

Preview: eFEP Options for Supporting EBFM through Catch monitoring, ecosystem data collection, and research

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Catch monitoring, ecosystem data, and research

- PDT draft – to be presented June 10
- Ecosystem management is achievable with existing data sources and sampling (catch monitoring, bottom-trawl surveys, ecomon, remote sensing, etc.)
- Improving precision, reducing bias, and improving timeliness promotes better estimation and adaptive management
 - But comes at a cost
 - Potential for cost tradeoff – electronic monitoring and sensing
- Active participation by fishermen and other marine activity participants
- Diet information for marine mammals, birds, and turtles
 - Factored into operating models and assessments

Fishery-dependent data from required reports for Northeast Multispecies (O'Keefe et al., 2015)

Data Type	Vessel Trip Report (VTR)	Vessel Monitoring System (VMS)	Dealer Report	Observer Reports (NEFOP)	At-Sea Monitoring (ASM)	Dockside Monitoring
Vessel Permit	X	X	X			X
Operator Permit	X	X				
Area Fished (statistical area)	X					X
Area Fished (lat/lon)		X		X	X	
Time Fished	X	X		X	X	
Landed Species (for sale)	X		X	X	X	X
Landed Species (not sold)				X	X	
Discarded Species	X			X	X	
Species Disposition				X	X	
Landing Date			X	X	X	X
Landing Port			X	X	X	X
Dealer Demographics			X			
Market Category			X			
Landed Species Price			X			
Tow Duration		X		X	X	
Steaming Time		X				
Vessel Characteristics				X	X	
Gear Characteristics				X	X	
Target Species				X	X	
Biological Information				X		

Fishery-independent data

- Bottom trawl, dredge, and acoustic surveys
- Cooperative surveys
- Protected species surveys
- Ecomon plankton and larval surveys

Ecosystem data

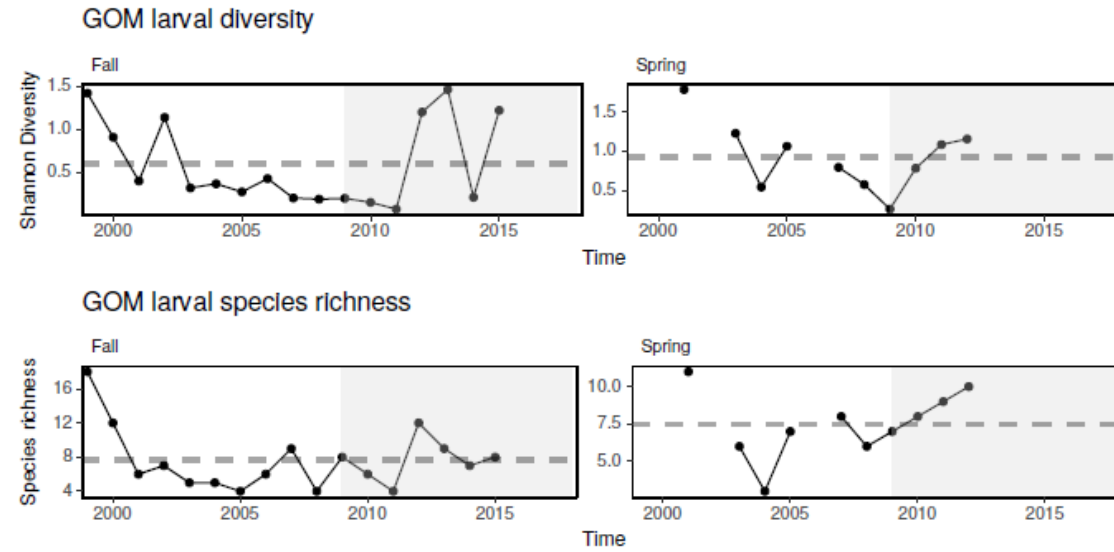


Figure 24: Larval diversity indices from ECOMON surveys in the Gulf of Maine.

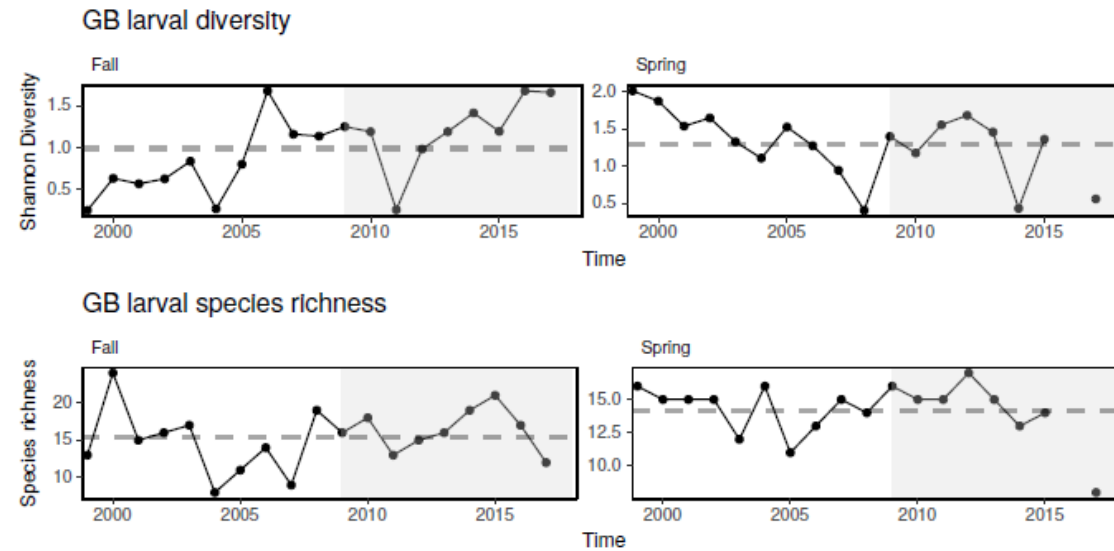


Figure 25: Larval diversity indices from ECOMON surveys on Georges Bank.

Research

- Consumption to parameterize predator-prey relationships in food-web models
- Habitat role and function, effects on prey productivity
- Continued improvement in socio-economic indicators

eFEP Strategies for Forage Fish Management

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Draft white paper

- **Initial draft developed by Dr. Gaichas and others for the EBFM PDT – Jan 2015**
- **Used MAFMC Forage Fish White Paper as a guide – revised focus on New England area**
- **Some sections need updates and revisions, more New England focus and examples**
- **Policy input needed**
- **Useful as an appendix to the eFEP for a MSE process?**

- Example forage fish list

Table 2. 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/B _{msy} F/F _{msy}	Management Authority	Bycatch Important Y/N
Atlantic herring	<i>Clupea harengus</i>	Y	82,422.4	3.3 0.52	NEFMC/ASMFC	Y
Atlantic menhaden	<i>Brevoortia tyrannus</i>	Y	210,776.0	0.22-1.4* 3.36	ASMFC	N
Atlantic mackerel	<i>Scomber scombrus</i>	Y	12,003.2	Unknown Unknown	MAFMC	Y
Butterfish	<i>Peprilus triacanthus</i>	Y	244.1	1.7 0.025	MAFMC	Y
Alewife	<i>Alosa pseudoharengus</i>	Y	605.2	“Depleted” Unknown	ASMFC	Y
Blueback herring	<i>Alosa aestivalis</i>	Y	6.2	“Depleted” Unknown	ASMFC	Y
Longfin squid	<i>Doryteuthis pealii</i>	Y	9,892.0	1.284 Unknown	MAFMC	Y
Illex squid	<i>Illex illecebrosus</i>	Y	11,227.5	Unknown Unknown	MAFMC	Y
Bay anchovy	<i>Anchoa mitchilli</i>	N		Unassessed		N
Striped anchovy	<i>Anchoa hepsetus</i>	N		Unassessed		N
Silver anchovy	<i>Engraulis eurystole</i>	N		Unassessed		N
Round herring	<i>Etrumeus teres</i>	N		Unassessed		N?
Thread herring	<i>Opisthonema oglinum</i>	Y	0	Unassessed		Y, small
Spanish sardine	<i>Sardinella aurita</i>	Y	0	Unassessed		Y, small
Sand lance	<i>Ammodytes americanus</i> and <i>A. dubius</i>	N	0	Unassessed		N
Atlantic silverside	<i>Menidia menidia</i>	Y	6.4	Unassessed		N

*The Atlantic menhaden technical committee (2012) pointed out a mismatch between F and B reference points used; if compatible F and B reference points are used, menhaden B is below the target reference threshold assumed to be equivalent to B_{MSY} (B/B_{30%} = 0.22), and also below the limit reference point assumed to be ½ B_{MSY} (B/B_{15%} = 0.44) while it is above the currently used B threshold (B/B_{MED.T} = 1.4).

Stock complexes and Fishery functional groups

- **Definitions** (see also <https://s3.amazonaws.com/nefmc.org/Glossary.pdf>)
- **Trophic guild** - A group of species that feed on similar items or have similar dietary requirements and therefore have a similar ecological function within the structure of an ecosystem.
- **Stock complex** - A group of related species at a defined trophic level that have similar diets and life-history characteristics. Catch limits for stock complexes would be set, their total not to exceed the overall EPU catch limit.
- **Fishery functional group** - A group of species that are typically caught together in a particular type of gear and feed on similar food items. In terms of EBFM, a functional group is the intersection of stock complexes (see definition below) with a fishery, i.e. they are caught together.

- Examples

- Examples

Questions in White Paper draft

- **What are the Council policies with respect to forage fish management (Page 2)**
 - Explicit: Herring, Squid, Menhaden, Mackerel
 - Implicit: Regulated Mesh Areas and Exemptions
 - Unmanaged or ecosystem component species
 - River herring and shad
 - Sand lance
 - Risk policy

- NEFMC risk policy

“(C) The benefits of protection afforded to marine ecosystems are those resulting from maintaining viable populations (including those of unexploited species), maintaining adequate forage for all components of the ecosystem, maintaining evolutionary and ecological processes (e.g., disturbance regimes, hydrological processes, nutrient cycles), maintaining the evolutionary potential of species and ecosystems, and accommodating human use.”

Questions in White Paper draft

- **What are or will be the NEFMC definition of forage fish (Page 5)?**
 - **MAFMC definition**

Table 1. Definition of forage fish provided to MAFMC by its Ecosystems Subcommittee of the Scientific and Statistical Committee, March 2012.

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}

- Data updates and NE centric revisions

Table 4. Ranking of important forage species groups by predator type (highest frequency and/or consumption are first on the list).

Fish	Marine mammals	Sea Turtles	Seabirds
All in NEFSC database, including MAFMC managed Crabs and shrimp Amphipods Other zooplankton Fish (incl. unid.) Anchovies Hakes Sand lance Herrings Molluscs Unid. cephalopods Longfin squid Bivalves Annelids Ctenophores	Baleen Whales Krill Herrings Other zooplankton Sand lance Large gadids Mackerels Other fish	Crabs Fish (scavenged?) Ctenophores and jellyfish	Pelagic/coastal Gulls: fish, offal and fish scavenged from commercial fishing operations, euphausiids <i>Shearwaters:</i> fish (sand lance, saury), squids <i>Storm petrels and Phalaropes:</i> zooplankton, fish eggs and larvae <i>Gannets:</i> fish (menhaden, mackerel, saury) <i>Fulmars:</i> euphausiids, squids
All in NEAMAP database Crabs and shrimp Fish (incl. unid.) Anchovies Butterfish Sand lances Scup Menhaden Drums Amphipods Polychaetes Molluscs Bivalves Longfin squid Mysids	Toothed Whales and Dolphins Squids Mackerels Other fish Small gadids Herrings Mesopelagics		
Highly Migratory <i>Large coastal sharks:</i> Fish (unid, bluefish, summer flounder) Skates/rays/sharks Crabs <i>Large pelagics:</i> Squids (incl. <i>Illex</i> sp.) Fish (unid, mackerel, butterfish, bluefish, hakes, sand lance)	Seals Other fish Sand lance Small gadids Flatfish Herrings Large gadids Squids	ESA listed fish (sturgeons) Annelids Shrimp Other benthic invertebrates	Coastal Fish and crustaceans; extremely varied diet along salinity gradients Osprey, Cormorants and Pelicans— Menhaden, herring, estuarine fish (mullet, drums, anchovy...)

- Herring forage base

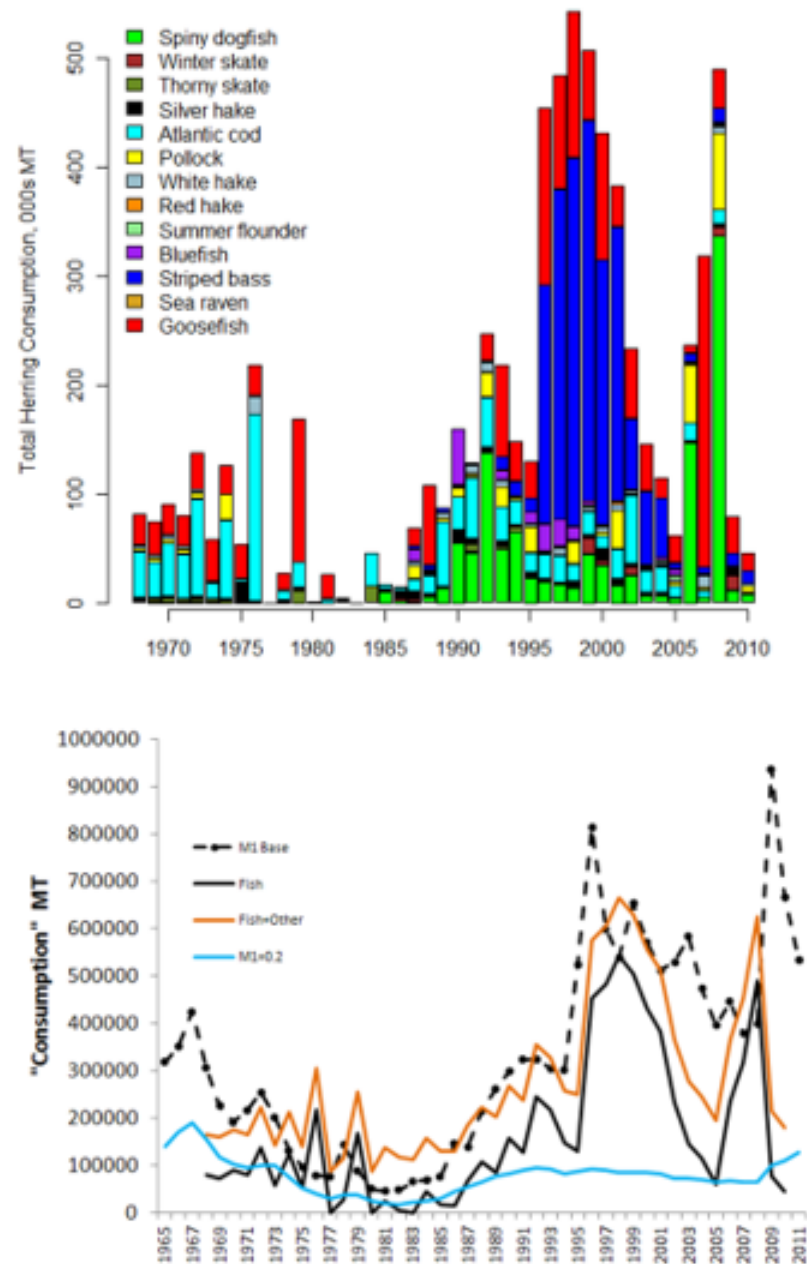


Figure 2. Consumption estimates of Atlantic herring, 2012 benchmark stock assessment.

- **Revise table to focus on herring landings, instead of squid, mackerel, and butter fish?**
- **Other species?**

Table 5. Communities landing over 100,000 lbs and/or \$100,000 of Squid-Mackerel-Butterfish in 2012

Community	Pounds	Community	Value
North Kingstown/Saunderstown, RI	18,972,719	Narragansett/Point Judith, RI	\$10,953,170
Cape May, NJ	18,776,939	North Kingstown/Saunderstown, RI	\$10,495,820
Narragansett/Point Judith, RI	10,288,046	Cape May, NJ	\$8,564,656
Montauk, NY	3,903,965	Montauk, NY	\$4,941,669
Hampton Bays, NY	3,625,168	Hampton Bays, NY	\$3,294,589
New Bedford, MA	3,460,644	New London, CT	\$2,089,494
New London, CT	1,656,386	New Bedford, MA	\$1,506,719
Gloucester, MA	1,477,881	Stonington, CT	\$1,417,898
Stonington, CT	1,357,003	Point Lookout, NY	\$535,135
Hampton, VA	682,747	Belford, NJ	\$514,341
Point Lookout, NY	567,555	Woods Hole, MA	\$455,104
Woods Hole, MA	492,742	Point Pleasant, NJ	\$268,772
Belford, NJ	463,610	Gloucester, MA	\$220,924
Point Pleasant, NJ	361,013	Hampton, VA	\$193,469
Fall River, MA	346,158	Newport, RI	\$190,148
Newport, RI	219,726	Sandwich, MA	\$144,237
Sandwich, MA	133,950	East Lyme, CT	\$136,992
		Falmouth, MA	\$111,086

- **Section 6: Forage fish management background**
 - **Page 17**
- **Section 7: Potential management measures for New England forage species**
 - **Targeted and managed forage species**
 - **Page 20**
 - **Update needed for Herring Amendment 8**
 - **Unfished and unmanaged forage species**
 - **Page 22**
 - **Anchovy, Atlantic silverside, sand lance, round herring**
 - **Ecosystem component species, option 2 on page 23?**
 - **Option 3 (prohibiting directed fishing with small mesh gear) is the status quo for Regulated Mesh Areas**

- **Page 19**

In the New England region the Atlantic herring and Atlantic menhaden are by definition typical forage species, and their fisheries are managed with designated ABCs and effort controls based on biomass and fishing mortality reference points commonly applied in single-species management. At present, Atlantic herring has good status relative to these reference points. Other forage species like the sand lance are not currently fished or managed, but do play a role in supporting production of managed fish and other predators in the ecosystem. In the next section, we describe potential alternative management measures for currently fished and unfished New England forage species.

- **Page 21 – More conservative management strategy for managed and targeted forage fish?**

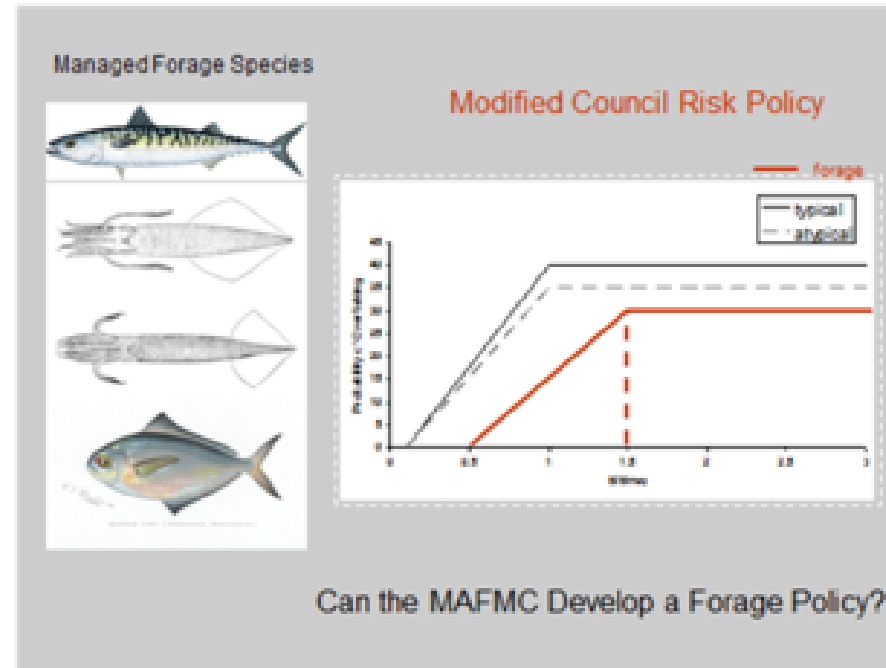


Figure 4. Conceptual illustration of a control rule with recommended buffers for targeted forage species in a managed fishery. In this version (one of a nearly infinite set of possibilities), substantial buffers to F and B are indicated as a precaution to conserve biomass and the benefits the forage species provides as prey for marine predators. In this illustration, there is a reduction in the acceptable probability of overfishing at any stock size, and instead of requiring sequentially lower probabilities of overfishing below B_{msy} , the required probability begins decreasing at 150% of B_{msy} , which is more precautionary than the current risk policy.

- **Page 20 - Approaches**

- Adopt a policy of less risk (P^* less than 50% probability of becoming overfished or exceeding the target)
- Adopt a P^* penalty when biomass is below target
- Maintain biomass above B_{msy} by fishing at less than F_{msy}
- Scale natural mortality (M) to predator abundance

- **Page 21 – More conservative management strategy for managed and targeted forage fish?**

Regardless of the approach chosen the Council must be mindful of the difference between accounting for scientific uncertainty, natural stock size variability, and provision of ecosystem services to NEFMC (Georges Bank EPU; regardless of management authority?) managed species when setting ABCs for fished forage species versus adopting more conservative reference points (i.e., to maintain forage stocks at levels higher than the MSA standard of B_{msy}). The Council should include a thorough evaluation of this issue and the social and economic tradeoffs between alternative levels of forage fish harvest and risks to predator production. In addition, the utility of MSE to determine the appropriate target biomass levels for forage stocks should be explored, and each species should be assessed individually to help ensure net benefits to society are maximized.

- Adopt and/or modify the MAFMC forage fish management process?
- Page 22

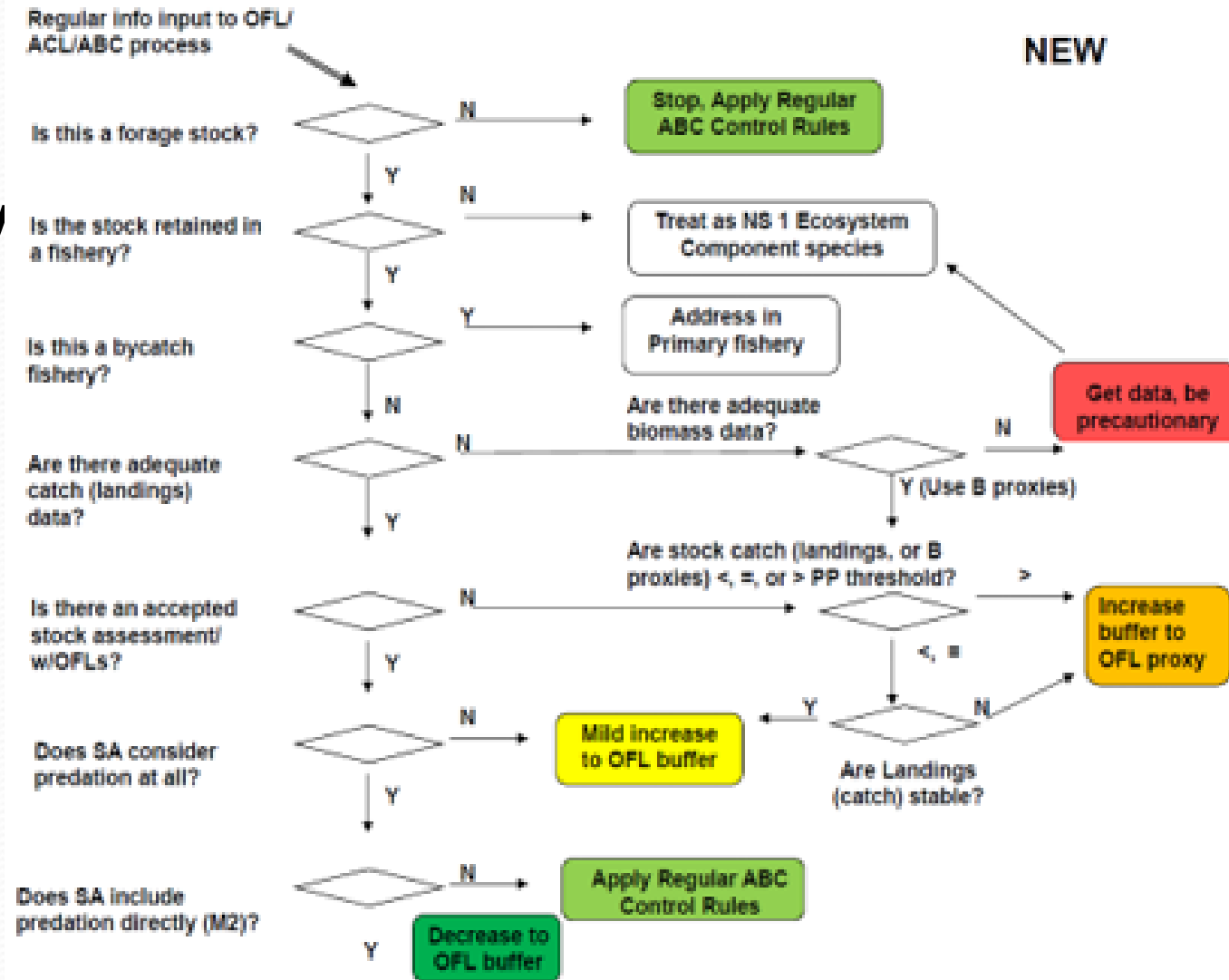
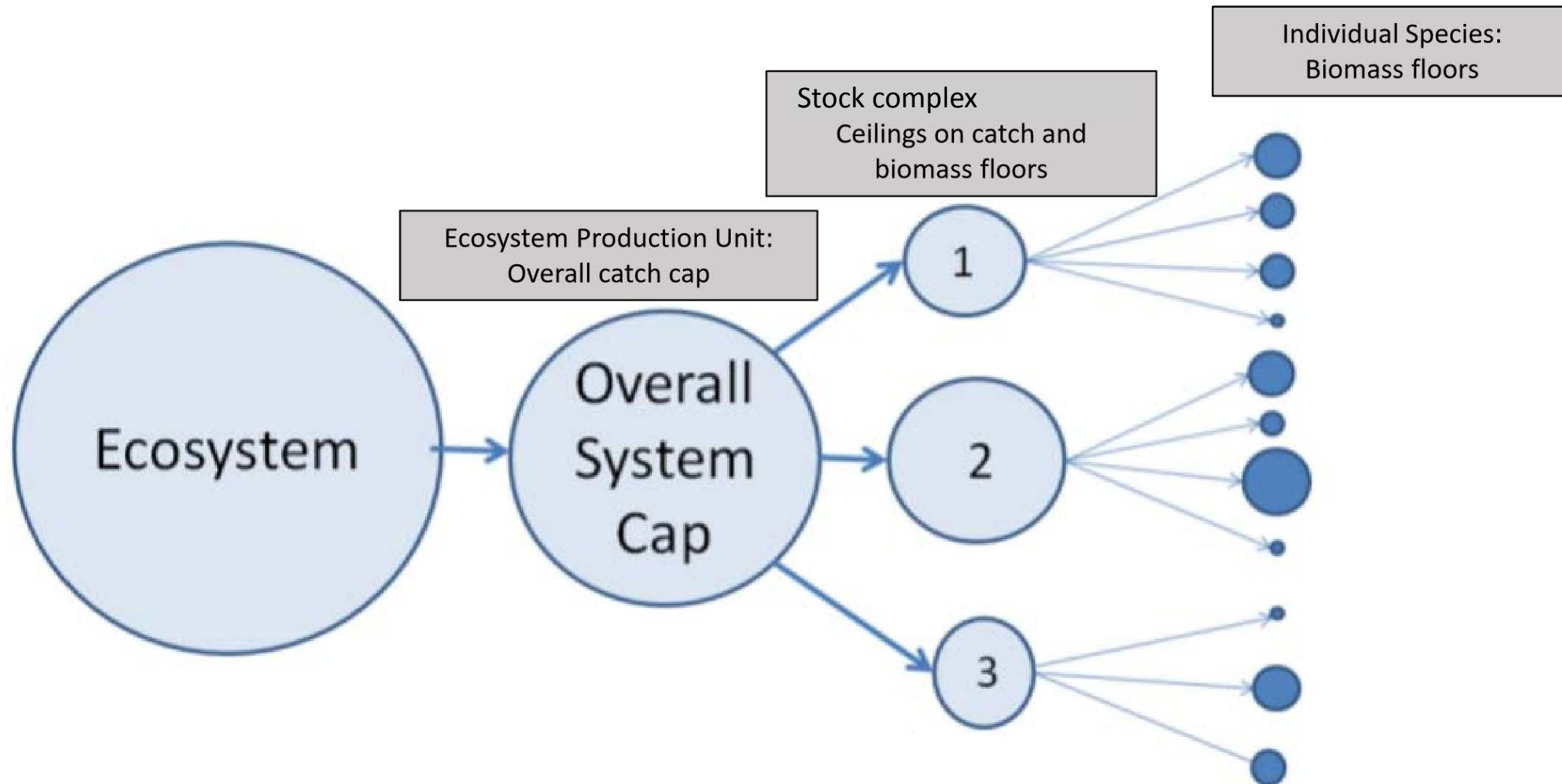


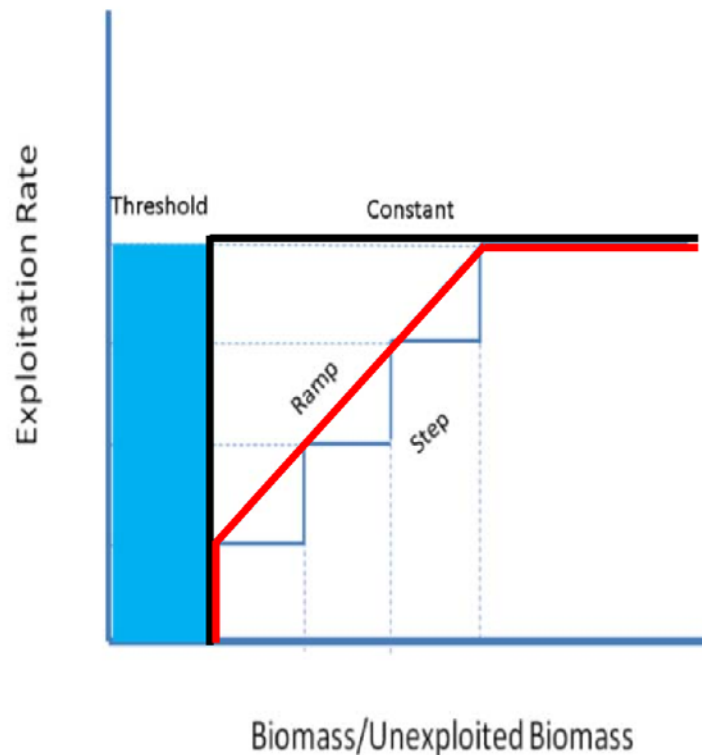
Figure 5. Forage management process proposed by MAFMC SSC (2012).

Stock complex harvest control rules



Stock complex harvest control rules

ToR 6: Review harvest control rules embodying the proposed floors and ceilings approach using the ceiling reference points in ToR 5 to cap removals at the Ecological Production Unit and Functional Group levels, while ensuring that no species biomass falls below the single species floor reference points.



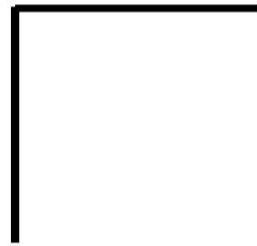
- Two main forms of harvest control rules:
 - 1) Threshold exploitation
 - 2) Ramp-down exploitation

ToR 9: Review simulation tests and performance of the proposed management procedure incorporating the floors and ceilings approach, given the set of EBFM goals and objectives.

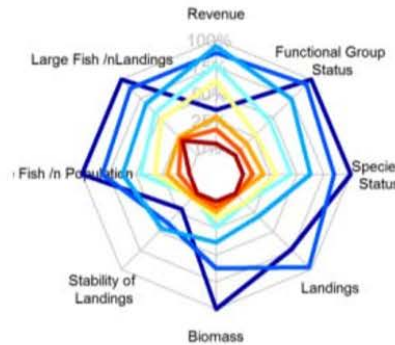
Performance of Harvest Control Rules

Worked
example

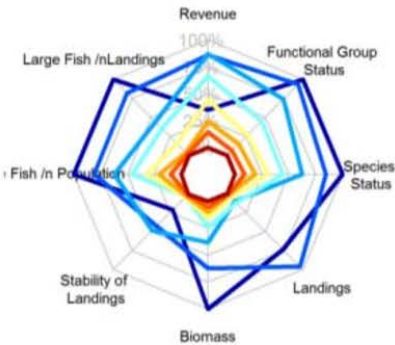
Fixed Rate HCR



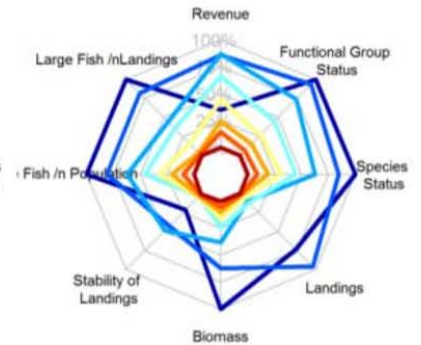
(a) Fixed Rate: Functional Group



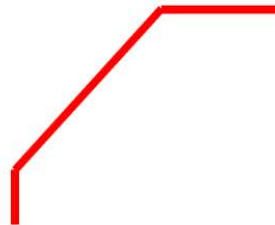
(b) Species



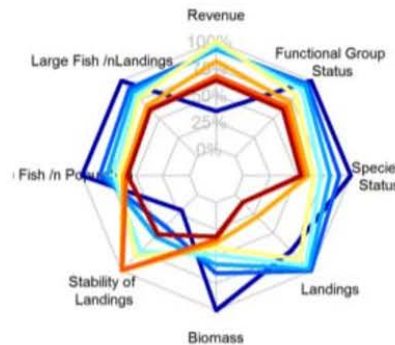
(c) Species (Increased Threshold)



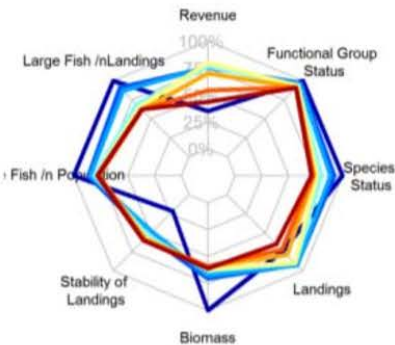
Ramped Rate HCR



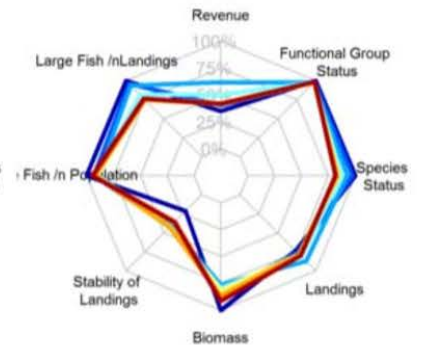
(d) Ramped Rate: Functional Group



(e) Species



(f) Species (Increased Threshold)



ToR 9: Review simulation tests and performance of the proposed management procedure incorporating the floors and ceilings approach, given the set of EBFM goals and objectives.

Portfolio Analysis

Worked
example

