Atl. Salmon - Draft #2

US Atlantic Salmon Stock Structure, Status, and Metrics Information Brief For New England Council to amend the Atlantic Salmon FMP in 2010

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SUMMARY: This species, unlike other NEFMC managed stocks, has not been subject to a plan review by the National Marine Fisheries Service because the current FMP prohibits possession of Atlantic salmon and any directed or incidental (bycatch) commercial fishery for Atlantic salmon in federal waters. Due primarily to significant ongoing threats from poor marine survival, dams, and the inadequacy of existing regulatory mechanism for dams, the Gulf of Maine Distinct Population Segment (GOM DPS) of Atlantic salmon was listed as endangered under the Endangered Species Act (ESA) in June 2010. The other stock complexes in the US - Long Island Sound and Central New England and the trans-boundary Outer Bay of Fundy complex are also well below conservation limits. A metric used by salmon managers, Conservation Spawning Escapement, is comparable to minimum stock size threshold (MSST) and under current natural mortality regimes US salmon stock complexes are below the minimum stock size at which rebuilding to BMSY will occur within 10 years. Since 1967, CSE has not been achieved for a stock complex and the highest abundances noted are less than 25% of these conservation minima and the median values are less than 10% -even with extensive hatchery support.

Stock Structure and Management Units

Atlantic salmon (*Salmo salar*) are circumpolar in distribution and in North America range from Ungava Bay southward to Long Island Sound. As a consequence of human development, many native United States populations were extirpated. Salmon life history is complex owing to its use habitat as diverse as headwater streams and distant water marine habitats. US Atlantic salmon spawn in rivers, spending 1-3 years in nursery streams. When juveniles (parr) exceed 13 cm in the autumn, they develop into smolts and migrate to the Atlantic Ocean the following spring. Tagging data indicates that US salmon commonly migrate as far north as West Greenland and return after 1-3 winters at sea. Non-maturing adults remain at sea feeding in the coastal waters of West Greenland, Newfoundland and Labrador.

Strong homing capabilities of Atlantic salmon foster the formation and maintenance of local breeding groups- stocks. These stocks exhibit heritable adaptations to their home range in rivers and likely at sea. The importance of maintaining local adaptations has demonstrated utility in salmon conservation. Because of significant declines in Atlantic salmon populations in the US, analyses of population structure was conducted and some populations are managed under the Endangered Species Act (ESA, 74 Federal Register 29346, June 19, 2009). The Act required that subgroups must be separable from the remainder of and significant to the species to which it belongs to warrant ESA protection (Fay et al. 2006). Biologists then delineated US Atlantic salmon populations into four discrete stock complexes that are now managed in differing manners: 1) Long Island Sound stock complexes; 2) Central New England stock complexes; 3) Gulf of Maine Distinct Population Segment and the 4) Outer Bay of Fundy Salmon Fishing Area (Figure 1). Both the Long Island Sound and Central New England stock complexes native stocks were extirpated in the 1800's. Remnant native populations of Atlantic salmon in the United States now persist only in Maine in the endangered Gulf of Maine DPS and cross-boundary headwater populations from the Outer Bay of Fundy SFA.

Currently, the Gulf of Maine DPS is managed under a recovery program under the ESA (NMFS and FWS 2005). The Long Island Sound and Central New England stock complexes are under restoration using donor stocks from Maine and are managed under coordinated Federal and Interstate restoration efforts, in the form of stocking and fish passage management. While, Atlantic salmon stocks from the Penobscot River in Maine were used in the restoration programs in the Connecticut (Long Island Sound DPS) and in the Merrimack and Saco in the (Central New England DPS) these programs are now genetically isolated. US watersheds in the Outer Bay of Fundy region are supplemented by St. John River Atlantic salmon broodstock and the core populations of this management unit have freshwater nursery areas primarily in Canadian watersheds. Within Canada, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed population structure and status and is moving forward with a species level assessment of Atlantic salmon in eastern Canada expected to be complete by November, 2010 and the outer Bay of Fundy (oBoF) stock complex is currently noted as of particular concern warranting proactive recovery planning.

Stock Status

US Atlantic salmon populations are assessed by the US Atlantic Salmon Assessment Committee (USASAC), a team of state and federal biologists tasked with compiling data on the species throughout New England and reporting population status. Annual assessments are available on-line (http://www.nefsc.noaa.gov/USASAC/ USASAC 2010). Currently population status of salmon is determined by 1) counting returning adults either directly (traps and weirs) or 2) indirectly using redd surveys. Total returns also include fish retained from angling in some states and historical US time series includes these data (USASAC 2010).

The modern time series of salmon returns to US Rivers starts in 1967 (Figure 2). Average annual Atlantic salmon returns to US rivers from 1967 to present was 2,173 and the median is 1,670. Because many of the populations in southern New England were extirpated and the Penobscot River was at very low levels, the salmon returns graph illustrates the sequential rebuilding of the populations through restoration efforts in the 1970s – with increased abundance first seen in the Penobscot River then the Merrimack and Connecticut Rivers. Unfortunately, the trajectory of this recovery did not continue in the late 1980s and early 1990s. Starting in the early 1990s there was a phase shift in marine survival and an overall reduction in marine survival occurred in all US and most Canadian populations. Average annual Atlantic salmon returns to US rivers from 1991 to present is 1,878 only 86% of the time series average. There has been a downward trend in production of salmon on both side of the Atlantic (particularly populations dominated by 2SW fish) that have affected US populations. In addition, recovery from historical impacts was never sufficient so US populations were at low absolute abundance when the phase shift began.

Returns to US waters in 2009 were 2,336 fish ranking 17th out of the 43 year time series which is nearly 1,000 fish above complete series median and only the second year above median since 1998. Relative to the average during the current marine survival regime (1991-present), returns were 6th highest out of the 19 years. Given consistency in stocking levels and natural smolt production measurements, increased marine survival is thought to be the primary cause of this increase.

To assess the relative status of the stocks, it is informative to examine conservation spawning escapement (CSE) goals. CSE targets also called conservation limits, are widely used (e.g., ICES 2005) to describe the status of Atlantic salmon populations. Because juvenile rearing habitat can be measured or estimated efficiently, these data are used to calculate target spawning requirements to fully seed all juvenile rearing habitats. US CSE goals are set for accessible rivers using a method developed by Elson (1975). This method assumes a target egg deposition of 2.4 eggs/m2 is needed to fully seed a river (Elson 1975); female fecundity averages 7,200 eggs/female (Baum and Meister 1971, Baum 1997); Healthy salmon populations often greatly exceed CSE and as such this metric should be thought of as a minimal conservation target not fishery target. In self-sustaining populations, the number of returns would frequently exceed CSE by 50 to 100 percent allowing for sustainable harvests and buffers against losses between returns and spawning.

For the 3 stock complexes managed primarily by the United States, the CSE goal has been calculated at 29,199 spawners (Table 1). The average percent of the CSE achieved for the modern time series averaged 7.4% and 2009 returns were 8.0% of CSE. In the last decade, total returns have accounted for less than 2 percent of goals for Long Island Sound and Central New England stock complexes. However, salmon returns to the Gulf of Maine DPS have been as high as 20% of CSE during this period, largely due to hatchery smolt returns to the Penobscot River. In smaller rivers of the Gulf of Maine stock complex CSE ranged from 3-15%.

As such, the status of US Atlantic salmon populations is critically low for all stock complexes, with the remnant populations of the Gulf of Maine stock complex listed as endangered. Since the modern era of Atlantic salmon restoration and recovery (circa 1967) began, instances of spawners meeting a replacement rate of 1 let alone exhibiting population growth are infrequent at a population level and non-existent at a stock complex level. Because recovery and restoration plans have goals of self-sustaining (i.e., exclusively naturally reproducing) populations, the failure to meet replacement with extensive hatchery stocking support indicates that these populations are well below natural replacement rates. This indicates all US stock complexes are under the minimum stock size threshold (MSST) under current natural mortality regimes because they are below the minimum stock size at which rebuilding to BMSY will occur within 10 years.

Fisheries and Current Management Structures

Marine Fisheries

The ocean migrations of US Atlantic salmon take them to distant-water feeding grounds in the sub-Arctic where they overlap with Canadian and European stock complexes. Historically, fisheries for Atlantic salmon have been in coastal environments – both close to natal rivers and in distant coastal waters outside the US Exclusive Economic Zone (EEZ). US stocks were primarily harvested gill nets, weirs, and pound nets in the coastal waters of the United States, West Greenland, Newfoundland, and Labrador. Some catch also occurred in the Bay of Fundy, Scotian Shelf and East Greenland. As such, US Atlantic salmon become part of a mixed-stock marine resource that ventures into the fisheries zones of other countries where they may be exploited. Recognizing this reality, the United States joined the North Atlantic Salmon Conservation Organization (NASCO). NASCO is an international organization, established by an inter-governmental Convention in 1984 with the objective to conserve, restore, enhance and rationally manage Atlantic salmon through international cooperation taking account of the best available scientific information. To date, regulatory and other measures established by NASCO and its Parties have greatly reduced harvests of wild Atlantic salmon all around the North Atlantic.

The last commercial fishery for Atlantic salmon in the US was closed after the 1948 season in the Penobscot River, Maine (Fay et. al. 2006). Although never commonly targeted in offshore waters, regulations have been in place since 1987 restricting ocean harvest. According to the Atlantic salmon fishery management plan (FMP) - "The management unit for the Atlantic salmon FMP is intended to encompass the entire range of the species of U.S. origin while recognizing the jurisdictional authority of the signatory nations to NASCO" (NEFMC 1987). Accordingly, the management unit for this FMP is: "All anadromous Atlantic salmon of U.S. origin in the North Atlantic area through their migratory ranges except while they are found within any foreign nation's territorial sea or fishery conservation zone (or the equivalent), to the extent that such sea or zone is recognized by the United States." Presently there is a prohibition on the

possession of Atlantic salmon in the EEZ. Effectively this protects all US populations in marine waters and is complementary to management practiced by the states in riverine and coastal waters.

Distant water fisheries must be considered to effectively conserve and restore US salmon populations. Commercial fisheries for Atlantic salmon in Canada and Greenland are managed under the auspices of the North Atlantic Salmon Conservation Organization (NASCO), of which the United States is a member. The mixed-stock fisheries in Canada were managed by time-area closures and quotas, however all commercial fisheries for Atlantic salmon in Canada have been closed since 2000. The Greenland fishery has been managed by a quota system since 1972. In 1993, a modified quota system was agreed to, which provided a framework for quotas based on a forecast model of salmon abundance. From 1993-1994, quotas were bought out through a private initiative, but the fishery resumed in 1995 under forecast modeling-based quotas. In 2002, salmon conservationists and the Organization of Fishermen and Hunters in Greenland signed a five-year, annually renewable agreement, which suspended all commercial salmon fishing within Greenland territorial waters while allowing for an annual internal use only fishery. In 2007, a similar agreement was signed and will be in effect through 2013.

Bycatch in Marine Fisheries

Within US waters directed fishing for other species does have the potential to intercept salmon as by-catch. Beland (1984) reported that fewer than 100 salmon per year were caught incidental to other commercial fisheries in the coastal waters of Maine. In most modern fisheries, the surface oriented pelagic distribution of Atlantic salmon would minimize encounters. Using resources from the Standardized Bycatch Reporting Methodology confirms only rare occurrences of Atlantic salmon in observer databases. For the period of record 1989-2009, Atlantic salmon were observed in 5 of 12 years. A total of 44.8 pounds of Atlantic salmon were reported about 50% was discarded. A typical catch was documented in NEFSC (2010) – 9 pounds retained from statistical area 514, coastal Massachusetts from a large mesh sink gillnet in the July 2008 – June 2009 time period. During this period of record, Atlantic salmon were recorded in the following areas and months:

512: June
514: Mar
521: March
522: April
525: May
537: June, November

Most observations appear to be single fish. The spatial and temporal distribution of catch suggests bycatch reported may be adults returning to spawn from a southward route upon return from West Greenland. The numbers of fish observed south of Maine also suggest origins could be any of the 4 stock complexes.

Recent investigations also confirm the potential for Atlantic salmon bycatch to be occurring in pelagic and midwater fisheries due to an overlap in space and time of the fish and gear. As noted above there are few observations and they are too limited to quantitatively project bycatch with any confidence for most fisheries. The by-catch of Atlantic salmon in herring fisheries is not considered a significant mortality source for U.S. stocks (ICES 2004).

Recreational and Freshwater Fisheries

Recreational angling for Atlantic salmon in the US has been targeted in rivers. Some anecdotal reports of fishing in coastal waters suggest saltwater recreational angling may sometimes occur but it is uncommon. Targeted angling for sea-run Atlantic salmon has been eliminated in all New England since spring 2008 with the re-closure of the Penobscot River, Maine fishery. Maine has recreational harvest that phased into catch and release from the 1970's through 1999. In 2000, recognition of returns well below CSE and exceptionally low marine survival trigger a closure of all targeted Atlantic salmon fisheries including catch-and-release fisheries in Maine. However, the Penobscot River was briefly reopened to an experimental targeted catch-and-release fishery in 2006-2008. The rationale behind the re-opening was to reengage local anglers and citizens in Atlantic salmon recovery. Low license sales and regulatory measures that failed to maintain quotas combined with listing of the Penobscot River Atlantic salmon population resulted in the state again closing the experimental fishery in 2009.

Outside Maine, targeted fishing for sea-run Atlantic salmon in prohibited. However, there are opportunities to catch Atlantic salmon offered with New Hampshire and Massachusetts. A recreational fishery has been conducted annually on reconditioned surplus hatchery broodstock released in the Merrimack and Massachusetts and Rhode Island ponds. Reconditioned broodstock have contributed to one or more cohorts of hatchery production. The Merrimack River recreational fishery was initiated in 1993. The New Hampshire Fish and Game Department manages the Atlantic salmon broodstock fishery in the mainstem Merrimack River and a lower portion of the Pemigewasset River. In a typical year, a total of 1,200 to 1,500 fish are released and 1,350 to 1,450 licenses are sold. Reconditioned Connecticut River domestic broodstock surplus to the needs of the Connecticut restoration program are made available to states to create sport fishing opportunities. Stocking occurs in lakes and ponds outside of the Connecticut River and its tributaries in ponds in Massachusetts and Rhode Island. Anglers make about 10,000 trips a year to fish for surplus salmon broodstock.

Biological Reference Points

Biological reference points for US Atlantic salmon are different from most other assessed species because they are managed in numbers not biomass at the population level. Also, triggers are different because 1) they are a protected species and 2) none of

the historic domestic fisheries that targeted salmon are still active. Conventional fisheries targets (MSY, BMSY, FMSY, etc.) have not been developed because current populations are so low relative even to sustainable conservation levels. A proxy for Minimum Stock Size Threshold (MSST) for US Atlantic salmon is CSE since this provides the minimum population number needed to fully utilize available freshwater nursery habitat. As noted above, since 1967 CSE has not been achieved and the highest abundances noted are less than 25% of these conservation minima even with hatchery support.

Table 1 Two-sea winter (2SW) conservation spawning escapement requirements for US River populations and 2SW returns (with % of CSE) in 2009

DPS or Other Composite	CSE	Returns 2009 (%)
Long Island Sound	10,094	75 (0.7%)
Central New England	3,435	92 (2.7%)
Gulf of Maine DPS	15,670	2,169 (13.8%)
Total	29,199	2,336(8%)

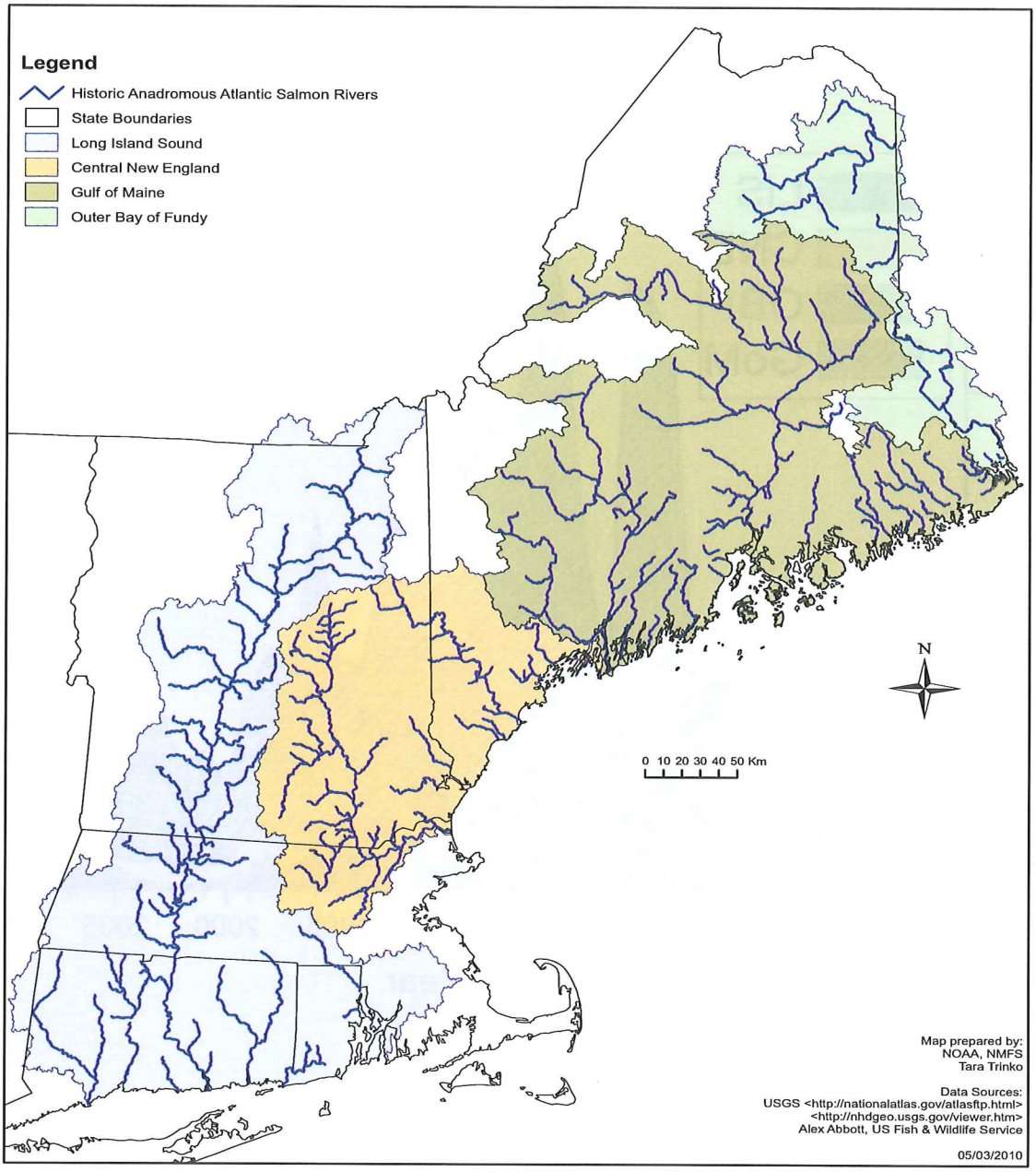

Figure 1. Map of New England Atlantic Salmon management stock complexes by region from north to south- Outer Bay of Fundy (OBF), Gulf of Maine DPS (GoM), Central New England (CNE), and Long Island Sound (LIS) Regions

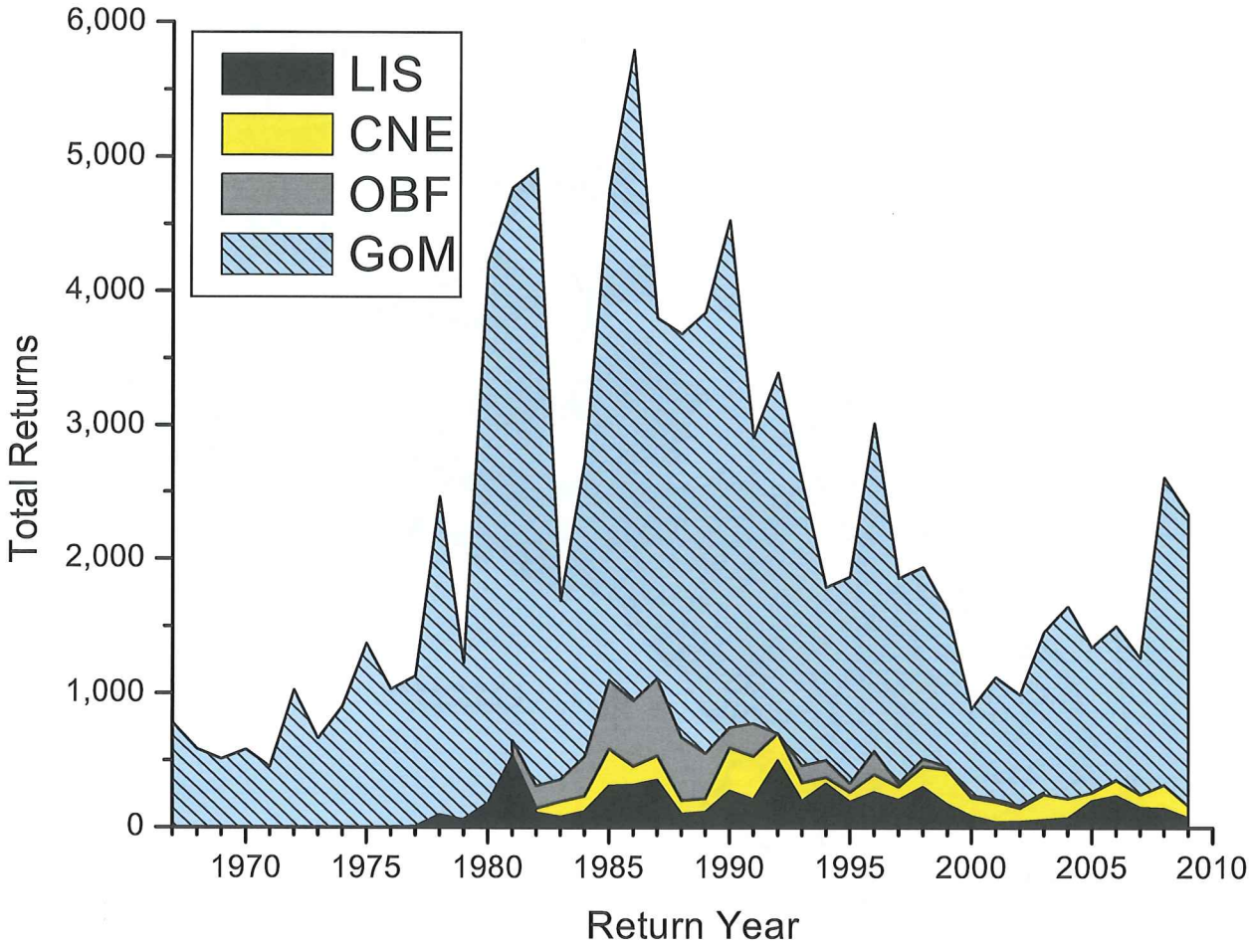

Figure 2. Estimated total returns to New England 1967-2009 from USASAC databases for Outer Bay of Fundy (OBF), Central New England (CNE), and Long Island Sound (LIS) Regions and the Gulf of Maine (GoM) Distinct Population Segment.

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