New England Fishery Management Council
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E.F. "Terry" Stockwell III, *Chairman* | Thomas A. Nies, *Executive Director*

MEMORANDUM

DATE: April 11, 2016

TO: EBFM Committee

FROM: EBFM Plan Development Team Chair

SUBJECT: **Progress Report and Overview**

As you know, the PDT has been meeting to develop a more thorough description of an example Fishery Ecosystem Plan (eFEP), building on the rough outline presented at the last committee meeting. A draft document that outlines appropriate goals and objectives and provides a framework of eFEP compontents is available, but more detailed discussion of its elements that was requested by the Committee is not yet ready.

The PDT held a conference call on December 7, 2015 to identify sub-teams to draft topical discussion documents and a strawman for various eFEP components. The PDT met again on January 13 and on March 29-30 to review the initial draft documents, but a variety of important questions were raised by the sub-teams that require more work by the PDT and/or guidance from the EBFM Committee. Progress has been somewhat hampered by the availability of PDT members at meetings and a meeting scheduled for February 11 had to be cancelled. To help broaden the scope of expertise on the PDT and aide participation by the Ecosystem Assessment Program, the Council added Dr. David Stevenson (Ecologist, GARFO), Dr. Danielle Palmer (Protected Resources Division, GARFO), and Dr. Sean Lucey (Ecosystem Assessment Program, NEFSC) to the PDT. The current PDT membership is listed in the table below:

Table 1. EBFM PDT membership

Andrew Applegate, chair, NEFMC staff	Sarah Gaichas, NEFSC Ecosystem Assessment
Peter Auster, U.Conn. Dept Mar. Sci.	Sean Lucey, NEFSC Ecosystem Assessment
Tobey Curtis, GARFO Sustainable Fisheries	Daniel Palmer, GARFO Protected Resources
Timothy Cardiasmenos, GARFO NEPA	Kevin St. Martin, Rutgers U., Dept. Geography
Kiersten Curti, NEFSC Population Dynamics	Richard Seagraves, MAFMC staff
Geret DePiper, NEFSC Social Sciences	David Stevenson, GARFO Habitat Conservation
Michael Fogarty, NEFSC Ecosystem Assessment	Michael Waine, ASMFC staff

During the PDT meetings, five general principles have emerged that would apply to the eFEP:

- Reference points and catch limits for an Ecosystem Production Unit (EPU) should be informed by trophic relationships and interactions, tied to the Council's risk policy that recognizes both uncertainty and potential consequences of mis-specification.

- A total system cap - The combined catch limits of all species or functional groups should not exceed a fixed percentage of primary production, about 40%.
- Aggregate, functional groups - Stocks should be managed in functional groups of ecologically related species (i.e. guilds), but individual stocks require special conservation if they become overfished or depleted.
- Management should be applied through a hierarchical place-based (i.e. spatial) framework
- A place-based management approach coupled with catch limits defined at the functional group level could be more robust to climate-induced changes in productivity and distribution.

Total system catch cap and functional group catch limits

An initial focus of a prototype eFEP should be on a Georges Bank EPU, due to the predominance of various ecosystem assessment models for Georges Bank. Several types of models have been applied to Georges Bank species, but would require better parameterization, testing, and peer review before they can be used to establish management reference points and catch limits.

The models range from simpler models (e.g. surplus production and multispecies catch at age) with 10 stocks to more complex models including harvested and unharvested species with a broader range of trophic levels (Ecosim/Ecopath; Atlantis). The models also include an ecosystem production model that can provide advice about the overall productivity of the system and transfers of energy to higher trophic levels, but not catch advice for harvested species in functional groups.

Except as a general principle, guidance for how the various types of models would be integrated to provide biological reference point and catch advice (Annual Biological Catch, or ABC) remains to be developed. For models that include only 10 stocks (e.g. surplus production and multispecies catch at age), it is not yet clear whether and how single species assessments might be integrated to provide catch advice for a complete functional group of species in the commercial and recreational catch. Work is also needed to provide reliable estimates of uncertainty which could be used to set Annual Catch Limits (ACL) by functional group.

The PDT consensus is that catch limit advice could be developed for functional groups, identified on the basis of trophic characteristic, body size, maximum age and age at maturity, and fishery interactions (separating species caught with different gears or fishing fleets). Examples of a functional group are demersal benthivores, demersal piscivores, small-bodied pelagic planktivores (forage fish), large-bodied pelagics, etc. An analogous catch limit framework that is familiar to the Council is the one applied to the skate complex, where larger skates captured for the wing market and smaller skates captured for a bait market, each group having an aggregate catch limit. The total catch for these functional groups should not exceed a total system cap, derived from estimates of primary productivity and energy transfer efficiency.

Figure 1 illustrates a framework based on a total system cap and catch limits defined by functional groups, including unmanaged species, jointly managed species, and species managed by other authorities (MAFMC, ASMFC, NMFS-HMS, Canada). Table 1 provides a list of species observed within a Georges Bank EPU from 2011-2015.

Since functional groups for a Georges Bank EPU would include species that are managed by different authorities, we could estimate functional group catch limits and then reduce them proportionally by the estimated biomass of species in the functional group not managed by the NEFMC. For a place-based FEP to be effective, some level of coordination and cooperation is needed that is consistent with the FEP goals and objectives. Cooperative management for an FEP might be accomplished in a manner similar to the US/CA sharing agreement or in a structure similar to the coordination between the MAFMC/ASMFC and coastal states for federally managed species, but the details about such an approach remain to be fleshed out.

Figure 1. Diagrammatic example of eFEP catch limit framework.

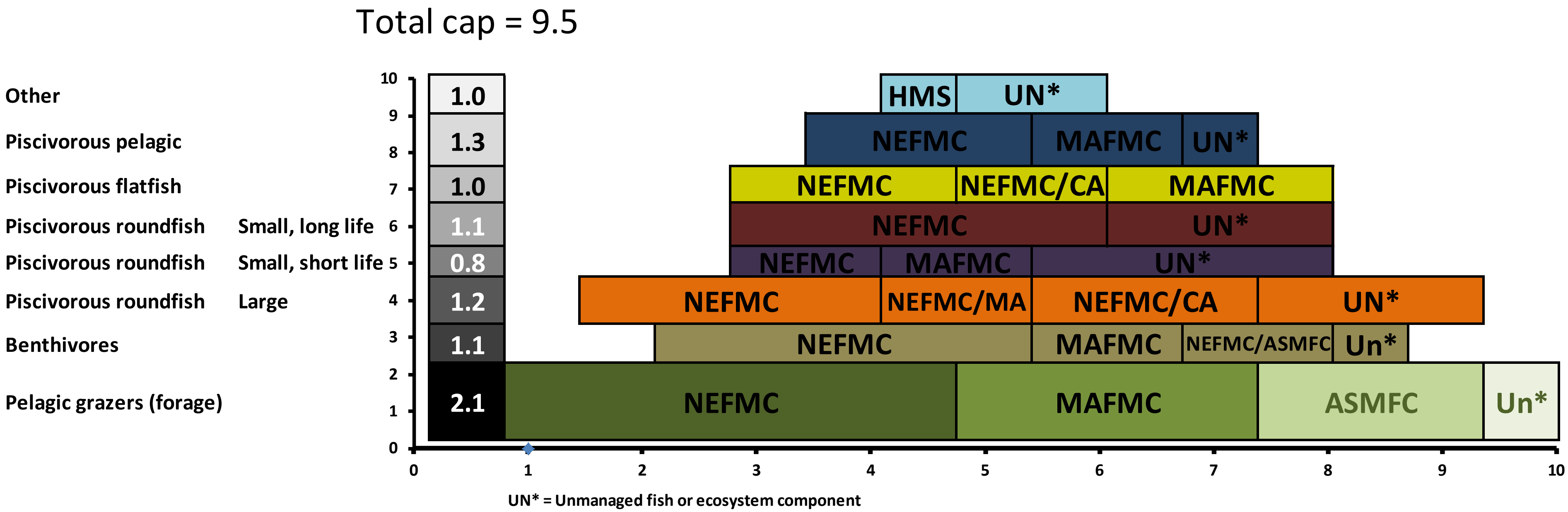

Table 2. List of species in observed 2011-2015 catch from the Georges Bank EPU.

Species	Bottom longline (lbs)	Trawls (lbs)	Sink gill nets (lbs)	Scallop dredges (lbs)	Grand Total (lbs)	2011-2015 landings, dollar value	Georges Bank management authority	Functional group or guild	Trophic level	Trophic group (example listed)	Adult body size	Maximum age
SCALLOP	-	1,495	81	25,046,918	25,048,493		NEFMC			Benthic invertebrate		
SILVER_HAKE	-	3,107,274	259	3,574	3,111,106		NEFMC			Piscivorous gadid		
WINTER_SKATE	177	183,839	715,156	188,784	1,087,955		NEFMC					
LOLIGO_SQUID	-	985,177	26	41	985,244		MAFMC			Pelagic invertebrate		
LITTLE_SKATE	103	128,731	15,344	410,011	554,190		NEFMC					
RED_HAKE	50	436,459	95	8,651	445,255		NEFMC					
SPINY_DOGFISH	23,735	174,072	218,079	10,756	426,642		NEFMC/MAFMC			Piscivorous other demersal		
MONKFISH	-	18,259	6,226	270,936	295,421		NEFMC/MAFMC			Piscivorous other demersal		
HADDOCK	1,220	248,867	1,375	1,034	252,496		NEFMC			Benthivore		
BUTTERFISH	-	146,258	0	2	146,259		MAFMC			Pelagic piscivore		
UNCL_SKATE	-	20,081	12,869	106,531	139,481		NEFMC					
FOURSPOT_FLOUNDER	-	90,956	-	12,615	103,571		Unmanaged					
STARFISH	-	382	106	85,361	85,848		Unmanaged					
BARNDOOR_SKATE	25	36,310	7,925	36,342	80,602		NEFMC					

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SUMMER_FLOUNDER	-	55,270	98	18,459	73,827		MAFMC/ASMFC					
WINTER_FLOUNDER	-	29,014	437	44,313	73,764		NEFMC/ASMFC			Piscivorous flatfish		
ILLEX_SQUID	-	51,974	-	38	52,011		MAFMC					
LADY_CRAB	-	46,987	-	7	46,995		Unmanaged					
ATL_MACKEREL	-	44,437	10	6	44,453		MAFMC					
JONAH_CRAB	7	2,011	1,483	28,529	32,030		ASMFC					
YELLOWTAIL_FLOUNDER	-	12,259	26	19,089	31,373		NEFMC					
ATL_HERRING	-	28,521	17	2	28,540		NEFMC/ASMFC			Pelagic forage		
SEA_URCHIN	-	1	-	28,161	28,162		Unmanaged					
LOBSTER	6	12,109	6,911	8,285	27,311		ASMFC/NMFS					
RED_WHITE_HAKE	-	25,996	-	-	25,996		NEFMC					
LITTLE_WINTER_SKATE	-	6,704	67	18,926	25,696		NEFMC					
COD	1,016	5,117	15,094	1,515	22,741		NEFMC					
SANDDAB	-	4,462	24	17,203	21,689		Unmanaged					
CHAIN_DOGFISH	21	1,771	444	15,541	17,777		Unmanaged					
ROCK_CRAB	-	2,643	160	12,802	15,606		Unmanaged					
SMOOTH_DOGFISH	-	15,070	32	-	15,102		Unmanaged					

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SCUP	-	11,843	-	1	11,845		MAFMC/ASMFC					
SEA_RAVEN	-	1,466	779	9,306	11,551		Unmanaged					
WITCH_FLOUNDER	-	4,433	8	4,904	9,345		NEFMC					
CONCHS	-	192	-	8,867	9,058		Unmanaged					
SEA_CUCUMBERS	-	1	-	8,227	8,228		Unmanaged					
POLLOCK	275	532	7,113	7	7,927		NEFMC					
JOHNDORY	-	7,096	-	5	7,100		Unmanaged					
NORTHERN_SEAROBIN	-	6,204	-	479	6,683		Unmanaged					
BLUEFISH	-	4,860	1,197	-	6,056		MAFMC/ ASMFC					
AMERICAN_PLAICE	-	4,499	3	1,526	6,029		NEFMC					
STRIPED_BASS	-	5,926	36	-	5,962		ASMFC					
ALEWIFE	-	5,918	1	0	5,919		ASMFC					
SHAD	-	4,330	32	-	4,362		ASMFC					
OCEAN_QUOHOG	-	25	-	4,182	4,207		MAFMC					
WHITE_HAKE	443	2,396	1,074	175	4,087		NEFMC					
OCEAN_POUT	4	3,029	-	557	3,589		NEFMC					
BLACK_SEABASS	-	3,448	-	21	3,469		MAFMC/ASMFC					
MUSSELS	-	17	15	3,246	3,278		Unmanaged					

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THORNY_SKATE	250	404	249	1,719	2,621		NEFMC					
SEAWEEDS	-	435	115	1,465	2,015		Unmanaged					
SMOOTH_SKATE	38	327	108	1,192	1,665		NEFMC					
ATL_HALIBUT	-	92	521	64	677		NEFMC					
CUSK	613	-	37	5	655		Unmanaged					
CHANNEL_WHELK	-	-	-	574	574		Unmanaged					
CANCER_CRAB	-	197	328	34	559		Unmanaged					
BLUEBACK_HERRING	-	494	-	0	494		ASMFC					
UNCL_CRAB	-	6	-	427	433		Unmanaged					
WOLFFISH	10	38	121	192	361		NEFMC					
REDFISH	30	214	29	5	278		NEFMC					
GOLDEN_TILEFISH	277	-	-	-	277		MAFMC					
WORMS	-	4	-	148	152		Unmanaged					
CLEARNOSE_SKATE	-	-	-	140	140		NEFMC					
SURF_CLAM	-	-	-	112	112		MAFMC					
ROSETTE_SKATE	-	94	-	15	109		NEFMC					
MENHADEN	-	107	-	-	107		ASMFC					
SPIDER_CRAB	-	81	1	9	91		Unmanaged					
OTH_SHARK	-	80	-	-	80		Unmanaged					
BLACKBELLY_ROSEFISH	-	78	-	0	78		Unmanaged					

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HORSESHOE_CRAB	-	12	27	38	77		ASMFC					
STRIPED_SEAROBIN	-	63	-	10	73		Unmanaged					
CUNNER	-	2	15	52	69		Unmanaged					
SCULPIN	-	-	-	51	51		Unmanaged					
OFFSHORE_HAKE	-	47	-	1	48		NEFMC					
TAUTOG	-	22	-	3	25		ASMFC					
RED_CRAB	-	9	7	5	21		NEFMC					
WEAKFISH	-	7	-	-	7		ASMFC					
LUMPFISH	-	-	-	4	4		Unmanaged					
OCTOPUS	-	2	-	1	3		Unmanaged					
UNCL_SEAROBIN	-	-	-	2	2		Unmanaged					
BLUE_CRAB	-	0	-	-	0		Unmanaged					

Overfished or depleted stocks

Individual stocks within functional groups could decline to low biomass which could begin to affect ecosystem function and productivity, i.e. a choke-point, whether due to fishing, environmental change, or natural variability. There are three considerations to address this issue: status determination, management response, and recovery determination. The minimum biomass threshold (MBT) concept is a key consideration under current law, but might be derived on a different basis and calculated differently than it currently is.

The level of an MBT could be derived on broader ecosystem principles than it currently is based on single-species maximum sustainable yield (MSY) calculations. Stocks that are key components of the ecosystem and drive productivity (e.g. a forage species) could require a higher MBT than another species that plays a less central role in the ecosystem. Similarly, the consequences of low biomass should also be considered. Is the species highly resilient (i.e. does it generally recover quickly)? Is there risk to future recruitment (i.e. a strong stock-recruitment relationship)? Is the stock highly valued or does it directly support another predator that is highly-valued, either economically or ecologically?

Other questions arose about how to monitor biomass and determine status, particularly if there is no single-species assessment for a species. What is used to monitor the stock, i.e. what would be an appropriate index threshold using survey and/or CPUE data? How are key ecosystem species that are not well sampled by surveys (e.g. sand lance) or appear seasonally in an EPU monitored?

Other than more conservative management measures (e.g. selective gear, area closures to act as a refuge for the species, incentives to avoid catching the species and target abundant species/groups, lower catch limits for the functional group it belongs) that benefit an overfished/depleted species or stock, it is unclear how a rebuilding program would be specified, in the context of ecosystem management. Would rebuilding within a specific time frame to a condition that is consistent with single-species MSY still make sense? How would a rebuilding program be developed in the context of risk management, and if it were, how would it comply with the Magnuson Stevens Act (MSA) requirements? In terms of a target to determine when rebuilding was accomplished, would the target be different (higher or lower) than they are now and would that be legal? Should rebuilding targets be set on something other than a single species biomass, such as a restoration or a rebalancing of ecosystem functional group composition? If the species composition in an EPU is being affected by climate change, how is that taken into account in a rebuilding program and how would it affect status determination?

With regard to an overall framework to set a total system cap, establish reference points, estimate catch limits functional groups, and rebuild overfished/depleted stocks, a document describing how an ecosystem ABC framework would work and how it would comport with MSA and National Standard 1 requires considerable more thought and work.

Forage Fish Management

A document describing marine forage fish in the New England region has been drafted by the PDT and others[1] and was discussed at the March 29-30 PDT meeting. It was adapted from the MAFMC forage fish white paper and tailored to the species that occur here.

Questions arose about what factors would define a forage fish and about objectives for forage fish management in a full ecosystem management plan (eFEP), which might differ from those adopted by the MAFMC. For example, the MAFMC forage fish definition excluded species that exceed 25 cm as adults, but still serve as an important source of forage as juveniles. Is that appropriate in the context of a New England FEP? Should the definition also include invertebrates that serve as an important source of forage for some species? Table 2 Lists the factors adopted by the MAFMC to define forage fish and Table 3 lists species that would be considered forage fish in the New England region by applying these factors.

[1] Patricia M. Clay, Geret DePiper, Sarah Gaichas, Jon Hare, Edward Houde, and Richard Seagraves

Table 3. Characteristics that could define species considered to be “forage” fish[2].

Is the stock a “forage” fish? Forage is defined as a species that: • Is small to moderate in size (average length of ~5-25 cm) throughout its lifespan, especially including adult stages; • Is subject to extensive predation by other fishes, marine mammals, and birds throughout its lifespan; • Comprises a considerable portion of the diet of other predators in the ecosystem in which it resides throughout its lifespan (usually >5% diet composition for > 5 yrs.); • Has or is strongly suspected to have mortality with a major element due to consumptive removals; • Is typically a lower to mid trophic level (TL) species; itself consumes food usually no higher than TL 2-2.5 (typically zooplankton and or small benthic invertebrates); • Has a high number of trophic linkages as predator and prey; serves as an important (as measurable by several methods) conduit of energy/biomass flow from lower to upper TL; • Often exhibits notable (pelagic) schooling behavior; • Often exhibits high variation in inter-annual recruitments; and • Relative to primary production and primary producers, has a ratio of production and biomass, respectively, to those producers not smaller than on the order of 10^{-3} to 10^{-4}

[2] From a draft white paper on “Managing Forage Fishes in the New England Region” by Patricia M. Clay, Geret DePiper, Sarah Gaichas, Jon Hare, Edward Houde, Richard Seagraves.

Table 4. Forage fishes and squids in 1) managed, targeted fisheries in the New England region and 2) present but not targeted or managed in New England. For the targeted species the combined, Mean Annual Landings (metric tons) for the New England and Mid-Atlantic regions (from NOAA Commercial Fishery Statistics) are given for the five-year period, 2008 – 2012. Atlantic menhaden mean annual landings are from reports of the Atlantic States Marine Fisheries Commission and include landings from New England, the Middle Atlantic and South Atlantic. The "Fished Y/N" column refers to fisheries in the western North Atlantic. The "Bycatch Important" column refers to importance of the species as a bycatch in managed MAFMC fisheries. This table considers only species that are forage-sized throughout the lifespan.

Common name	**Species**	**Fished Y/N**	**Mean Annual Landings (mt) (2008-2012)**	**Current status B/Bmsy F/Fmsy**	**Management Authority**	**Bycatch Important Y/N**
Atlantic herring	*Clupea harengus*	Y	82,422.4	3.3 0.52	NEFMC/ASMFC	Y
Atlantic menhaden	*Brevoortia tyrannus*	Y	210,776.0	0.22-1.4* 3.36	ASMFC	N
Atlantic mackerel	*Scomber scombrus*	Y	12,003.2	Unknown Unknown	MAFMC	Y
Butterfish	*Peprilus triacanthus*	Y	244.1	1.7 0.025	MAFMC	Y
Alewife	*Alosa pseudoharengus*	Y	605.2	"Depleted" Unknown	ASMFC	Y
Blueback herring	*Alosa aesitvalis*	Y	6.2	"Depleted" Unknown	ASMFC	Y
Longfin squid	*Doryteuthis pealii*	Y	9,892.0	1.284 Unknown	MAFMC	Y
Illex squid	*Illex illecebrosus*	Y	11,227.5	Unknown Unknown	MAFMC	Y
Bay anchovy	*Anchoa mitchilli*	N		Unassessed		N
Striped anchovy	*Anchoa hepsetus*	N		Unassessed		N
Silver anchovy	*Engraulis eurystole*	N		Unassessed		N
Round herring	*Etrumeus teres*	N		Unassessed		N ?
Thread herring	*Opisthonema oglinum*	Y	0	Unassessed		Y, small
Spanish sardine	*Sardinella aurita*	Y	0	Unassessed		Y, small
Sand lance	*Ammodytes americanus* and *A. dubius*	N	0	Unassessed		N
Atlantic silverside	*Menidia menidia*	Y	6.4	Unassessed		N

What would be the objectives for forage fish management in an FEP? Key issues discussed by the PDT are risk to ecosystem function and impacts on the productivity of valuable predator species. How should risk to non-harvested predators (including birds and cetaceans) be taken into consideration, for example?

The PDT needs guidance about the objectives of forage fish management to identify how and why a catch control rule would be different for forage fish than for other harvested species. The PDT recognized that the MAFMC and ASMFC are developing or have articulated their objectives for forage fish management, which may or may not be consistent those that would be developed in a full FEP for Georges Bank. Since there are many forage species in common between Georges Bank, the Gulf of Maine, and the Mid-Atlantic regions, there is a potential for collaboration and synergies amongst the management bodies.

Habitat Conservation and Spatial Management

While the Omnibus Habitat Management focused on minimizing gear impacts on vulnerable complex substrates and on limiting groundfish catches when spawning is occurring, spatial management in an FEP could have a broader context, focused on the role that various types of fish habitat play in maintaining or building diversity, reducing ecosystem risk, and enhancing productivity (i.e. providing ecosystem services). Thus, spatial management might focus on conserving essential fish habitat (EFH), whether it is based on physical (e.g. substrate and thermal) and/or biotic characteristics used by the functional groups (guilds). Spatial management could build on the progress made in the Omnibus Amendment, potentially controlling effects of fishing or other activities on groundfish and non-groundfish spawning, seasonally vulnerable habitat utilized by larval and juvenile fish, seasonal use of areas for important ecological functions, and minimize potential localized depletion of prey as it effects productivity of managed species. While the Omnibus Habitat Amendment focused on habitats with long recovery periods, it could also be ecologically important to control chronic impacts on habitat that have shorter recovery periods.

The PDT only began discussing the role of habitat conservation and spatial management in an FEP at its last meeting. Therefore, more thought and work is needed to develop a coherent draft spatial conservation management approach as it relates to a FEP. Council guidance on articulating objectives for spatial management approaches in an FEP would be useful.

Management Strategy Evaluation (MSE)

The PDT briefly discussed how developing a MSE would fit into an eFEP testing and validation phase that the Council identified when it decided to develop an eFEP. The general consensus is that stakeholders (fishermen, other ocean users, and interested parties) should be involved from the outset in developing objectives and evaluating tradeoffs. We also recognize that this process could also serve as 'scoping'. At this time, it is unclear what an MSE for a Georges Bank EPU FEP would entail, but the MSE process the Council is beginning for modifying an Atlantic herring control rule will lead the way and be informative.