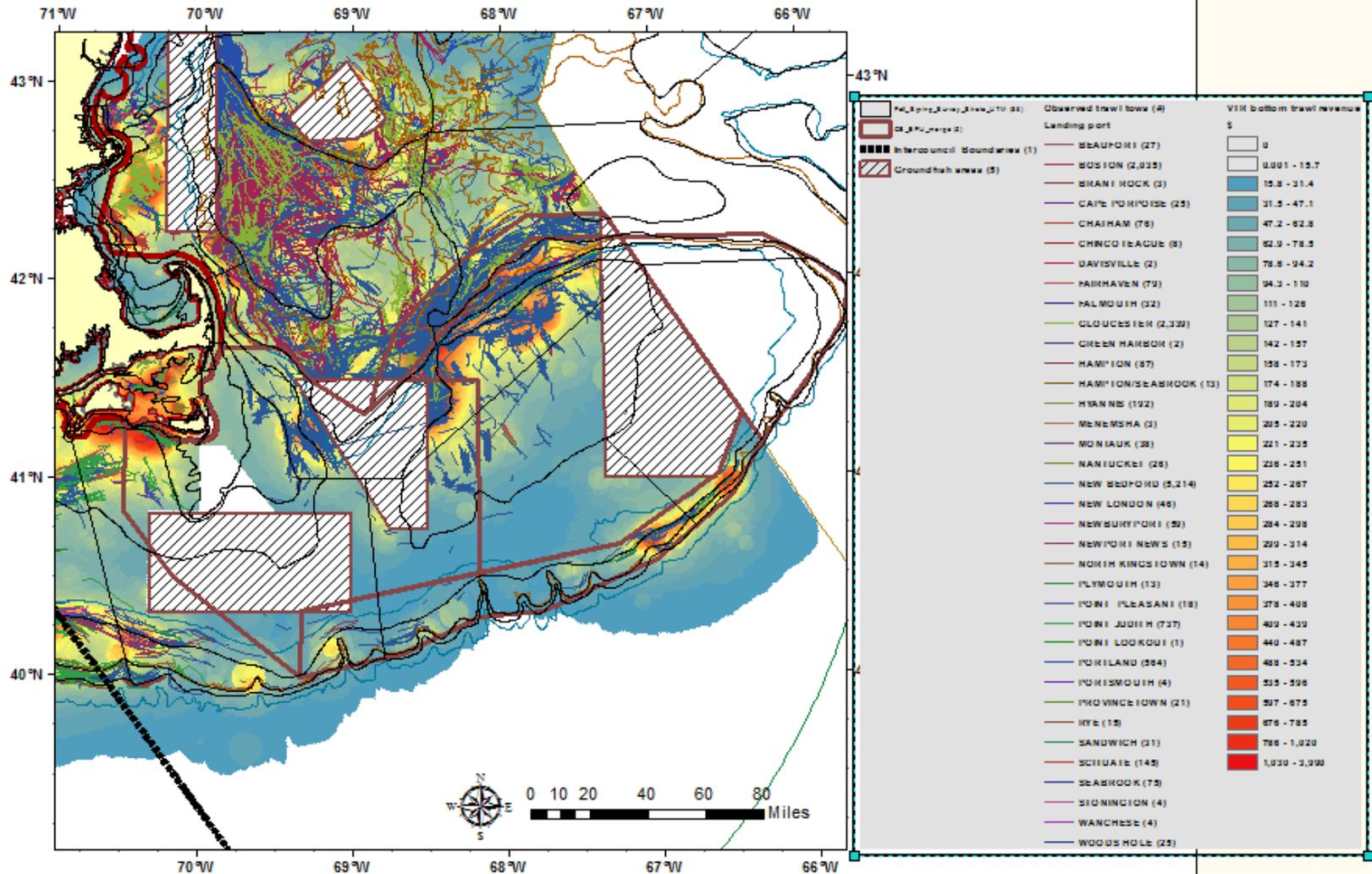
# NEFMC Managed Species

Figure 2. NEFMC-managed species. This update report focuses on the major fish species in the multispecies groundfish, spiny dogfish, small mesh (hake), skate, monkfish, and herring management plans



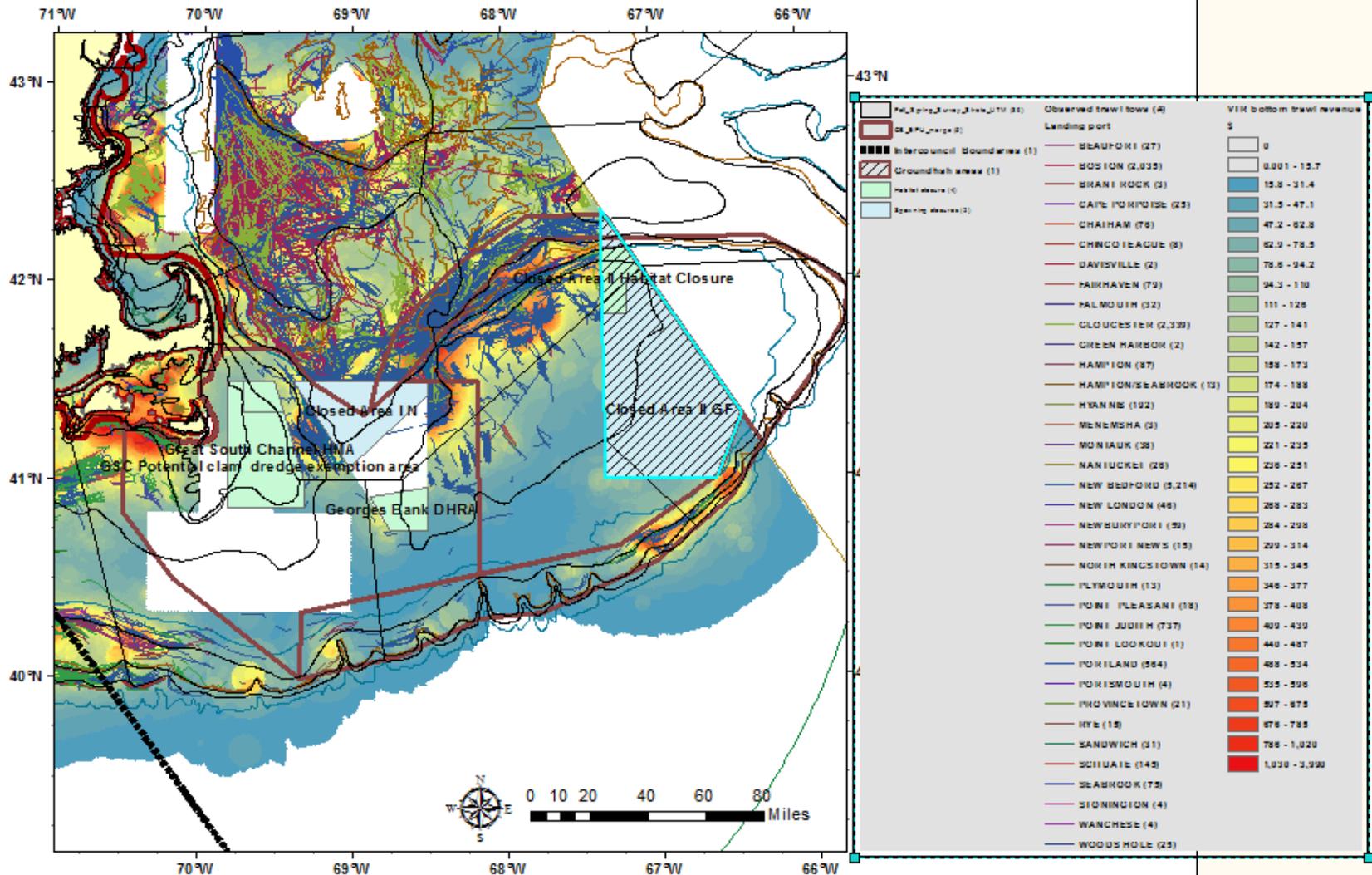
# Trawl fishing distribution 2015

## Georges Bank EPU

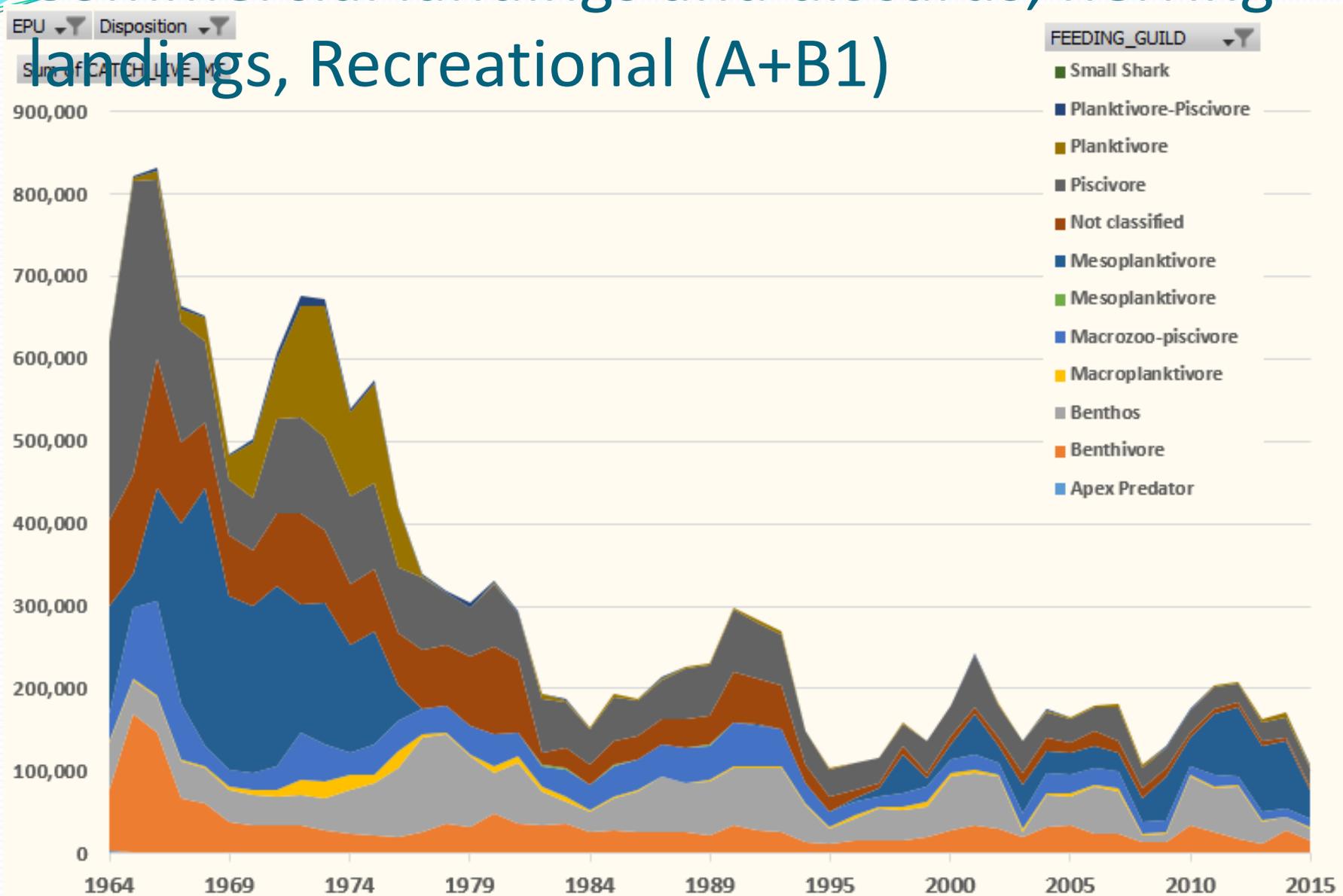


# Georges Bank EPU

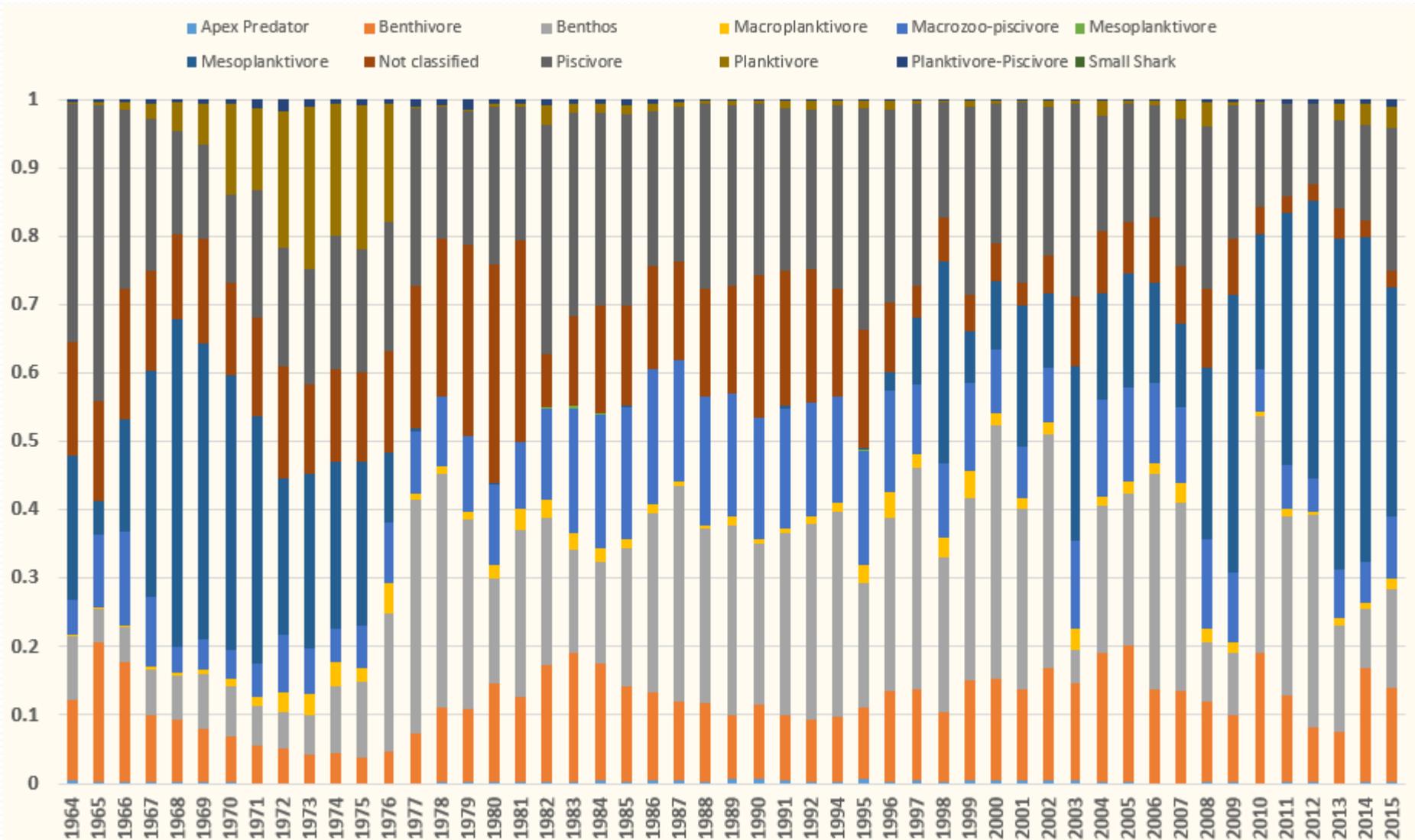
## New Habitat and Spawning Closures



# Georges Bank catch (mt) by Feeding guild: Commercial landings and discards, herring landings, Recreational (A+B1)



# Georges Bank catch proportion by Feeding guild



# Catch advice framework

- A more scientifically defensible underpinning for fishery management,
- A framework for managing mixed stock fisheries,
- A simpler and robust approach with fewer biological reference points that constrain management options but yet provide sufficient conservation and protection for individual stocks, and
- Management procedures that are potentially based on simpler stock assessment methods that are less susceptible to problems plaguing current stock assessments.



# Biological Reference Points and Harvest Control Rules

- **Stock complexes**
  - Maximum catch limits determined for groups of interrelated species (defined by similar diets and life histories)
  - MSY for stock complexes is determined by assessment
  - Special consideration for forage species and juvenile fish
    - Draft Discussion Document 10
- **Assessment**
  - Multispecies assessment with interactions every three (?) years
  - Single species benchmark assessments for overfished stocks



# Biological Reference Points and Harvest Control Rules

- **Overfishing**
  - Level determined as the average mortality that would produce MSY for the stock complex, considering the appropriate catch composition to meet plan objectives
- **Overfished stocks and Rebuilding**
  - Level for a stock determined from an evaluation of its
    - Vulnerability to fishing (i.e. how quickly biomass declines to excessive mortality),
    - Resilience (how quickly will a stock recover when biomass below the threshold), and
    - Role in the ecosystem (less risk allowed for species that play a key role, e.g. forage fish).
  - Uses appropriate survey biomass indices and possibly standard commercial catch per unit effort data (lbs. per area swept) to make annual status determinations



# Catch Allotment/Allocation

- Allocations made to permit holders in functional groups of species (i.e. a stock complex caught by gear type)

- A permitted vessel would receive an annual catch allocation of one or more functional groups that are caught by a Georges Bank fishery.

- Recreational catch allocations

Table 2. Catchability-adjusted average biomass for the Georges Bank EPU derived from spring and fall trawl surveys, categorized by feeding guild (columns) and functional group (rows representing technical interactions).

Functional group	Value Total biomass, '000 mt # of Species	Feeding guild									Total		
		Apex Predator	Benthivore	Benthos	Macroplanktivore	Macrozooplivore	Mesoplanktivore	Piscivore	Planktivore	Planktivore-Piscivore		Small Shark	
Bottom trawl	Biomass Species		10		34.3 4		7		569.1 10		0.0 1		32
Mid-water Trawl	Biomass Species							5		62.2 2			7
Sink gillnets	Biomass Species		2		0.3 2	68.3 2			553.1 6		0.0 1		13
Drift gillnets	Biomass Species	1											1
Bottom longline	Biomass Species		1		0.3 2		2		411.0 5				10
Drift longline	Biomass Species	3											3
Pot	Biomass Species		11										11
Saine	Biomass Species		949.3 3		5.3 1	83.0 3		4	26.6 3	50.8 1			15
Dredge	Biomass Species		2	4					1.2 1				7
Demersal recreational	Biomass Species		12		10.8 4	6			569.1 10		0.0 1		33
Pelagic recreational	Biomass Species	4							5.6 1	50.8 1			6
P. species consumption	Biomass Species				30.3 2			4					6

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Ecosystem component	Biomass Species	1	9	1	3	3			34.5 4		1		22

# Operating Model Peer Review

- That a broad-based peer review be conducted on the proposed Georges Bank operating models and supporting data, incorporating the appropriate national and international reviewers, upon completion of operating models and worked examples of control rules for Georges Bank.
- That the approach include establishing an EPU catch cap and developing methods of setting catch limits by functional groups of species defined by trophic interactions represents an acceptable approach for further development as an example.



# Phase III 2018?

- eFEP as a prototype for focusing discussion
- FEP Management Strategy Evaluation
  - Worked example developed in Phase II as a starting point
  - Solid basis and sound scientific underpinning
  - Participation by fishermen and interested parties
  - Evaluate tradeoffs and optimize outcomes



# Operating Model Peer Review

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# Committee guidance

- **Overfished status determination and rebuilding**
  - Based on ecosystem risk?
  - Response dependent on root causes of condition?
- **Hindcast operational models to compare with results under single species management**
- **Evaluate maximum retention policies**
  - Incentives to target more productive stocks
  - Disincentives to target more vulnerable stocks
- **Evaluate integration of fishery dependent data**
- **Investigate role of consumption of pre-recruits**

