

Session: Introduction to NEFSC Science

Ecosystem Research Program of the Northeast Fisheries Science Center

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The NEFSC has maintained a long-standing commitment to ecosystem monitoring, modeling and analysis in support of management. The elements of the program encompass climate science, physical oceanography, lower trophic processes (including primary and secondary productivity), living marine resource dynamics, habitat ecology, and protected resource dynamics from the Gulf of Maine to Cape Hatteras. Global, national, and regional initiatives are now underway to effect the transition to Ecosystem-Based Management (EBM) and its component parts including Ecosystem-Based Fishery Management (EBFM).

In the Northeast, the New England and Mid-Atlantic Fishery Management Councils and the Atlantic States Marine Fisheries Commission are developing strategies for integrating ecosystem considerations into their respective management programs. Initiatives are also underway in New England and the Mid-Atlantic regions to frame ocean management plans under the provisions of the U.S. National Ocean Policy, implemented in 2012. The Northeast Fisheries Science Center is providing scientific support for each of these initiatives while also working closely with the NMFS Greater Atlantic Regional Fisheries Office to meet requirements for protected species management, habitat protection, and fisheries management. We have structured our overview of NEFSC ecosystem science programs to focus on how we are addressing these management requirements in the context of a rapidly changing environment.

The Northeast U.S. Continental Shelf is experiencing some of the most rapid rates of change in temperature of any region of the world ocean. We have documented concomitant shifts in distribution patterns and high levels of ecological risk for a broad spectrum of species on the shelf. These ecological changes translate to risk posed to human coastal communities dependent on these ecosystem services and the benefits derived from our connections to the sea. The narrative arc of the review is structured to trace the physical, ecological, and social implications of these changes and the potential pathways for management approaches framed in an ecosystem undergoing rapid change. The main themes of the nationwide NMFS Ecosystem Science Reviews: (1) Management Context and Strategic Planning, (2) Ecosystem Data, (3) Ecosystem Modeling and Analysis, (4) Incorporation into Management, and (5) Communications and Peer Review further serve as structural elements in our review.

Marine EBM and EBFM are place-based. These approaches account for inter-relationships among the physical, biological, ecological, and human dimensions of the system, and address the central importance of maintaining ecosystem structure and function. Throughout the review, we focus on addressing these core elements of EBM/EBFM while also describing evolutionary pathways to making the transition from single-species/single-sector approaches to more holistic management approaches. Humans are an integral part of the ecosystem under this construct and we have integrated social and economic considerations throughout our approach.

Confronting complexity is a critical challenge in making EBM/EBFM operational. Marine ecosystems are highly dimensional and a strategy of deliberately addressing this complexity in a way that can lead to effective management is essential. Core elements of our approach to facing this challenge include: (1) a commitment to Management Strategy Evaluation and development of (potentially simple) management procedures tested through simulation, (2) application of multispecies and ecosystem assessment models spanning a range of detail and collectively considered using principles of multi-model inference, (3) development of indicator-based approaches that are model-free but focus on integrative composite metrics, and (4) attention to development of communication tools to reach a broad audience of stakeholders, including the use of conceptual model frameworks to convey basic principles.

Our initiatives for EBFM have been structured to address specific requests from the New England and Mid-Atlantic Fishery Management Councils. The NEFMC passed a resolution in April 2015 requesting its EBFM Plan Development Team (PDT) to develop:

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.

In structuring its approach, the PDT returned to core elements of a ‘roadmap’ to EBFM developed by the NEFMC Scientific and Statistical Committee (Figure 1). In the course of this review, we will document our efforts to address each of these elements related to scientific requirements in support of management.

In its 2015 Strategic Plan, the Mid-Atlantic Fishery Management Council provided the following instructions related to development of an ecosystem approach to fisheries management:

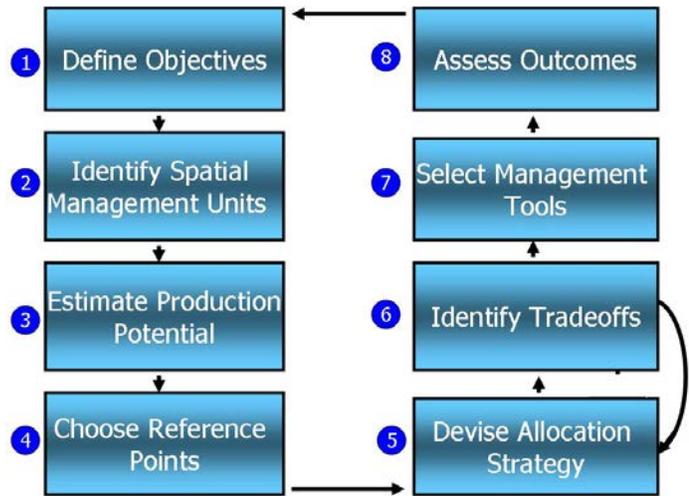


Figure 1. Adaptation of NEFMC SS roadmap to EBFM

- Complete and implement the *Ecosystem Approach to Fisheries Management Guidance Document*
- Incorporate consideration of species interactions into fishery management plans and coordinate these considerations across appropriate management plans
- Determine and incorporate the relationship between essential fish habitat and productivity of marine resources into management

NEFSC scientists have been directly involved in the development of the draft *Ecosystem Approach to Fisheries Management Guidance Document* completed in April 2016.

NEFSC direct engagement with the Atlantic States Marine Fishery Commission on ecosystem issues centered on development of a Multispecies Virtual Population Analysis tailored to examination of the role of forage species, with particular emphasis on Atlantic menhaden.

NEFSC Scientists have contributed to the development of regional ocean management plans developed by the Northeast and the Mid-Atlantic Regional Planning Bodies through the Marine Life Data and Assessment Team, which worked with both groups in the development of their respective plans.