FUTURE DIRECTIONS IN FISHERIES MANAGEMENT: AN ECOSYSTEM-BASED APPROACH

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BROADER HORIZONS IN FISHERIES MANAGEMENT

The standard approach to fisheries management has been to focus on one species at a time, using catch level, life history, and economic yield in order to determine a management plan for the fishery (Figure 1). The challenge at hand is to successfully incorporate pivotal information such as habitat characteristics, interactions between species, and natural variability.

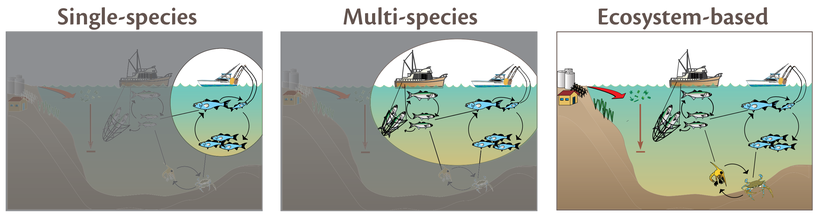


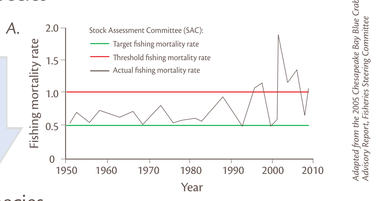
Figure 1: The evolution from single-species to ecosystem-based fisheries management involves a widening of scope toward our current position - on the verge of implementation.

BROADER HORIZONS INCREASE COMPLEXITY

All approaches, even the least complex (single-species management) require substantial research and monitoring effort before a management plan may be developed.

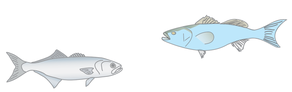
Single-species

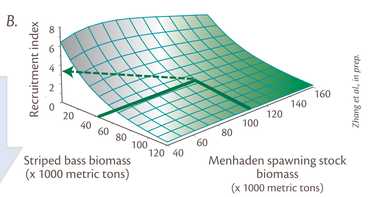
- Largely based upon assessing population in relation to fishing mortality rate targets & thresholds; fishing mortality rate (Figure 2A) is used to adjust harvests.
- Goal = a **maximum** sustainable yield (Figure 2A)



Multi-species

- Adds a new level by addressing species interactions
- Relies mainly upon diet composition and recruitment data (fish added to the exploitable stock each year) to predict the effects of varied fishing effort (Figure 2B)





Ecosystem-based

- Addresses factors affecting all species (e.g. habitat availability and quality, primary production)
- Supports a comprehensive look at an entire system, rather than a narrow representation of one species at a time.
- With such a comprehensive look, both sensitive and more resilient species may be more fully represented (Figure 2C)
- Goal = an **optimum** sustainable yield

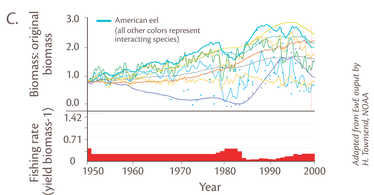
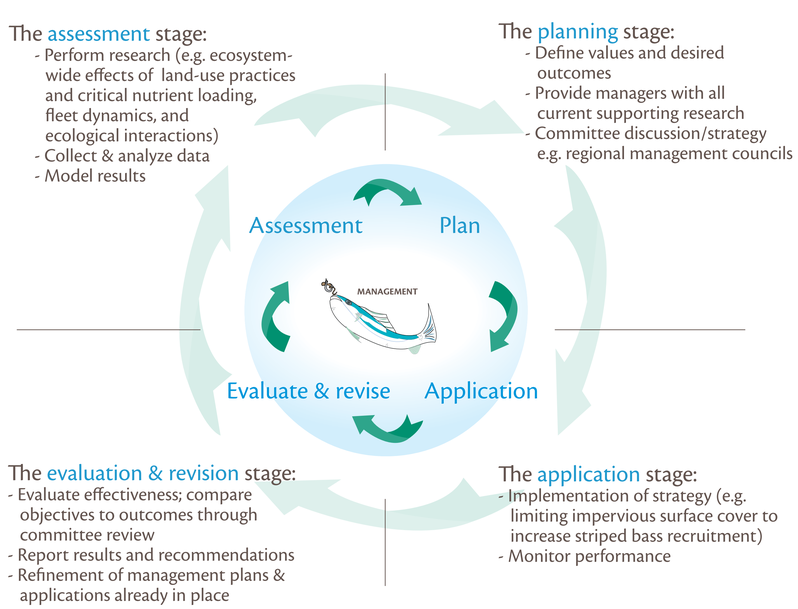


*Figure 2: A-C: Examples of modeling tools used or in development: (**A**) standard target and threshold system; (**B**) multi-species theoretical model predicting recruitment based upon biomass from the previous year; (**C**) example of an ecosystem-based model simultaneously modeling species interactions, fishing pressure, and nutrient loading.*

THE ADAPTIVE PROCESS

Sound management is an adaptive process, reducing costs and enabling feedback by continual evaluation and refinement of the plan's effectiveness. The first planning stages require an integrative ecosystem committee comprised of managers, researchers, and stakeholders.



MANAGING MIGRATORY SPECIES

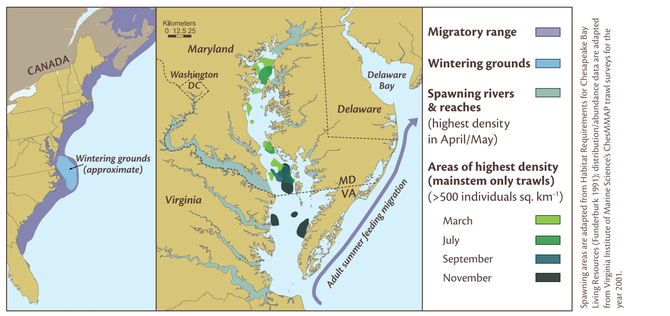


Figure 3: Distribution and migration of Atlantic striped bass populations reflected by a map of spawning rivers and reaches and high-density distribution (mainstem only) of striped bass in Chesapeake Bay.

- Migratory species are a management challenge, ranging across jurisdictional zones.
- The variability of certain habitat characteristics (e.g. dissolved oxygen) further compounds the difficulty of managing species.
- Requires the partnering of multiple authorities such as the Atlantic States Marine Fisheries Commission with regional and state agencies.

BEYOND THE THEORY

Despite still being in its infancy, the ecosystem-based strategy is increasingly being evidenced in international and national documentation. The greatest challenges to implementing EBFM lie in coordinating multiple stakeholders and government agencies and defining desired outcomes.

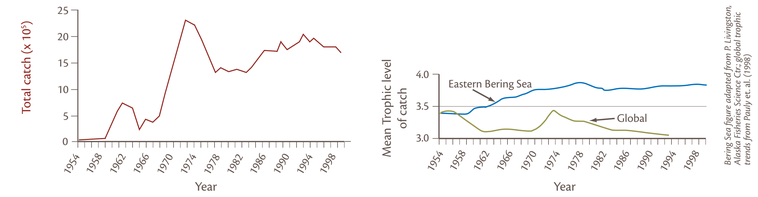


Figure 4: Total catch and mean trophic level of the Bering Sea fishery compared with global trends in mean trophic level of landings. The Sea's relative trophic stability is unique, indicating that its higher-level consumers are not being overfished whereas globally, the larger, spawning-age populations are being depleted.

- The Bering Sea has maintained relative stability in its groundfish population and mean trophic levels of catch using an EBFM approach (Figure 4).
- Success in the Bering Sea can be attributed to annual trawl surveys of populations (Figure 4) and a network of Marine Protected Areas providing fish habitat.
- Translating an EBFM approach that works in an open-ocean system into a estuarine or coastal ecosystem is a great challenge to be faced.
- At present, EBFM has made its way into research and planning efforts, but implementation is still in its early stages of development.

Captain R. A. Pawlowski; Allen Shimada (NMFS), NOAA Image Library

Pacific trawl surveys and catch sorting aboard the research vessel *Miller Freeman*.

PROGRESS IN THE CHESAPEAKE BAY

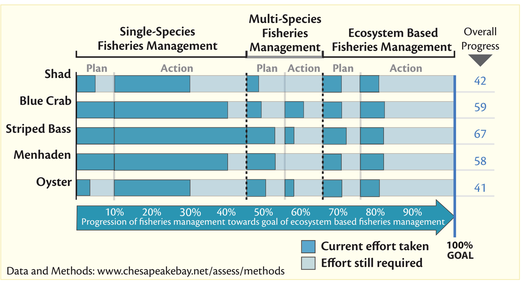


Figure 5: An index of fisheries management effort in the Bay according to the Chesapeake 2000 Agreement.

- Currently in Chesapeake Bay, a fisheries ecosystem plan (FEP) has been published, serving as a guide for ecosystem-based fisheries management.
- Ecosystem-based modeling efforts may help to account for new parameters, such as the effects of habitat restoration or varied nutrient loading into the Bay.
- Recent estimates of effort towards implementation of the plan ranged from 41-67% for each of five species (Figure 5).
- Recommendations include defining essential habitat and critical areas as well as considering how the population of each species affects the entire ecosystem.

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Further Information:
- EBFM at NOAA Chesapeake Bay Office: http://noaa.chesapeakebay.net/fisheriesecosystem.aspx

References:
- Zhang, X., R.J. Wood, E.D. Houde and H. Townsend (in preparation) Modeling the influence of potential predation of striped bass on Atlantic menhaden stock recruitment in Chesapeake Bay.
- Funderburk, S.L., J.A. Mihursky, S.J. Jordan, and D. Riley (eds.). 1991. Habitat Requirements for Chesapeake Bay Living Resources.
- Livingston, P.A., L-L. Low, and R.J. Marasco.1999. "Eastern Bering Sea Ecosystem Trends." in Kenneth Sherman and Quisheng (eds), Large Marine Ecosystems of the Pacific Rim - Assessment, Sustainability, and Management. (Blackwell Science) pp. 140-162.
- Pauly, D., V. Christensen, J. Dalsgaard, R. Froese, and F. Torres, Jr. 1998. Fishing down marine food webs. Science. **279**: 860-863.