FS-2010-02

NOAA FISHERIES SERVICE

Ecosystem-based Fishery Management for the Northeast Continental Shelf

There is now broad agreement that we need to recognize both the many benefits derived from our connections to the sea and the many ways in which human activities affect the ocean in order to chart a sustainable course of action. This holistic approach will require some form of Ecosystem-based Management (EBM; see "A New Ocean Policy," left). Virtually all definitions of marine EBM share at least three common elements: (1) a commitment to establishing spatial management units based on ecological rather than political boundaries, (2) consideration of the relationships among ecosystem components, the physical environment, and human communities, and (3) the recognition that humans are an integral part of the ecosystem. The dimension of EBM that deals specifically with fishing is Ecosystem-based Fishery Management (EBFM). We need to make sure that as we develop an approach to EBFM, it can be fully integrated into the more comprehensive EBM framework. One of the fundamental ways in which EBFM will differ from more traditional fishery management approaches is in the development of integrated management plans for entire ecological regions rather than for individual species/stocks by themselves.

Figure 1. Examples of some important ecosystem services (blue icons), stressors (red), adverse effects (yellow), and issues of special concern (green) that will be considered in Ecosystem-Based Management on the Northeast U.S. Continental Shelf (adapted from image by Barbara Ambrose, National Coastal Data Development Center).

A New National Ocean Policy

A new era in ocean resource management was ushered in on July 19, 2010 when the President signed an Executive Order implementing his recently developed National Ocean Policy. The Policy identifies nine objectives, the first of which establishes Ecosystem-based Management (EBM) as its guiding principle.

EBM is not a new concept, and many fishermen have followed its development with interest. Most are intrigued by its potential to take into account the many factors that affect resource abundance in the ocean (Figure 1). The NOAA 2005-2015 Strategic plan provides the following definitions:

"An ecosystem is a geographically specified system of organisms, including humans, the environment, and the processes that control its dynamics."

"An ecosystem approach to management is management that is adaptive, specified geographically, takes into account uncertainties, considers multiple external influences, and strives to balance diverse social objectives."

Some Benefits of Adopting EBFM

- *Potential simplification of management in moving from a large number of stock-based management plans to fewer integrated plans for ecologically defined areas*
- *More effective coordination of management actions for fisheries, protected resource species, biodiversity conservation, and habitat protection*
- *Direct accounting for fishery interactions (e.g., bycatch) and biological considerations (e.g., predation, biodiversity, habitat requirements, protected resources) along with climate change and environmental variability within a single framework*
- *Consideration of biological constraints on simultaneous efforts to rebuild stocks to long-term target levels and evaluation of compatibility with stock–specific recovery plans*
- *Increased stewardship from broader participation of stakeholders, wider sharing of ecological and fisheries knowledge, and greater opportunities for developing place-based governance approaches and comanagement*
- *Potential for greater stability and predictability by focusing on higher-level ecosystem processes, resulting in more predictable planning horizons for the fishing industry*

How Do We Get There from Here?

Currently, the New England Fishery Management Council has lead authority for 9 fishery management plans. The Mid-Atlantic Fishery Management Council has the lead for another 6. The Atlantic States Marine Fisheries Commission is responsible for 23 plans. Adopting EBFM would substantially consolidate individual fishery management plans administered by the Councils and the Commission with fewer place-based plans, and it would potentially result in a number of other benefits (see sidebar).

Still, we need a way to make a transition from our current structure to new approaches leading to full EBFM. One way forward would be initially to retain our existing management plans, now mostly viewed as separate and unconnected (Figure 2, left panel) and begin to think about them in an ecosystem context. We would also want to take into account the important interactions among species and also among fisheries. We would further consider the effects of climate variability more directly than in our existing plans.

Ultimately, this transitional approach (Figure 2, middle panel) will have to be replaced for at least two reasons: (1) as more factors are taken into account within the existing plans, they will become increasingly complex and unwieldy and (2) these plans will be more difficult to place within the broader context of EBM for the region because they will still retain a dominant focus on fishery stocks rather than on the system as a whole. The place-based approach of EBM, focusing on ecological boundaries, and the development of integrated management plans for these regions will ultimately be much better suited for both EBFM and for integration into EBM (Figure 2, right panel).

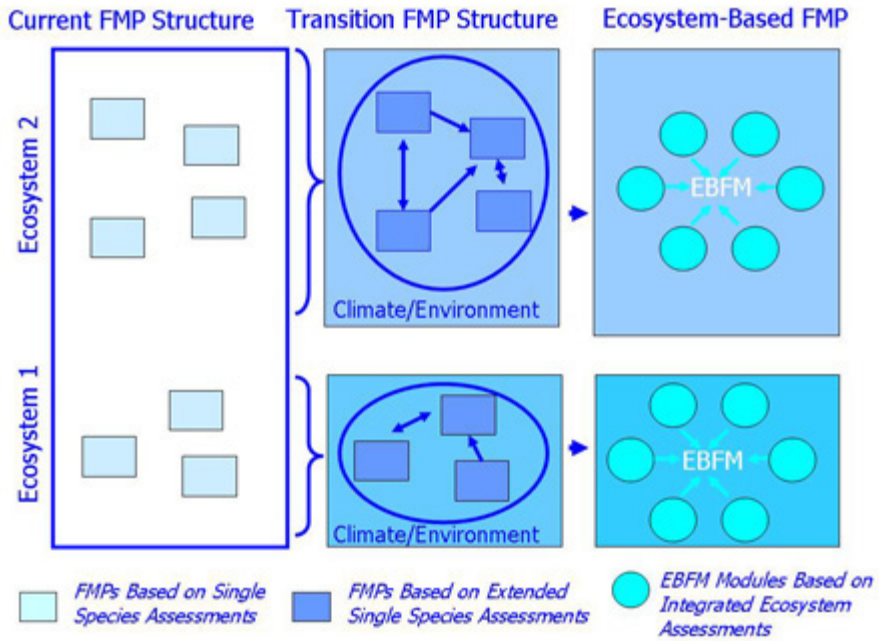


Figure 2. Pathways to development of a full Ecosystem-based Fishery Management strategy from our current single stock approach (left) through a transition strategy of extending single-species approaches and recognizing ecosystem boundaries and interactions (middle) to the development of integrated Ecosystem-based Fishery Management Plans.

A Roadmap to EBFM on the Northeast Continental Shelf

Once we become more comfortable with using ecosystems as a major way of thinking about managing ocean resources, we need to lay out concrete steps, a roadmap to implement EBFM. We would move from our transition strategy of expanding existing species/stock management plans to developing fully-integrated place-based management plans. The insights gained during the transition phase, such as identifying important interactions among species and among fisheries and the role of environmental change, will be very important in taking this step. There are many possible ways to proceed, but one approach that could work well in our region would be to follow a pathway like the one shown below in Figure 3.

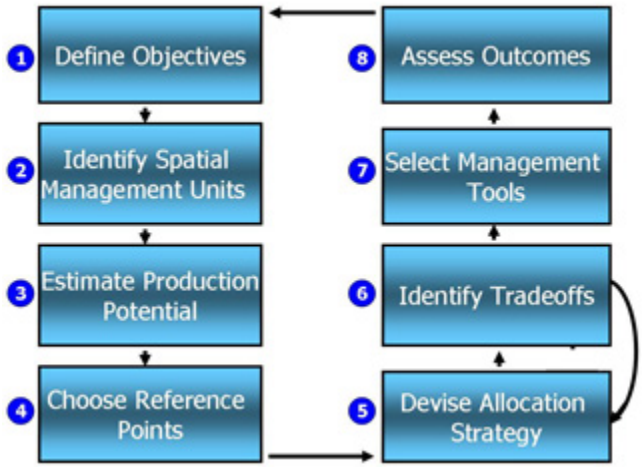


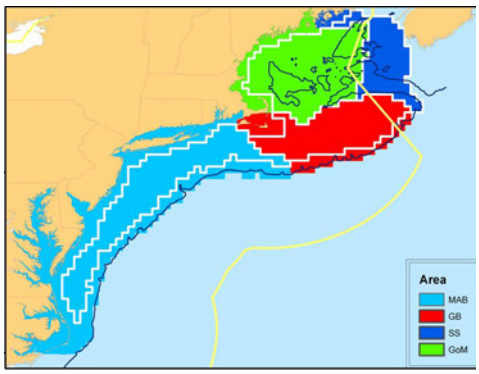
Figure 3. One possible roadmap to full EBFM in the Northeastern United States.

The first step is (1) to agree to a set of objectives for what we hope to accomplish. We then (2) begin to apply the principles embedded in these objectives to ecological management areas (see Potential Management Areas). Once these spatial management areas have been agreed upon based on consideration of both natural boundaries and the way humans relate to these areas through fishing patterns and other ways, we can (3) determine how much fish and shellfish can be produced in each area based on how much food comes in at the base of the foodweb and how this amount shifts over time because of environmental change and other factors (see Fishery Production Potential).

Just as in single species management approaches, we will then need (4) to choose reference points to identify our targets for ecosystem-based management. Fishermen and managers are used to thinking about biological reference points such as Maximum Sustainable Yield (MSY) and the fishing rate that results in Maximum Economic Yield. We can extend this idea to groups of ecologically-related species to define multispecies MSY (See Figure 4).

Potential Management Units

We base our definition of ecological boundaries on patterns of depth, bottom type, and basic oceanographic conditions (temperature, salinity, and stratification of the water column). We further consider conditions at the base of the food web, specifically the amount of food fueling the ecosystem and how it changes over time. We have identified four major ecological "production" units on the Northeast Continental Shelf.



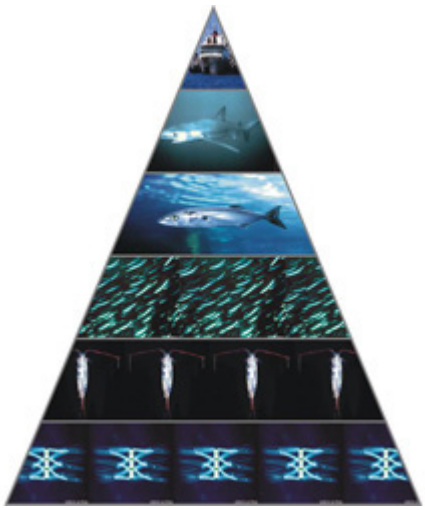
Possible spatial management units (1) Western-Central Gulf of Maine (GoM) (2) Eastern Gulf of Maine-Scotian Shelf (SS), (3) Georges Bank-Nantucket Shoals (GB) and (4) Middle-Atlantic Bight (MAB)

We have also mapped these areas by the time spent by vessels from different ports, gear types, and sizes to understand how well these natural ecological boundaries match the human ecology revealed by fishing patterns. Spatial considerations also allow us to relate fishers and communities to the fishing grounds and resources on which they depend.

Fishery Production Potential

Both current fishery management practices and EBFM share important spatial considerations: stock structure and distribution for single species management and the identification of ecological regions for EBFM. A second area of shared importance is the concept of biological production.

The production of individual species/stocks is a function of growth, mortality, and recruitment. Production of ecological regions starts at the base of the food web and underlies growth and other factors at the species/stock level. The common currency of space and production can serve as a bridge between the current management system and the EBFM system based on ecologically-defined spatial units.



We can then trace the flow of energy in the ecosystem as a whole from the tiny plants at the base of the food web up through the higher levels of the ecosystem, including fish and shellfish, to determine the fishery production potential for the system as whole, as shown in the pyramid above.

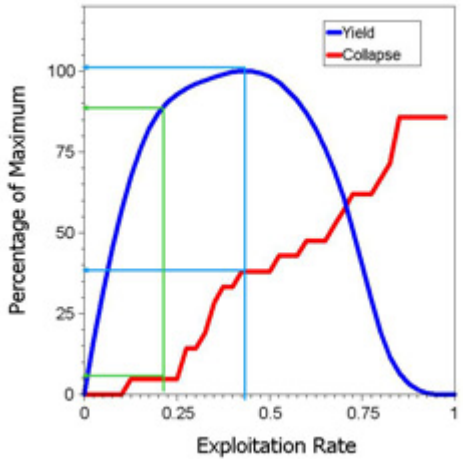


Figure 4. Multispecies production model showing total catch (all species), and the proportion of collapsed species for a 21 species system on Georges Bank (J. Collie, URI, personal communication). If we set the exploitation rate to achieve the multispecies maximum yield (MMSY; medium blue lines), nearly 40% of the species in the system will be classified as collapsed. With an exploitation rate of 20% though (green lines) , we still get over 85% of MMSY but now have less than 10% of the species classified as collapsed. Thus, we can greatly reduce risk of stock collapse at little economic cost, which will likely increase economic efficiency.

After we have determined a sustainable level of overall catch that we can extract from the system as a whole, it will be necessary to (5) decide how much of each species can be taken or allocated without exceeding the total catch determined for the entire system. Nearly forty years ago, the International Commission on Northwest Atlantic Fisheries developed and applied just such a method of estimating the total fishery production for the shelf as a whole and then splitting up the part that could be sustainably harvested among different user groups.

This overall process will inevitably reveal the need to (6) consider tradeoffs among our objectives and the need to find a way to balance potential conflicts among them. For example, management actions targeted at one group of species might have direct and indirect impacts on other groups of species in the ecosystem. We will need to address these tradeoffs directly because we may not be able to meet all our objectives simultaneously, and choices will have to be made to best meet our overall needs.

We will then need to (7) choose the right tools to meet our objectives. These will be mostly drawn from our existing management toolkit (e.g., controls on catch or fishing effort, gear modifications, marine protected areas) but likely with a different balance of approaches to meet our particular objectives. Finally, we will need to (8) assess how effective our management choices have been and make adjustments as necessary.

While there are many important challenges, we do have the information and the experience needed to make Ecosystem-based Fishery Management a reality in the Northeast. If we work together, take it step by step, learn along the way, and apply the lessons learned, we can succeed.