COLUMN
PERSPECTIVE

Atlantic Salmon *Salmo salar* Pre-Smolt. This individual shows fading vertical parr marks, a characteristic of the parr stage, gradually taking on the silvery sheen of the smolt stage in advance of migrating to the North Atlantic Ocean to feed. Photo credit: E. Peter Steenstra/U.S. Fish and Wildlife Service

Atlantic Salmon Recovery Informing and Informed by Ecosystem-Based Fisheries Management

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2019 is the International Year of the Salmon with events and projects planned across the Northern Hemisphere. Obviously, much of the focus will be on salmon. Yet, we contend in this perspective that salmon recovery, specifically Atlantic Salmon *Salmo salar* recovery, can inform and be informed by Ecosystem Based Fisheries Management (EBFM). We provide the status of Atlantic Salmon recovery and the definition and objectives of EBFM and then walk through Atlantic Salmon recovery in the context of the definition of EBFM. Our purpose is to provide insight into EBFM in practice. Then we use the principles of EBFM to examine Atlantic Salmon recovery and provide an ecosystem perspective of the recovery efforts. Our intent is to provide a practical approach to considering EBFM and a broader approach for considering Atlantic Salmon recovery.

INTRODUCTION

2019 is the International Year of the Salmon—an opportunity to consider what can be done to conserve and restore salmon and their habitats (https://yearofthesalmon.org/). The focus will obviously be on salmon, but there are also opportunities to consider salmon conservation and management as examples in a broader context of fisheries management. From this perspective, we explore links between salmon conservation and fisheries management. Specifically, we consider two lines of thoughts: (1) Atlantic Salmon *Salmo salar* recovery efforts as an example of Ecosystem-Based Fisheries Management (EBFM) and (2) applying EBFM to Atlantic Salmon recovery efforts.

For our first line of thought, many scientists and managers in fisheries are interested in EBFM but still ask, "What is it in practice?" Here we walk through the definition of EBFM using Atlantic Salmon recovery as an example. We recognize that the example is imperfect, but we believe that scientists and managers can follow our example and walk through the EBFM definition using their species or ecosystem. The result of this exercise is a clearer understanding of EBFM, as well as the start of a plan for implementing EBFM in specific situations.

For our second line of thought, we contend that EBFM can contribute to Atlantic Salmon recovery efforts. EBFM asserts that fisheries management can be more successful when a broader ecosystem perspective is applied. We believe that Atlantic Salmon recovery efforts can benefit from formal consideration of the EBFM approach. We walk through the principles of EBFM as they relate to Atlantic Salmon recovery. We encourage scientists and managers involved in fish conservation to do the same, and then to consider applying the insights and perspectives gained.

ATLANTIC SALMON RECOVERY

Atlantic Salmon in the United States were once native to almost every coastal river in New England. Populations declined from the colonial period as a result of overfishing, dams, pollution, water removals, as well as other factors (Parrish et al. 1998). Now, the last wild populations of U.S. Atlantic Salmon are found in Maine. These populations comprise the Gulf of Maine Distinct Population Segment, which is listed as endangered under the Endangered Species Act (ESA; Federal Register 2005). Two federal agencies have joint responsibility for the recovery: U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS). As an endangered species, a Recovery Plan has been developed (Federal Register 2005; NMFS & USFWS 2019) and USFWS, NMFS, the State of Maine, and the Penobscot Indian Nation are working together to recover the species.

ECOSYSTEM-BASED FISHERIES MANAGEMENT

Ecosystem-Based Fisheries Management has a long history in fisheries management (Link 2010). The concept of linking fisheries exploitation to ecosystem components started in the late 19th century (see Hobart 1995) and continued in the first half of the 20th century with the advent of systems ecology (see Link 2018). As fisheries management developed in the latter half of the 20th century, ecosystem principles (e.g., predator–prey, habitat) were sidelined and most analytical development focused on the dynamics of single species or stocks (see Smith 1994). In 1976, the Magnuson–Stevens Fishery Conservation and Management Act codified the concept of single stock maximum sustainable yield as a central tenet in U.S. marine fisheries management (Mace 2001). The National Marine Fisheries Service is responsible for marine fisheries management in U.S. federal waters under the Magnuson–Stevens Fisheries Conservation and Management Act.

Calls for taking a more ecosystem-based approach were renewed in the beginning of the 21st century (Ecosystem Principles Advisory Panel 1999; Pikitch et al. 2004), and EBFM is now being implemented in marine fisheries nationally and globally (Pitcher et al. 2009; Link and Marshak 2019). In the United States, NMFS recently released an EBFM Policy (NMFS 2016) that states the agency, "strongly supports implementation of Ecosystem-Based Fisheries Management (EBFM) to better inform and enable better decisions regarding trade-offs among and between fisheries (commercial, recreational, and subsistence), aquaculture, protected species, biodiversity, and habitats." This Policy defines EBFM as "a systematic approach to fisheries management in a geographically specified area that contributes to the resilience and sustainability of the ecosystem; recognizes the physical, biological, economic, and social interactions among the affected fishery-related components of the ecosystem, including humans; and seeks to optimize benefits among a diverse set of societal goals."

In addition to the definition, the EBFM Policy defined six hierarchical, guiding principals (Figure 1). These principals include defining objectives, defining needs to meet objectives, identifying priorities, evaluating options, providing advice and measuring outcomes. Operationally, EBFM has been modeled similar to current single species management and advice through the development of an iterative Integrated Ecosystem Assessment framework (Levin et al. 2009).

Despite the conceptual development, the adoption of national and international policies, and examples of implementation, many in the fisheries community still ask of EBFM, "what is it in practice?" The definition and principles above outline the core components: an ecosystem-level approach, a defined geographic area, consideration of ecosystem sustainability, recognition of the myriad of interactions affecting fisheries including natural and human, and management efforts to optimize benefits across societal goals. For many, going through a worked example can help connect the conceptual to the practical.

Figure 1. Illustration of the interconnected and interdependent nature of the major ecosystem-based fisheries management (EBFM) guiding principles (NMFS 2016).

ATLANTIC SALMON RECOVERY INFORMING EBFM

We contend that Atlantic Salmon recovery efforts in the United States can serve as a practical example of EBFM for scientists, managers, and stakeholders (see also Patrick and Link 2015; Link and Browman 2017). To illustrate this point, we will review the EBFM definition from the perspective of Atlantic Salmon recovery.

Systematic Approach to Fisheries Management

The recovery of Atlantic Salmon is based on a systematic approach defined in the Atlantic Salmon Recovery Framework (NMFS et al. 2011) and Atlantic Salmon Recovery Plan (Federal Register 2005; NMFS & USFWS 2019), which support management under ESA (Federal Register 2009a). The federal agencies work jointly with the Maine Department of Marine Resources and the Penobscot Indian Nation to create the framework with a goal of significantly increasing abundance of wild Atlantic Salmon to support population persistence over time and distribution over a wide geographic range. A number of non-governmental organizations are also involved in recovery efforts. Part of the recovery plan is the preservation of genetic, life history, and morphological diversity of Atlantic Salmon as well as improved ecosystem function. Action teams include scientists and managers with specific skills and expertise that work with partners from other organizations to address both local and regional conservation needs.

In addition to the systematic approach for recovery, Atlantic Salmon fisheries management is hierarchical, including state, federal, tribal, and international levels. The State of Maine manages Atlantic Salmon in state waters and has a prohibition against targeted angling. Under the Magnuson–Stevens Fisheries Conversation and Management Act, the New England Fishery Management Council (NEFMC) developed an Atlantic Salmon Fishery Management Plan (NEFMC 1987). This plan prohibits possession of wild Atlantic Salmon in U.S federal waters and the establishes U.S. management authority over all Atlantic Salmon originating from U.S. rivers. The Penobscot Indian Nation requires a sustenance permit to take Atlantic Salmon and requires that all fish be registered with their Department of Natural Resources. In Canada, some populations are designated as endangered under the Species at Risk Act, and the Atlantic Salmon Research Joint Venture has formed among Fisheries and Oceans Canada, Indigenous groups, provincial agencies, non-government organizations, academic institutions, NMFS, and other stakeholders to promote the sharing of scientific research with the goal of conserving and rebuilding the species. Internationally, the Convention for the Conservation of Salmon in the North Atlantic Ocean (1983) created the

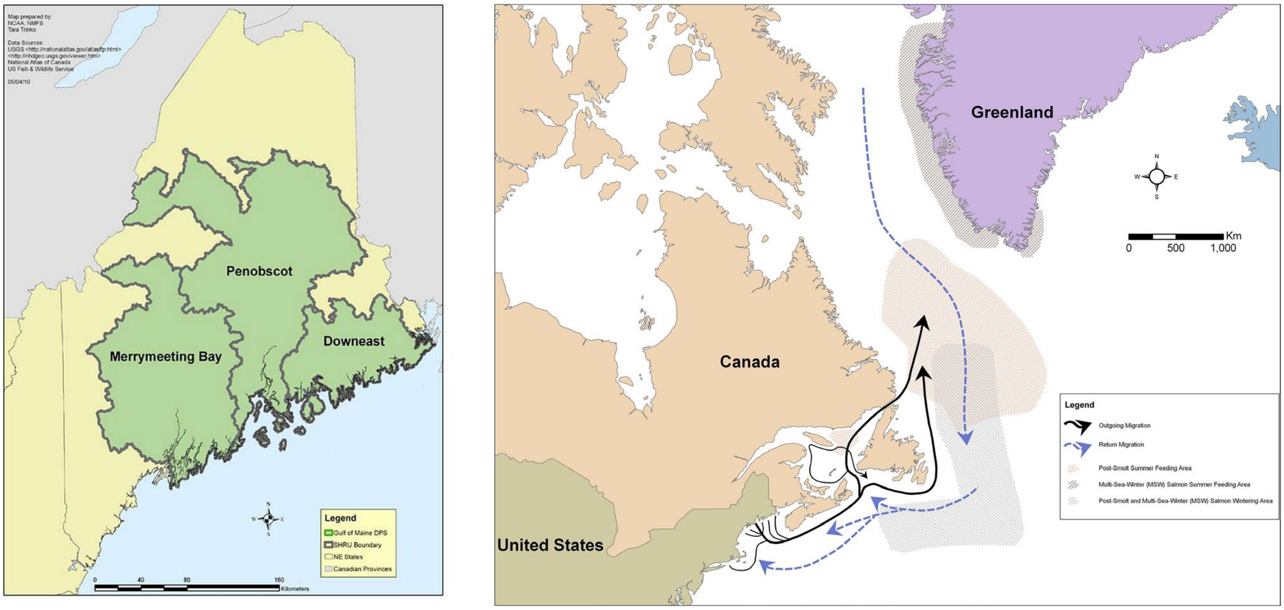

Figure 2. Map of the geographic distribution of Salmon Habitat Recovery Units for Gulf of Maine Distinct Population Segment of Atlantic Salmon and of the larger area used by adults at sea as foraging and overwintering grounds (source: Greater Atlantic Regional Fishery Office, NOAA Fisheries).

North Atlantic Salmon Conservation Organization, an inter-governmental organization that works to conserve, restore, enhance, and rationally manage Atlantic Salmon through international cooperation. Atlantic Salmon from the United States are captured in the fisheries of other nations, and these fishing activities are managed by member countries under North Atlantic Salmon Conservation Organization.

In a Geographically Specified Area

The geographic focus of U.S. Atlantic Salmon recovery is well defined (Figure 2). The Gulf of Maine Distinct Population Segment of Atlantic Salmon includes all naturally reproducing remnant populations from the Kennebec River to the mouth of the St. Croix River (Federal Register 2009a). When Critical Habitat was defined in 2009 for the Gulf of Maine Distinct Population Segment (Federal Register 2009b), three Salmon Habitat Recovery Units were identified to link geography to the distribution of genetic diversity with the goal of strengthening the overall resilience of the species. Recovery efforts also include the ocean areas used by the Gulf of Maine Distinct Population Segment during their life cycle: summer feeding grounds in the Labrador Sea and coastal West Greenland, overwintering areas south and east of Newfoundland, and the regions of ocean used for migration between these locations and from rivers in Maine.

Across this geographic area there are a number of integrative science efforts operating at different scales. For example, NMFS has established the Penobscot River Habitat Focus Area. The goals for Habitat Focus Areas are consistent with EBFM: to improve habitat conditions for fisheries, coastal communities, and marine life, as well as to provide other economic, cultural, and environmental benefits. One of the specific objectives of the Penobscot River Habitat Focus Area is Atlantic Salmon recovery. The National Marine Fisheries Service has also joined in a Cooperative Research and Development Agreement with the Maine Center for Coastal Fisheries and the Maine Division of Marine Resources, the purpose of which is to explore methods for ecosystem-based fisheries management in Maine waters. Including the connection between freshwater and marine systems will be an important part of this work. The International Council for the Exploration of the Sea (ICES) also has integrative activities related to Atlantic Salmon and related to the Northwest Atlantic. There is an ICES Working Group on North Atlantic Salmon, which summarizes the status of Atlantic Salmon across the North Atlantic for the North Atlantic Salmon Conservation Organization and for the member nations of ICES. The ICES Working Group on the Northwest Atlantic Regional Sea is developing Integrated Ecosystem Assessments for the region, which includes most of the area occupied by U.S. Atlantic Salmon.

That Contributes to the Resilience and Sustainability of the Ecosystem

Recovery efforts of Atlantic Salmon focus on increasing freshwater connectivity, habitat restoration in freshwater habitats, and stewardship of land adjacent to Atlantic Salmon habitats. Improving freshwater connectivity (i.e., fish passage) includes large integrated projects like the Penobscot River Restoration Project that led to the removal of the Great Works Dam in 2012 and Veazie Dam in 2013, as well as the construction of a nature-like bypass at the Howland Dam (Day 2006; Opperman et al. 2011). This latter project restored unimpeded access to 14 km of mainstem river, improving access to over 90% of historic habitat for many diadromous species that use lower river habitats (Trinko Lake et al. 2012). The greatest effect observed from these dam removals have been an increase in the number of migrating river herring (Alewife *Alosa pseudoharengus*; Blueback Herring *A. aestivalis*) in the Penobscot River (Watson et al. 2018).

Restoration of freshwater habitats is an important element of Atlantic Salmon recovery. Historically, commercial forestry involved log drives using the river and stream network, which reduced habitat complexity by widening and straightening channels and removing boulders and large wood. There are a number of efforts underway to restore natural stream processes and these efforts will aid Atlantic Salmon recovery, as well as improve habitat quality for a suite of riverine species.

Changes in land use include riparian buffer zone management, which reduces sediment moving into streams and rivers, and provides shade, leaf litter, and large woody debris for the in-stream ecosystem. These efforts contribute to moderating stream temperature and improving water quality for Atlantic Salmon, as well as for stream communities (see Haberstock et al. 2000).

Although the above activities are undertaken as part of Atlantic Salmon recovery, they are focused on restoring ecological processes including connectivity, habitat diversity, nutrient fluxes, temperature control, and flood and runoff control. Thus, these activities serve to improve the resilience and sustainability of Maine's river and stream ecosystems.

Recognizes the Physical, Biological, Economic, and Social Interactions Among the Affected Fishery-Related Components of the Ecosystem, Including Humans

The role of physical interactions in Atlantic Salmon recovery are relatively well understood. The primary physical features of Atlantic Salmon habitat are outlined in the ESA Critical Habitat designation (Federal Register 2005). In freshwater, these features include river substrate of suitable size and quality, adequate flow, appropriate water temperatures and acceptable water quality. Many habitat restoration efforts seek to recreate these habitat characteristics to increase spawning potential in rivers. The physical features of marine habitats are less well understood, but the availability of appropriate thermal habitat has been identified as an important feature in Atlantic Salmon survival at sea (Friedland et al. 1993, 1998).

Biological interactions also have been recognized as an important part of Atlantic Salmon recovery (Figure 3). Saunders et al. (2006) summarized Maine's diadromous fish community and discussed links to Atlantic Salmon recovery. The health of the diadromous fish community is considered a primary element for recovery in the ESA Critical Habitat designation. Predator and prey dynamics are also important; as an example, the rebuilding of the Striped Bass *Morone saxatilis* population increases predation pressure on Atlantic Salmon smolts and potentially restricts recovery (e.g., Daniels et al. 2018). Prey buffering, whereby abundant river herring provide alternative prey for predators of salmon, may also be an important component of predator–prey dynamics related to recovery (Saunders et al. 2006). As another example of complex interactions, the semelparous Sea Lamprey *Petromyzon marinus* remove fine sediments from stream beds creating attractive spawning sites for Atlantic Salmon and provide marine-derived nutrients to river systems (Saunders et al. 2006). In Maine, these positive factors are thought to outweigh parasitism, which is a fisheries management challenge with lamprey in the Great Lakes.

Economic and human interactions are also crucial to Atlantic Salmon recovery. The trade-offs involved in managing for recovery in the context of a number of human activities is addressed below (e.g., energy, transportation, fisheries, agriculture). Social interactions are also paramount to recovery. A recent study indicated that many communities have lost historical connections to diadromous fish, as well as the water bodies and habitats these fish require (Liebich et al. 2018). Recovering the human connections to nature and overcoming stakeholder apathy is a critical component of species recovery.

The combination of physical, biological, economic, and social interactions resulting from a changing climate are also impacting Atlantic Salmon recovery. Changes in seasonal temperature and flow regime in freshwater environments will likely exert complex or conflicting interactions across the range of Atlantic Salmon in terms of freshwater survivorship, growth, smoltification, and timing of emigration (Todd et al. 2011). In Maine, at the southern extent of the species' range, the effects of these interactions will likely be negative (Hare et al. 2016). Warming conditions at sea also affect growth, maturation, and survival (Friedland 1998; Friedland and Todd 2012). Long-term changes in the marine prey base are linked to reductions in the energy content of the Atlantic Salmon forage base, which may affect at-sea survival (Renkawitz et al. 2015). Successful recovery of Atlantic Salmon in Maine in the face of changing climate will be a difficult task and will require an ecosystem-based approach that includes the consideration of climate change.

And Seeks to Optimize Benefits Among a Diverse Set of Societal Goals

There are trade-offs associated with Atlantic Salmon recovery and many of the actions taken have optimized the cost and benefits between recovery and other societal goals. In the Penobscot River Restoration Project, two dams were removed from the main stem to improve fish passage. Power production was increased at the remaining dams on the Stillwater Branch of the river, and as a result total hydropower energy production from the basin will be maintained or increase slightly (Opperman et al. 2011).

As another example, the State of Maine Department of Transportation has a policy, process, and design guide with best management practices for fish passage with the goal of meeting regulatory requirements and the habitat needs of Atlantic Salmon, while delivering safe, cost effective, and timely transportation projects (ME DOT 2015). Smaller projects are also important—the USFWS estimates that 45% of more than 5,000 road–stream crossings (i.e., culverts) surveyed on public lands in Maine represent physical barriers to fish migration (https://www.fws.gov/northeast/mainefisheries/aquatic_connectivity.html). New culvert designs facilitate stream connectivity and are more resilient to high streamflow events thereby protecting both river connectivity and human infrastructure.

There are also trade-offs in the management of the Atlantic Salmon fisheries by other nations and in international waters. While catches of U.S. Atlantic Salmon are relatively rare in Labrador, Saint Pierre, and Miquelon fisheries (Bradbury et al. 2018), harvest in West Greenland remains a concern (Sheehan et al. 2009). Given the low abundance of U.S. Atlantic Salmon populations, impacts of the West Greenland fishery when prorated to total returns average about 10% of total return potential—lower than rates of approximately 30% in the early 1980s, but still a concern to U.S. managers. Reducing mortality in the West Greenland fishery remains a priority for the United States as part of the North Atlantic Salmon Conservation Organization recognizing the proportion of U.S. fish in this fishery is quite low. The North Atlantic Salmon Conservation Organization is working to

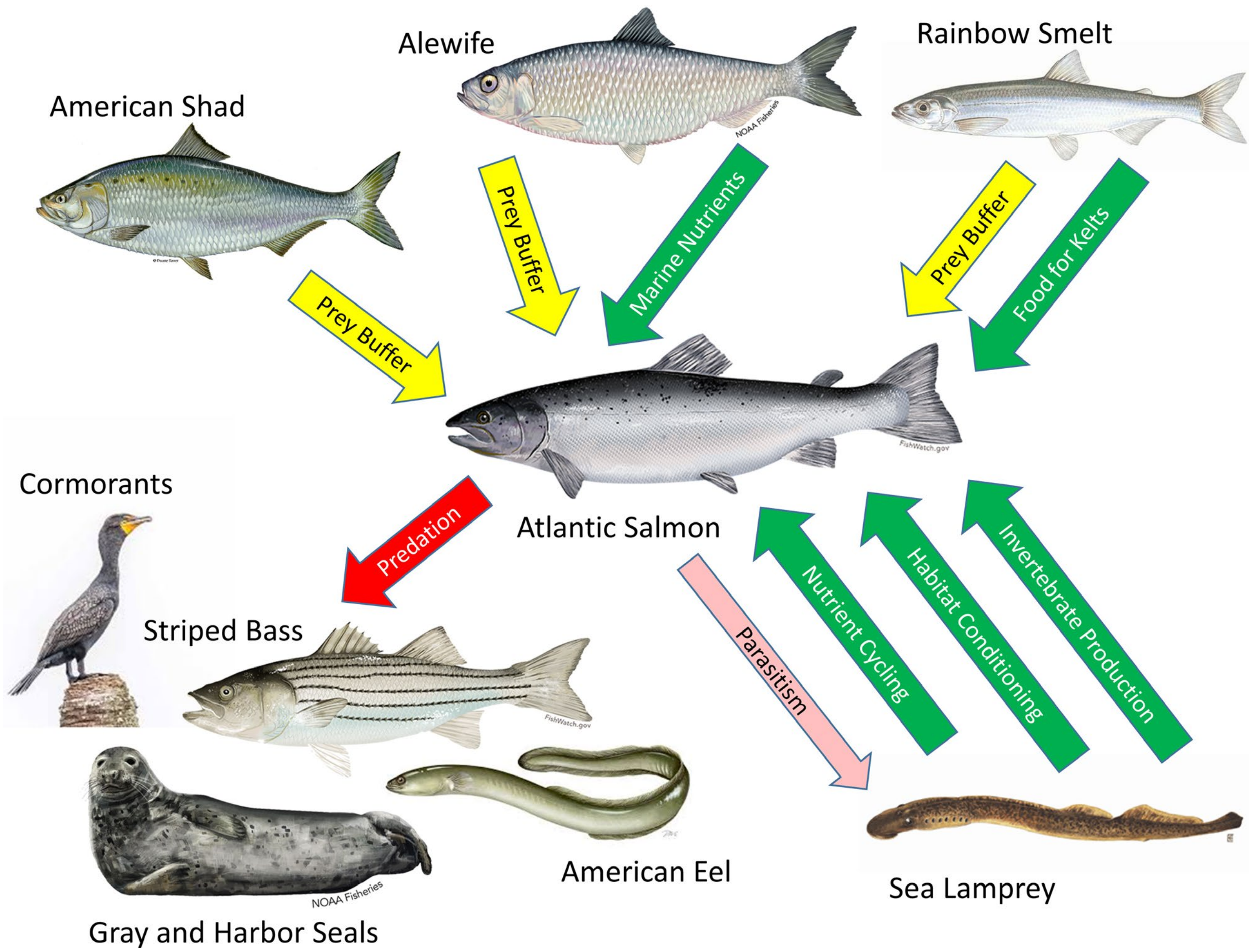

Figure 3. Schematic of hypothesized biological interactions that affect Atlantic Salmon recovery. Green arrows towards salmon are positive impacts to salmon populations, red arrows away are negative impacts (predation and parasitism). The yellow prey buffering arrows denoted potential positive interactions.

American Shad *Alosa sapidissima* https://www.fws.gov/fisheries/freshwater-fish-of-america/american_shad.html
Alewife *A. psuedoharegus* https://www.fisheries.noaa.gov/species/alewife
Atlantic Salmon *Salmo salar* https://www.fisheries.noaa.gov/species/atlantic-salmon
Striped Bass *Morone saxatilis* https://www.fisheries.noaa.gov/species/atlantic-striped-bass
American Eel *Anguilla rostrata* http://www.asmfc.org/species/american-eel
Gray seal *Halichoerus grypus* https://www.fisheries.noaa.gov/species/gray-seal
Rainbow Smelt *Osmerus mordax* https://www.mass.gov/service-details/learn-about-rainbow-smelt
Double-crested comarant *Phalacrocorax auritus* https://www.aphis.usda.gov/wildlife_damage/nwrc/publications/17pubs/REP%202017-062.pdf
Sea Lamprey *Petromyzon marinus* https://www.dec.ny.gov/animals/94259.html

improve catch monitoring and compliance with catch limits, which will support recovery and sustainability goals in multiple countries across the North Atlantic. A new range-wide genetic baseline for Atlantic Salmon from North American and European rivers will allow regional assignment of individuals targeted in international mixed stock fisheries (Jeffery et al. 2018).

Atlantic Salmon recovery efforts optimize hatchery production and wild production. A river-specific stocking program is used to support the recovery plan and is designed to maintain the genetic integrity of stocks in the different rivers (Wilke et al. 2015). The role of hatcheries is complicated as marine survival per capita is four or more times higher for wild or fry-stocked Atlantic Salmon relative to smolt stocked fish (U.S. Atlantic Salmon Assessment Committee 2018). However, the numerical advantage of smolt-stocked recruitment to the ocean results in these fish dominating (85%) adult returns. Efforts to develop alternative stocking approaches (e.g., egg planting, adult stocking) are being investigated in concert with an improved spatial design of stocking practices at the watershed level to optimize use of available hatchery product and identify underutilized production areas across the designated Critical Habitat. Atlantic Salmon aquaculture is also a large business in Maine and New Brunswick and there have been documented escapes in several Maine rivers. The magnitude and consequences of introgression between wild and cultured Atlantic Salmon are largely unknown in Maine but there is a rich literature from other regions (see Glover et al. 2017) and the range-wide genetic baseline (Jeffery et al. 2018) will assist in monitoring for introgression. Containment of commercial aquaculture fish is a shared interest of the industry, regulators, and the conservation community.

EBFM GUIDING PRINCIPLES AND ATLANTIC SALMON RECOVERY

We argue above that Atlantic Salmon recovery can inform the practice of EBFM. From the reverse perspective, we argue that formal adoption of EBFM as a set of organizing principles can inform Atlantic Salmon recovery. To illustrate this point, we walk through the six guiding principles of EBFM (Figure 1) from the perspective of Atlantic Salmon recovery.

(1) What are Our Objectives?

The objectives of recovery could be broader and placed in an ecosystem context: for example, recover salmon-oriented ecosystems for ecological, economic, and social benefits. The rationale for this broader context is supported by current recovery efforts benefiting other species and the recovery of other species benefiting Atlantic Salmon (e.g., predator buffer, habitat conditioning, increased forage base). This broader context is also warranted given the value of the potential benefits to the State of Maine and the surrounding region (e.g., increased recreational value, increased cultural value, increased ecological resilience; see Roman et al. 2018).

(2) What is the Foundational Science We Need? and (3) What Are Our Priorities?

These questions have been answered for Atlantic Salmon (National Research Council 2004; NMFS & USFWS 2019) but not for salmon-oriented ecosystems. Ecosystem science needs and priorities would have to be consistent with Atlantic Salmon recovery under ESA, but could include other aspects of the ecosystems (recreational value, cultural value, commercial fishing). The shift from a freshwater–Atlantic Salmon perspective to an ecosystem–diadromous fish perspective is already occurring under the Atlantic Salmon Recovery Framework (NMFS et al. 2011). As an example of this shift, much of the science effort has focused on freshwater and estuarine systems, with good reason. Yet, there is an increasing awareness that a better understanding of survival in the ocean is needed. In addition, some habitat restoration efforts and strategies are being designed to scientifically test their effectiveness relative to promoting survival (e.g., Stich et al. 2014). Such a science-based approach will benefit ecosystem restoration efforts globally.

(4) What are Our Options?

Considering options requires an understanding of trade-offs. As presented above, there are examples of Atlantic Salmon recovery describing and balancing trade-offs (e.g., energy production, aquaculture production, road-crossing construction). Additional efforts in this area could contribute to Atlantic Salmon recovery. For example, Management Strategy Evaluation is developing as a tool to examine trade-offs related to management objectives and this approach has been used to evaluate strategies for reducing incidental catch of winter Chinook Salmon *Oncorhynchus tshawytscha* on the West Coast (Winship et al. 2013). Restoration of the broader salmon-oriented ecosystems is more complex. The development of a Fishery Ecosystem Plan for these ecosystems would be one approach to promote more holistic restoration (Levin et al. 2018). The use of Management Strategy Evaluation, Fishery Ecosystem Plans, and similar tools could advance Atlantic Salmon recovery, as well as broader efforts to restore and recover salmon-oriented ecosystems.

(5) What is Our Advice?

Many elements of Atlantic Salmon recovery incorporate ecosystem considerations (e.g., habitat restoration, importance of species interactions). However, the Atlantic Salmon recovery effort could benefit from formally incorporating broader objectives (e.g., recovery of diadromous fish), with a subsequent reassessment of needs, priorities, and strategies. In addition, greater emphasis should be placed on evaluating the success of management actions, to allow learning and to contribute to ecosystem restoration activities more generally. Re-evaluation of governance structures (e.g., policies, partnerships, organizations) is also critical to ensure that advice is provided that is congruent with the ability to act upon the advice.

(6) Outcomes

A more deliberate implementation of EBFM for Atlantic Salmon and salmon-oriented ecosystems would include measureable outcomes. The Atlantic Salmon Recovery Plan (NMFS & USFWS 2019) establishes quantitative metrics to evaluate progress toward the fundamental objectives of recovery: increasing the abundance and distribution of Atlantic Salmon. A similar strategy could be developed for recovery of salmon-oriented ecosystems with defined outcomes and metrics to measure success (Link and Browman 2017). Such an approach would truly exemplify Ecosystem-Based Fisheries Management.

CONCLUSION

We recognize the comparisons between Atlantic Salmon recovery and EBFM are imperfect. Atlantic Salmon recovery is focused on a single species and is perhaps better classified as an example of Ecosystem Approach to Fisheries Management, which uses ecosystem information in the management of a single species or stock. In contrast, EBFM applies to multiple species and stocks in an ecosystem (see Dolan et al. 2016). However, walking through the EBFM definition from an Atlantic Salmon perspective illustrates the practicalities of implementing EBFM.

Similarly, the goals of EBFM are different than the goals of Atlantic Salmon recovery. EBFM seeks to manage the harvest of fisheries in an ecosystem context. Atlantic Salmon recovery in the United States forbids harvest. However, Atlantic Salmon recovery in an endangered species context is analogous to rebuilding in a fisheries management context. Improving habitat, recruitment, spawning success, ecological conditions, and, in general, enhancing population abundance can be considered as options to manage for the success of a species along a spectrum of stock status (endangered, threatened, between threatened and overfished, overfished, not overfished). Many of the approaches used in the Atlantic Salmon recovery plan would be useful in a fisheries rebuilding plan and in fact would promote ecosystem approaches to rebuilding fisheries.

Additionally, the importance of salmon-oriented ecosystems to Atlantic Salmon recovery is illustrative as an example of EBFM. Atlantic Salmon recovery improves the situation for all of Maine's diadromous fishes and explicitly addresses tradeoffs within the fishery sector (recreational, international, aquaculture) and among other sectors (transportation, energy production, agriculture). Considering salmon-oriented ecosystems is related to many other fisheries management issues (e.g., river herring as forage, improved habitat for American Eel *Anguilla rostrata*). As the objectives of Atlantic Salmon recovery shift to the recovery of salmon-oriented ecosystems, then these activities will truly provide an example of EBFM. The mutually informative approaches from Atlantic Salmon conservation and EBFM can perhaps be taken-up more broadly as the International Year of the Salmon brings more attention to the status of salmon and salmon-oriented ecosystems worldwide.

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