IMPLICATIONS OF SENSE OF PLACE FOR RECOVERY OF ATLANTIC SALMON AND OTHER IMPERILED FISHES

By

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ABSTRACT

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Once chock-full of river herring and salmon, coastal river systems draining New England historically served as movement corridors for these and other highly migratory fish. Within the past four centuries, humans have methodically reshaped the region's rivers and their tributaries to enhance their capacity to transport raw materials, provide power, accommodate roads, and irrigate crops. These activities fragmented movement corridors, and reduced accessibility to and quality of critical spawning, rearing, and feeding grounds. As a result, the region's migratory fish community is, as a whole, imperiled and several species sit on the brink of extinction. Recovery of remnant populations and associated fisheries faces a unique challenge: motivating multiple human generations with no real recollection of or connection to these fish to invest significant resources into restoring their habitat. To better understand potential contemporary motivators, I surveyed over 300 Maine residents about the nature of their connections to waterbodies and fish within their *home turf* (i.e., the geographical area where they carried out their typical weekly routine). Due to frequent and customary interactions, this was the area expected to be most relevant to residents; for example, where they would be most likely to have established a sense of place, and be able to draw on social relationships to mobilize resources to restore or protect valued place attributes or waterbody features consistent with recovery of native migratory fish. The study findings suggest that today, waterbodies are almost universally valued as places to escape from day-to-day stressors. However, the native community of fish is not essential for this increasingly important need to be met. Sense of place literature suggests that

motivation to act on behalf of a place (and its fish) hinges on high attachment, coupled with low satisfaction. Surveyed residents were generally satisfied with contemporary waterbodies. Efforts to engage the public in recovering the native fish community can be made more relevant and therefore motivating by linking recovery to valued attributes like clean water and the health benefits of quality nature escapes. These efforts also need to redefine a new baseline against which waterbody health is measured by prioritizing connectivity from headwaters to the sea, natural hydrologic regimes, and robust native fish and wildlife communities.

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PREFACE

Using federally-endangered Maine Atlantic salmon (*Salmo salar*) as a case study, we explored the relevance of fish and waterbodies in residents' contemporary senses of Chapter 1 describes the rise and fall of wild anadromous Atlantic salmon in New England, with a focus on Maine—their final tenuous U.S. foothold. Their story, and what is needed to recover their lost legacy, cannot be told without first considering the advantages that a migratory life cycle afforded the native fish community; and how humans have, over the past four centuries, reshaped the landscape and vastly decreased the ability of native fish to draw life from its waters.

Chapter 2 introduces sense of place theories relevant to fisheries conservation, stewardship and sustainability. This chapter interprets the results of a survey titled "*A Survey of Maine Residents about "Home Turf" Conservation: unique places, waterbodies and networks of people*;" and incorporates models exploring the interaction between sense of place and public engagement in waterbody conservation within Maine drainages that historically supported robust populations of salmon and other ecologically-linked diadromous species. This chapter highlights the need to find common ground between the values humans associate with the landscape today and what a robust migratory fish community needs to thrive.

Chapter 3 is presented as published in "Sustainable Fisheries: Multi-Level Approaches to a Global Problem" (Mueller and Taylor 2011). In the context of Atlantic salmon recovery, this chapter discusses a broader need to revisit Aldo Leopold's "Land Ethic" philosophies and sustain the worldwide network of extremely diverse and regionally distinct fish communities.

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Absent from the Throne, the Lost Legacy of Anadromous Atlantic Salmon (*Salmo salar*) in New England: Can the King of Fish Re-Ascend?

This chapter describes the rise and fall of wild Atlantic salmon in New England, with a focus on Maine—their final tenuous U.S. foothold. The story of Atlantic salmon in the U.S., and what is needed to recover their lost legacy, cannot be told without first considering the advantages a migratory life cycle once afforded the native fish community; and how humans have, over the past four centuries, reshaped the landscape and vastly decreased their ability to draw life from its waters.

A Lost Legacy

"As species disappear they lose both relevance to society and the constituency to champion their revival, further hastening their decline" (*Waldman 2010).*

Today, "Atlantic salmon" is synonymous with a readily available and affordable food fish. Produced commercially in net pens along the coasts of Norway, Ireland, Scotland, Maine, Canada, Chile and Alaska, farmed Atlantic salmon have a growing presence in both the northern and southern hemispheres, as well as the Atlantic and Pacific Oceans. These individuals have spent their entire life cycle in controlled environments designed to maximize production efficiency, not survival in the wild. Atlantic salmon aquaculture has grown exponentially over the past several decades (Figure 1), with almost two million metric tons valued at $10 billion U.S. produced in 2004 alone (FAO 2006).

In contrast to their domesticated counterparts, wild Atlantic salmon have experienced precipitous declines, and both local and regional extinctions. It is estimated that range-wide returns of wild adults have declined by eighty percent (Parrish et al. 1998), and worldwide production of farmed Atlantic salmon now exceeds reported nominal catches of wild stocks (Figure 2) by 1,000 times (Kocik and Brown 2002).

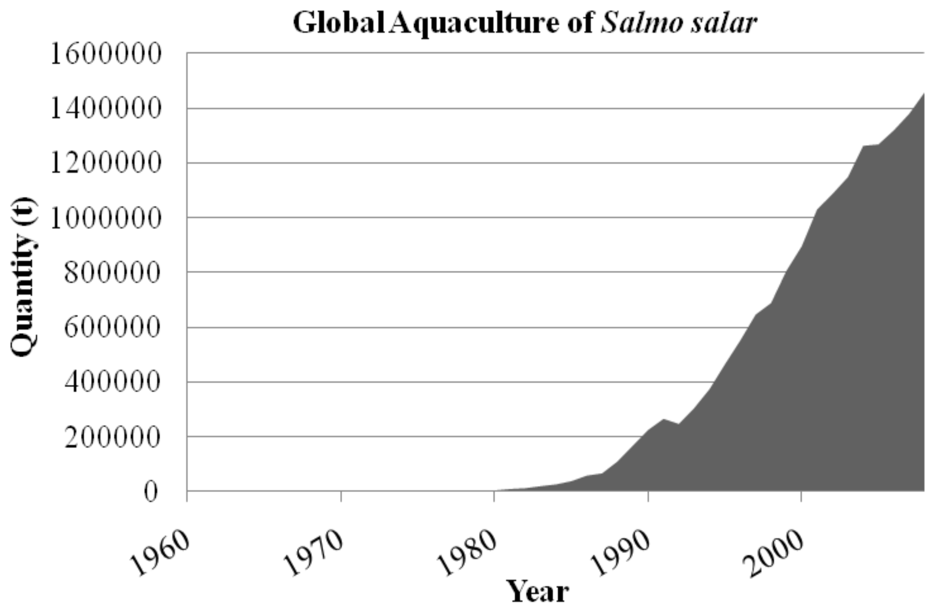

Figure 1. Global Atlantic salmon aquaculture production, 1960-2009 (FAO 2006, pre-1980 data; ICES 2010, 1980-2009).

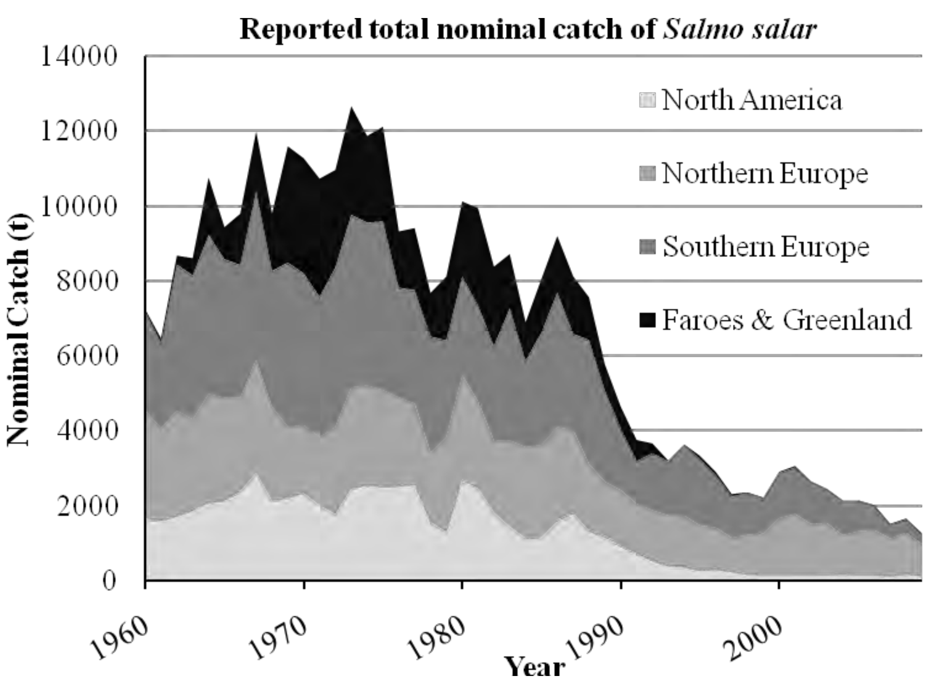

Figure 2. Reported total nominal catch of Atlantic salmon (tonnes round fresh weight) in four North Atlantic regions, 1960-2008 (ICES 2010).

It has become increasingly easy for society to be unaware of, or ignore, the plight of wild Atlantic salmon and the factors that have caused their crash. In particular, the decision to substitute wild with farmed food sources has been made easier as traditions and stakeholder identities linked directly to the usability of former have declined. For example, in New England, salmon and peas used to be a 4th of July staple (a tradition born by Abigail and John Adams in 1776) when people still relied on seasonal and locally-available food sources. Salmon clubs briefly extended the life of this tradition in Maine by purchasing farmed Atlantic salmon as an incentive for anglers to practice catch and release (Rzasa 1996). The Presidential Salmon tradition, where recreational anglers vied annually for the distinctive honor of catching the first wild Atlantic salmon of the season to be presented to the President of the United States, ended in 1992 (Baum 1997).

Pool-specific salmon fishing clubhouses that emerged in the 1800s and 1900s along Maine's coastal rivers once had long membership waiting lists. They now struggle to recruit new members to join the "old timers" that angled during the heyday of modern recreational salmon fishing in the 1960s, 70s and 80s. A salmon club member's statement in the wake of the Penobscot River's limited recreational fishery being closed in 2009 captured this trend: "...[It] *is the death bell of the salmon clubs on the river ‗cause, first off, there‗ll be less interest in the fish, but more so most of the members in the clubs are a lot older. How it works is the younger guys learn from the older guys. Unfortunately it‗s a tradition that‗s lost*" (Maine Watch 2009).

As traditions associated with wild Atlantic salmon decline and disappear, new traditions around non-native fishes better adapted to contemporary aquatic landscape features are poised to emerge. For example, non-native smallmouth bass (*Micropterus dolomieu*) thrive in Maine's rocky, coolwater, and now heavily impounded coastal river systems. Habitat restoration efforts targeting native alewife (*Alosa pseudoharengus*) have been met with opposition by some stakeholders that fear their recovery will negatively affect popular bass fisheries (Willis 2006). A major shift in the freshwater fish community from one dominated by native migratory species to non-native freshwater residents has coincided with the loss of their habitat and societal memory of the former.

Historical advantages of diadromy

The Atlantic salmon is one of a small minority (approximately 0.1%) of fishes worldwide that undertake extensive migrations between freshwater and marine ecosystems. Assuming free access between these systems, migration affords diadromous[1] (sea-run) species several advantages. For example, dispersing age-classes spatially and temporally reduces competition and cannibalism. Heterogeneous freshwater habitats provide juveniles with ample cover not available in pelagic ocean environments, and adults can greatly increase their growth potential by leaving freshwater systems to exploit abundant, prey sources of high nutritional value at sea (Gross et al. 1988).

Anadromous fish naturally tend to dominate the freshwater fish community in both number and biomass in those latitudes where ocean productivity exceeds that of adjacent freshwaters (McDowall 1996). Atlantic salmon biologists John Kocik and Ken Beland liken the diversity of freshwater niches once dominated by anadromous fishes in the Northeast to those of the Northwest. Alewives, for example, are similar to sockeye salmon (*Oncorhynchus nerka*) in that both species spawn and rear in headwater lakes. Likewise, American shad (*A. sapidissima*) and blueback herring (*A. aestivalis*) are similar to pink and chum salmon (*O. gorbuscha and O.*

[1] Greek: „dia' means „between' and „dromous' means „a running' (includes anadromous and catadromous species). The former spawns in freshwater and the latter spawns at sea.

keta) in their historical relative abundances and tendency to utilize the lower reaches of coastal rivers for shorter periods of time (Kocik, personal communication).

The native wild range of wild Atlantic salmon includes the North Atlantic Ocean and coastal river systems bounded by North America, Europe, and Scandinavia between 40-70°N (MacCrimmon and Gots 1979; Page and Burr 1991; Gross 1998). Migration routes, destinations, and timing; length of freshwater and marine residency; and age at maturity tend to vary greatly as a result of diverse environmental conditions across the north-south and east-west gradients of their range (Wedemeyer et al. 1980; Hutchings and Jones 1998; Verspoor et al. 1999).

The U.S. once supported at least four distinctly unique metapopulations that differed genetically, behaviorally, and physically (Fay et al. 2006). These differences were a function of natural selection favoring different traits within and among populations along the gradient of habitats present. This, coupled with a small percentage of individuals straying from their natal (birth) rivers to those nearby, resulted in a wide array of habitats being utilized and also increased the likelihood that at least some populations would rebound following a disturbance (Holling 1973; McElhany et al. 2000; Hilborn et al. 2003; Walker et al. 2004; Healey 2009). Analogous to asset diversity on the stability of financial portfolios, diverse habitat options result in a breadth of adaptive diversity within and among salmon populations (Schindler et al. 2010). For example, decades-long research by the University of Washington has shown that the resiliency of Alaska's Bristol Bay sockeye salmon stock complex is a function of the wide array of intact freshwater habitat available within nine major drainages (Schindler et al. 2010). The recognition of "distinct populations segments" (DPS) by the Endangered Species Act further speaks to the importance of diversity for species resiliency (Waples 1995; FWS-NOAA 2009).

Figure 3 typifies the life cycle stages of remnant U.S. Atlantic salmon populations. After one to three years at sea, adults return to spawn in their natal river between April and October; adult returns peak between May and July (Saunders et al. 2006; NOAA 2009). Spawning occurs between late October and mid-November. As this spawning period can be protracted, early arrivers require refuge from predators, high or inadequate flows, and high summer water temperatures. Adults will not migrate upstream in water temperatures that exceed 23°C and can die if temperatures reach 26-27°C for several days (DeCola 1970; Garside 1973). Habitat features that can provide critical refuge during the hot summer months include cold water springs and upwellings, pools, mouths of shaded headwater tributaries, large in-stream wood or overhanging trees, and undercut banks (NOAA 2009).

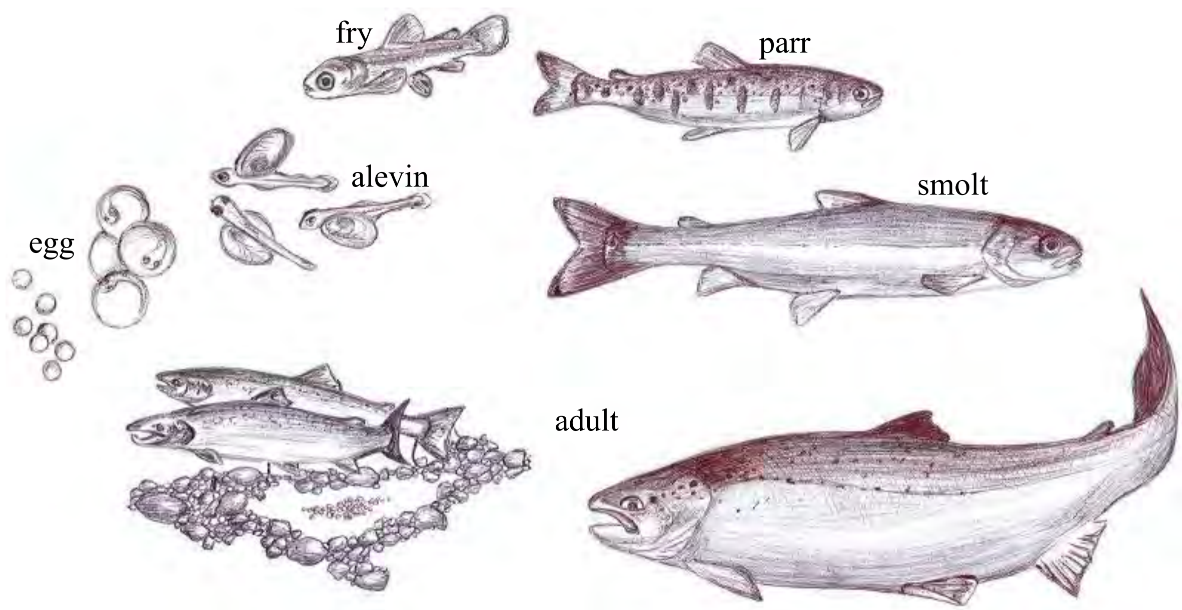

Figure 3. Typical life cycle stages of remnant U.S. Atlantic salmon populations.

When they are ready to spawn, adults find a suitable riffle and use their tails to disturb (and, in so doing, clean) an area of gravel that can contain multiple *redds* (nests). After spawning, they use their tails to bury[2] the fertilized eggs beneath approximately 12-20 cm of gravel. Here, developing embryos are bathed in cold (4-7.2°C), well-oxygenated water and protected from spring flood events that may scour the top several inches of substrate (DeCola 1970; Peterson et al. 1978; Danie et al. 1984; Elliot et al. 1991; NOAA 2009).

Embryos incubate in the gravel until the following March or April when they hatch. Termed *alevin*, or *sac fry*, they remain in the redd for several weeks (typically until mid-May) until depleting their yolk sac reserves and emerging as *fry* (Fay et al. 2006). Juveniles can utilize a variety of habitat types, but are commonly found in stream reaches where shallow, low velocity habitats are located near higher velocity areas. This maximizes the availability of drifting invertebrate prey and feeding efficiency (Marschall et al. 1998; NOAA 2009). As fry grow, they become territorial and develop lateral parr markings: at approximately 4 cm in length they are termed *parr* (Danie et al. 1984).

Approximately 90% of parr undergo a transformation called *smoltification* after two years in freshwater. The transformation from the parr to smolt life stage includes both morphological and physiological changes that aid the transition from freshwater to saltwater (Hoar 1976; Saunders et al. 1983; McCormick et al. 1998). Because of the osmoregulatory changes required for this transition, smolts are particularly sensitive to water chemistry (e.g., McCormick et al. 1998).

Smolts (typically 13-17 cm in length) migrate seaward between late April and early June (USASAC 2007). Mortality can be particularly high if physical barriers cause delays, unfavorable water chemistry conditions are present, or smolts fail to avoid the variety of estuarine and marine predators with which they have no prior experience (Anthony 1994;

[2] Large adults can dig deeper redds and thus better protect eggs from scouring events.

Hansen and Quinn 1998). The timing of the smolt emigration coincides with the upstream spawning migration of alewives, blueback herring, and American shad. Because of their similar size and much higher historical abundances, these anadromous clupeids could have provided a significant buffer against smolt predation (Saunders et al. 2006). As shown below, the legacy of salmon is interwoven with the community of native fishes with which they co-evolved, and so too will be their recovery.

Entering the Gulf of Maine, smolts consume a variety of prey, including juvenile Atlantic herring (*Clupea harengus*), euphausiids, and polychaete worms (USASAC 2007). From there, stocks from North America (<62°N) either move directly to feeding grounds off west Greenland and then overwinter in the Labrador Sea (Figure 4) or, as suggested in a recent review, enter the North Atlantic Subpolar Gyre and travel counterclockwise until returning to their natal river (Hansen and Quinn 1998; Dadswell et al. 2010). European and North American origin Atlantic salmon intermingle at sea, where they feed predominately on capelin (*Mallotus villosus*) and squid.

Approximately 10% of adults return to spawn after one winter at sea. Termed *grilse,* or one sea-winter (SW) salmon, these fish weigh an average of 1.8 kg and most (95-98%) are male. The majority of Atlantic salmon that originate in U.S. waters (over 80%) spend two winters at sea before returning to their natal river. These 2SW salmon are typically 71-76 cm in length and weigh 3.6-5.4 kg. Less than 10% return after three or more winters at sea, and the majority (55-75%) are females. These multi-sea-winter salmon can reach upwards of 13.6 kg in weight (Fay et al. 2006). Unlike their anadromous Pacific counterparts (with the exception of steelhead, *O. mykiss*), Atlantic salmon are capable of spawning multiple times. The proportion of repeat spawners varies as a result of dynamic environmental conditions. For example, repeat spawners comprised as much as 11% of the adult population that returned to Maine's Narraguagus River in the 1960s and the Penobscot River in the 1980s, whereas roughly only 3% of adults returning to Maine rivers today will ultimately spawn more than once in their lifetime (Fay et al. 2006). Of those that survive the stress of spawning, approximately 90% (referred to as *kelts*, or "black salmon" for their dark post-spawn coloration) will remain in the lower river zone restoring their energy reserves on available prey such as anadromous rainbow smelt (*Osmerus mordax*) before making their way back out to sea the following April or May (Fay et al. 2006).

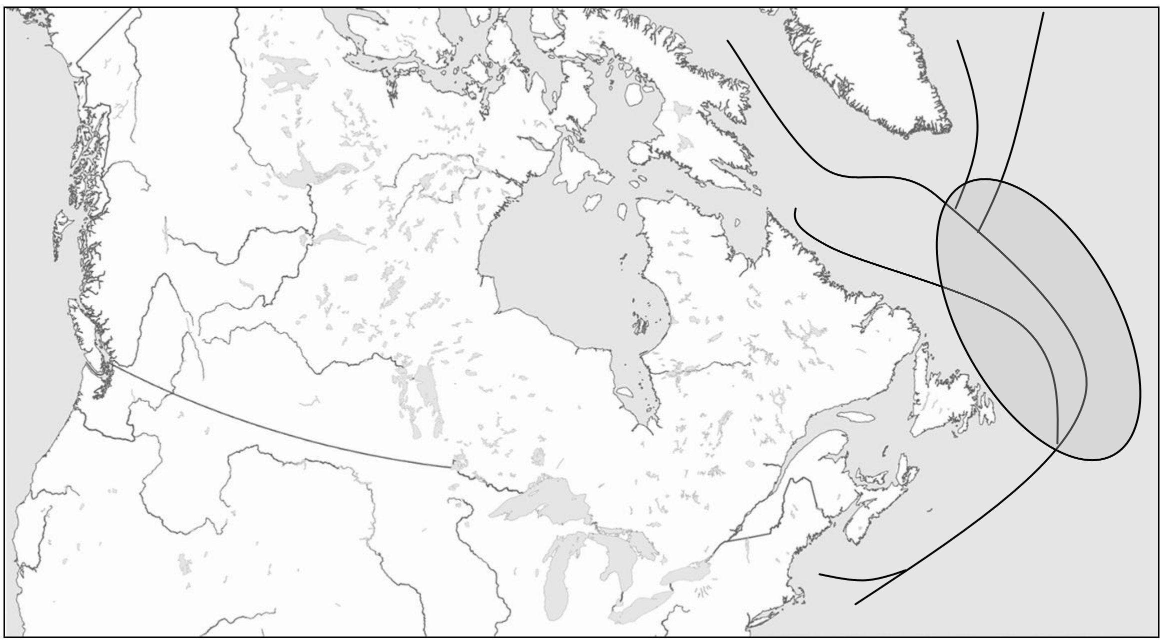

Figure 4. Generalized marine migration route for U.S./Canadian Atlantic salmon.

The Demise of New England's Diadromous Dynasty

> *"The salmon is one of the most valuable fish we have; yet…mankind seems more bent on destroying the whole race of them than that of any other animal, even those which are most obnoxious* (Cornish 1824, 4-5).

While a migratory life history strategy enabled wild Atlantic salmon and other diadromous fish to sustain a dominant presence in what is now New England for millennia, it has been detrimental when combined with those cultural norms and worldviews brought to the New

World by European explorers and settlers. In particular, utilitarian, exploitative, and linear development, Western notions of nature (i.e., dominion over nature), and liassez-faire capitalism reshaped the landscape and fish community (Rowe 1990; Gadgil and Berkes 1991; Hall et al. 2010).

For example, by the time the first Atlantic salmon was landed with a rod and reel in 1832 in eastern Maine, populations had disappeared altogether from southern New England and commercial fisheries would be, within a few decades, defunct outside a few rivers in Maine (McFarland 1911; Pawling 2007). High prices reflected their growing rarity, with the first Atlantic salmon taken from Maine's Kennebec River in 1840 being sold in Boston, Massachusetts for over forty dollars—equivalent to over $1,200 today (Montgomery 2003). In 1948, the year the Atlantic Sea Run Salmon Commission was created, the commercial harvest in Maine's largest river, the Penobscot, was only 40 fish weighing less than 225 kg; the commercial capture fishery that targeted returning adults was eliminated the following year (NRC 2004).

While salmon would continue to be targeted recreationally until the original Endangered Species Act listing of populations occupying Maine's small coastal rivers as Endangered in 2000, and then on a limited basis in the Penobscot River until the last limited season in 2008, several centuries of drastic changes to the New England landscape had taken its toll. Within several centuries, two of four unique U.S.-origin metapopulations had been extirpated, and salmon returning to spawn in New England had declined from upwards of an estimated 300,000-500,000 individuals annually at the height of their known historical abundance to an average of less than 2,000 annually in the last decade (Stolte 1981; Beland 1984; Kohler and Hubert 1999; Fay et al. 2006; USASAC 2010).

Because they feed on marine or estuarine prey sources of high nutritional value and abundance relative to freshwater prey sources, anadromous fish are generally large in size relative to those species that opt to remain in freshwater. Their size, coupled with predictable annual migration timing and concentrated spawning densities, made these fish particularly attractive as food and easy to capture at temporary camps or well-defined villages and towns in the vicinity of migration bottlenecks such as waterfalls or rapids (Gross et al. 1988; McDowall 1992; 1996; 2009).

For thousands of years prior to the Colonial Era, native peoples inhabiting the geographic area now known as New England, Quebec and the Maritime Provinces (i.e., the Abenaki, Penobscot, Maliseet, Passamaquoddy and Mi'kmaq) harvested Atlantic salmon and other diadromous fishes for subsistence. Harvested fish were eaten fresh and smoked for winter (Speck 1997; Montgomery 2003). While archaeological evidence and historical accounts suggest that some diadromous species were utilized more than others (e.g., Carlson 1988 and Robinson et al. 2009), having a diverse suite of sea-run species available for consumption allowed tribes and early settlers to utilize one species while another was at sea or experiencing natural population fluctuations (Verrazano 1524; Speck 1997; Montgomery 2003; Pawling 2007). This was true in the Pacific Northwest as well, where natural fluctuation in regional salmon abundance was dealt with via the foundation of salmon gift economies that equally distributed food throughout the region (Lichatowich 1999). Because human survival hinged on locally- and regionally-available food sources, the transfer of responsive, local ecological knowledge from one generation to the next was a necessity; today this is not the case.

Early European colonists harvested Atlantic salmon and other diadromous fishes locally for consumption. Atlantic salmon, because their native range includes Europe, was a familiar and valued table fish. Diadromous fishes provided an incredibly important inland food source for settlers that were attempting to establish new communities (Belding and Corwin 1921; Pawling 2007). In addition to being relatively easy to catch at migration bottlenecks, natural fluctuations in the abundance of one diadromous species could be compensated for by harvesting another species that was experiencing high abundances. For example, if unfavorable conditions in the north Atlantic Ocean resulted in natural depression of Atlantic salmon stocks, species with near shore migrations (e.g., anadromous rainbow smelt) or those that used a different ocean area (e.g., catadromous American eel, *Anguilla rostrata*) could be harvested in their absence. In fact, McFarland (1911) reported that, *"eventually the salvation of the colonists rested upon the abundance of…fish that were easily obtained"* (39), and *"…others without hooks and nets caught the fish with their hands, and were thus provided for until other kinds of food came"* (55).

Human population growth in the 1700s required a corresponding growth in food production. The need for fertilizer for crops also grew as plow-based agriculture began to exhaust New England's soil resources. Harvest pressure on Atlantic salmon and other abundant diadromous fishes that could be easily captured during spawning migrations increased to meet these needs (Cornish 1824; Montgomery 2003; Pawling 2007). This continued into the 1800s, with commercial fishers deploying hundreds of gill nets, weirs, traps, and pound nets in Maine's Penobscot River alone to capture in-migrating adults (Stolte 1981; Baum 1997; Montgomery 2003).

Atlantic salmon were not only directly extracted for food when returning to spawn, but also impacted indirectly via human activities occurring throughout the watershed. The benefits of diadromy in terms of enhanced growth, reproduction, and survival depend ultimately on the connectivity of required freshwater and marine habitats; a highly mobile life cycle quickly becomes disadvantageous when physical, biological, and/or chemical barriers delay or prevent movement and migration among critical habitats.

Timber extraction for shipbuilding and settlement in Maine began in the early 1600s, with the first sawmill dam built in southern Maine in the 1634 (Pope 1965). This industry was inextricably linked to river systems, with small headwater tributaries and large mainstem rivers alike being used to transport lumber to a growing number of mills located throughout any given drainage (Moody 1933; Clark 1970; Wilson 2001). While it was understood that rivers served as migration corridors for salmon and other native fishes, the ability of rivers to transport lumber downriver to mills, and later provide power for mills, factories, homes and businesses, was valued more (Figure 5).

Figure 5. Left, pine long logs being driven down the West Branch of Maine's Machias River, c. 1950; Right long log drive through Skowhegan Falls, Maine, c. 1865 (mainememory.net).

The use of rivers to transport logs was largely incompatible with the habitat needs of Atlantic salmon and other fish adapted to the cold, unimpounded freshwater river systems typical of the Northeast region. For example, natural stream features (e.g., meanders, boulders, roots, and log jams) provided cover and created heterogeneous habitat for salmon. These features also slowed the movement of logs to the mills and so were actively removed. To further enhance the movement of cut logs, vast networks of dams were put in place, with the resultant impoundments benefiting log driving efforts by widening and straightening the channel and storing water that could be used to flush logs downstream to the mills as needed (Wilson 2001).

While very effective in enhancing rivers as transportation corridors, impoundments not only hindered the movement of adults and juveniles among dispersed resources (e.g., food, shelter, refuge, overwintering habitat, and spawning grounds), but also depleted those resources (NRC 2004). For example, dams placed selectively across high gradient reaches to maximize head were not just barriers: they inundated key instream and riparian habitats and dewatered downstream reaches (Zorn et al. 2001). Impoundments drowned upstream riparian vegetation that formerly provided shade (critical in keeping summer water temperatures tolerable) and leaf litter inputs (a key food source for aquatic insect prey preferred by juvenile Atlantic salmon and other native fish); converted fast, cold and well-oxygenated riffle/run habitat ideal for reproduction feeding on drifting insects to slow backwaters; altered natural flow regimes; interrupted natural transport of sediment, root wads, and other organic matter; and warmed water temperatures.

Pine logs up to two meters in diameter (Wilson 2001) moving downstream in enormous volumes scoured and homogenized stream channels, further decreasing habitat complexity that had already been actively reduced to improve log drives, or indirectly altered as a result of changing land cover and hydrological regimes. This was to the detriment of all life stages of Atlantic salmon, from staging adults seeking refuge to juveniles relying on insect drift.

Log driving was ubiquitous in New England by the 1800s; by the 1830s there were approximately 1,300 sawmills in Maine alone (Montgomery 2003). By the 1860s there were over 3,000 manufacturing establishments in Maine (mostly mills) harnessing hydropower (Wells 1869). While the log driving era ended in the 1960s, its legacy still remains. For example, initial assessments in eastern Maine suggest remnants of these structures are geographically widespread, continue to alter hydrology and act as barriers to juveniles during certain or all times of year (Figure 6).

Figure 6. A remnant log drive dam located on a tributary to the Machias River in Eastern Maine before its removal in 2010 (photo by K. Mueller).

The end of the log drive era in the 1970s coincided with the construction of extensive road networks to access commercial forest stands and transport lumber. For example, in eastern Maine, the Stud Mill Road (the main artery for commercial truck traffic transporting lumber between the easternmost U.S./Canadian border and Milford, Maine) was constructed in 1970. Roughly 150 miles of commercial forest gravel roads were added per year in this area for approximately 15 years. Because corporate landowners St. Regis and Champion International were aware of the significance of salmon habitat in main-stems and larger tributaries, the road network was designed to run parallel to these tributaries; road crossings of these waters were kept to a minimum and primarily consisted of bridges with minimal impact to fish passage. However, this resulted in roads crossing virtually all first- and second-order streams relatively close to their confluence with larger tributaries (Koenig, personal communication).

It is now known that these headwaters streams are significant to all freshwater life stages of salmon in that they provide cold water refugia, rearing habitat, and movement corridors; deliver sediments, nutrients, organic matter, and wood from upper portions of the drainage; and moderate temperature regimes (Kircheis and Liebich 2007). Traditional round culverts tend to be inadequate from a fish passage standpoint, with common design flaws of culverts surveyed to date including: excessive distance between the outlet and water surface or excessive jump height to pool depth ratios (jump barrier); constricted and/or high flows or lack of roughness through the crossing (velocity barrier); insufficient water depth in the crossing or subsurface flows in the vicinity of the crossing (depth barrier); excessive aeration at the outlet (turbulence barrier); or inadequate/excessive attraction flows at the outlet/inlet or lack of light (behavioral barrier). Road crossings that fail to incorporate new stream simulation design standards (e.g., Bates et al. 2003; VDFW 2007) also reduce the quality and quantity of critical headwater habitats by altering stream hydrology and associated processes (e.g., sediment transport) (Figure 7). Consequently, the National Research Council (2004) ranked roads second only to mainstem dams as the most significant impediment to salmon recovery.

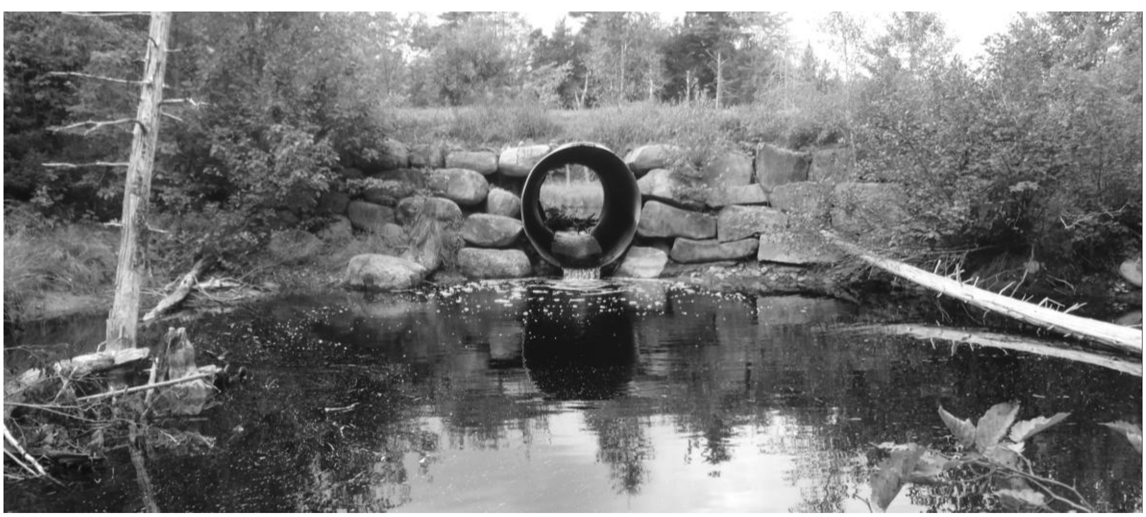

Figure 7. Traditional round culverts tend to be undersized relative to bankfull conditions and placed above the streambed, causing fish passage barriers during some or all flows and altering/fragmenting natural flow regimes and stream processes (photo by K.Mueller).

Developers began to construct hydroelectric facilities to serve factories, paper mills, and towns in the late 1800s. Like the log drive dams, hydropower dams caused delays in (or completely prevented) migration and seasonal movements between feeding, over-wintering, and spawning areas (Figure 8), and also decreased the suitability of habitat for native fishes adapted to free-flowing systems (Walter and Merritts 2008).

Log driving, road building, and the harnessing of hydroelectric power are just some of many human activities that have resulted in a reduction in the quality, quantity, and connectedness of spawning and rearing habitats and therefore salmon production dynamics. For example, industry, towns, and agriculture depended on rivers to bring raw materials on site, provide power and water for drinking and industrial processes, and ship products and carry point and non-point sources of pollution downstream.

Figure 8. An Atlantic salmon attempting to pass Caribou Dam in Aroostook County, Maine, c. 1900 (mainememory.net).

While not intentionally directed at harming the region's native fish community, these activities altered New England's coastal river systems at a scale and rate that was not compatible with species conservation and fisheries sustainability. As an observer during the 1850s, when Maine was leading the nation in lumber production, noted that "*…dams, saw-mills, and other obstructions, the result of Yankee enterprise, have driven them [Atlantic salmon] from the United States…New England traded its salmon for milldams and factories"* (Montgomery 2003, 21). This same statement can be applied to other diadromous species needing free upstream and downstream passage as well. For example, Maine's State Fish Commissioners concluded that not one of Maine's rivers "*maintained its fisheries in a fair degree*" (Foster and Atkins 1869, 71-72), and implicated dams as the principal cause of migratory fish losses in Maine (Atkins and Foster 1868). Thirty years earlier, Williamson (1839) had reported that American shad were taken "*in all our rivers, till their spring-runs were checked by dams…*" (160).

In the late 1800s, it was estimated that only 10% of original spawning habitat remained (Atkins 1887) and that "*…insurmountable dams, the pollution of water by manufacturing plants and the sewage of cities, agricultural operations…cause the waters to become muddy during the spawning season, and the extensive fisheries usually placed at the mouths of rivers*" being the major culprits (McFarland 1911, 216). Belding and Corwin (1921) echoed these findings: *"In Massachusetts practically all the coastal streams were formerly frequented by this fish [alewife], but as a result of the activities of man, it has been exterminated in many localities"* (11).

Habitat destruction, exacerbated by overfishing, had in fact exterminated two of four U.S. metapopulations by this time: loss of Connecticut River stocks in the early 1800s and Merrimack River stocks in the mid-1800s marked the extirpation of the Long Island Sound and Central New England DPSs, respectively (Stolte 1981; Meyers 1994). Historical catch records indicate that the Gulf of Maine DPS was on its way to a similar fate; Maine's Penobscot River (its largest coastal system) was only sustaining catches of approximately 34,000 kg (approximately 6,000 average sized returning adults) per year (NRC 2004; Fay et al. 2006).

Recommendations to restore Atlantic salmon were straightforward: do not over-fish them or poison their water, allow them passage, and restock where necessary (Foster and Atkins 1869). Fifty years later, these same issues still persisted with Belding and Corwin (1921) identifying the four prominent causes of declining populations of anadromous alewives as: "*(1) destruction of spawning grounds; (2) obstructions which prevented returning adults from accessing spawning grounds; (3) pollution of streams, and 4) overfishing, the result of unwise regulation*" (47)…They suggested "*the first step in the reconstruction of the alewife fishery is the removal of existing obstructions, to make a clear passage-way…*" (60).

While laws to protect anadromous fish were enacted as early as the first half of the 1600s, they were not adequately enforced. Belding and Corwin (1921) cited the Marston's Mills Herring River in Massachusetts as an example, and also hinted at a larger problem—human indifference: "*The neglect of the town officials to force the cranberry bog owners to respect the rights of the alewife fishery has been the principal cause of the depletion… The inevitable result was the ruin of the fishery because the fish could not get to the spawning grounds…The attitude of the town officials was but the reflection of the indifference of the majority of the people who did not care whether the fishery existed or not. Because of its depleted condition…no one had purchased the fishery since 1903…Without co-operation upon the part of the coastal communities all cultural efforts for its restoration are useless*" (52-53).

Stocking of Atlantic salmon and other sea-run species to counter declines was initiated in the mid-1800s (New York Times 1894; McFarland 1911; Belding and Corwin 1921). Adults were (and still are) intercepted on their way up river to spawn and their gametes extracted and taken to conservation hatcheries to be reared and eventually re-released into their parents' river of origin. While stalling declines and preserving some genetic continuity, conservation hatcheries only provided a "band aid" as hatchery-reared individuals are ultimately stocked into habitat that has been made largely unsuitable and fragmented (Fay et al. 2006). Further, intervening in the natural life cycle of Atlantic salmon removes opportunities for natural selection to act on both juvenile and adult life stages, and therefore stifles the dynamic processes by which the adaptive diversity necessary for resiliency is created.

Even though the latter half of the 20th Century was considered one of the most productive times for recreational angling in Maine (Table 1), catches were low; an average of only 400 salmon a year would be caught during this time period from all rivers draining the Gulf of Maine (Baum 1997). Targeting fish below dams or natural barriers (e.g., Rzasa 1996), or in pool refuges, recreational salmon fishing was a social activity and status builder for successful anglers that landed the so-called "Fish of a Thousand Casts" or, better yet, the Presidential Salmon (Rzasa 1996; Baum 1997; Beland and Bielak 2000): "*You may have to wait over two hours before it is your turn to fish. There is a rod rack with numbers, and when you arrive at the pool, you place your rod at the bottom, finding six or seven rods already on the rack at 4:00 a.m.!...There are benches to sit on over-looking the pool...you might hear a loud call from the benches: Rotate.*" (Rzasa 1996, 35-36). Both social and secretive, "*flies proudly displayed were not necessarily the files that ended up in the water*" (35). Minimum estimates indicate that recreational anglers, most of whom (greater than 80%) did not practice catch and release, removed 20-25% of adults returning to the Narraguagus, Machias and Penobscot Rivers during the 1960s, 70s and 80s (Baum 1997; NRC 2004).

While commercial fishing for Atlantic salmon was eliminated in U.S. waters by 1950, adults originating from the U.S. and Canada were still vulnerable to capture in international waters. In the 1960s, the feeding grounds of Atlantic salmon in the Atlantic Ocean were discovered, and an international commercial fishery rapidly expanded off the coast of West Greenland, in the Northern Norwegian Sea, and near the Faroese Islands. This fishery has since become the focus of an international treaty agreement which sets limitations on harvest and provides a forum for cooperation between those countries with jurisdiction over salmon-producing rivers and those bordering the marine feeding and over-wintering areas (Colligan et al. 2008).

Table 1. Years with highest recorded recreational catches of Atlantic salmon in Maine.

River	Drainage area (miles^2)	highest reported catch (year)	# caught (reported)	% released (reported)
Androscoggin	1,502	1983/6	3	67
Kennebec	5,869	1990	106	57
Sheepscot	320	1966	40	0
Ducktrap	36	1986	25	40
Penobscot	8,610	1990	1,106	61
Union	500	1973	75	0
Pleasant	85	1961	45	0
Narraguagus	232	1959	167	0
Machias	460	1961	133	0
East Machias	251	1959	87	0
Dennys	132	1980	210	10

In 1982, the final version of the "Convention for the Conservation of Salmon in the North Atlantic Ocean" was adopted and resulted in the creation of a new inter-governmental organization, the North Atlantic Salmon Conservation Organization (see http://www.nasco.int/). A major provision of the Convention with the most immediate effect was to prohibit fishing for Atlantic salmon beyond the areas of fisheries jurisdiction (i.e., 12 nautical miles from land) of member nations: Canada, Denmark (in respect of the Faroe Islands & Greenland), the European

Union, Norway, the Russian Federation, the U.S., and Iceland (the latter withdrew in 2009). This provision resulted in the immediate elimination of the capture fishery that had been taking place in the northern Norwegian Sea, and was harvesting approximately 1,000 tons of Atlantic salmon in 1970 alone. However, a shift in ocean conditions in the late 1980s and early 1990s, and subsequent decrease in marine survival, brought populations that were already at critically low levels and at risk of crashing throughout North America to the tipping point (Chaput et al. 2005; ICES 2010).

Current Status

Fragmentation and alteration of freshwater habitat critical for spawning, egg incubation, juvenile rearing, and migration have significantly affected all fishes native to the Northeast U.S., including both sea-run and resident species (Foster et al. 2003; Limburg and Waldman 2009). In fact, over half of New England's native diadromous species are formally listed as endangered under the U.S. Endangered Species Act, candidates for listing, or as Species of Concern (Table 2). Others (e.g., American shad and Eastern brook trout) have experienced local extirpations, and are well-below historic levels (Moyle and Cech 2000; Williams et al. 2007).

Table 2. The status of over half of the species comprising New England's native sea-run fish community is formally recognized as poor or of concern by the National Marine Fisheries Service.

Common Name	Conservation Status
Alewife	Species of Concern
American eel	Species of Concern, status review pending
Atlantic salmon	Endangered
Atlantic sturgeon	Species of Concern, candidate for listing
Blueback herring	Species of Concern
Rainbow smelt	Species of Concern
Shortnose sturgeon	Endangered

The human activities described above have contracted the U.S. range of wild Atlantic salmon approximately two degrees north in latitude and four degrees east in longitude (Fay et al. 2006). Over a century and a half after the Long Island Sound and Central New England DPSs were extirpated, the Gulf of Maine DPS was listed as Endangered under the Endangered Species Act. The Outer Bay of Fundy metapopulation that inhabits watersheds spanning northern Maine and parts of Atlantic maritime Canada has experienced significant declines as well (Fay et al. 2006) and is likely to soon be listed as a species "of concern" as per draft documents of the Committee on the Status of Endangered Wildlife in Canada (Kocik, personal communication).

While their current status in New England is often summed up by the phrase "death from a thousand cuts," Atlantic salmon are affected most by range curtailment, simplified river channels resulting in altered habitat forming processes, altered fish communities, physical habitat that favors predatory invasive species, recently unfavorable ocean conditions, and inundation of spawning habitat (e.g., Fay et al. 2006). Sufficiently diverse, accessible, and suitable freshwater habitats are especially critical during times of unfavorable ocean conditions and poor marine survival. The latter can vary greatly by year and stock as a result out-migrant quality, predation, variation in marine prey, changing marine temperature and salinity regimes (Friedland 1998; Friedland et al. 1998; Hansen and Quinn 1998; Lackey et al. 2006), and climate change.

Today, suitable[3] freshwater habitat considered fully accessible[4] to the Gulf of Maine DPS is estimated at only 8.1% of historic levels. This number does not take into account culverts or unsurveyed/undocumented dams, so the amount of fully accessible, suitable habitat is actually

[3] Habitat that received a qualitative functional habitat unit score of a 2 or 3 on a scale of 1-3, where 3 is fully functional (see NOAA 2009 for a detailed description of scoring methodologies).
[4] Habitat that does not have impeded access (e.g., habitat that does not require passage through a fishway to access it).

less (Trinko, personal communication). This estimate is also an average for the Gulf of Maine DPS's entire range. For recovery to occur, a minimum number of adult spawners must be present in each of three distinct geographical areas, or Salmon Habitat Recovery Units (SHRUs). Each SHRU has its own uniquely distinct geology, water chemistry, hydrology, zoogeography, and anthropogenic influences (NOAA 2009). It is estimated that less than 5% of the total habitat units considered suitable for salmon are considered fully accessible in two of the three SHRUs (Bentivoglio, personal communication). Put in terms of asset diversity on the stability of financial portfolios, the Atlantic salmon is extremely high risk (see the Schindler et al. 2010 "portfolio effect" theory).

Progress made towards conserving Atlantic salmon to date includes fishing restrictions and closures at-sea and in home waters, removal of and/or fish passage improvements at several large dams, improvements in culvert design, reductions in point sources of pollution in the U.S. as a result of the Clean Water Act, and maintenance of the Gulf of Maine DPS gene pool via conservation hatchery production. These however, have not been enough to recover remnant U.S. populations. Recovery hinges on significantly increasing the distribution of Atlantic salmon within rivers and across their native range (USFWS and NOAA 2009). The life history, genetic, and morphological diversity needed for resiliency will require geographically widespread restoration of the abiotic and biotic habitat features and landscape processes upon which salmon depend for completion of their life cycle. Because human-induced freshwater habitat alterations and associated changes to the New England fish community are so sweeping, this will require significant societal investment into strategic restoration of freshwaters that flow through private, municipal, and public lands. This cannot be accomplished without a major shift in how the segment of society that is interested in Atlantic salmon recovery and habitat restoration communicates with and engages the other, larger segment of society that, to date, has not prioritized meeting the needs of migratory fish despite their ecological, cultural, and economic importance and potential. Motivating geographically widespread public investment in habitat restoration to benefit wild anadromous Atlantic salmon, now largely absent within their native range, continues to rest on society's will and ability to integrate their needs into contemporary human values and senses of place. By exploring sense of place associated with waterbodies and the contemporary freshwater fish community in Maine, Chapter 2 highlights the need to find common ground between the values humans associate with the landscape today and what a robust migratory fish community needs to thrive.

CHAPTER II

Is There Still a Place for Fish? Changing senses of place and implications for recovery of Atlantic salmon and other native species on the brink

Introduction

People have long been linked to fish and the waters they inhabit, with communities being strategically situated for ease of access, and their individual and collective identities being intimately tied to associated fisheries and places. In Maine, the Penobscot Nation contended that access to sea-run fish that migrated past the islands below Old Town Island on the Penobscot River to reach their spawning grounds each year was the most important advantage to their residence; archaeological remnants of riverside pits where catadromous American eel were held in preparation for smoking still mark the locations of temporary camps and permanent villages (Speck 1997; Pawling 2007). Relative to historical abundances, these fish are largely absent today as a result of human activities that fragmented their movement corridors and blocked their annual migrations. However, New England and Maritime Canada place names still bear evidence of their former significance to people (Table 1). In the Pacific Northwest, sentiments about salmon indicate that, at least to some people, fish, and place are still inseparable: *"The Pacific Northwest is simply this: wherever the salmon can get to"* and "*In the Northwest, a river without salmon is a body without a soul*" (Egan 1990); *"When I look at a salmon, I don't just see a silver fish, I see the Northwest"* (Lichatowich 1999).

Places, and the ways in which people modify them, dictate the quality, quantity, and accessibility of habitat available to fish; shape fish community structure; and drive fisheries productivity. Increased access to fisheries resources originating from distant places and aquaculture operations has shifted human reliance away from native resources available locally and on a seasonal basis, and weakened the person-fish-place connection. For example, local ecological knowledge about fish and their habitat needs has become less essential and we have been able to move away from "living off the land" and relying on local resources, to just living *on* it while relying on those originating from elsewhere.

Table 1. Examples of tribal place names in the Northeast and Maritime Canada that reflect historical usage of seasonally-available native fisheries.

Wabanaki word	**Translated meaning**	**Places bearing name today**
Kenduskeag	eel weir place	Maine township and stream
Mattamiscontis	alewife stream	Maine township and lake
Damariscotta	many alewives	Maine township and river
Cobbosseecontee	place where sturgeon are found	Maine lake and river
Misquamicut	place where salmon are caught	Rhode Island beach
Plumweseep	salmon river	New Brunswick river

Because fish—perhaps more so than any other animal—are valued for their direct consumptive utility to humans, they are particularly vulnerable to people becoming disinterested in their well-being when that utility decreases, or is failed to be perceived. Today, recreational anglers that directly utilize and interact with fish when they are in their natural habitat make up less than 15% percent of the U.S. population, and recruitment and retention of new anglers is declining nationally (USFWS 2007). Largely invisible in their natural habitats and to non-anglers, fish found in the marketplace are often literally faceless, their origin unfamiliar, unstated, or unimportant to today's buyer. Atrophying awareness of native fish and their habitat needs has significant implications for their conservation. Waldman (2010) said: "*As species disappear they lose both relevance to society and the constituency to champion their revival, further hastening their decline.*" The term "disappear" can be interpreted literally, as in physical declines or extinctions, or figuratively, as in a loss of presence in our day-to-day lives.

Theoretical Foundation

From a fisheries conservation and management standpoint, places in practice tend to be areas of biological relevance, for instance waterbodies, watersheds, basins, biomes and their associated biophysical attributes and processes (e.g., climate, water budgets and routing, nutrient cycling, and predator-prey relationships). However, the essence of a place includes more than the physical attributes of its landscape and associated biological community: it also incorporates the social and psychological experiences and interpretations that people associate with it (Figure 1) (Proshansky et al. 1983; Stedman 2002; 2003). As Gieryn (2000) said, "*place is, at once, the buildings, streets, monuments, and open spaces assembled at a certain geographic spot and actors' interpretations, representations, and identifications*" (466-467).

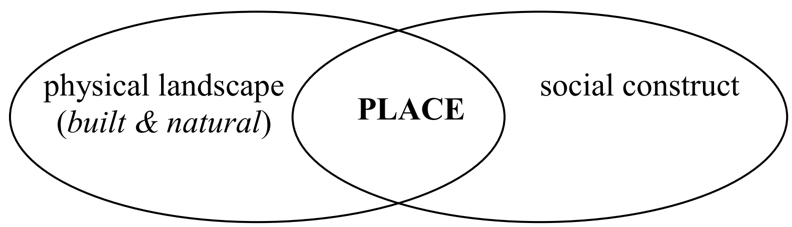

Figure 1. Place can be thought of as a physical space imbued with meaning.

In fact, some view places primarily or solely as products of human interpretation. Namely, space becomes a place only after people assign meaning to it (Ryden 1993). For example, Greider and Garkovich (1994) view landscapes as symbolic environments that are created as people confer meaning on nature and the environment. Rogan et al. (2005) said "*a place is its people*" (34), and Gieryn (2000) explained that "*places are made as people ascribe qualities to the material and social stuff gathered there*" (472). Humanistic geographer E. Relph (1976) described places as products of human memories and affections that arise from repeated encounters and complex associations. As direct interactions between people and fish decline, we can expect to see fish increasingly absent in social constructions of place. This has implications for how fisheries professionals sustain and communicate the relevancy of their programs to the public for whom they are managing trust resources.

Places also focus, and are products of, social interactions. As described by Butz and Eyles (1997, 2), places are "*where one is known and knows others*"—a medium "*through which social life happens*" (Gieryn 2000, 467). As foci, places can actively bring people together or passively constrain them to interact (Feld 1981). Social interactions influence behaviors, including those that directly and indirectly shape fish habitat, species composition, and fisheries productivity. Feld's focus theory would postulate that the individuals associated with a particular place would tend to become interpersonally tied and form a cluster, with important implications for collective action. For example, creation of a reservoir with a dam may result in non-native smallmouth bass becoming established and people buying shoreline property. The reservoir may focus shoreline owner interactions and result in the formation of an organized lake association, or fishing guides may organize around the new fishery and develop a clientele. Over time, stakeholders build traditions and memories around the fishery, reservoir, shoreline, or the outlet dam itself. Fear of change may lead to opposition of any perceived threat that may alter what these groups value, including restoration efforts that seek to restore historical habitat features and reestablish now unfamiliar native species via alterations to, or removal of, the outlet dam. Likewise, when the object, or focus, of a river community (e.g., historical fisheries) is lost, the community itself is forced to evolve as interests necessarily disperse and needs are met via other means (e.g., non-native fisheries, non-consumptive river uses). For river communities whose way of life has been closely linked to an intact and productive native fishery and ancestral past, this loss may threaten the core of their collective identity. The Penobscot Nation, for example, shares the name of the river their ancestors depended upon for sustenance. Their way of life has been interrupted by the dams that impounded the river and blocked the spawning migration of native fishes to which their subsistence needs and way of life were tied.

The structure of these social networks, for example their size, whether they are closed to outsiders or restrict entry, and the rate of member immigration and emigration can affect the generation of social capital and influence how norms develop over time to prevent (or enable) social dilemmas and resource degradation (Ostrom 1998; Portes 1998; Ostrom 2000). For example, people can draw on their social capital and enlist others to help enforce norms that restrict the overexploitation of common resources or help free embedded resources (such as information or manpower) held by members of the collective (e.g., Nickelsburg 1998; Ostrom 1998). One of the best known examples of network structure influencing a fisheries commons can be found in Maine, where tightly knit coastal communities and "gangs" of lobster fishermen self regulate who participates and enforce strict codes of conduct to sustain the fishery (Acheson 1988).

Places also form the basis for community by locating human interactions and sentiments (Agnew 1987; Entrikin 1991; Butz and Eyles 1997). Eyles (1985) postulates that place, people and their institutions, and a sense of belonging, are the salient elements of community. Likewise, places are shaped, and evolve, via group social processes such as development, negotiation, and enforcement of norms. According to Proshansky et al. (1983), how people interact with a place (or act on behalf of it) is "*a function of what other people do, say, and think about what is right or wrong and good or bad...*" (60). McCay and Jentoft (1998) stated that "*community exists, it counts, and it shapes the nature and outcomes of commons problems*" (23).

The collection of sentiments that individuals or groups associate with a place is referred to as a *sense* of place (Williams and Stewart 1998; Stedman 2002; Farnum et al. 2005).

Williams and Stewart (1998) suggest that this field of study has a wealth of applications in natural resource management, including a framework for managers to "*anticipate, identify, and respond to the bonds people form with places*" (18). Despite a broad array of definitions across such fields as environmental psychology, sociology, humanistic geography, and forestry, most include one, several, or all of the following constituent elements of place: attachment, satisfaction, identity, and meaning.

In the context of sense of place, attachment is generally thought of as a bond between people and a place (Williams et al. 1992; Moore and Graefe 1994) based on affect (how we feel) (Lawler and Yoon 1998; Milligan 1998; Farnum et al. 2005; Hernández et al. 2007) and cognition (how we think) (Proshansky et al. 1983). Past experiences and memories associated with a place and the potential future experiences imagined and anticipated to be possible in a setting (i.e., expectations) influence attachment (Milligan 1998). Biophilia literature suggests that attachment also arises directly from the physical environment. For example, certain environmental attributes (e.g., open plains and waterbodies) are more appealing than others from an evolutionary standpoint as these are the areas where we could catch game, see predators easily, and access fresh water (Wilson 1984; Gullone 2000).

Place satisfaction captures the attitude-like dimensions of place cognitions. As an attitude, place satisfaction can be thought of as a summary evaluative judgment of, for example, the ability of a place (the attitude object) to meet certain basic needs (Guest and Lee 1983; Farnum et al. 2005). The concept of place satisfaction mirrors what some have termed *place dependence*, i.e. the fit between one's intended use of an area and the area's ability to support that use relative to other places (Farnum et al. 2005).

Places can play a critical role in the definition of self (Cheng et al. 2003). Environmental and social psychologist Harold Proshansky (1978) defines place identity as "*those dimensions of self that define the individual's personal identity in relation to the physical environment by means of a complex pattern of conscious and unconscious ideas, feelings, values, goals, preferences, skills, and behavioral tendencies relevant to a specific environment*" (155). Place identity can thus be thought of as an interpretation of self that uses environmental meaning to symbolize or situate identity (Cuba and Hummon 1993) or incorporation of place into a person's larger concept of self or identity (Proshansky et al. 1983). Place identity is evident when people describe themselves in terms of feeling „at home' (Cuba and Hummon 1993) or „belonging' to a specific place (Buttimer 1980; Hernández et al. 2007) as a result of shared social values and sentiments (Butz and Eyles 1997). Important places may become so crucial to our self-definition that a place-person merger may occur (Stedman 2002). Identifying with a place (or a collective, as in Frank 2009) can have a powerful influence on both individual and collective actions (Gieryn 2000; Cheng et al. 2003) that are both the cause of, and solution to, commons issues that frequently impact fisheries resources.

Finally, place meaning encompasses both symbolic and evaluative beliefs (Stedman 2002), as well as instrumental and intangible values (Cheng et al. 2003). Stedman (2003) suggests that both experience with a setting *and* the physical characteristics of a setting shape meaning. For example, Stedman's (2003) findings regarding the influence of the lake-rich landscape of north central Wisconsin on sense of place found that the physical environment served as the basis of meanings.

The interplay between these elements (Figure 2) is thought to have significant implications for behavior towards and within a place (Williams and Stewart 1998; Stedman

2002, 2003; Cheng et al. 2003; Hernández et al. 2007) and, consequently, the fish that live there. For example, we attribute meaning to space and, in turn, become attached to those meanings (Stedman 2002). Likewise, meaning underpins satisfaction: people make judgments of place quality based on expectations that arise from the meaning assigned to it. Place attachment and satisfaction are thought to influence behavior in a place independently via cognition and affect. For example, studies suggest that those with strong, positive place attachment and low satisfaction are most likely to say they would act on behalf of a place (or its fish). The low satisfaction (or threat of declining satisfaction) is a key motivator in that it generates a sense of urgency to act. People with low attachment to a place, regardless of satisfaction, are less likely to act, as are people with high satisfaction, regardless of attachment.

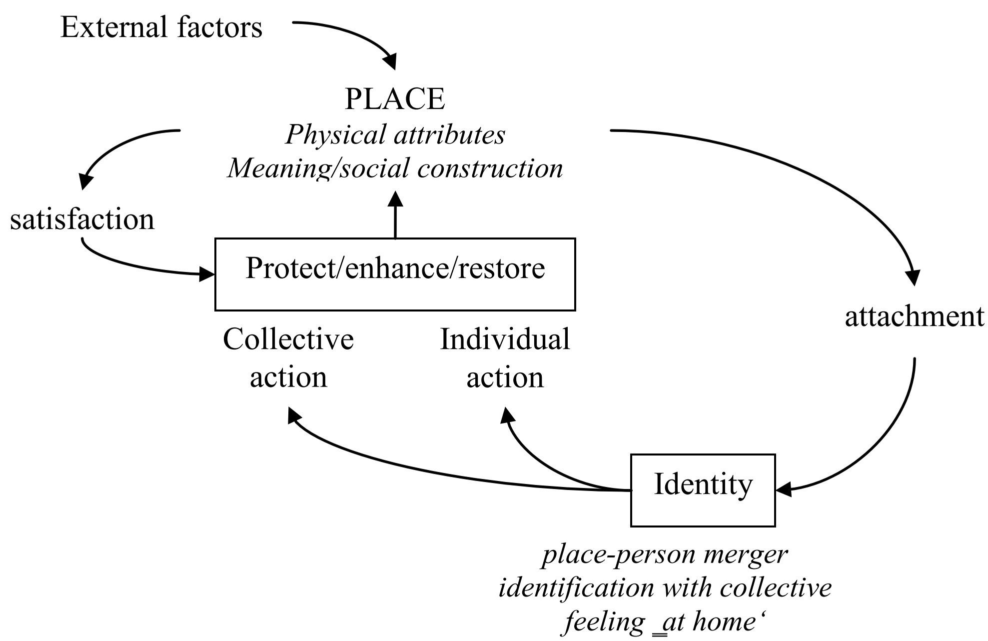

Figure 2. Conceptual schema of sense of place informed by literature review.

The literature described above clearly illustrates that human connections with natural resources (including fisheries) and associated landscapes are multifaceted, complex, and saturated with meaning. Fish populations and fisheries are dynamic—when they are depleted, their day-to-day meaning and salience to humans can decline. Response actions (e.g., dam removal to restore connectivity along a migratory corridor) have the ability to create, transform, restore or even destroy the meanings of places and likewise can be met with hostility, enthusiasm or indifference. People's ongoing, dynamic relationship with the land (i.e., their sense of place) is a critical piece of information fisheries managers and habitat conservationists need to 1) understand the conditions under which the public may support or resist changes that arise from their actions (Preister and Kent 1997; 2001; Rogan et al. 2005), and 2) develop communication plans that are relevant and effective. If place meanings less and less incorporate associated inland, nearshore, and pelagic fisheries resources, it will become increasingly imperative that fisheries interests consider places, and the sense of place they foster, when seeking to advocate for species recovery/conservation and habitat restoration.

Study goal and objectives

Using the endangered Gulf of Maine DPS of Atlantic salmon as a focal point, I explored the salience of fish in contemporary senses of place, and implications for the conservation of native fishes experiencing declines or on the brink of extinction. This study was motivated by the need to understand ways in which residents sharing the landscape with endangered Atlantic salmon might be motivated to invest in the geographically widespread restoration of their habitat.

With the goal of determining what features of waterbodies that historically supported salmon are relevant to, and valued by, residents today, I identified their contemporary connections to the geographical area they considered their *home turf* (i.e., where they carry out their typical weekly routine). Due to frequent and customary interactions, this is the area where residents were expected to be most likely to establish a sense of place, and have social relationships to draw on to mobilize resources to restore or protect valued place attributes or waterbody features that are consistent with salmon recovery. Environmental historian William Cronon (1995) describes "home" as where : "…*we make our living…the place for which we take responsibility…try to sustain so we can pass on what is best in it (and in ourselves) to our children."*

The objectives of this research were to 1) qualify respondents' relationship to their home turf in Maine; 2) describe the relative salience and value of fish to residents; 3) characterize the contemporary significance and meaning of home turf waterbodies in residents' lives and their attachment to and satisfaction with those waterbodies; and 4) relate attachment and satisfaction to behavioral intentions (i.e., likely engagement in waterbody conservation).

Methodology/Research Design

Phase 1: Exploratory Interviews

I conducted exploratory interviews with fifteen Maine residents representing state and federal agencies, academia, non-profit organizations, commercial forestry, and environmental consulting firms. The interview format was semi-structured to allow for topic flexibility and follow-up questions during the interview. Participants were interviewed in their home or office and topics included Atlantic salmon as a conservation "poster child" and efforts to engage the public in recovery to date. Emergent themes were used to shape the study focus and inform the development of the survey instrument.

Phase 2: Survey Instrument

A draft survey instrument was informed by the exploratory interviews and piloted with ten individuals sharing characteristics of likely respondents (i.e., members of salmon clubs watershed councils, and non-members) in 2008. The pilot served to: 1) determine what scale was fine enough so that respondents could bound in detail on a map the outline of their home turf and, at the same time, coarse enough that it would encompass their entire home turf; 2) identify the optimal survey length; and 3) eliminate jargon, clarify questions and concepts, and improve overall user-friendliness. The latter was primarily aimed at reducing the effort costs to respondents that might result in them discarding the survey, as suggested by Dillman (2007).

Another ten individuals were recruited to help assess the draft survey instrument. The project goals and need to pilot the survey prior to full implementation were explained in person. No incentive was provided and all individuals approached agreed to participate. Pilot participants ranged in age from 26-80, had variable histories in Maine (i.e., born in Maine/never left, born in Maine/left/returned, or immigrated to Maine from somewhere else) and included small business owner (coffee shop, bed and breakfast), sales associate, cashier, college student, high school biology teacher, former stay-at-home mom turned substitute teacher, local newspaper reporter, postal worker, and retiree. Two of the ten were active in either a salmon club or watershed group.

Six pilot participants completed the survey in person and were requested to "talk aloud" as they took the survey. This allowed for documentation of their immediate reaction to the survey questions, design and layout. The other four took the survey on their own time and were directed to complete the survey in one sitting, time themselves, and take note of general user-friendliness and any questions or directions that need clarifying. Approximately one week after pilot participants received the survey and directions, an in-person meeting was scheduled to obtain their feedback regarding survey design. Meeting locations for both sets of participants (talk-aloud and take-home) were determined by participants and included a library, places of work, participants' homes and public eateries. Following each in-person meeting, the draft instrument was modified to incorporate participant feedback. The talk-aloud and take-home approaches were complementary as the talk-aloud approach avoided reliance on participant recall for feedback and the take home strategy allowed for the gauging of the survey's length.

The finalized survey instrument (Appendix A) was approved in 2008 by Michigan State University's Social Science/Behavioral/Education Institutional Review Board (IRB). The 16-page survey weighed 1 oz at the time of printing and was structured as an 8.5 in by 5.5 in booklet that could be closed by the respondent, sealed, and returned. To maximize respondent convenience, one 1-inch diameter white mailing seal and a first class stamp were included. In accordance with IRB requirements, the Maine Game of Chance Office was contacted and subsequently granted approval for me to conduct the proposed $500 drawing incentive. The survey consisted of open-ended, yes/no, and 5-point Likert-scale questions.

The survey cover read, "*A Survey of Maine Residents about* "*Home Turf" Conservation: unique places, waterbodies and networks of people*" and a hand written note stating "*Postage provided!*" was included at the top of each survey. A short description on page two explained that the survey targeted Maine residents age 18 and older "*about their connections to the place they live (i.e., their 'home turf'), particularly waterbodies and other people*" and that their participation would play a role informing the development of relevant tools and opportunities for public engagement in stewardship of waterbodies within the historic range of Atlantic salmon. As determined in the pilot, the approximate length of commitment to complete the survey (15-20 minutes) was also included. A consent statement approved by the IRB on April 24, 2008 (IRB #05-260) indicated that the survey was voluntary and anonymous. Respondents were informed that they would receive one entry into a drawing for $500 if they completed and returned the survey, and one entry if they completed the one-page bonus section at the end of the survey. Two tickets for the drawing were printed on page three and indicated that any contact information participants provided for the drawing would only be used for the purposes of that drawing. Finally, a note stating "*many thanks in advance for your time*" was included as a token of appreciation as recommended by Dillman (2007). Following the introductory pages, the survey was broken into the following sections:

Defining home turf. Respondents were asked to identify their home turf by outlining its boundary on a map insert. The following statement provided respondents with guidance regarding the outlining of their home turf boundary: *We define HOME TURF as 'the geographical area in which you carry out your* ***typical*** *weekly routine.' In other words, the place where you live, work, get together with friends, shop day-to-day, recreate outdoors locally, exercise, attend religious services etc.* A unique map was created for each target township in ArcGIS, glued onto the facing page, and folded in half. Maps included township boundaries and names, roads (interstate, state highway and local), rivers, and lakes (these layers are available at the Maine Office of GIS: http://megis.maine.gov/catalog/). As identified in the pilot, maps with a scale of 1:680,000 generally provided enough detail whereby respondents could easily identify major roads, lakes and rivers they might use/see throughout the duration of their weekly routine and was also sufficiently large enough to encompass most home turf boundaries. This exercise provided a context from which respondents could describe their relationship with their home turf and the waterbodies/fish within. It also provided information about what types of boundaries were spatially relevant to residents living in historical range of Atlantic salmon (e.g., watersheds, roads, townships, or counties).

Home turf attachment and satisfaction. Respondents were asked to indicate how well a series of statements described their home turf (e.g., "*There are a lot of familiar faces here*," "*I feel 'at home' here*," "*I do **ALL** of my outdoor recreation here*"). They were also asked a series of questions about their history in their home turf, including length and type of residency, and the degree to which different factors (e.g., natural resources, people, and work opportunities) influenced their home turf attachment. Finally respondents were asked to indicate the relative likelihood of three future scenarios: "*You will still be living here, in your home turf, as you are now," "You will be living somewhere else in Maine,"* or *"You will be living somewhere outside the state of Maine."* This three-part question assessed the likelihood that respondents were going to stay in their home turf and be available to participate in waterbody conservation.

Salience and value of home turf fish. Respondents were asked to identify their home turf's most distinguishing natural landscape and manmade/built features, as well as the animals that most contributed to their home turf's character. We expected these to be features and fauna identified with "home" and most salient on a day-to-day basis. In particular, we wanted to determine how waterbodies, dams, and native and non-native fish species would populate these responses. Respondents were also asked to identify their experience with fishing and what about fishing they found most rewarding (non-anglers were given the option to describe the benefits of healthy fish/fisheries if they had not had a fishing experience). Anglers were asked to identify up to three species they tended to target and why. They were also asked to identify three fish species found in Maine waters they valued most and why, three species they valued least and why, which sea-run fish had the greatest real/potential value, and what that value was.

Characterizing sense of place associated with home turf waterbodies. After respondents identified their home turf and the nature of their relationship with it, they were asked to "*think of the waterbody or collection of interconnected waterbodies located in your home turf that you, yourself, value the most*" and answer a series of questions about associated uses, attachment, satisfaction, and meaning. For example, to establish the nature of their attachment to home turf waterbodies, respondents were asked to identify the degree to which the waterbodies they valued played an important role in various aspects of their weekly routine.

Waterbody satisfaction was likewise established by asking respondents to indicate the degree to which they were satisfied with various waterbody attributes including the following: water quality, ability to support animals and plants they value, public accessibility, outdoor recreational opportunities, surrounding development and overall health. Because satisfaction is related to knowledge and perceptions about what is good and bad, respondents were also asked to identify three traits of healthy waterbodies. They were also asked to indicate the degree to which 1) they felt fish were indicators of water quality, 2) their activities at home or in the workplace affected home turf waterbody water quality, 3) the impact of various factors on water quality (e.g., the legacy of past industries and land-uses, present-day forestry practices, present-day industry, suburban sprawl, roads, presence/absence of native sea-run fishes, and dams). Respondents were also asked to indicate their perceptions of the net effect of home turf dams on local and regional conditions (e.g., water quality, character, economy, public safety, native plants and animals, Gulf of Maine fisheries), as well as the net effect of reviving sea-run fisheries on those same conditions. They were also asked to identify their three primary sources of information about local waterbodies.

Finally, waterbody meaning was established by asking respondents to indicate the degree to which waterbodies symbolized the following to them: economic vitality, a healthy community, the heart of the community, a pristine wilderness, or an escape. Respondents were also asked to describe, in open-ended format, what about the waterbody they identified was most valuable to them and why, what (if anything) would increase its value to them, and what (if anything) threatened to degrade what they valued.

Behavioral intentions. Respondents were asked to indicate the degree to which they would be willing to help conserve a valued home turf waterbody by engaging in the following activities: joining an organized group, following rules and regulations, practicing voluntary "backyard" conservation, taking part in a landowner stewardship program, enlisting the help of others (e.g., friends/neighbors), using peer pressure to hold others accountable, participating in informal town meetings, participating in formal public hearings, and contacting public officials. They were also asked to indicate the likelihood that they would ask neighbors, work-related friends, members of groups in which they were currently active, active community members/leaders, and members of conservation groups for help conserving a waterbody located in their home turf, and also who of these listed they would help if asked.

Because many of these actions have a social component, we assessed respondents' social networks by asking them to identify up to three organized groups with which they were currently active in their home turf, and indicate the number of active members (0, 1-5, 6-24, and 25+) and meeting frequency. They were also asked to think about any in-person socializing they did in their home turf ("*beyond small talk*") and indicate the frequency of interactions, closeness of friendships, and number of people they socialized with in each of the following groups: family, neighbors, work-related friends/colleagues, group members, active community members/leaders, and members of local conservation groups. They were also asked to indicate if they regularly socialized with locals born in Maine with long family history there, permanent residents that were not born in Maine and seasonal residents. Exploratory interviews suggested these were distinct groupings of people with potentially separate social networks.

Study Area, Sampling Frame and Survey Distribution

Several criteria were considered when defining the study area and establishing a sampling frame. These included 1) selecting a geographical area that was relevant from a salmon recovery standpoint; 2) incorporating a home turf mapping exercise at a fine enough scale to adequately understand respondents' sense of place within their home turf; 3) inclusion of both permanent and seasonal residents; and 4) budgetary constraints.

To ensure the study area was relevant from a salmon recovery standpoint, we aligned it with the boundary of the GOM DPS's historical freshwater range. This area includes all coastal river systems from Maine's Androscoggin River in the southern part of the state to the Dennys River at the U.S./Canadian border (NOAA & FWS 2009). These systems comprise three Salmon Habitat Recovery Units (SHRUs) distinguished by their uniquely distinct geology, water chemistry, hydrology, zoogeography, and anthropogenic influences. For recovery of the GOM DPS to occur, each SHRU must support a minimum number of adult spawners (NOAA 2008). This framework also aims to promote resiliency by ensuring a wide distribution of salmon across diverse habitats to lessen the vulnerability of the overall population to localized environmental variation.

All organized townships falling within this range were assigned a number using a random number and a random number generator from which forty were randomly chosen to implement the survey instrument. The randomly selected townships ranged in population size from 51 residents to 31,000 and include inland, coastal and coastal island locations. Unorganized townships[5] were not included in the selection (Figure 3).

Stamped surveys were distributed at venues where residents would be expected to purchase food or gas, such as supermarkets, "superettes," convenience stores, quick stops, one-stops, and general stores (see examples in APPENDIX B). Permission was obtained by store owners or managers to display the survey at the check-out area. A unique identifier was hand-written on the surveys at the time of delivery. This facilitated the identification of 1) when (date) and 2) where (i.e. venue and township) returned surveys had been distributed. This method of distribution enabled us to draw not only from residents of a particular township but also others that had a home turf that encompassed that venue. Where townships had more than one venue, survey distribution was geographically widespread. Some study townships did not have distribution venues. In these cases, surveys were distributed at the nearby venues in neighboring townships.

Surveys were also delivered to active members of salmon clubs (i.e., those in attendance of salmon club banquets and monthly meetings), watershed councils and land trusts. These groups included the Eddington, Penobscot and Veazie Salmon Clubs; the Penobscot Conservation Association; the Lower Penobscot, Cove Brook and Sheepscot River Watershed

[5] While these areas have an extensive commercial land management infrastructure, they are sparsely populated and land use is regulated by Maine's Land Use Regulation Commission.

Councils; and the Great Pond Mountain Conservation Trust and Sheepscot Valley Conservation Association. These groups were targeted to ensure they were represented in the population sample and determine how, if at all, their members differed from the general public and what implications these differences might have for future restoration activities.

Data Analyses

The survey responses were summarized and interpreted using a combination of descriptive and inferential statistics to characterize respondents' contemporary senses of place and meet the objectives described above. Several data reduction techniques were employed. For example, open-ended questions were categorized by topic to identify emergent themes and patterns. Factor analyses were also conducted to identify potential ways in which to group responses to questions with multiple sub-questions. For example, the nine potential behavioral intentions related to engaging in waterbody conservation (e.g., enlisting the help of others and joining an organized group) were tested for correlations and a reliability analysis and factor analysis conducted in SPSS was used to identify potential groupings. Once the survey data had been summarized and reduced, the exploratory interview findings, sense of place literature was used to guide a univariate analysis of variance. This technique was used to identify the linkage (or lack thereof) between sense of place and action on behalf of waterbodies (and, indirectly, fish).

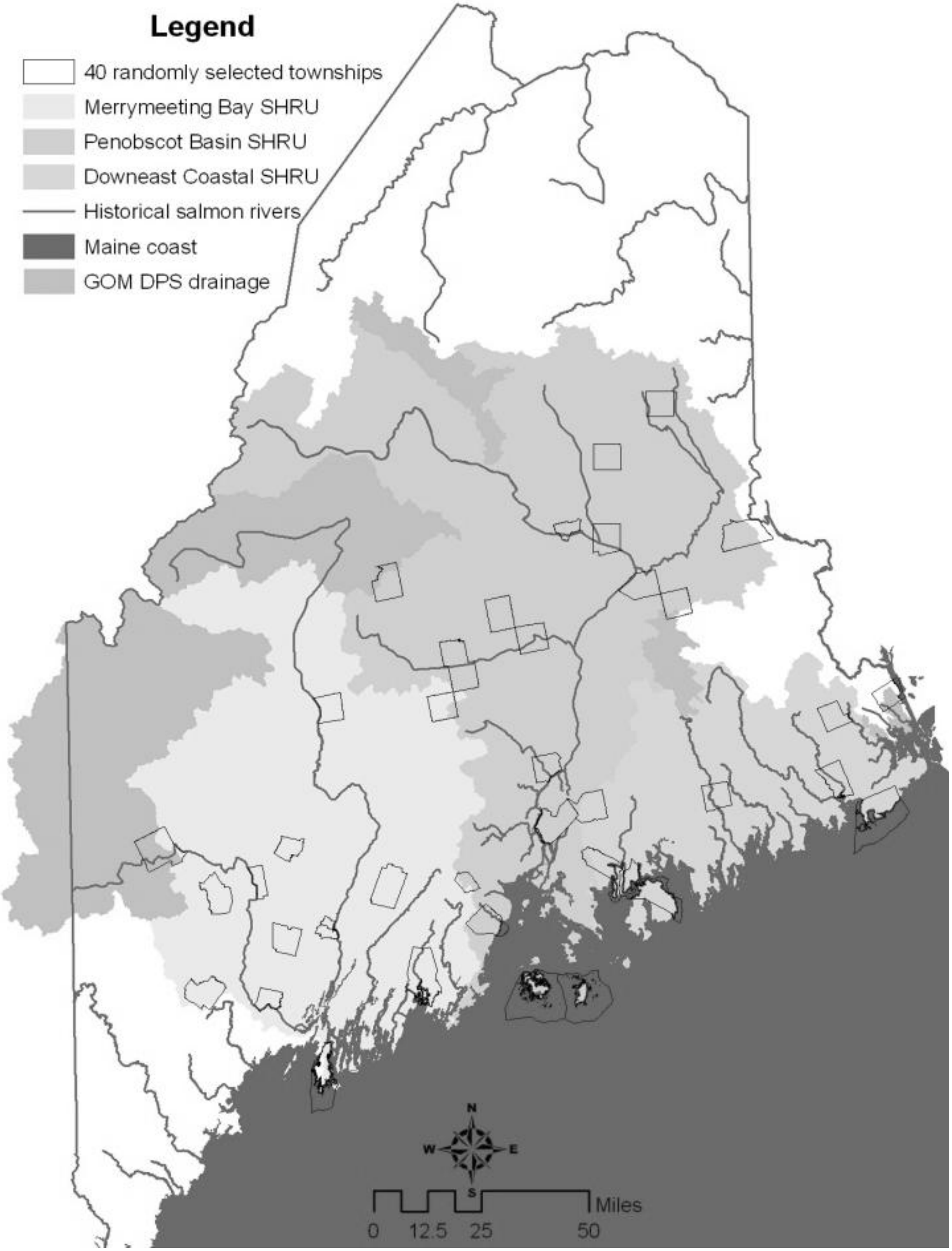

Figure 3. Map depicting 40 randomly selected townships and three SHRUS as they fall within the historical range of the GOM DPS.

Results

Phase 1: Exploratory Interviews

Exploratory interviews indicated that two false assumptions have been made by Atlantic salmon interests that seek to engage a broader segment of the public in their recovery: 1) wild Atlantic salmon are motivational to a broad segment of society and 2) watersheds are a relevant boundary within which to engage people in activities that benefit salmon. For example, when asked what might motivate a resident to join one of the salmon-centric watershed councils that emerged from the 1997 Maine Atlantic Salmon Conservation Plan (MASCP), one interviewee explained: *"**I don't know and I mean that*** [emphasis in voice] *because I don't know if I would be on the council. If I had some other job in life, if I was a pharmacist, would I be interested? I don't know...I think they'll tell you that they care about the health of the watershed...I think you'd be very hard pressed to find people who care about salmon."*

Describing a trip to the Pacific Northwest, another interviewee articulated the lack of salience and motivational power of Atlantic salmon on a day-to-day basis in Maine relative to what she observed of Pacific salmon in the Northwest: *"It was wonderful...the fish* [in the Pacific Northwest] *you can see* [laughed]*...And they're this big* [gestured to indicate large size]. *And I think that has a lot to do with it...I think a lot of the older folks that remember seeing them* [Atlantic salmon] *are dying off. They* [Atlantic salmon] *aren't tangible."* Another, when asked if Atlantic salmon were an effective conservation icon for habitat restoration, indicated that they were a catalyst for people fearing the potential impacts of an Endangered listing on state industries (e.g., forestry) to rally around the MASCP. However, at the time of the interview, the 2000 listing of the GOM DPS as endangered on the Endangered Species Act had not had the negative impacts that were initially feared. This interviewee questioned whether the Atlantic salmon was still an effective conservation icon if people's initial motivation to support conservation initiatives was based on fear that turned out to be unfounded, adding that *"change scares people – you either need to get them in their pocket book or meet their own values."*

The relevance of using watersheds as a platform to engage people was also questioned: *"There is not much, if any, identification with watersheds. It doesn't really mean anything to residents. Really, people identify with towns. And the Narraguagus* [River] *itself. They call the river and its estuary The River. The tributaries are less important as far as identifying with something..."* Another interviewee commented on the failure of some watershed councils to recruit and retain public members: "*there is no local ownership. They did not originate from the ground-up*." This statement refers to the call by the MASCP to create "grassroots" watershed councils as a means to bolster local governance just prior to the 2000 listing. These watershed councils were to include "*all interested stakeholders*" that would cooperatively guide land use and other activities within each watershed in partnership with state and federal agencies (MASCP 1997). One person said the groups that emerged as a result of the MASCP have been dependent on government, instead of community members like a grassroots organization should be, for support. "*They didn't develop basic resources like fundraising skills that would be required to get public support...*" Another interviewee explained, "*there is a lack of strong leadership...civilian leadership*." At meetings, it is not uncommon for state and federal agency representatives to outnumber the public, and the majority of watershed councils have struggled to maintain active participation (Demont 2005). This lack of public engagement in certain groups points to a lack of relevance, or failure to adequately communicate the relevance of their mission to a broader audience.

That sense of place was motivating various public's actions also emerged during the interviews. For example, one interviewee described support for habitat restoration mobilized within two small watersheds, 36 and 11 square miles, respectively: *―Ducktrap and Cove Brook* [watershed council members] *are passionate about their special place.*" She also alluded to differing senses of place and potential implications for recovery when she said, *"there's tremendously strong social stuff Downeast...the butting of heads between those with an environmental ethic of protection/wise use and then agriculture/fishing—consumptive: a strong sense of place but different perspectives."* Interviews also suggested that elements of sense of place, particularly attachment and satisfaction, were likely important drivers of public engagement (or lack thereof) in recovery efforts: *"When I talk to people, they want to keep it the way it is, you know,* "my family is from here."*"*

The statements below illustrate that societal memory of a place can change over time with potentially important implications for motivating people to engage in restorative actions that target species on the brink of extinction. For example: *"things* [contemporary habitats] *look good...but they're not. There are spruce/fir forests without any spruce. There are small firs and red maples – they look good and provide shade and some functionality. The trees are small though and don't create habitat or change channels because they are all less than 50 cm [diameter at breast height]...the Sheepscot* [River] *is productive, but that's driven by anthropogenic factors. The productivity has changed in the estuaries with lack of fish coming in, really it's all connected."*

A lack of contemporary connections to waterbodies and historically-important fisheries was identified as a potential challenge to recovery of salmon in Maine: *"In Sheepscot, kids don't even know which river is the Sheepscot."* A Downeast resident explained, when asked how much interest there was in restoring historically significant fisheries: *"Stueben, just down the road, used to be the biggest harbor in East Coast…it was the same with Milbridge. People are not so attached to this anymore - they're mostly attached to lobsters now where it used to be cod and long lining."* Another interviewee expressed a need to *"… keep residents in touch, connected. Get them to buy into why [Atlantic salmon] recovery's important."*

Phase 2: Survey Instrument

Three-hundred and twenty seasonal and permanent residents living within the historical range of the GOM DPS returned the questionnaire. Approximately two-thirds (67.3%) of respondents acquired the survey in their township of residence. The other third tended to live in adjacent or nearby townships (the venue at which they acquired the survey fell within the boundary of their home turf). Some townships showed high levels of fidelity, such as Phippsburg (a coastal peninsula), where all respondents that acquired a survey in the township were also residents there. Trenton Township, on the other hand, has a large grocery store on the main artery between Ellsworth and Bar Harbor/Acadia National Park that is frequented by commuters and vacationers. All respondents that acquired a survey in there resided in an adjacent township (e.g., Lamoine or Bar Harbor).

Each of the three GOM DPS's SHRUs was proportionally well-represented based on land area: 19% of respondents resided in townships within the Downeast Coastal SHRU, 45% lived within the Penobscot Bay SHRU, and 33% were residents of townships located in the Merrymeeting Bay SHRU. Three percent of respondents resided in townships outside the GOM DPS boundaries (i.e., in the Central New England DPS or St. Croix Department of Fisheries and Oceans Recovery Unit), but their home turf overlapped the GOM DPS.

The ratio of female to male respondents (50:50, n=312) corresponded with Maine's slightly higher female to male ratio (51.2% female). Accounting for respondents that were members of salmon clubs (90% male, n=28), females represented just over 53% of the sample population. Non-salmon club members who provided age-related data (n = 283) ranged in age from 18-93 years with a mean age of 50 and median[6] of 53. Salmon club members tended to be older, with a mean and median age of 65.

Respondents' age at their first contact with their current home turf ranged from birth to 69 years with a median of 23 years and a mean of 24 years. The total amount of time respondents had spent in their home turf ranged from only one year or season to over 90: the median home turf residency was 23 years with a mean of 26 years. Almost three quarters of respondents had immigrated to their current home turf from another part of Maine or out-of-state. Of those born in their home turf, only five percent had left for more than four years before returning. Almost half (47%) of home turf immigrants arrived between the ages of 25 and 44. Because the survey was not printed and implemented until August 2008, our sample population was primarily comprised of year-round residents (90%).

Respondents represented 17 of the 20 categories of professions described in the North American Industry Classification System. Additionally, 12 respondents were stay-at-home parents, seven were students, six were self-employed, six were disabled, and five were seeking employment. The number of jobs held by respondents ranged from one to three. While the age structure of our general public sample did corresponded with the State of Maine's latest census estimates, individuals of retirement age (including salmon club members) did make up a larger portion of our total population sampled than the state's average: twenty percent of respondents

[6] The 2010 Census identifies the median age of Maine residents, including youth under age 18, as 43. The survey instrument only targeted persons 18 and older so the median ages of Maine residents and survey respondents is comparable.

listed their primary occupation as retired. Some retirees did provide past employment history and had since been re-employed in second careers or on a part time basis.

Home Turf Attachment and Satisfaction (Objective 1)

Respondents' home turfs ranged in size from smaller than a township to larger than multiple counties. Home turf border types included township and county boundaries, natural landscape features, generalized circles, and, most frequently, roads systems (Figure 4). Commonly driven routes (e.g., between home to work) tended to bound respondent's home turf and cross or border the waterbodies identified as valued. Similar to Gieryn's (2000) findings, these areas tended to bounded by the sequences of places along one's daily rounds (e.g., home, work, recreation, socializing). In no cases did home turf boundaries align with watershed boundaries.

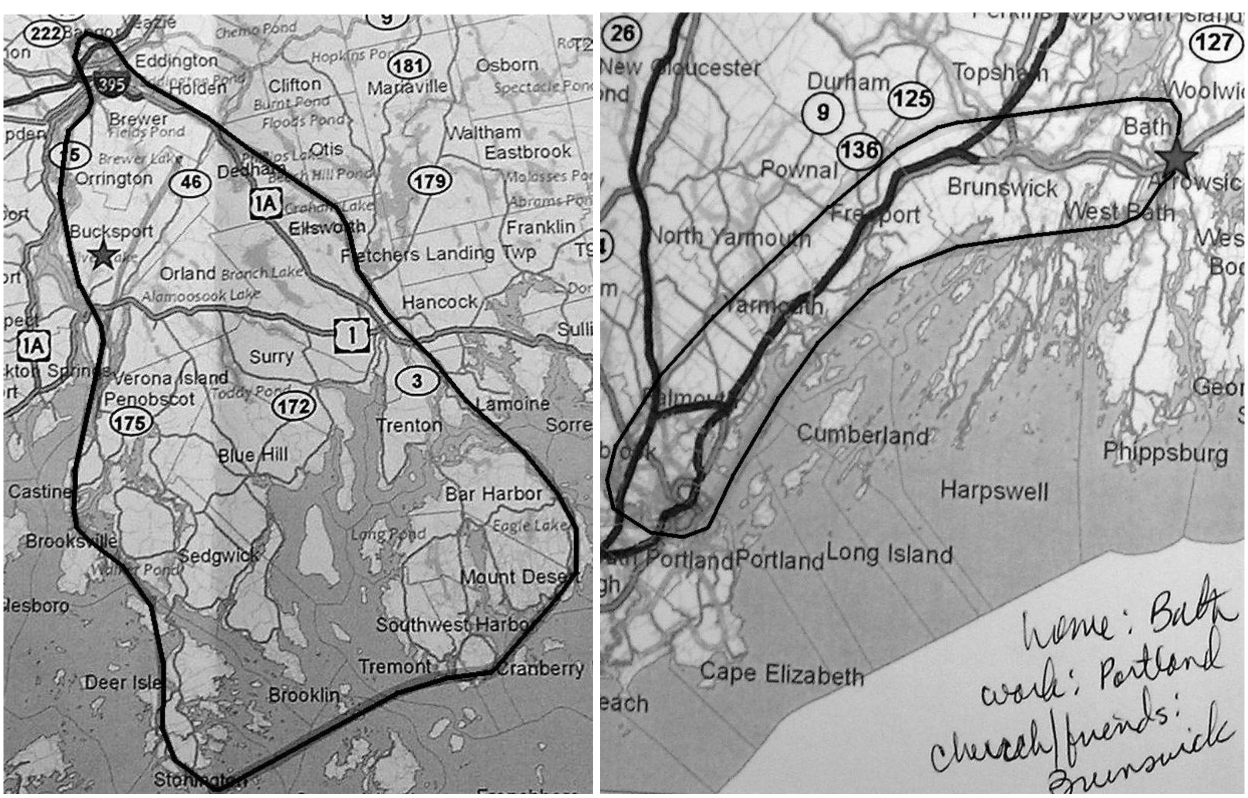

Figure 4. Examples of different home turf boundaries drawn by respondents.

Over 80 percent of respondents indicated that the statement ―*I feel at home here*” described their home turf well (i.e. selected 4 or 5 on a 5-point Likert scale, with 1 being *not well* and 5 being *very well*). Likewise, two-thirds of respondents thought the statements ―*There are a lot of familiar faces here,”* ―*We share a strong sense of place/community here*,*”* and ―*Most people that live here are trustworthy”* described their home turf well. However, only half of respondents agreed with the statements ―*I do ALL of my recreation here”* and “*I have everything I need here”* (Table 2).

Table 2. Percent of respondents that agreed or disagreed with a series of statements about their home turf.

How well does each statement describe your home turf?	***% agree***	***% disagree***
“I feel at home here”	82.8	2.6
“There are a lot of familiar faces here”	68.9	10.6
“Most people that live here are trustworthy”	68.0	6.5
“We share a strong sense of place/community here”	65.9	10.9
“I have everything I need here”	54.7	17.0
“I do ALL of my outdoor recreation here”	48.1	22.4

The majority (83%) of respondents indicated that it was likely (i.e., they selected 4 or 5 on a 5-point Likert scale, where 1 was *very unlikely* and 5 was *very likely*) that they would be living in their home turf into the foreseeable future. Likewise, 83% indicated it was unlikely (1-2 on the 5-point scale) that they would be living outside of Maine in the foreseeable future (Table 3). A fitted linear regression model using two variables (*I feel at home here* and *I have everything I need here*) explained 21.4% of the variation in respondents' likelihood of staying in their home turf into the foreseeable future ($P<0.01$).

Table 3. Respondents' likely future within their current home turf.

In the foreseeable future, how likely are the following scenarios?	***% likely***	***% unlikely***
You will be living here, in your home turf, as you are now	83.1	10.2
You will be living somewhere else in Maine	12.3	68.3
You will be living somewhere outside the state of Maine	3.9	83.9

Over 85% of respondents indicated that natural resources, the environment, and the lifestyle/quality of life played a significant role influencing their attachment to their home turf(i.e., they selected a 4-5 on the 5-point scale, where 5 was *very much so* and 1 was *not at all*). Over 70% of respondents indicated that outdoor recreational opportunities significantly influenced their attachment, and over 60% indicated the community of people was likewise influential. Presence of family and heritage/tradition significantly influenced attachment for just over 50% of respondents, and work opportunities influenced attachment for only 31% of respondents: over 45% indicated that work opportunities did not influence their attachment much or at all (Table 4).

Table 4: degree to which respondents' attachment to their home turf is influenced by a series of factors including natural resources and environment.

How much do the following influence your attachment to your home turf?	***Average score***	***% influenced a lot***	***% not much or at all***
Its natural resources & environment	4.4	85.0	4.2
The lifestyle/quality of life	4.3	86.1	4.4
Outdoor recreational opportunities	4.0	70.7	10.5
The community of people	3.7	63.3	12.5
Heritage & tradition	3.5	53.2	20.8
Presence of family	3.3	53.2	36.4
Work opportunities	2.8	31.1	45.6

Relative salience and value of fish (Objective 2)

Animals identified as contributing most to home turf character (Figure 5) were commonly seen large charismatic megafauna. For example, over 66% of respondents identified white tailed deer (*Odocoileus virginianus*) or moose (*Alces alces*), and 40% identified birds (particularly raptors in the family *Accipitridae* and the wild turkey (*Meleagris gallopavo*). These frequently seen animals tended to come to mind before fish (see trend lines in Figure 6). Less than 10% of respondents identified sea-run fish as contributing to their home turf's character. Of these, over 50% were members of salmon clubs or watershed groups (10 club members identified salmon and two identified American eels). Of the 3% of respondents that identified sea-run fish and were not salmon club members (eight respondents identified alewives, followed by Atlantic salmon, sturgeon species, striped bass (identified four times each); eels (identified by three respondents); and American shad (identified by only one respondent).

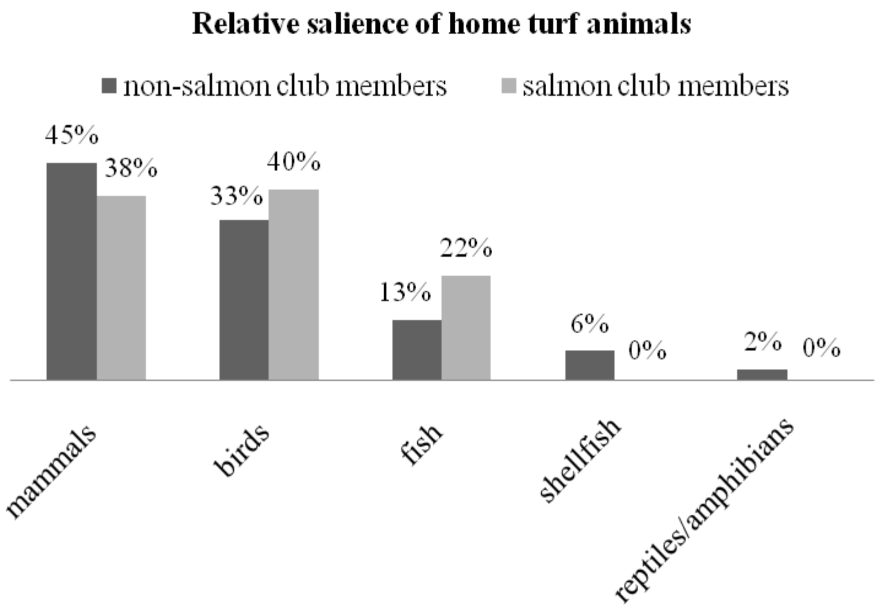

Figure 5. Summary of responses to the question "*what wild animals most contribute to your home turf's character?*"

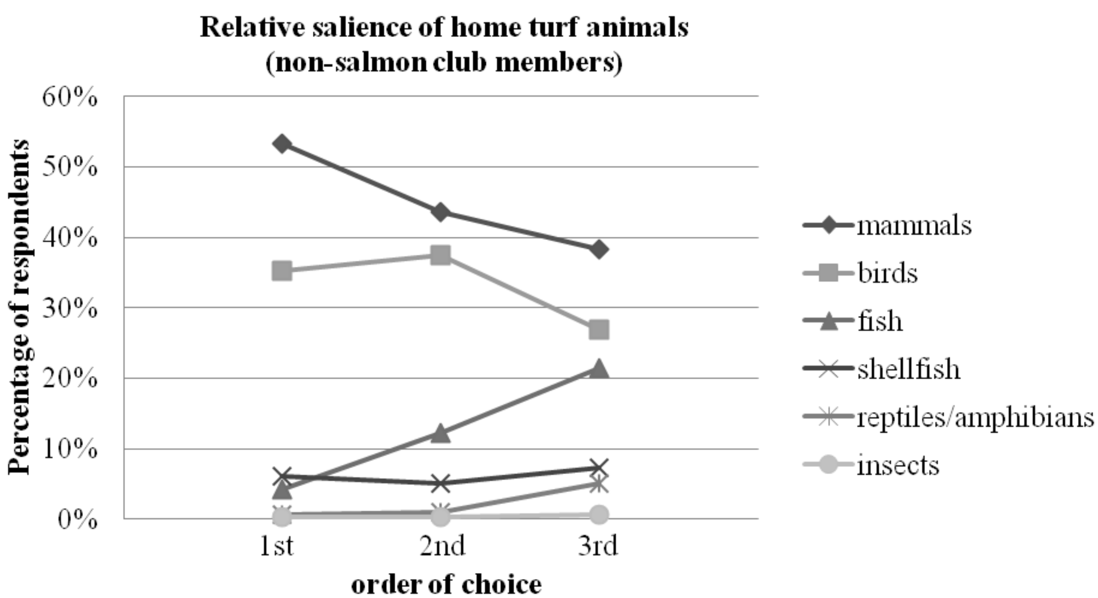

Figure 6. Trend information for respondents' 1st, 2nd and 3rd choices of wild animals that most contribute to home turf's character.

In combining the open-ended responses regarding rewarding aspects of fishing, most valued species, and perceived benefits of healthy fisheries, eight major value categories were established (Table 5). Fewer than 25% of respondents said their typical interaction with valued home turf waterbodies involved them, or another family member fishing, and catching a fish was not always the central goal. For example, responses suggest that experiential factors, like setting quality, were equally important (Figure 7). Only half of respondents were able (or chose to) identify the value of healthy fisheries; the others either indicated they did not know, or decided against answering the question.

Table 5. Major value categories associated with fisheries by anglers and non-anglers.

Value	***Definition/traits***	***Examples from open-ended responses***
catchability	abundant, easy, fun, big, present	*“fun to catch”“king of sport fishing”“beautiful fighter” “challenge to catch”“not endangered”*
setting	escape, connecting with nature	*“just being in nature”“disconnecting with the rat race” “isolated watersheds with very little access” “enjoy fishing the habitat”*
food	tastes good, cheap, healthy	*“they are healthy to eat”“good fish for smoking in smoke house” “satisfaction of gathering wild food…from clean, local waters for free”*
ecological or intrinsic	valuable to other species, physical traits/behavior	*“knowing they are there!”“needed for food base”“seals come up river to eat them” “extensive migration” “living dinosaurs, really cool!”*
indicator	indicator, at risk	*“indicator of clean water and balanced development”“they are a symbol of a…disappearing way of life”“sign of a healthy environment” “rarity”*
social	time with family friends	*“getting together with friends and family-making memories”“being with my fiancé when she caught her first fish”“the companionship”“quality time spent with my family”*
economic	Jobs and income	*“local employment opportunities”“keep the business going in winter”“the money” “economic engine for community”*
Heritage/ tradition	memory, place heritage	*“part of our heritage”“trout fishing with my dad. Caught my limit every time”*

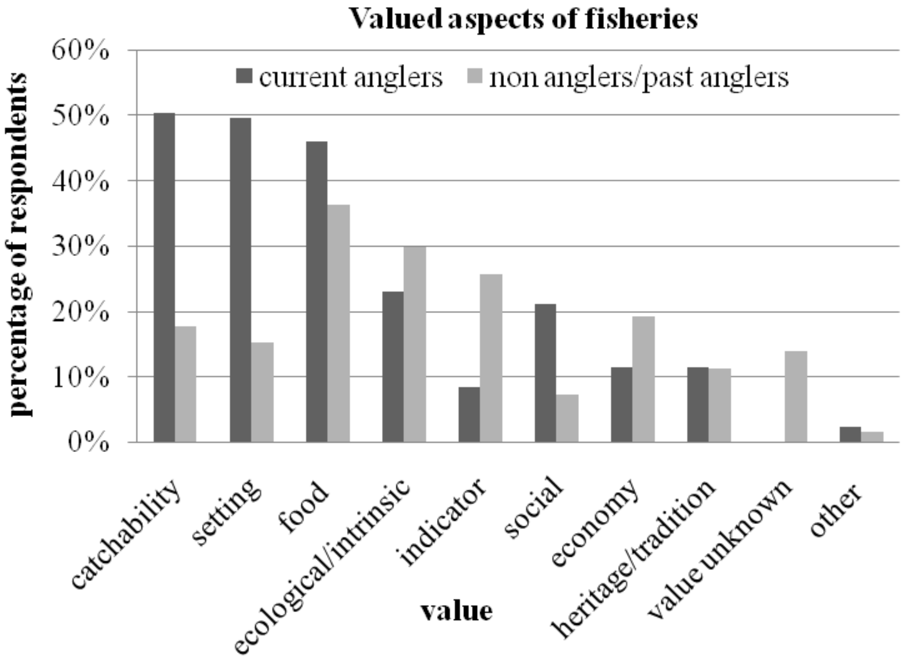

Figure 7. Combining open-ended responses of what anglers find rewarding about fishing, what species they value most and why, and perceived benefits of healthy fisheries by non-anglers.

Specifically, anglers tended to like brook trout fishing because of the seemingly pristine settings in which they tend to be found. Largemouth and smallmouth bass, and "panfish" species were valued for their catchability. Sturgeon were valued for their interesting appearance, rarity and long lifespan, while alewives were valued as a forage species for valued wildlife (e.g., osprey) and other fish. Atlantic salmon tended to be valued as a sportfish and their history in the region (tradition and heritage). Haddock tended to be valued as a food fish by both anglers and non-anglers alike. All of the respondents (14%) who answered "*I don't know*" to questions about the value of fish and healthy fisheries were non-anglers. A common response following "*I don't know*" was "*I don't fish*" or "*I don't eat fish*," suggesting a perceived link between utility and value. Ten percent of those surveyed did not provide any answers to fishing-related questions.

Respondents were asked to indicate which three fish they valued most (Figure 8). Eighty-four percent of salmon club members that answered the question identified sea-run Atlantic salmon as one of their top three. Non-salmon club members tended to value freshwater resident species more. However, a greater diversity of other sea-run species, particularly rainbow smelt and striped bass, were identified by respondents that did not belong to a salmon club. Non-club members also tended to have a lower response rate, with just over 60% identifying fish of value.

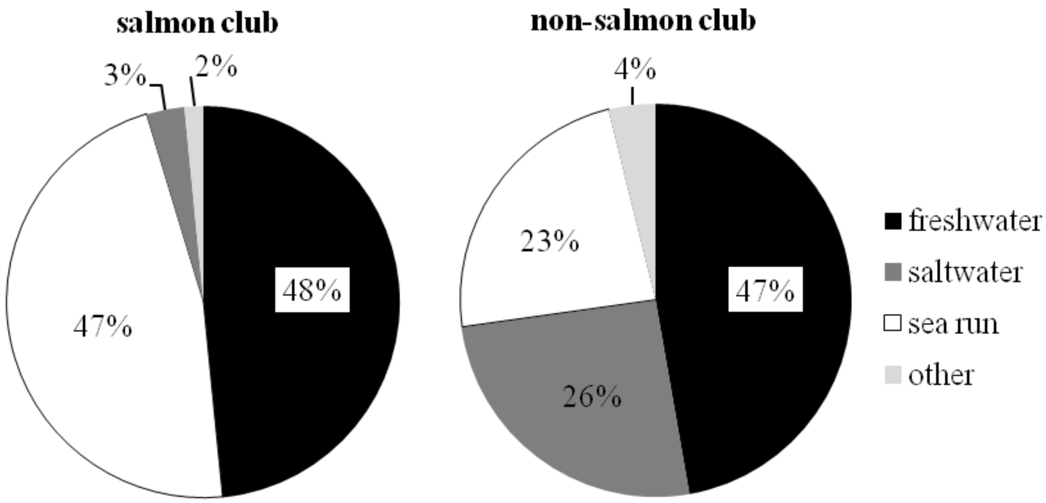

Figure 8. Most valued type of fish for salmon club members verses non-members.

Responses to the question "*Which sea-run fish do you think have the greatest real/potential value? What is it?*" represented five major categories: ecological/intrinsic (including potential as an indicator/positive icon), heritage and tradition, recreation and tourism, commercial, and food value (Figure 9). From a recreation/tourism standpoint, striped bass, American shad, Atlantic salmon and rainbow smelt were seen as having the most potential. Alewives and American eel were perceived as holding particularly high commercial value, including as sources of bait: "[eel/elvers] *by far has the highest value potential for Maine*" and "[alewives are] *critical to the lobster industry*". Blueback herring and eels, followed closely by alewives, were also seen as holding high ecological value as a "*major predator in streams, moves nutrients*," "[alewives] *support groundfish recovery*," "[blueback herring are at the] *bottom of food chain*." On the other hand, eels and sea lamprey were considered by some respondents as least valuable, mostly because of their appearance ("*slimy and resembles snake*," "*too ugly and looks like a snake*"). Almost twenty percent of respondents identified haddock and or cod as Maine's most valuable sea-run fish, suggesting that there is some confusion about the life history of these fishes as neither species is sea-run.

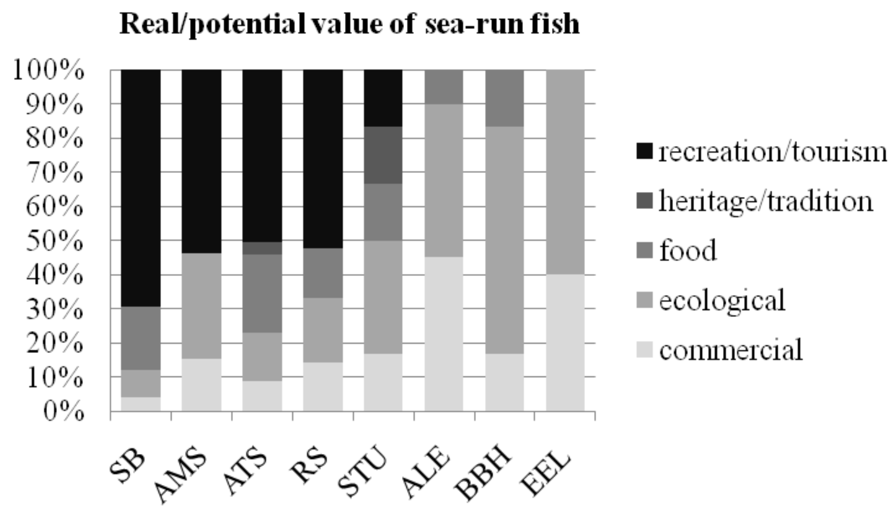

Figure 9. Value of sea-run fish in Maine according to survey respondents. From left, striped bass, American shad, Atlantic salmon, sturgeon, alewife, blueback herring, and American eel.

Contemporary Connections to Home Turf Waterbodies (Objective 3)

Respondents' typical interactions with valued home turf waterbodies located in the historical range of Atlantic salmon varied broadly from passive or active viewing from home, work or during a daily commute; recreating, exercising or socializing on, directly adjacent to or nearby; working; and remembering past loved ones (Figure 10).

Examples of respondent interactions with waterbodies

—*Gazing, usually; I am affected by it [Frenchman Bay] in many indirect ways; I play by it occasionally”*—21 year old Bar Harbor female

—*Cross it [East Machias River] and drive along it every day. I can also hear it from home. I watch the tides come and go*—36 year old East Machias male

—*I work on it…trying to make a living from it…enjoy just being around it and in it”*—51 year old Whitneyville male

—*Go to the town pier everyday without fail - my husband's ashes are out there”*—58 year old Bar Harbor woman

—*Watch it [Kennebec River], walk near it”*—49 year old Farmingdale woman

—*Everyday I walk it [Penobscot River], I see it every day, I look out my window and see it, my kid and I look at boats, trains, the bridge and sometimes look for crabs”*—24 year old Bucksport female

—*viewing while passing through (car), swimming”*—61 year old Casco male

—*Hunting, fishing, canoeing - some combination thereof”*—22 year old Bangor man

—*Walk around it [Narraguagus River], look at it, listen to it, watch the birds that are attracted to it…”*—61 year old Cherryfield woman

—*We have a summer cottage on the shore [of Lower Wilson Pond]. Have been here since 1963 summers”*—73 year old Greenville female

—*Eating on the shore, picking up shells on the shore, viewing it from the kitchen window, and checking the tide and boats…”*—67 year old Waldoboro female

Figure 10. Examples of open-ended answers to the question “*what is your typical interaction with it* [waterbody or collection of interconnected waterbodies that you, yourself, value most]?”

A general theme that emerged from the survey was that most notable role of home turf waterbodies in respondents’ lives as providing an escape from daily stresses (Figure 11). In fact, three-quarters of respondents felt strongly that their home turf waterbody(ies) provided an escape (i.e., they selected a 4-5 on a 5-point Likert scale, where 1 was *not at all* and 5 was *very much so*, in response to the question *“To you, does it symbolize any of the following?”*). Touching the water in traditional ways (e.g., fishing and boating) was not necessary for a waterbody to be considered a valued escape: over one-third of respondents utilized waterbodies only as a visual backdrop. Open-ended responses to *"What about it do you value most and why?"* clearly illustrated this.

Home turf waterbodies as escapes

“*The escape to a beautiful place [Embden Lake]"*—18 year-old Solon woman

“*The isolation and quietness away from the community. There are only 7 camps on the pond [Greenleaf Pond] ... 2 of the camps are used sparingly by out of state owners*—36 year-old Parkman female

“*Isolation from the rest of the world!*—79 year-old Newcastle male on Marsh Creek

“*Escape from mundane day-to-day behavior patterns dominated and mandated by economic realities.' Reconnecting with what is real"*—58 year-old Brooksville man on visiting the Bagaduce River and unnamed small waterbodies on his property

“*Place to relax and de-stress"*—40 year-old Bucksport female on Silver Lake

“*Solitude—very quiet, like you own the [Kennebec] river"*—53 year-old Solon male

“*[Spirit Pond] is a quick get-away and stress reliever"*—24 year-old Phippsburg female

“*It is refreshing to see the tides come and go day after day. It is an escape from the human-based world"*—36 year-old Machias male describing the Machias River

“*It's wild, open, beautiful, always changing, smells good, is full of animals, plants, birds, provides a vista free of people or buildings"*—48 year-old Bar Harbor female on Blue Hill Bay.

Figure 11. Examples of open-ended responses to the question, "What do you value most about it and why?" that indicate waterbodies are used as escapes by people of varying ages, genders and regional locations.

Responses to the question *"For you, does it play an important role as a point of contact with the natural world"* provide additional evidence that waterbodies are escapes: over 75% of respondents selected 4-5 on a 5-point Likert scale (where 1 was *not at all* and 5 was *very much so*). One quarter to 50% of respondents likewise indicated that waterbodies played important roles in other facets of their lives (Table 6).

Table 6. Percentage of respondents that agree and disagree that waterbodies play an important roles in various facets of their lives, and average score on a 5-point Likert scale.

For you, does it play an important role…	***Average score***	***% agree***	***% disagree***
…as a point of contact with the natural world?	4.2	79.7	9.2
…in your weekly outdoor recreation/exercise routine?	3.3	50.2	30.0
…at your home or workplace?	3.2	45.4	36.2
…providing a link to the past?	3.0	41.5	39.2
…linking you to your community?	3.0	38.3	32.9
…in your weekly social routine?	2.7	26.6	47.8

Fifty-eight percent of respondents felt that waterbodies symbolized a healthy community (i.e., they selected 4-5 on the 5-point scale), followed by a pristine wilderness (50%), the heart of the community (47%) and economic vitality (38%). In addition to providing insight into waterbodies as escapes, open-ended responses to the question *"What do you value about it most and why?"* also illustrated how waterbodies are viewed by some as central to their community (Figure 12):

Home turf waterbodies as central to community

―I've been here my whole life. It [China Lake] *basically is China. Without it, the town would not survive"* —51 year-old China female

―Town water supply, fishing. Vital to town's well being"—26 year-old Bucksport man on Silver Lake

―...watermen love it [Kennebec River] because they get fish in it. The whole town loves it. Bath Iron Works needs it. Without the river the town wouldn't be there"—65 year-old Bath male

―[The Kennebec River's] potential for ecological and economic recovery in the area – ecotourism"—54 year old China male

―...I love the way people meet there [Frenchman's Bay] *and that a lot of jobs are here, i.e. the fishermen"*—53 year-old Bar Harbor resident

―It [Lake Wassookeag] *is a major tax base for the support of our schools, town etc."*—62 year-old Dexter man

―It [Gulf of Maine] *provides a livelihood for thousands up and down the coast"*—27 year-old Whiting male

Figure 12. Open-ended responses portraying waterbodies as central to community.

Using maximum likelihood factor analysis, a two-factor solution (i.e., waterbodies as high environmental quality escapes and as central to the community and) explained 62.5% of the scale's variation (Figure 13 and 14, Table 7).

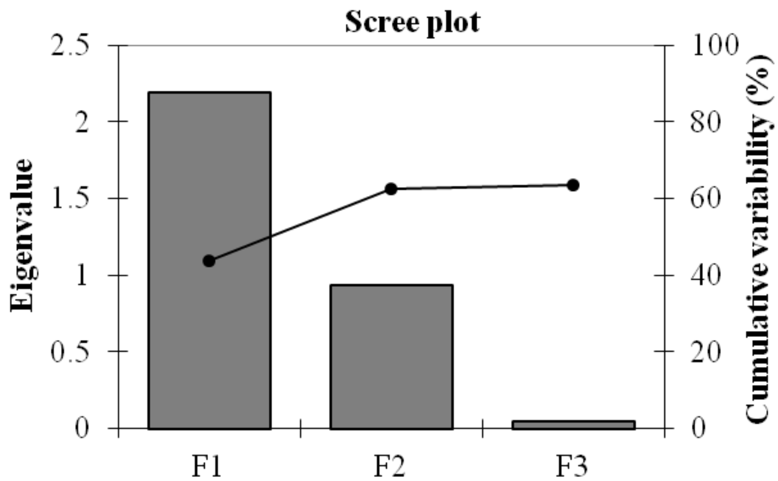

Figure 13. A Scree plot indicated that two common factors were sufficient to describe the symbolic meanings associated with waterbodies (the computed p-value is greater than the significance level alpha = 0.05).

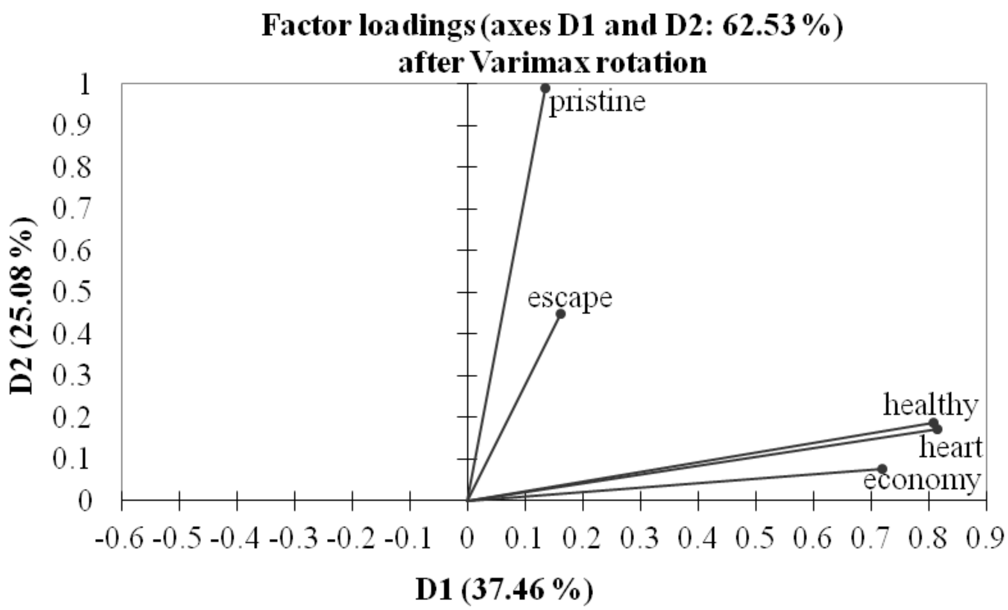

Figure 14. Factor loadings grouped "a pristine wilderness" with "an escape" and "economic vitality" with "a healthy community" and "the heart of the community."

Table 7. The percentage of respondents that agree (i.e., selected 4-5 on a 5-point scale where 1 was *not at all* and 5 was *very much so*) that waterbodies hold symbolic meaning as central to community or escapes of high environmental quality. Factor loadings <0.20 are not displayed.

Symbolic waterbody meaning	***% agree***	***% disagree***	***Factor 1 Community***	***Factor 2 Escape***
Economic vitality	38.6	37.0	.717	
A healthy community	58.2	19.0	.808	
The heart of the community	46.8	29.2	.814	
A pristine wilderness	50.0	28.1		.991
An escape	74.8	11.5		.449

Factor	***Eigenvalue***	***% variance***	***Alpha***
Community	2.194	37.455	0.834
Escape	0.933	25.075	0.637

Satisfaction with Home Turf waterbodies (Objective 3)

Respondents' degree of satisfaction with various contemporary waterbody attributes tended to be skewed towards satisfied over unsatisfied (15% or fewer of respondents were dissatisfied with listed attributes, with one exception) (Table 8). Respondents were least satisfied with development surrounding waterbodies (30% were unsatisfied) and most satisfied with outdoor recreational opportunities (80% satisfied and less than 10% unsatisfied), despite the fact that 50% of respondents traveled outside of their home turf for at least some of their outdoor recreational pursuits.

Table 8. Percentage of respondents satisfied (i.e., chose 4-5 on the 5-point scale) and unsatisfied (i.e. chose 1-2 on the 5-point scale) with various attributes of the waterbody(ies) they valued most in their home turf (average score is included).

How satisfied are you with its…	***Average score***	***% satisfied***	***% unsatisfied***
…outdoor recreational opportunities?	4.2	79.6	8.3
…public accessibility?	4.0	71.9	9.3
…ability to support animals and plants you value?	3.9	72.0	10.6
…water quality?	3.7	63.8	14.1
…overall health?	3.6	60.1	15.1
…surrounding development?	3.2	40.2	30.4

Respondent perceptions about what traits healthy waterbodies have and what impact various stressors have on valued home turf waterbodies have the potential to influence satisfaction. Respondent perceptions tended to be formed through personal experience/observation and word of mouth—as one respondent put it: "*lifelong dialogue with other citizens*" (Figure 15). Two-thirds of respondents identified the top trait of healthy waterbodies as purely visual, i.e., clear water, no scum, no algae, no debris, clean appearance, and presence of life. Only one-quarter indicated that balanced species communities and healthy systems were indicators of waterbody heath, and less than 10% identified usability (e.g., swimmable, fishable, drinkable, edible shellfish). While over 90% of respondents agreed that fish can tell us a great deal about water quality, over 75% of respondents did not feel they themselves impacted water quality in their home turf.

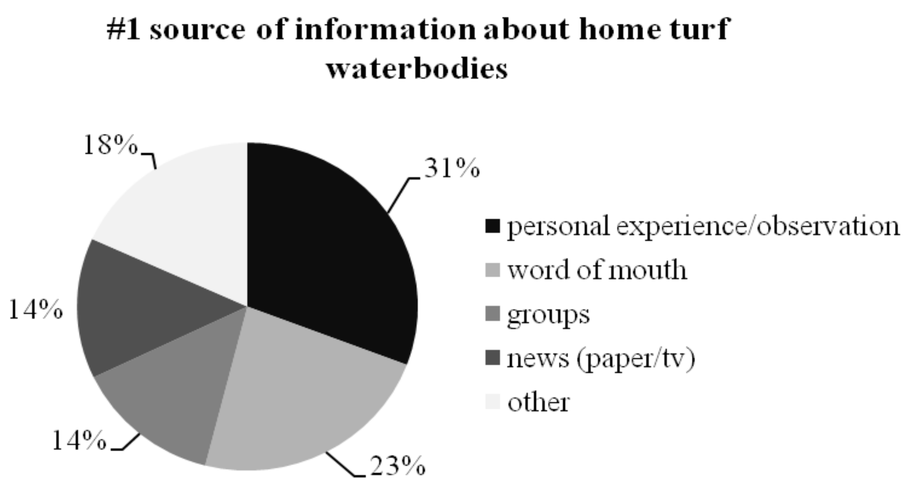

Figure 15. Respondents' top sources of information about local waterbodies.

Further, over 75% of respondents did not perceive dams as having a net negative impact on local area conditions (i.e., water quality, area character, economy, native species, fishing opportunties, and preferred recreation), or they were unsure (Figure 16). Only a small percentage of respondents felt that the net effect of reviving sea-run fish on local conditions would be negative. However, almost 50% of respondents were unsure of the net effect of dams, or the potential net effect of reviving sea-run fish, on Gulf of Maine fisheries (Figure 17).

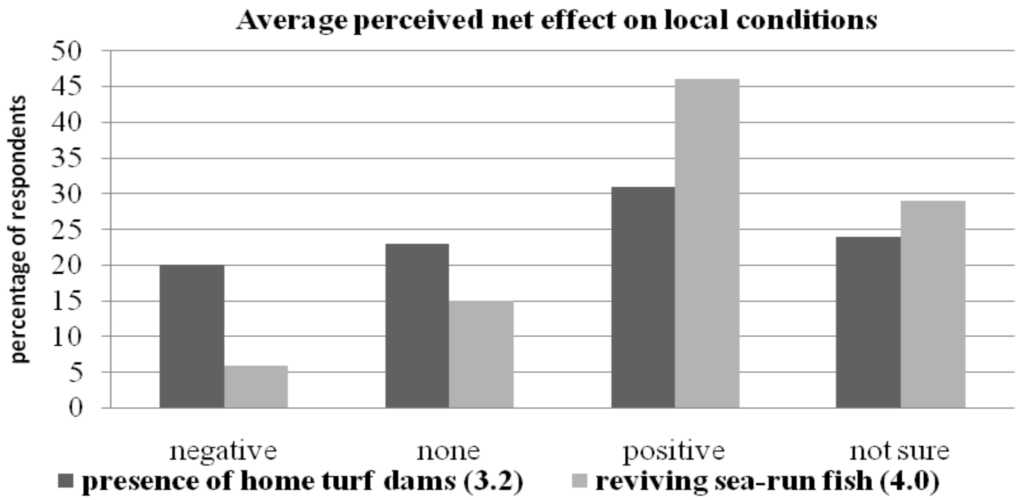

Figure 16. The perceived net effect of home turf dams (any size) and reviving sea-run fish on local conditions. Average score on a 1-5 Likert scale included.

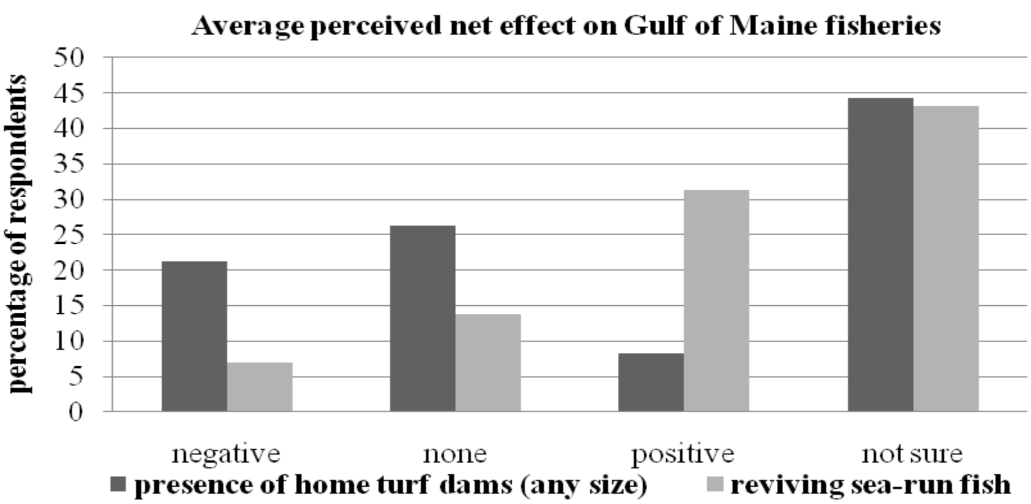

Figure 17. Perceived net effect of dams and reviving sea-run fish on Gulf of Maine fisheries.

Behavioral Intentions (Objective 4)

Respondents who attributed low symbolic meaning to waterbodies as escapes were less likely to participate in conservation activities on behalf of those waterbodies when compared to those who indicated waterbodies held high symbolic meaning as an escape. However, the mean likelihood scores for both groups were not significantly different at a 95% confidence interval (Table 9).

Table 9. because the majority of respondents viewed waterbodies as escapes, escape was not a good predictor of behavioral intentions.

	ESCAPE				
	Low meaning		High meaning		***Are means significantly different at 95%CI?***
Behavior type	***Mean***	***N***	***Mean***	***N***	
Join group	2.9	42	3.0	179	No
Enlist others	3.0	42	3.3	182	No
Peer pressure	3.2	41	3.3	182	No
Town meetings	3.6	42	3.4	182	No

On the other hand, the degree to which respondents viewed home turf waterbodies as central to their community (i.e., symbolizing economic vitality, a healthy community and focal point) was significantly and positively correlated with the likelihood of engagement in waterbody conservation. Those who indicated that waterbodies held high symbolic meaning as being community-centric were, on average, more likely to join an organized group, use peer pressure, enlist the help of others or participate in informal town meetings than those that indicated they did not (Table 10).

Table 10. respondents that indicated waterbodies held high symbolic meaning as a community place were more likely to engage in social behaviors for conservation.

	COMMUNITY				
	Low meaning		High meaning		***Are means significantly different at 95%CI?***
Behavior type	***Mean***	***N***	***Mean***	***N***	
Join group	2.6	74	3.3	145	Yes
Enlist others	2.9	75	3.6	145	Yes
Peer pressure	3.1	74	3.6	146	Yes
Town meetings	3.1	75	3.7	147	Yes

All measures of behavioral intentions towards home turf waterbodies were significantly correlated, and a reliability analysis and factor analysis indicated that they could be grouped together (Chronbach's Alpha 0.880). The resultant factor was used as the dependent variable in the univariate analysis of variance (Table 11). Independent variables included in the model were: 1) whether or not a valued home turf waterbody was threatened ("threat_nothing"); whether or not respondents indicated that they valued sea-run fish when asked to identify three species found in Maine waters they valued most ("SRF_best"); 3) whether or not respondents were actively involved in a non-consumptive, activity-based outside group such as the Downeast Outing Club or Moosehead Area Birding and Nature Club[7] ("nonconsum"); 4) respondents' age at the time of the survey ("Age_now"); 5) degree to which respondents perceived their own behaviors as potentially impacting home turf water quality ("you_WQ"); 6) degree to which valued home turf waterbodies were linked to community identity/considered an indicator for community vitality[8] ("WB_SymCOMM"); 7) degree to which respondents' perceived a strong shared sense of place by community members ("HTSOP"); and 8) the degree to which waterbodies played an important role in respondents' weekly routine (specifically exercise, social, point of contact with the natural world, and linking them to their community[9] ("Role_exsocpoccomm").

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[7] Compared to those focused on the community/heritage (e.g., Surry Historical Society), consumptive pursuits (e.g., rod and gun clubs), fish (e.g., salmon clubs), religious/spiritual, waterbody (e.g., lake associations), watershed, landscape (e.g., land trusts), none, or other.
[8] This composite is based on factor loadings that grouped "economic vitality" with "a healthy community" and "the heart of the community." A reliability analysis in SPSS produced a Chronbach's Alpha of 0.833 for these three variables.
[9] A reliability analysis including these four variables resulted in a Chronbach's alpha of 0.694.

Table 11. SPSS output for best fit model of factors that best explain respondents' likelihood of engaging in behaviors that conserve home turf waterbodies located in the historic range of Atlantic salmon.

Between-Subjects Factors

		N
threat_nothing	0	244
	1	30
SRF_best	0	172
	1	102

Tests of Between-Subjects Effects (Dependent Variable: behavioral intentions)

Source	***Type III Sum of Squares***	***df***	***Mean Square***	***F***	***Sig.***
Corrected Model	55.629[a]	8	6.954	12.774	.000
Intercept	11.337	1	11.337	20.827	.000
threat_nothing	5.487	1	5.487	10.081	.002
SRF_best	6.817	1	6.817	12.524	.000
nonconsum	2.948	1	2.948	5.415	.021
Age_now	5.831	1	5.831	10.712	.001
you_WQ	2.349	1	2.349	4.315	.039
WB_SymCOMM	5.648	1	5.648	10.376	.001
HTSOP	1.946	1	1.946	3.576	.060
Role_exsocpoccomm	.377	1	.377	.693	.406
Error	144.250	265	.544		
Total	3896.807	274			
Corrected Total	199.879	273			

R Squared = .278 (Adjusted R Squared = .257)

Parameter Estimates (Dependent Variable: behavioral intentions)

Parameter	***B***	***Std. Error***	***t***	***Sig.***	***95% C.I.*** Lower Bound	Upper Bound
Intercept	1.345	.333	4.039	.000	.690	2.001
[threat_nothing=0]	.465	.146	3.175	.002	.177	.753
[SRF_best=0]	-.335	.095	-3.539	.000	-.522	-.149
nonconsum	.103	.044	2.327	.021	.016	.190
Age_now	.010	.003	3.273	.001	.004	.016
you_WQ	.075	.036	2.077	.039	.004	.147
WB_SymCOMM	.154	.048	3.221	.001	.060	.248
HTSOP	.161	.085	1.891	.060	-.007	.328
Role_exsocpoccomm	.053	.064	.832	.406	-.072	.178

This model explained just over 25% of the variation in respondents' behavioral intentions. I tested the colinearity between WB_SymCOMM and Role_exsocpoccomm using a reliability analysis in SPSS and found that, while there is some colinearity, it is not severe (<10%). The standard error did not increase when I ran the model with just WB_SymCOMM or Role_exsocpoccomm. When dependent variables with a social component (e.g., peer pressure) were grouped, several additional sense of place and social/quasi tie independent variables became significant predictors of behavioral intentions in the univariate analysis of variance. These included: the degree to which familiar faces were present in one's home turf, feeling that home turf residents shared a strong sense of place, feeling at home in one's home turf, and the degree to which other home turf residents were perceived as trustworthy. Respondents were more inclined to interact with others to conserve waterbodies when the waterbody value is perceived as being tied to the community and its members.

Validity of Findings

Survey respondents were self-selected. It is therefore possible that because the survey title included the words "conservation" and "waterbody" that respondents were more interested in waterbody conservation than the average Maine resident. A number of younger respondents volunteered that they did not have time to participate in waterbody conservation. It is also possible then that survey respondents were skewed towards retirees for that same reason. Further, the timing of the survey distribution also favored year-round residents. Of the several seasonal residents that participated, their responses (e.g., "[unlikely because] *we're only here five months in summer*" in response to the question "*would you be inclined to help conserve a home* *turf waterbody if asked?*") suggest that they may view their role in waterbody conservation differently than full-time residents.

Discussion

"*Virtually any resource or land planning effort is really a public exercise in describing, contesting, and negotiating competing senses of place and ultimately working out a shared future sense of place*" (Williams and Stewart 1998, 23).

Human connections to fish and the waterbodies they inhabit are evolving. Federal and state entities responsible for maintaining public trust resources like migratory fishes for future generations—and other entities seeking to protect, restore, or enhance fish populations and their habitat—must simultaneously adapt public communication strategies to reflect an understanding of new motivators, including contemporary senses of place. Maine Atlantic salmon biologist Ed Baum (1997) highlighted the need to more effectively engage the public in fisheries management and habitat conservation when he said, *"…public apathy has been, and continues to be, the number one threat to the restoration and management of viable Atlantic salmon populations in Maine rivers"* (138). Today, apathy towards now-remnant populations of anadromous Atlantic salmon stems from their overall lack of presence and relevance in residents' day-to-day lives. Baum's sentiment can be applied more broadly to other fishes native to the region that have experienced localized extinctions and drastic declines as a result of massive habitat fragmentation and alteration (e.g., Waldman 2010). For example, Lackey et al. (2006) stated "*restoring runs of wild salmon is a widely-professed goal for the region of western North America encompassing southern British Columbia, Washington, Idaho, Oregon, and California…for all the talk of sustainability, society has yet to make the painfully difficult choices required to achieve it*" (15). A widespread societal disregard towards fish and their habitat needs is further evidenced by Jelks et al.'s (2008) finding that nearly 40% of all fish taxa in North American are imperiled and, for greater than 90% of these species, habitat degradation from human activities is the main cause of their imperilment.

With this in mind, a much broader segment of society needs to feel motivated to come "to the table" to discuss options, set goals, and participate in habitat conservation and restoration of Atlantic salmon and other ecologically-linked species. This will not happen until the relevancy of species recovery and habitat restoration is elevated in their daily lives, or linked indirectly to other things they care about. This study provided insight into what does and does not motivate residents living in the historical range of the GOM DPS. Salmon stakeholders can use the study results to begin to actively address the challenges associated with engaging the public in Atlantic salmon recovery by identifying common threads between recovery and contemporary motivators.

Today's Challenges

The Native Fish Community Lacks Visibility

Fish spend their time under the water's surface and are typically only visible when pulled from their natural habitat by an angler or when concentrated at migration bottlenecks (e.g., falls) or during spawning. Rachel Carson's seminal book "Silent Spring" (1962) helped launch the environmental movement of the 1960s with images of a spring without birds and their songs. With the exception of fish species that become visibly present during their migration or inhabit popular diving/snorkeling areas, fish tend to go largely unnoticed because they do not lend themselves to passive viewing or interaction.

Native sea-run fish as a whole are not readily visible to the majority of people living in or visiting Maine and the Northeast U.S., and the factors currently driving their low abundances likewise go unseen, or unnoticed. For example, poor survival at sea is not well understood nor is it a tangible concept that can be grasped or visually seen by the public. Likewise, the functional changes to habitats and historical fish communities discussed in Chapter 1 occurred long before today's residents were alive. Reference conditions can only be visualized through historical photographs or written accounts made by explorers and early settlers.

Loss of Consumptive Utility

As a result of their low numbers and endangered conservation status, Atlantic salmon fishing in the U.S. is closed and therefore the utility (i.e., catchability and food value) of wild stocks has been lost. That loss of utility has resulted in a concomitant decrease in the membership composition of the salmon clubs. Today, these clubs are comprised of primarily older men who angled during (and remember) the modern heyday of recreational salmon fishing in the 1960s-1980s.

Of those respondents that answered the question "*what fish do you value most?*," freshwater resident fish species populated half of all responses. Contemporary conditions now favor these freshwater residents over once-dominant sea-run fishes (McDowall 1996; Saunders et al. 2006). This finding suggests that, because they are valued for their consumptive utility, people value fish that are present and easily accessed[10]. If Great Lakes basin residents were asked this same question, non-native salmonids introduced from the Pacific Northwest (e.g.,

[10] Saltwater fish may have populated more responses if more coastal residents participated, or if they were more accessible to the average resident. Haddock and other valued species were often valued for their commercial food value.

chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *O. kisutch,* steelhead, and brown trout, *Salmo trutta*) would likely populate the majority of responses. Arctic grayling (*Thymallus arcticus*), blue pike (*Sander glaucus*), *Coregonus* species, and other imperiled or extirpated fishes (see Michigan Natural Features Inventory's list of endangered, threatened, special concern, and presumed extirpated) would likely be absent.

Finally, with today's globalized market, sustenance can easily be obtained elsewhere. Human interactions with waterbodies, and dependency on local aquatic resources, have subsequently evolved away from consumptive uses. Non-anglers and people that do not eat locally-obtained fish have limited opportunities to interact with, and learn about, fish and their needs; and therefore have less motivation to act as stewards on their behalf. This was reflected in the "*don't fish, don't eat, don't know*" mentality held by respondents that did not interact with fish through recreation or consumption who also indicated that they were unable to identify any specific fish that they valued or did not value. People interested in conserving fish will continue to be a minority so long as the supply chain allows consumers to be disconnected from fisheries resources and human-fish interactions are limited to anglers. This has clear implications for public engagement strategies in that many people do not even perceive a problem, let alone how to help address it and why.

Fish Aren't Critical for Escape

This study revealed that the type of attachment to waterbodies close to home, however brief or seemingly superficial, plays an important role combating contemporary stresses in residents' daily lives. For the majority of respondents, however, fish were not essential for this need to be met. Even for anglers, being in a setting with escape qualities (e.g., undeveloped, real or perceived lack of people) was found to be just as important as catchability, suggesting that catching a fish—any fish (native or non-native)—was not critical to the experience being enjoyed. Schramm and Gerard (2004) had similar findings. They surveyed freshwater recreational anglers about why they fished and found that being outdoors and relaxation was consistently important between 1987 and 1997. During this time period, the importance of family recreation and being with friends decreased while the importance of opportunities to escape increased significantly (Schramm and Gerard 2004). This supports this study's finding that, for many, the species (or even presence) of fish present is not critical. It also illustrates the need to think beyond fish when developing fisheries conservation messages.

Baselines and Satisfaction with Contemporary Conditions

Overall respondent satisfaction with contemporary waterbody conditions was high, despite major hydrological changes and losses in productivity of native, formerly abundant sea-run fishes. This tendency for the baseline against which we measure our satisfaction to shift with each passing generation, and be shaped by what is known and familiar, is described by Pauly (1995) and Dayton et al. (1998).

Today, the baseline against which most people measure waterbody health does not encompass what Atlantic salmon need to recover and thrive; for instance, an intact native fish community (see Saunders et al. 2006) and free flowing rivers. Efforts to engage the public in recovering Atlantic salmon and other ecologically-connected fishes need to redefine a new baseline against which waterbody health is measured that prioritizes: 1) connectivity from headwaters, through lakes and streams to the sea and 2) natural species communities and processes. Associated messages should be provide a clear linkage between conservation goals and topics residents care about. For instance, respondents generally dislike the presence of algae. A message advocating removal of fish passage barriers could explain that draining backwaters can help riparian vegetation re-grow. Regrowth not only provides cooling shade for cold water fishes and the leaf matter their food based depends upon, but also decreases algal growth that makes waterbodies appear "unclean" and the substrate unpleasant to walk across. Removing barriers also reestablishes natural flow and sediment regimes (critically important to sea-run fish recovery), but this should not necessarily be the hook.

To a large degree, respondents were largely satisfied with home turf waterbodies, including their water quality, ability to support animals and plants they value, public accessibility, outdoor recreational opportunities, and overall health. The literature and findings of this study indicate that high satisfaction does not motivate action. As the popular adage goes, "*if it ain't broke, don't fix it*." This finding related to satisfaction is likely a function of shifting needs and baselines, and a lack of awareness of what has been lost over the past four centuries. For example, two-thirds of respondents identified the top trait of healthy waterbodies as purely visual, rather than functional or useable, describing clear water, clean surroundings, a "*clean bottom*," lack of sediments, presence of wildlife "*to prove it's clean*," and absence of scum, algae, debris, and pollutants.

Natural turbidity tends to be associated with contamination even though biologically productive and ecologically functional aquatic systems often exhibit intermittent or seasonal turbidity and algal growth (Stockner et al. 2000). What Anders and Ashley (2007) describe as the "clear-water paradox" suggests that these conceptions about what is truly "healthy" are not unique to the Northeast. Namely, U.S. residents tend to want "*crystal clear public waters and ecosystem services or benefits like harvestable fish populations but simultaneously enforces* *water quality standards that limit or prohibit the biological productivity and ecological processes required to produce and maintain those benefits* (126)."

The average respondent—slightly over 50 years of age—grew up when industry on rivers and associated pollution was extensive and obvious both visually and from an olfactory standpoint. For example, Maine's Androscoggin River—still one of the nation's most polluted—was a "*vile, lifeless, stinking sewer*" by the 1940s (Jones 1975). 1941 marked the river's worst year from an olfactory standpoint when a major drought exposed sediments polluted by waste reactants and other impurities from the sulfite pulping of wood for paper (State of Maine 1941; Campbell 1942; Lawrance 1961). A long-term resident in his 70s said, "*You don't see or smell pollution like it once was. Since I've grown up, it really has improved — a complete turnaround from what it was*." However, he added: "*I wouldn't want to swallow any of it*." (Washuk 2010).

For many, this has shaped the baseline against which they measure contemporary conditions. For example, the Cuyahogo River catching on fire in 1969, cultural eutrophication from agricultural and sewage runoff, and other similarly drastic events prompted major amendments to earlier pollution laws in the U.S. Clean Water Act and perhaps also a bias towards clean and clear above all else. A desire for aesthetically pleasing waters, with little reference to a balanced native species community, natural ecosystem function, or useable, suggests that contemporary perceptions of what is healthy is the result of baseline set during this era.

Despite major improvements in visual "cleanliness" of U.S. waterbodies over the past five decades, suitability and accessibility of the majority of habitat available to New England's diadromous fish community has been extensively reduced by historical and contemporary regional land and wateruse practices (e.g., driving logs downriver, installing dams, and failing to incorporate fish passage and natural stream function into road-stream crossing design). As a result, waterbodies and the communities of life they support are very different than they were 400 years ago, even though they may appear relatively pristine to eyes that are accustomed to physically degraded habitat. Human relationships with these waters have also shifted from consumptive to non-consumptive uses. Perhaps this is why most people are satisfied with contemporary despite the fact that strict consumption advisories have been issued by the State of Maine Center for Disease Control and Prevention (see http://www.maine.gov/dhhs/eohp/fish/) for all freshwater resident fish due to freshwater contamination from a host of chemicals including mercury and PCBs that are the legacy of the industrial era. In Maine, if residents still depended on sea-run fisheries for subsistence, jobs, and quality of life, perhaps satisfaction levels would better reflect the loss of these ecosystem goods and services.

It's Not my Fault or Responsibility…or I'm Powerless

The finding that three-quarters of respondents did not feel they had an impact on water quality in their home turf, or perceived waterbody conservation as somebody else's responsibility (e.g., the Maine Department of Environmental Protection's), or felt powerless to make a difference ("*it's difficult to stop development unless you have a great deal of money*," "*it's useless to clean up the river if the mill's still dumping in the river...*"), suggest there are many different reasons why people choose not to engage in waterbody conservation.

Macy (1991) suggests that rational actors will be more likely to allocate resources if they think their efforts will make a difference while being cost effective (i.e., I am not going to be acting rationally if I allocate my resources to something that is unlikely to accomplish some goal). Macy's hypothesis side steps Hardin's (1968) double bind problem related to free riding by suggesting another way for someone to be rational other than exploiting a commons. He suggests that there is a threshold at which initial momentum from a critical mass can ultimately spread to all members of the group as each new contribution triggers others. In this “chain of cooperation” model, each actor assesses the contributions of others before deciding if joining in will be beneficial. Salmon recovery efforts need momentum, and engaging a situation-specific “critical mass” of people may be enough to convince others that joining will make a difference.

The idea that actors who identify with others in a social system as a collective are more likely to allocate resources uniformly throughout the entire system via a quasi tie could also be integrated with the ideas presented by Macy. Specifically, it would seem that seeing others allocating resources to a common pool (and the fact that this improves efficiency of the group to hold on to what they identify with) would help motivate people to engage in allocation of their own resources as well: the more resources allocated, the better the likelihood that people would think their allocation could make a difference. How close to the critical mass restoration efforts are in Maine remain to be seen as large restoration projects like the Penobscot River Restoration Project progress and the degree to which diadromous fisheries rebound.

Opportunities: Thinking Beyond Salmon to Engage the Public

This study indicated that Maine residents value opportunities to escape from built (versus nature-like) environments that are perceived to be fast-paced and stressful. Attention restoration theory (so coined by Rachel and Stephen Kaplan in the 1980s) suggests that forays into natural environments or even just short exposure to natural features (e.g., through a window or on a lunch break) help trigger recovery from directed attention fatigue (a neurological phenomenon that results from overuse of the brain’s inhibitory attention mechanisms which handle incoming distractions while maintaining focus on a specific task). Research also suggests that interactions with natural environments promote psychological well-being, stress reduction, and cognitive clarity for effective day-to-day functioning at work and home (Ulrich 1983; Kaplan and Kaplan 1989; Hartig et al. 1991; Kaplan 1995; Gullone 2000; Felsten 2009). This theory posits that people need "*a tranquil respite, an opportunity to regain composure and focus, a way to keep from being swept away by the distractions of the moment*" (Kaplan 2001b, 482).

This study showed that the majority of residents seek out and value waterbodies as escapes. Waterbodies, their surroundings, and the fish and wildlife they produce provide for the kind of respite described by Kaplan because they command involuntary attention at a low attentional cost (i.e., they don't call on tired cognitive processes or require a great deal of effort like directed attention does). For example, the novelty of being in a different setting or the feeling of being away from everyday routine demands, expectations, and obligations allows for a redirection of attention. Fascinating features (i.e., "otherness"), can hold one's attention without effort. If effort is required, the environment is not restorative because stores of directed attention that have already been depleted continue to be tapped. As environmental historian William Cronon (1995) put it, the "otherness" of plants, animals, and the landscape is fascinating and thus commands our attention. E.O. Wilson's (1984) biophilia hypothesis further contends that humans have an "*innate tendency to focus on life and lifelike processes*." While restorative environments and contemporary interactions with them range broadly, they tend to be dominated by settings where built[11] features, relative to the rest of one's day, are absent or concealed (e.g. Ulrich 1983). Korpola et al. found that natural settings were over-represented among favorite places and found a positive link between favorite places and restorative experiences (2001).

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[11] In the case of dams on rivers, some have been around for centuries and are valued for the reservoir they create and the history/memories associated with it.

If sea-run fish proponents want improved buy-in and engagement in their programs, they need go beyond simply disseminating information about species and their habitats and instead market restoration in the context of what people care about. This study found that clean water and habitats that provide quality escapes are motivators. This points to a meaningful context by which to engage the public in improving habitat for native fishes. This indirect way of reaching conservation goals is needed in cases where species no longer have a strong presence, or for those (like fish) that do not typically receive as much attention from non-consumptive users as "charismatic megafauna" (e.g., whales and bald eagles).

Although respondents were largely satisfied with contemporary waterbody conditions, satisfaction with surrounding development was lowest out of all the variables measured. Concerns about encroaching development reflect its potentially negative impact on waterbodies' ability to provide a quality escape. Where satisfaction did emerge as significant in the model predicting behavioral intentions was if the escape qualities were threatened, for example shoreline development. Stedman (2002; 2003) had similar findings in Wisconsin Lakes. In Maine, the threat of development on escape is epitomized in the backlash against proposed development of Moosehead Lake's shoreline. From a motivational standpoint, it is timely to begin making the link between shared qualities of escapes and ecosystems that support native fish communities to help shape development ventures that minimize visible and functional impacts to aquatic ecosystems.

Highlighting commonalities between recovery of salmon and improved opportunities for escapes, with heavy focus on the health benefits of mental restoration for youth and adults, can help make recovery efforts more relevant to the public. For example, there are growing concerns about the prevalence of attentional problems in children (e.g., attention deficit hyperactivity disorder, or ADHD—see Barkley and Murphy 2005), and the potentially linked “nature deficit” in the daily lives of today’s youth (Louv 2005) which likely relate to the nationwide trend of declining recruitment and retention of hunters and anglers[12] (USFWS 2007). Today’s youth spend less time outdoors than any previous generation. In fact, a national Kaiser Family Foundation survey found that 8-18 year-olds devote an average of over 7.5 hours a day using entertainment media, and an additional two hours texting and talking on cell phones (Rideout et al. 2010), leaving little time for mental restoration via restorative environments. The implication of this for conservation is clear: how can youth develop a stewardship ethic epitomized in naturalists like Leopold (1949) or Dillard (1976) without spending time outdoors? Human health is a universal motivator, and from a parent’s perspective, there is a big opportunity to frame conservation messages in terms of escapes being good for our health and the health of our children (and fish).

People’s tendency to place importance on visibly clean water should be the starting point for discussions about a more holistic picture of waterbody “health” that incorporates connectivity from the headwaters to the sea. Messages should highlight the health and economic benefits associated with a thriving native sea-run fish community (e.g., they don’t spend all their time in freshwaters that cause resident species to carry high contaminant loads, the potential economic savings that come with buying a fishing license vs. buying fish in the store).

Where waterbodies were valued as a community place, we found that residents were more likely to act on behalf of them, especially through social means (e.g., peer pressure or enlisting the help of others). This has important implications for choosing restoration sites

[12] anglers and hunters have a long history of supporting conservation in an effort to retain the quality of life they enjoy and family traditions that productive fisheries and hunting opportunities provide.

strategically where locals are likely to tap their social networks for added support. To revisit McCay and Jentoft (1998), "*community exists, it counts, and it shapes the nature and outcomes of commons problems*" (1998). Akerlof and Kranton (2005) describe how social bonding of "insiders" can really maximize effort towards a common goal. Atlantic salmon fishing clubs have been successful at this by holding banquets and maintaining social activities among long-standing members. State-sponsored groups have not established these kinds of traditions and social opportunities that keep members connected to each other socially regardless of success.

Efforts should provide ways for individuals to modify places in ways that improve escape qualities and habitat for fish, as well as engage people socially. Fun events that facilitate the formation of friendships (e.g., the Downeast Salmon Federation's smelt bakes) and traditions around fish are great ways to rebuild community support for species recovery and habitat restoration. For example, Feld's (1981) focus theory, where focus is defined as a "*social, psychological, legal, or physical entity around which joint activities/social relations are organized*" suggests that people sharing the same focus (e.g., a river running through a town), or compatible foci, would be more likely to be tied to each other. Research shows as people become linked to each other via a particular focus, they begin to develop attachments to those others and begin to also allocate resources to preserve not only the focus (e.g., the place, a lake, or a fishery), but also their membership in the group organized by the focus. Linking habitat restoration and healthy fish to healthy communities and people is critical, and can be used to generate a sense of community where by social relationships can be drawn upon to reach common goals that benefit both people and fish.

CHAPTER 3

Revisiting Leopold's Land Ethic for Global Fisheries Sustainability: Thinking like a Fish

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Throughout history, human societies have been closely linked to fish and associated water bodies that dictate fish abundances, community structure, and fisheries productivity. As described in this book, fish have influenced and continue to influence human settlement patterns, drive trade, supply critical food sources, offer recreational opportunities, and provide a source of income for both inland and coastal human communities. Fish are also extraordinary sentinels of ecosystem and societal resiliency—changes in their community structure and production dynamics can alert us to unsustainable human activities occurring at both local and global scales.

Despite these interdependencies, motivation to sustain the worldwide network of extremely diverse and regionally distinct fish communities has been shrinking for many centuries throughout much of the world. In part, this is a function of human communities' shift in dependency from local to distant fisheries and subsequent loss of awareness of both local and global carrying capacities. Reliance on distant places to supply sources of sustenance and maintain or enhance a certain quality of life will continue as long as the carrying capacities of local landscapes are exceeded or exotic resources sought for economic and cultural reasons. Societies dependent upon the importation of resources, along with those societies that supply distant places with locally available resources, put the resiliency of local human and natural systems at risk in exchange for immediate enhancements in their own standards of living. As this global exchange occurs, the supplying societies also become increasingly reliant on distant resources.

This cycle is a trap in that it distances human links in the global fishery supply chain from their effects on the conservation and sustainability of fisheries resources and associated habitats. This disconnect decreases our ability to immediately recognize the true social and ecological costs of our actions and, in so doing, allows us to borrow from the future as we slowly bankrupt the world's fisheries. This book has aptly demonstrated through case studies of fisheries throughout the world that this can ultimately lead to unintended and oftentimes undesirable ecological and social changes that, while challenging to prevent, can be even more difficult, if not impossible, to reverse (Box 1).

Box 1: Fish Diversity and Human Survival

Author Daniel Quinn said, "Diversity is a survival factor for the community itself" (from Quinn 1992). With almost 28,000 species described (Helfman et al. 2009), fish are the most diverse vertebrates in the world, competing in and among virtually all waters that cover the globe for food, shelter, and mates. The habitats and communities of life with which fish have coevolved and adapted have always been in flux, with individuals and populations responding to dynamic climatic regimes, prey abundances, predation pressures, and shifting habitat availability. However, the rate at which the human footprint is changing these communities and their habitat exceeds the rate at which many fish are able to adapt. Unsustainable harvests and reductions in the diversity of available habitat reduce inter- and intraspecies diversity and ultimately the resiliency of species, communities, and allied ecosystems. Today, many fish have a tenuous relationship with human communities that frequently place an excessive demand on their biomass and diversity via directed harvests and destruction of their habitats. As humans, we need to consider thinking like fish to understand what is needed to sustain their production dynamics and resiliency in the face of changing local and global ecological processes. Ultimately, fish influence and forecast our own quality of life and survival.

Aldo Leopold's classic essay "Thinking Like a Mountain" (from Leopold 1949) uses a simple example involving wolves, deer, and a mountainside to highlight the urgent need to strengthen our atrophied connections to land and greatly enhance our understanding of how land and aquatic systems interact and influence biotic communities and allied resources. Specifically, wolves keep deer (and thus themselves) in check, and as a result, deer do not overgraze the mountainside they depend upon for food. A loss of wolves may, as Leopold points out, increase deer herd abundance and thus enhance deer-hunting opportunities for humans in the short term. It also, however, puts the mountainside at risk of becoming denuded by overgrazing and increases the deer herd's vulnerability to starvation and population collapse. While Leopold's conservation focus was primarily terrestrial, land and waterscapes are intimately linked and similarly impacted by human activities. As with the mountain system's resiliency being driven by a delicate balance between predator and prey, humans, through their activities on the landscape and in its waters, have the ability to shape the biotic and abiotic features of aquatic ecosystems and, ultimately, the structure and sustainability of embedded fish communities.

Leopold said "only the mountain has lived long enough to listen objectively to the howl of a wolf" (from Leopold 1949). Likewise, aquatic systems and the fish communities they shape have born witness to centuries of dynamic changes. We need to better understand these dynamic systems and "think" like the fish within these systems in order to fully understand the complexity of interacting factors that affect their resiliency, as well as the human activities that threaten their long-term sustainability. Without this perspective, we will continue to degrade and lose our valued fisheries. Leopold's above statement can also be applied more broadly to our tendency to overlook those variables that change slowly over time relative to a human lifespan (e.g., climate, sea level, and soil composition) as we strive for prosperity. While these "slow" variables may not be recognized at a localized scale or over a short period of time, they very strongly influence the nature, dynamics, and sustainability of coupled human and natural systems at local and global levels (Chapin et al. 1996; Berkes et al. 2003; Chapin et al. 2009). Further, by increasing our dependency on costly and relatively short-term technological "fixes" that enhance our ability to harvest, produce, ship, process, distribute fish and other allied resources, we inadvertently introduce problems or produce unintended consequences (e.g., ecological disruptions or loss of cultural identities that hinge on a species or fishery persisting over time) that are beyond our ability and societal will to successfully and sustainably solve.

The competing agendas for immediate enhancement in quality of human life and ecological sustainability often result in rejection of a stewardship ethic that promotes long-term sustainability in favor of, as pointed out by Leopold, "safety, prosperity, comfort, long life, and dullness" (from Leopold 1949). Paradoxically, these comforts compromise the adaptive capacity and therefore resiliency of the human and the natural systems upon which they depend (Liu et al. 2007). In failing to conserve fisheries resources and the ecosystems with which they are associated, we put ourselves at risk of further degrading our inland, coastal, and high seas fisheries economies, relying on more distant fisheries and water resources for our livelihoods and sustenance. In so doing, we increase our vulnerability to natural and social disturbances while having an expectation that our quality of life will continue to improve indefinitely. Leopold offered sound advice when he cautioned, "To keep every cog and wheel is the first precaution of intelligent tinkering" (from Leopold 1949). In other words, it will take systems thinking to ensure the resiliency and integrity of fish communities and their ecosystems into the future.

According to environmental historian William Cronon (1983), "the choice is not between two landscapes, one with and one without a human influence; it is between two ways of living, two ways of belonging to an ecosystem." Cronon's "two ways of belonging to an ecosystem" are really a continuum along which human societies practice a land ethic, which, according to Leopold, "changes the role of *Homo sapiens* from conqueror of the land-community [i.e., soils, waters, plants and animals: collectively "the land"] to plain member and citizen of it" (from Leopold 1949). On one end of this continuum, cultures that depend on locally available resources for subsistence purposes must, out of necessity, be keenly aware of the carrying capacity of the landscape (Berkes 1999; Campbell and Butler 2010). Dependency on local resources for survival favors a strategy that incorporates in-depth understanding of local resources (often referred to as traditional or local ecological knowledge) and a land ethic that does not promote growth beyond the carrying capacity of the local landscape and the resources it can support.

On the other end of this spectrum are those societies that use technology and distant resources to augment the carrying capacity of local systems. In so doing, these latter societies can insulate themselves from the impacts of their actions on both local and distant human communities and ecosystems, at least in the short term. As such, this strategy does not favor resource management strategies, global supply chains, or governance structures that incorporate a land ethic. It also fails to realize the benefits of local social networks on resource conservation and sustainability (e.g., Frank et al. 2007; Mueller et al. 2008).

As we increasingly employ this latter approach towards enhanced quality of life, it is critical that we significantly strengthen our understanding and appreciation of not just local, but the global processes, carrying capacities, and linkages between fish, water, and people. Recent growth of social preferences for locally grown food suggests a renewed interest and awareness of the connections between local social and ecological systems that have been diminished over time and demonstrates that there is reason for optimism that societies can better govern their local communities in more globally sustainable ways.

Case study: wild anadromous Atlantic salmon in the U.S.

An example that highlights the importance of appreciating both local and global processes that affect conservation issues is the wild anadromous Atlantic salmon *Salmo salar*. Because diadromous (sea-run) fish populations utilize both marine and freshwater ecosystems, they are particularly good indicators of changing biotic and abiotic features along the continuum of habitats they use to carry out and complete their complex life history. The Atlantic salmon, in particular, provides a poignant example of the impact of reduced resiliency of the more locally based coupled human and natural systems that once linked the thriving suite of native diadromous and ground fishes to flourishing coastal economies and cultures driven by once highly productive coastal and inland fisheries (Box 2).

While Atlantic salmon and indigenous peoples co-existed for millennia in what is now the Northeast United States, this species was virtually extirpated from this region within only a few centuries of the arrival of principally Western European colonists. Demand for natural resources quickly exceeded the carrying capacity of the landscape and has resulted in Atlantic salmon almost entirely losing their presence in the United States. By the early 1800s, the southernmost Long Island Sound metapopulation had been extirpated, followed soon thereafter by central New England, which was extirpated by the 1850s. The Gulf of Maine metapopulation has declined to only a couple thousand returning adults annually and was first listed as "endangered" under the Endangered Species Act in 2000. The Outer Bay of Fundy salmon that utilizes watersheds spanning northern Maine and parts of Atlantic maritime Canada are likely to be listed as a species "of concern" in draft documents of the Committee on the Status of Endangered Wildlife in Canada.

Box 2: King of Fish—Absent from the Throne

The Atlantic salmon, referred to by some as "king of fish" is a high-value food fish and prized game fish (Beland and Bielak 2002; Kocik and Brown 2002; Montgomery 2003). The native freshwater and oceanic range of wild anadromous Atlantic salmon is bounded by North America, Europe, and Scandinavia between 408N and 708N (MacCrimmon and Gots 1979; Page and Burr 1991; Gross 1998). Exponential growth in aquaculture production over the past several decades has further elevated Atlantic salmon to a truly global species: today, domesticated forms have a significant presence in the worldwide market and are farmed in both the Atlantic and Pacific oceans and northern and southern hemispheres. The enhanced presence of domesticated forms over the past several decades has masked centuries-long declines and regional extinctions of wild populations. In fact, today, less than 10% of the adult Atlantic salmon worldwide actually live in the wild for all or part of their life. Of those, many stocks are actively maintained through conservation hatcheries that intervene in the salmon's life cycle to enhance production and prevent extinction where effective population size and life history variation can no longer sufficiently buffer against reductions in suitable habitat and variability in the marine environment (e.g. Gross 1998).

A survey conducted by K. Mueller in 2008 and 2009 indicates that Maine residents who value wild Atlantic salmon do so for their beauty and recreational value ("beautiful fighter," "king of fish," "superior to all others"), a symbol of local heritage, and as an indicator of ecosystem health. Despite being valued for these reasons, sustainability of wild anadromous Atlantic salmon appears to be largely incompatible with the uses of land and water resources generally associated with industrialized or industrializing nations. This trend becomes clear when evaluating the declines and localized extinctions of wild salmon across their native range, particularly when evaluated in association with human settlement patterns in the United States. In general, salmon tend to be more threatened in the southern extent of their ranges where human population growth and human alterations to landscapes and water resources has been more extensive (e.g., Montgomery 2003; Lackey et al. 2006; Box 3).

Declines of Atlantic salmon in the United States can largely be attributed to drastic habitat alterations and technological developments that, coupled with unsustainable governance practices, resulted directly and indirectly in the reduction of the number and type of fish species present in this region and their production. For example, in an effort to facilitate the growth of local and regional economies and meet the demands of an expanding human population with increasing levels of resource consumption, rivers were reshaped and impounded to enhance their ability to carry logs to the lumberyards as well as provide power for mills, factories, homes, and businesses. These changes, coupled with driving enormous volumes of wood downstream, hindered free access to essential resources and habitats required by fish for spawning, rearing, and feeding at different life stages and times of year. Additionally, the conversion of mature forests into agricultural and urbanized areas has altered hydrological, temperature, and sediment transport regimes to the streams, further reducing Atlantic salmon production. Other human activities (e.g., the channeling of streams under road networks through culverts that are not ecologically engineered) also significantly alter natural riverine processes, hinder the movement of fish, and further reduce the amount and quality of habitat available for production.

Box 3: Advantages and Disadvantages of Anadromy

The Atlantic salmon is one of a minority (approximately 0.1%) of fishes worldwide that undertake extensive migrations between freshwater and saltwater ecosystems (McDowall 2009). These diadromous (sea-run) fishes tend to dominate the freshwater fish community in numbers and biomass in latitudes where ocean productivity exceeds that of freshwater systems as long as free access between these habitats exists (e.g., McDowall 1996). The benefits of diadromy in terms of enhanced growth, reproduction, and survival dynamics are dependent ultimately on free access among and between a diversity of freshwater and marine ecosystems during various life stages and times of year. A highly mobile life cycle quickly becomes disadvantageous when physical, biological, and/or chemical barriers delay or prevent movement and migration among and between critical habitats.

Human activities, performed extensively over the entire landscape of this region for the past four centuries, altered ecosystem processes and community structure at a scale and rate to which salmon and other native fishes were unable to adapt. As a result, the native suite of sea-run fishes that once dominated the freshwater systems of the Northeast United States has largely been outcompeted by nonmigratory and nonnative fishes. These species include predatory residents capable of reaching large sizes in freshwater (e.g., smallmouth bass *Micropterus dolomieu*, chain pickerel *Esox niger*, northern pike *E. lucius*, and muskellunge *E. masquinongy*) and a variety of salmonids originating from the Northeast United States, Europe, and the Pacific Northwest. Some of these nonnative fish were introduced directly by humans into new water bodies, either by accident or in an attempt to provide new fisheries for local citizens. Other exotic fish populations moved into and established populations through habitat modifications within recently impounded and ecologically altered coastal river systems.

Activities that resulted in major changes to native ecosystems were carried out in the watersheds and the river systems where these fishes lived and bred, despite knowledge that these systems served as migratory corridors and production zones for a dozen species of native sea-run fishes that were important to human sustenance and livelihoods (e.g., Wood 1634; Atkinson 1869; Belding and Corwin 1921). In fact, this awareness is evidenced in one of the earliest topographical accounts from a resident of the Massachusetts Colony who, in describing the upstream migration of another sea-run species, the alewife *Alosa pseudoharengus*, observed that they had "such longing desire after the freshwater ponds, that no beatings with poles, or forceful agitations by other devices, will cause them to return to the sea, till they have cast their spawn" (from Wood 1634). A later accounted observed, "dams, saw-mills, and other obstructions, the result of Yankee enterprise, have driven them [Atlantic salmon] from the United States…New England traded its salmon for milldams and factories" (from Montgomery 2003).

In the spirit of a laissez-faire approach to management, technological fixes were developed and implemented as early as the 1800s in an effort to counter reductions in fish production associated with the demands of an expanding human population with a higher standard of living. For example, efforts to restore fisheries for Atlantic salmon and other sea-run species native to the Northeast United States were initiated in the mid-1800s and consisted of the capturing and spawning of adults in a controlled hatchery environment and the stocking of juveniles into river systems that had been depopulated by high harvest rates or made inaccessible by dams and other obstructions (McFarland 1911; Belding and Corwin 1921).

Advances in aquacultural techniques during the latter half of the 20th century set the stage for exponential growth in commercial production of Atlantic salmon for food. On one hand, raising salmon to a harvestable size in a fairly controlled environment enhanced site-specific capacity for food production while removing the uncertainty and variation associated with wild stock fisheries. On the other, a glut of industrially reared (farmed) Atlantic salmon on the world market, coupled with a gradual decline of wild Atlantic salmon varieties over many human generations, has created a context for society to ignore the loss of the region's productive wild fisheries and believe that this species is abundant when, in reality, most people will never see a wild Atlantic salmon migrating upriver to spawn.

While water quality has been drastically improved in the United States and harvests checked, technological fixes used to compensate for ecosystems no longer able to support desired species can, at best, only slow or stabilize declines of the world's fisheries in the absence of efforts to restore natural ecosystem structure and function. This lack of awareness and associated failure to respond to gradual reductions in species and systems over time can result in surprising and large scale changes in ecosystems that directly affect the productivity and sustainability of associated resources (Liu et al. 2007).

Where Do We Go from Here?

More than 60 years have passed since Aldo Leopold articulated the need to adopt a land ethic. We have largely failed as a global community in thinking like a mountain or, in the context of this book, like a fish at the local or global scale. There is no immediate or perceived incentive to practice a land ethic—our immediate survival does not depend on knowing the carrying capacity of the local and global landscape nor the social connections that are defined and limited by these landscapes via natural processes and interactions. Until this ethic becomes a priority, we will continue to borrow from our future without understanding or perhaps even caring that we are bankrupting distant fisheries resources and destroying those communities where fish provide the fabric of their sustenance, livelihood, and culture in exchange for immediate (but ultimately unsustainable) increases in our own quality of life.

Our sense of place and attachment to both local and global ecosystems continue to atrophy (e.g., Louv 2008). This loss of attachment eventually results in societies changing their expectations regarding the value of regional fish and the water resources. People become disconnected from the impact of their activities on resources at the most visible local level and consequently do not recognize what happens at the global level, as long as their needs are met. Over time, the measure that we use to gauge our satisfaction with ecosystem goods and services is continually lowered, with or without our knowing or caring, giving precedent to other human activities and neglecting the impact we have on ecosystems and embedded species. As illustrated in the case study above, habitat modifications have reduced Atlantic salmon and other native fishes adapted to free access between freshwater and marine habitats to only remnants of what they once were. Memories of subsistence, commercial, and recreational fisheries supported by Atlantic salmon continue to fade with each passing generation along with the motivation to engage in their restoration and incentive to practice a land ethic. With the “king of fish” now largely absent from its throne in the United States, the Endangered Species Act is largely driving recovery efforts for this once abundant species.

The Atlantic salmon story is just one of many that can be used to illustrate the failure of current tinkering to, as Leopold suggested, “keep every cog and wheel” as well as a general illiteracy about the many ways in which we directly and indirectly impact fish communities and vice versa. This failure is enabled by growing disconnects in the local and global fisheries supply chain. The story of Atlantic salmon is reflective of the essay by Leopold regarding the mountain—after all, fish always “know” and respond to what is happening in the rivers, lakes, and oceans they occupy. Like mountains, waterscapes will always be present—it is what draws life from them that changes or disappears.

We must think like fish to understand what they need and ensure their continued presence in the biosphere as well as our own. This book alerts us to the urgency of the need for a global conference and consensus on ways and means for providing sustainable fisheries at local and global levels of governance. It is clear from this book and from history that, in addition to thinking and acting locally, we increasingly need to think and act globally if we are to sustain these magnificent animals, the fisheries they support, and ultimately our own future.

APPENDICES

Appendix A: Final Survey Instrument

For interpretation to color in this and all other figures,
the reader is referred to the electronic version of this dissertation.

A Survey of Maine Residents
About

"Home Turf" Conservation

...unique places, waterbodies and networks of people

ABOUT THE SURVEY

We are surveying Maine residents about the their connections to the place they live (i.e. their "home turf"), particularly waterbodies & other people.

Your participation will play a key role informing the development of relevant tools and opportunities for public engagement in stewardship of aquatic resources!

The survey should take you about 15-20 minutes and you must be 18 to participate.

ENTER TO WIN $500!

Complete & return the survey in person today or in the mail.
Answer the bonus questions at the end & double your chances to be drawn!
Make sure you fill out one or both tickets (opposite page) for entry in the drawing.

In fall of 2008, a ticket will be drawn at random and the owner of the winning ticket will be contacted & awarded $500!

YOUR RIGHTS AS A PARTICIPANT

Your participation is completely voluntary.

You may choose not to participate at all, refuse to answer certain questions, or stop at any time.

You will remain anonymous.

You will not be identified by name or any other unique characteristic or set of characteristics in any written documents that result from this research. While your privacy will be protected to the maximum extent allowable by law, there is always the possibility of unforeseeable risks.

Follow-up questions/comments?

Contact me (Katrina Mueller) at (207) 866-7409 (o) / (517) 256-0914 (c) or my academic advisor, Dr. William Taylor at (517) 353-3048 (o).

Questions/concerns regarding your rights as a study participant?
Dissatisfied at any time with any aspect of this study?

Contact (anonymously, if you wish) Dr. Peter Vasilenko, Director of the Human Research Protection Program by phone: (517) 355-2180 X239, fax: (517) 432-4503, email: irb@msu.edu, or mail: 202 Olds Hall, East Lansing, MI 48824.

You indicate your voluntary agreement to participate in this research & have your answers included in the anonymous dataset by completing & returning this survey.

This consent form was approved by the Social Science/Behavioral/Education Institutional Review Board (SIRB) at Michigan State University. Approved 4/24/08 – valid through 4/23/09. This version supersedes all previous versions. IRB # 05-260

For entry in the $500 drawing, please fill out the ticket(s) below.

- *The contact information you provide is solely for the purposes of this drawing*
- *Your survey responses will remain anonymous*

Name:
Address
zip:
City:
Email:
Phone 1:
Phone 2:

I completed the survey: enter me to win $500!

••••••••••••••••••••••••

You must be 18 to participate

Name:
Address
zip:
City:
Email:
Phone 1:
Phone 2:

I answered all of the the bonus questions: enter me to win $500!

••••••••••••••••••••••••

You must be 18 to participate

Many thanks in advance for your time!

Researcher's Notes

Today's date:
Venue:
Township:
__ Read aloud
__ Take home

This survey focuses on your HOME TURF, i.e.
"the geographical area in which you carry out your ***typical*** *weekly routine"*

Your home turf is the place where you:
live, work, get together with friends, shop day-to-day, recreate outdoors locally, exercise, attend religious services etc.

START HERE:

1. Please outline or otherwise indicate your HOME TURF* on the map: →


Shirley
15
6
Monson
Willimantic
Guilford
16
Abbot
Sangerville
Parkman
23
7
Wellington
150
Dexter
Brighton Plt
Cambridge
152
Ripley
23
150
154
Harmony
Corinna
Saint Albans
43
151
43
11
7
Hartland
Newport
Cornville
23
Palmyra
2
Pittsfield
Detroit
Skowhegan
220
Plymouth
Canaan
23
Clinton
Burnham
Troy
202
7
Fairfield
Unity Twp
139
Benton
Thorndike
Waterville
Unity
Winslow
Knox

Please answer the following questions about your HOME TURF, as you mapped it

2. Circle how well *each* statement describes your home turf on a 1-5 scale:

	not well				***very well***
"There are a lot of familiar faces here"	1	2	3	4	5
"We share a strong sense of place/community here"	1	2	3	4	5
"I feel 'at home' here"	1	2	3	4	5
"I do **ALL** *of my outdoor recreation here"*	1	2	3	4	5
"Most people that live here are trustworthy"	1	2	3	4	5
"I have everything I need here"	1	2	3	4	5

3. In your opinion, what is your home turf's most distinguishing…

please be as specific as you can for each

...natural landscape feature?

...manmade (built) feature?

...hangout/public gathering place?

4. What 3 *wild animals most contribute to your home turf's character?**

*(*mammals, birds, fish, shellfish, reptiles, amphibians etc.)*

1.

2.

3.

5. What best describes your residency here, in your home turf? *(check only one)*

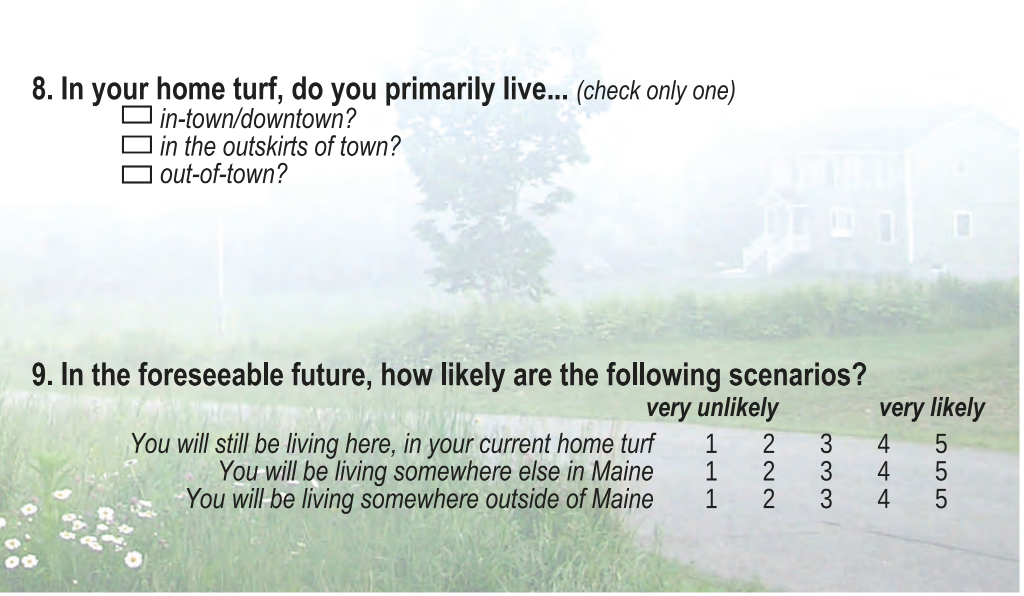
- ☐ *I am a year-round permanent resident*
- ☐ *I am here for seasonal, recreational or occasional use*
- ☐ *I am a student*
- ☐ ***Other** (please specify):*

6. During what ages have you lived here, in your home turf? *please specify:*

7. Are you attached your home turf for the following reasons?

	not at all				*very much so*
Presence of family	1	2	3	4	5
The community of people	1	2	3	4	5
The lifestyle/quality of life	1	2	3	4	5
Outdoor recreational opportunities	1	2	3	4	5
The natural resources & environment	1	2	3	4	5
Heritage & tradition	1	2	3	4	5
Work opportunities	1	2	3	4	5
Other	1	2	3	4	5

please specify:



8. In your home turf, do you primarily live... *(check only one)*

- ☐ *in-town/downtown?*
- ☐ *in the outskirts of town?*
- ☐ *out-of-town?*

9. In the foreseeable future, how likely are the following scenarios?

	very unlikely				*very likely*
You will still be living here, in your current home turf	1	2	3	4	5
You will be living somewhere else in Maine	1	2	3	4	5
You will be living somewhere outside of Maine	1	2	3	4	5

Think of the waterbody* located in your home turf that you, *yourself*, value the most

****or collection of interconnected waterbodies***

10. Is it a... *(check **ALL** that apply)*

- ☐ *pond or lake?*
- ☐ *reservoir (behind a dam)?*
- ☐ *bog, swamp or wetland?*
- ☐ ***Other** (please specify):*
- ☐ *freshwater stream or river?*
- ☐ *tidal river, flat or estuary?*
- ☐ *saltwater bay/the ocean?*

11. What is it called? *please specify:*

12. Can you...

...see it from your home or workplace?	☐ *yes*	☐ *no*
...access it easily from your home or workplace?	☐ *yes*	☐ *no*

13. What is your typical interaction with it? *please specify:*

14. For you, does it play an important role...

	not at all				***very much so***
...in your weekly outdoor recreation or exercise routine?	1	2	3	4	5
...in your weekly social routine?	1	2	3	4	5
...as a point of contact with the natural world?	1	2	3	4	5
...at your home or workplace?	1	2	3	4	5
...providing a link to the past?	1	2	3	4	5
...linking you to your community?	1	2	3	4	5

15. How satisfied are you with its...

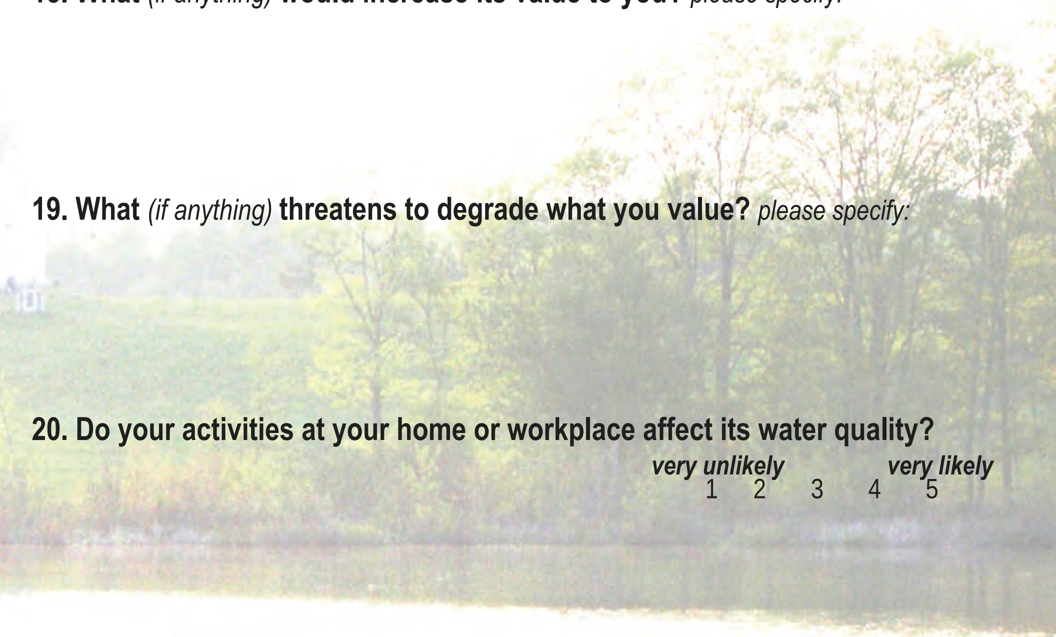
	very unsatisfied				***very satisfied***
...water quality?	1	2	3	4	5
...ability to support animals & plants you value?	1	2	3	4	5
...public accessibility?	1	2	3	4	5
...outdoor recreational opportunities?	1	2	3	4	5
...surrounding development?	1	2	3	4	5
...overall health?	1	2	3	4	5

16. To you, does it symbolize any of the following?

	not at all				*very much so*
Economic vitality	1	2	3	4	5
A healthy community	1	2	3	4	5
The heart of the community	1	2	3	4	5
A pristine wilderness	1	2	3	4	5
An escape	1	2	3	4	5

17. What about it do you value most and why? *please specify:*

18. What *(if anything)* **would increase its value to you?** *please specify:*



19. What *(if anything)* **threatens to degrade what you value?** *please specify:*

20. Do your activities at your home or workplace affect its water quality?

very unlikely				*very likely*
1	2	3	4	5

21. Will you help conserve this waterbody by...

	very unlikely				*very likely*
...joining an organized group?	1	2	3	4	5
...following rules & regulations?	1	2	3	4	5
...practicing voluntary "backyard" conservation?	1	2	3	4	5
...taking part in a landowner stewardship program?	1	2	3	4	5
...enlisting the help of others (e.g. friends/neighbors)?	1	2	3	4	5
...using peer pressure to hold others accountable?	1	2	3	4	5
...participating in informal town meetings?	1	2	3	4	5
...participating in formal public hearings?	1	2	3	4	5
...contacting public officials?	1	2	3	4	5

22. In your home turf, how much do the following affect water quality?

	not at all				*a lot*	*not sure*
the legacy of past industries & land-uses	1	2	3	4	5	NS
present-day forestry practices	1	2	3	4	5	NS
present-day agricultural practices	1	2	3	4	5	NS
present-day industry	1	2	3	4	5	NS
suburban sprawl	1	2	3	4	5	NS
road construction, drainage & maintenance	1	2	3	4	5	NS
presence/absence of native sea-run fishes	1	2	3	4	5	NS
acidification	1	2	3	4	5	NS
dams	1	2	3	4	5	NS

23. "Fish can tell us a great deal about water quality"

strongly disagree				*strongly agree*	
1	2	3	4	5	NS

24. What net effect do dams (*any size*) **located *in your home turf* have on:**

	negative		*none*		*positive*	
local water quality	1	2	3	4	5	NS
local area character	1	2	3	4	5	NS
the local economy	1	2	3	4	5	NS
public safety	1	2	3	4	5	NS
native animals & plants	1	2	3	4	5	NS
local fishing opportunities	1	2	3	4	5	NS
your preferred recreation	1	2	3	4	5	NS
Gulf of Maine lobster & groundfish fisheries	1	2	3	4	5	NS

25. What net effect might reviving sea-run fisheries have on:

	negative		*none*		*positive*	
local water quality	1	2	3	4	5	NS
local area character	1	2	3	4	5	NS
the local economy	1	2	3	4	5	NS
native animals & plants	1	2	3	4	5	NS
local fishing opportunities	1	2	3	4	5	NS
your preferred recreation	1	2	3	4	5	NS
Gulf of Maine lobster & groundfish fisheries	1	2	3	4	5	NS

26. In your opinion, what top 3 traits does a "healthy" waterbody have?

1.

2.

3.

27. What are your top 3 sources of information about local waterbodies?

Please be as specific as possible, for example:

word of mouth, personal experience, community events, public meetings, agency websites, TV, internet, magazines (e.g. Northwoods Sporting Journal, Downeast Coastal), conservation groups, extension agents, nature centers/naturalists, internet, daily/weekly paper, mailings, newsletters...

1.

2.

3.

28. In a typical week *(season permitting)*, **how many days are you outside...**

	days per week							
canoeing or kayaking?	0	1	2	3	4	5	6	7
using a motorized watercraft?	0	1	2	3	4	5	6	7
fishing?	0	1	2	3	4	5	6	7
camping?	0	1	2	3	4	5	6	7
wildlife viewing?	0	1	2	3	4	5	6	7
scouting & hunting?	0	1	2	3	4	5	6	7
trapping?	0	1	2	3	4	5	6	7
picking & gathering fruits, fiddle heads etc?	0	1	2	3	4	5	6	7
gardening?	0	1	2	3	4	5	6	7
managing a small woodlot?	0	1	2	3	4	5	6	7
snowmobiling?	0	1	2	3	4	5	6	7
cross-country skiing or snowshoeing?	0	1	2	3	4	5	6	7
four-wheeling?	0	1	2	3	4	5	6	7
Using foot or bike trails?	0	1	2	3	4	5	6	7
Other? ________________	0	1	2	3	4	5	6	7
________________	0	1	2	3	4	5	6	7
________________	0	1	2	3	4	5	6	7

Now, think about ANY organized groups you're currently involved with...

FOR EXAMPLE:

Community	*Kiwanis, neighborhood coalition...*
Professional	*union, guild...*
Environment/conservation/outdoors	*land trust, lake association, rod & gun club...*
Religious	*churches, synagogues, bible study…*
Veterans	*Veterans of America...*
Political	*Maine Federation of Young Republicans/Dems...*
Recreation/social	*bowling league, outing league, fishing club, fraternity...*
Youth	*scouts, PTA, 4H…*
Health/safety	*volunteer fire department, Red Cross...*
Special interest	*gardening, theater, book club, dogs, dancing...*

29. Pick up to 3 groups you're currently active in & fill in table below.

Name of organized group	***Number of active members*** *Zero* *1-5* *6-24* *25+*	***How often do you meet?*** *e.g. daily, weekly, bi-weekly, monthly...*
1		
2		
3		

...and about any in-person socializing you do ***<u>in your home turf</u>*** (beyond small talk)



30. If applicable, circle how often you socialize in-person with:

	daily		*monthly*		*yearly*	*Not applicable or never*
Family	1	2	3	4	5	☐
Neighbors	1	2	3	4	5	☐
Work-related friends/colleagues	1	2	3	4	5	☐
Members of groups you're currently active in	1	2	3	4	5	☐
Active community members / community leaders	1	2	3	4	5	☐
Members of local conservation groups	1	2	3	4	5	☐

31. Likewise, please circle how close your friendships are with:

	not close at all				*extremely close*	*Not applicable*
Family	1	2	3	4	5	☐
Neighbors	1	2	3	4	5	☐
Work-related friends	1	2	3	4	5	☐
Members of groups you're currently active in	1	2	3	4	5	☐
Active community members / community leaders	1	2	3	4	5	☐
Members of local conservation groups	1	2	3	4	5	☐

32. And please circle how many people you informally socialize with that are:

Family	*zero*	1 - 5	6 - 24	25+
Neighbors	*zero*	1 - 5	6 - 24	25+
Work-related friends	*zero*	1 - 5	6 - 24	25+
Members of groups you're currently active in	*zero*	1 - 5	6 - 24	25+
Active community members / community leaders	*zero*	1 - 5	6 - 24	25+
Members of local conservation groups	*zero*	1 - 5	6 - 24	25+

33. Finally, do you REGULARLY socialize in-person with: *(check **ALL** that apply)*

- ☐ *locals with a long family history in Maine*
- ☐ *permanent residents 'from away'?*
- ☐ *seasonal (e.g. summer) residents 'from away'?*

34. Who would you ask for help conserving a waterbody located in your home turf?

	not likely at all				*extremely likely*	*Not applicable*
Family	1	2	3	4	5	☐
Neighbors	1	2	3	4	5	☐
Work-related friends	1	2	3	4	5	☐
Members of groups you're currently active in	1	2	3	4	5	☐
Active community members / community leaders	1	2	3	4	5	☐
Members of local conservation groups	1	2	3	4	5	☐
Other	1	2	3	4	5	

please specify:

☐ It's unlikely I would ask anyone because:

35. Likewise, who would you be inclined to help if asked?

	not likely at all				*extremely likely*	*Not applicable*
Family	1	2	3	4	5	☐
Neighbors	1	2	3	4	5	☐
Work-related friends	1	2	3	4	5	☐
Members of groups you're currently active in	1	2	3	4	5	☐
Active community members / community leaders	1	2	3	4	5	☐
Members of local conservation groups	1	2	3	4	5	☐
Other	1	2	3	4	5	

please specify:

☐ It's unlikely I would help because:

What is your date of birth? (*month/day/year*):

What is your gender? *(check one)* ☐ *male* ☐ *female*

In what township are you a resident? ____________________

What is your primary occupation?

BONUS QUESTIONS: *double your chance at $500!*

1. What 3 aquatic animals FIRST come to mind when you think of your home turf?

#1:

#2:

#3:

2. What 3 aquatic animals are most valuable to you and why? *(can be the same as above)*

#1: *mostly because:*

#2: *mostly because:*

#3: *mostly because:*

3. How would you describe your experience with fishing? *(check **ALL** that apply)*

- ☐ *I myself don't fish*
- ☐ *I take other people fishing*
- ☐ *I'm a new/occasional recreational angler*
- ☐ *I'm an avid recreational angler*
- ☐ *I'm a professional fishing guide*
- ☐ *I'm a commercial fisherman*

4. What about your experiences fishing have you found most rewarding?

(*If you haven't had a fishing experience, what is a benefit of healthy fish/fisheries?)*

5. If you do fish, list up to 3 species you target fishing and why you target them:

#1: *mostly because:*

#2: *mostly because:*

#3: *mostly because:*

golden shiner white sucker fallfish/creek chubs landlocked smelt landlocked alewife whitefish cusk	landlocked salmon brook trout togue (lake trout) splake brown trout white/yellow perch bullhead (hornpout)	pumpkinseed black crappie largemouth bass smallmouth bass northern pike chain pickerel	sea-run salmon American eel striped bass sea-run smelt sea-run alewife American shad	sea lamprey Atlantic herring mackerel groundfish, e.g. cod bluefish winter flounder

6. What 3 fish found in Maine waters and listed above do you value MOST and why?

#1: *mostly because:*

#2: *mostly because:*

#3: *mostly because:*

☐ *I'm not familiar enough with the Maine's fish to answer.*

7. What 3 fish found in Maine waters and listed above do you value LEAST and why?

#1: *mostly because:*

#2: *mostly because:*

#3: *mostly because:*

☐ *I'm not familiar enough with Maine's fish to answer.*

Anonymous Survey Respondent

Katrina Mueller
249 Potter Rd.
Hudson, ME 04449

APPENDIX B: Survey Venue Examples

Alternative Market, Bar Harbor

A&B Naturals, Bar Harbor

Town Hill Market, Town Hill

Airline Snack Bar, Beddington

Matthews CH, Cherryfield

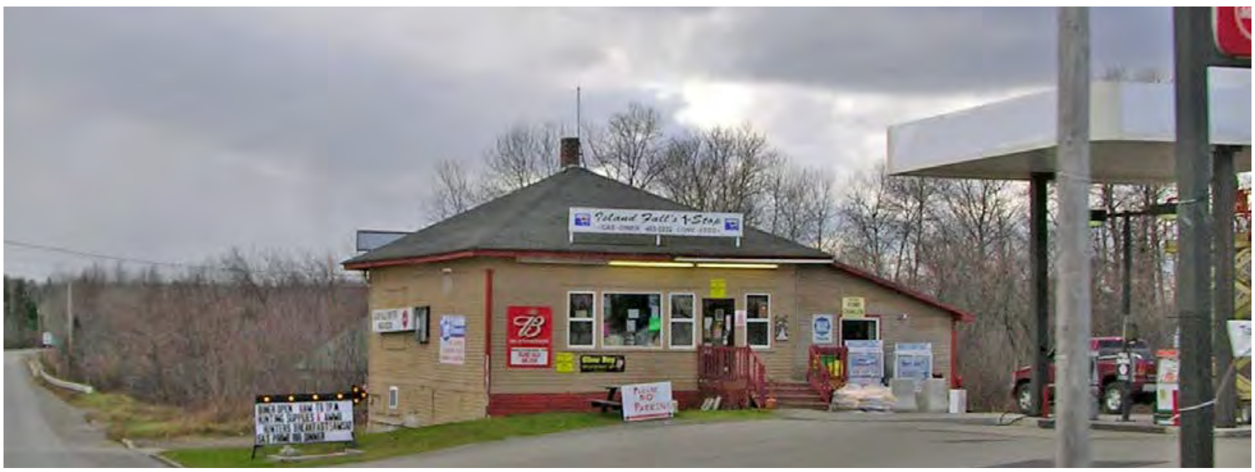
Archibald's One Stop, East Machias

Gulf, Machias

Bay Market, Surry

IGA Market Place, Trenton

Book Stacks, Bucksport



Island Falls One Stop, Island Falls

Jerry's Thriftway, Island Falls

Mill Stream Grocery, Springfield

Raymond's Variety, Lee

Debbie's Deli & Pizza, Patten

Smith's Grocery & Lunch, Brownville

The General Store & More, Brownville

C&J Variety, Milo

Maryanne's Market, Medway

Lennie's Superette, Medway

Pangburn Family Supermarket/IGA, Millinocket

Brettun's Variety, Livermore

Tilton's Market, Buckfield

Canton Variety, Canton

Bud's Shop'N Save, Dexter

Toot's Deli, Dexter

Jimmy's Market, Bingham

Solon Corner Store, Solon

Solon Superette, Solon

KJ's Variety, Greenville

Hard Drive Café, Greenville

Village Food Mart, Greenville

Indian Hill Shop 'n Save, Greenville

Monmouth Kwik Stop, Monmouth

Roadside Bakery, Monmouth

Monmouth General Store, Monmouth

Mt. Vernon General Store, Mt. Vernon

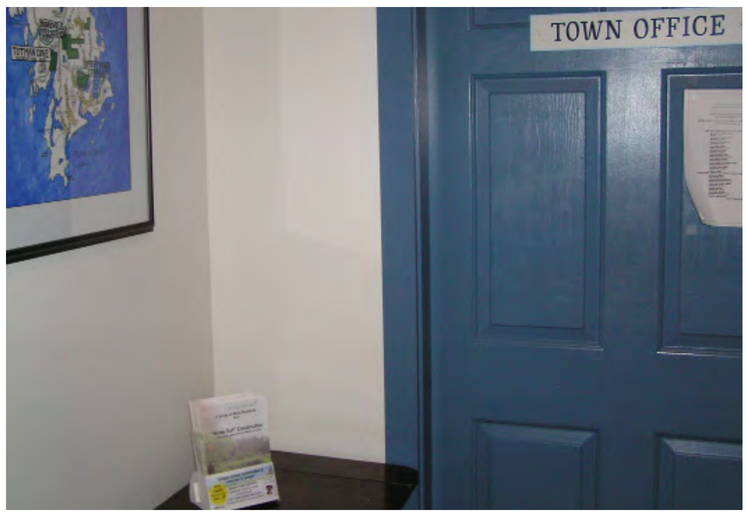
Flying Pond Variety, Mt. Vernon

China Village General Store, China

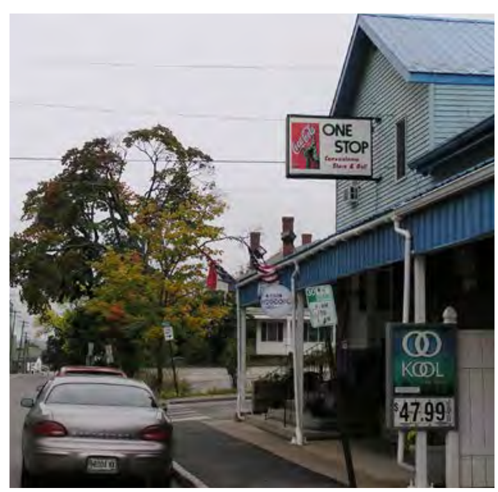
Lakeside Variety, China

Wentworth's General Store, Brooks

North Creek Farm, Phippsburg



Phippsburg Town Office



One Stop Food & Ice, Bath

Slate's Bakery, Waldoboro

Dead River Convenience Store, Farmingdale

Village Kitchen, Poland

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